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PREFACE

In all parts of the world, countries have realized the important role of research in development. Research is an academic activity that uplifts the standards of institutions. To become internationally and globally competitive, institutions base their policies, products and practices on research.

DMMMSU has continuously maintained its standards through research. Its participation and involvement in international research endeavors have encouraged and challenged its constituents to engage in research and extension not only in the local and national scenes but also in the global arena.

The production of the CAS Science Monitor of the College of Arts and Sciences of DMMMSU South La Union Campus is one of the strategies of the college in honing students' research capabilities. Through this, students are trained to conduct relevant and quality researches for dissemination. This annual journal features the full paper of student researches. It serves as a channel for dissemination of student researches in the field of mathematics and allied disciplines, biological and physical sciences, and humanities and social sciences.

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BS PSYCHOLOGY

Aggression Level, Work Attitude, and Job Profile of Butchers and Meat Cutters

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Jonalyn B. Moulic and Pascua, Zenaida D.C.

ABSTRACT

This study determined the relationship between aggression level, work attitude, and job profile of butchers and meat cutters. The study used descriptive research design and purposive sampling technique. The questionnaire on “The Aggression Questionnaire” and an adapted questionnaire for Work Attitude were used as instruments to gather the needed data. Frequency counts and Chi- square test of independence in SPSS were employed for data analysis.

Butchers scored slightly higher on all factors of aggression, especially on hostility, than meat cutters. However, Chi- square test of independence revealed that the difference is not significant. On the other hand, meat cutters scored higher on work attitude, which signifies a positive attitude on their workplace and on their job, Chi- square test proved that this difference is statically significant. Moreover, their job profile did not significantly affect their work attitude and aggression level.

Keywords: *aggression level, work attitude, job profile of butchers, meat cutters*

INTRODUCTION

Situation Analysis

Behind the sanitized world of fast-food, everyday grocery shopping and culinary delights- all meant to satiate to people’s basic pleasures and needs- is an extraordinarily vast realm of brutality as normal and routine as mealtime habits.

It has to be a nasty job, over years that alone can impact one’s personality. In addition, the act of killing day after day, month after month for years must make an imprint upon one’s personality. It would be the most intimate and bloodstained bond between humans and animals. The speed and the repetitive nature of the work in slaughterhouses make it one of the most dangerous jobs in the country. Common slaughterhouse injuries include deep cuts, accidental stabbings, and “cumulative trauma”. There is a psychological toll as well. Workers in industrial slaughterhouses commonly report a strong sense of dehumanization (Kilagour, 1991). Thus, it is no surprise that industrial slaughterhouses have one of the highest employee turnover rates of any job in the country.

Like all agricultural workers, slaughterhouse and meat-processing workers struggle to live above the poverty level and provide a decent quality of life for their family. Worker’s labor for long hours is one of the most dangerous working conditions in the country for a relatively low wage. The repetitive stress injuries that workers endure also have a significant influence on their lives outside work (Gullone et al., 2012).

With this scenario, the researchers wanted to find out the psychological and physiological effects of working in a slaughterhouse. They are not only exposed to a battery of physical dangers on the cut floor, but the psychological weight of their work erodes their well-being. It will come as no surprise that the consequences of such emotional dissonance include domestic violence, social withdrawal, drug and alcohol abuse and severe anxiety. As these are continually observed on slaughterhouse workers, the researchers conducted this study to systematically explore the results of killing sentient animals for a living.

This research sought to gain a better understanding on the aggression level, work attitude and job profile of slaughterhouse workers. Does their work dissociate them from their sense of themselves as human beings or the animals they are killing? Do they treat an animal as an animal rather than a widget or they assume that an animal does not have the same capacity for feeling as a human. Moreover, the researchers sought to know why they decided to go for this kind of career. Is it because it's a job that is easy of access for people who are uneducated or inexperienced or they have no other choice than to work in this industry?

Framework of the Study

In its most extreme forms, aggression is human tragedy unsurpassed. Thus, in recent years there has been renewed interest in learning why humans sometimes behave aggressively. Some of the causes of increased violence have been identified. Recent psychological research has yielded promising new treatments (Borduin, 1999), new empirical discoveries (Baumeister et al., 1996; Bushman, 1995), and new theoretical analyses (Eron et al., 1994; Geen & Donnerstein, 1998; Huesmann et al., 1996). These theoretical perspectives seek to impose theoretical coherence on the massive number of established risk factors for aggression.

Human aggression is any behavior directed toward another individual that is carried out with the proximate (immediate) intent to cause harm. In addition, the perpetrator must believe that the behavior will harm the target, and that the target is motivated to avoid the behavior (Bushman & Anderson, 2001; Baron & Richardson, 1994; Berkowitz, 1993; Geen, 2001).

Major domain-limited theories of aggression include cognitive neoassociation, social learning, social interaction, script, and excitation transfer theories. These five main theories of aggression guide most current research. The theories themselves overlap considerably, which are what instigated early

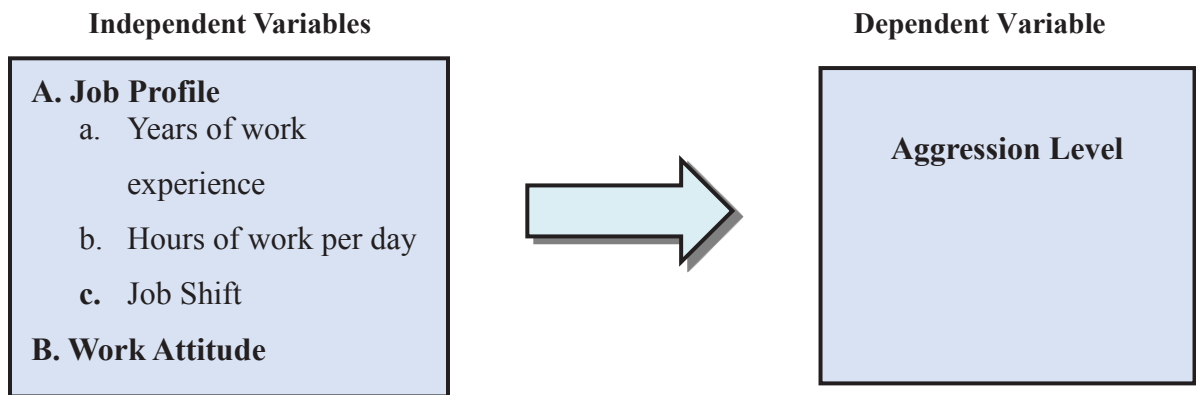
attempts to integrate them into a broader framework (Anderson et al., 1995, 1996).

Cognitive neoassociation theory has proposed that aversive events such as frustrations, provocations, loud noises, uncomfortable temperatures, and unpleasant odors produce negative effect. Negative effect produced by unpleasant experiences automatically stimulates various thoughts, memories, expressive motor reactions, and physiological responses associated with both fight and flight tendencies. The fight associations give rise to rudimentary feelings of anger, whereas the flight associations give rise to rudimentary feelings of fear.

Huesmann (1986, 1998) proposed that when children observe violence in the mass media, they learn aggressive scripts. Scripts define situations and guide behavior: the person first selects a script to represent the situation and then assumes a role in the script. Excitation transfer theory (Zillmann, 1983) notes that physiological arousal dissipates slowly. If two arousing events are separated by a short amount of time, arousal from the first event may be misattributed to the second event. If the second event is related to anger, then the additional arousal should make the person even angrier. The notion of excitation transfer also suggests that anger may be extended over long periods of time if a person has consciously attributed his or her heightened arousal to anger. Social learning theory is the key concept regarding the development.

I³theory, which is process-oriented meta-theory, is designed to identify the circumstances under which a nonaggressive interaction can move into an aggressive one. It can build upon these previous theories, can integrate them with recent research in the self-regulation tradition, and can specify the ways in which aggression risk factors interact to predict aggressive behavior.

Research Paradigm



Statement of the Problem

This study intended to determine the aggression level of the butchers and meat cutters and its relationship to their job profile and work attitude. Moreover, the study also aimed to distinguish the difference between the respondents' aggression levels and work attitudes.

METHODOLOGY

Research Design

A descriptive-correlational research design was used in this study. It was selected because it provided a relatively complete picture of the psychological and physiological effects of working in a slaughterhouse. This method demanded the technique of using a questionnaire to measure the level of aggression and to find out the work attitude of slaughterhouse workers. The researchers chose correlation to figure out the effect of working in a slaughterhouse to the level of aggression and work attitude of butchers and meat cutters.

Sources of Data

The researchers gathered the needed data from the slaughterhouse in Guilig, Mangaldan, Pangasinan. The researchers chose Mangaldan because of the availability of respondents. The researchers used purposive sampling because they accessed a particular subset of slaughterhouse workers (butchers and meat cutters) in the said municipality.

Instrumentation and Data Collection

This study used a questionnaire as a major tool in gathering the needed data. Also, the researchers adapted a questionnaire "The Aggression Questionnaire" from the Journal of Personality and Social Psychology by Buss, A.H., & Perry, M.P. The questionnaire for aggression yielded four scales: nine items for physical aggression, five items for verbal aggression, seven items for anger and eight items for hostility. A five-point scale ranging from extremely characteristic and extremely uncharacteristic was followed. To ensure the validity of the questionnaire, it was evaluated by the experts from the College of Arts and Sciences and was rated with a descriptive rating of "highly valid" that is equivalent to a value of 3.77. Furthermore, the computed reliability is equivalent to .910 with a descriptive rating of "very high reliability".

The various scales correlated differently with various kinds of aggression. The respondents rated each item as to how accurately it describes them. The questionnaire was written in English language with Filipino translation.

The researchers also adapted a questionnaire for the respondents' work attitude from the dissertation of Boadilla, et al. entitled "Problems and Perceived Work Attitudes of Bus Vendors and their Relation to Some Variables".

For the profile of the respondents, the researchers used the following descriptive statistics: frequency count, percentages, and average weighted mean. The researchers also used the Chi-Square Test to find out if there's a significant correlation between each variable in the study.

RESULTS AND DISCUSSION

This chapter presents the results, analysis, and interpretation of gathered data through the questionnaire and test administered to the respondents, concerning the significant relationship between each of the following variables. The data were shown in tables and figures with corresponding interpretations and were analyzed systematically. Discussions and thorough analysis of the results are also reflected in this chapter.

Table 1 summarizes the average weighted means and overall mean of the aggression level of the butchers and meat cutters with their respective descriptive ratings.

As shown, meat cutters obtained an average weighted mean of 2.50 on physical

aggression and 2.53 on anger with a descriptive rating of high level respectively of those particular factors of aggression. Conversely, meat cutters scored low on verbal aggression and hostility with an average weighted mean of 2.43 and 2.48. While butchers consistently got a high AWM in all factors of aggression which are as follows; 2.88 on physical aggression; 2.92 on verbal aggression; 3.01 on anger; and 3.11 on hostility. Result supports previous research published in the Society and Animals journal indicating that people who work in slaughterhouse are more likely to be desensitized to suffering, which in turn could make them more likely to be violent. The novel written by Upton Sinclair, *The Jungle*, galvanized readers after describing that the hellish world of factory slaughterhouses was as dangerous to human beings as it was to animals being slaughtered. FBI work has also shown that animal cruelty is a prominent behavior in the profiles of violent criminals. It was also found that butchers' aggression levels were so high. They are similar to the score for incarcerated populations (Dillard, 2010). It had also been established that the more positive a person's attitude to animals, the lower their aggression levels, and that the reverse is also true—those who are cruel to animals, are more likely to be violent to humans (Taylor, 2012).

Table 1. Aggression of Butchers and Meat Cutters (N=90)

Aggression Level	AWM		Descriptive Rating	
	Butchers	Meat Cutters	Butchers	Meat Cutters
Physical Aggression	2.88	2.50	High	High
Verbal Aggression	2.92	2.43	High	Low
Anger	3.01	2.53	High	High
Hostility	3.11	2.58	High	Low
Overall Mean	2.98	2.49	High	Low

CONCLUSIONS

The following are the conclusions of the study based on the salient findings:

1. Butchers of Mangaldan slaughterhouse have worked for six to 10 years than meat cutters who have worked for one to five years. Majority of the respondents worked for six to seven hours per day. There are more butchers and meat cutters working during daytime because of the indolence of the workers who are work at nights according to their supervisor.
2. Butchers scored higher in all factors of aggression, especially in hostility, than meat cutters. Butchers have a high level of aggression; conversely, meat cutters have a low level of aggression.
3. Meat cutters have a more positive work attitude than butchers.
4. There is no significant relationship between the respondents' job profile and aggression level.
5. There is no significant relationship between the respondents' job profile and work attitude.
6. There is no significant relationship between the aggression level and work attitude of the respondents.
7. There is a significant difference between the respondents' aggression level.
8. There is a significant difference between the respondents' work attitude.

RECOMMENDATIONS

Based on the conclusions of the study, the following recommendations were drawn:

1. The researchers recommend the slaughterhouse workers to treat the slaughter animals humanely by not torturing them such as kicking, stomping on their heads, clubbing and punching them in the face, before killing. They should employ the appropriate way of handling animals before slaughtering. Because needlessly beating them up contribute to the desensitization and loss of compassionate concern for sentient, sensitive creatures being slaughtered.

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2. The slaughterhouse must adapt methods of 'stunning' intended to make animals unconscious before slaughtering such as the use of captive bolt, electric, and gas chambers, so they won't be stabbed while conscious. Stunning prior to bleeding out will render slaughter animals insensible to pain until death.

3. There should be a well-planned, well-executed and controlled cleaning and sanitation programme for rooms, machines and equipment. It is very important to achieve a hygienic standard. Cleaning and sanitation alone, however, will not assure a hygienic standard in production where process hygiene as well as person meal hygiene are important factors. For example cleaning during processing, removal of solid waste and sufficient space in processing rooms are factors which facilitate cleaning, equipment available, sanitary facilities and water and energy supplies.

4. The researchers aimed to show that the workers should not be called "evil" or "bad people" which are sometimes heard or read from some animal advocates and blogs from the internet. The core problem is the animal-industrial complex, the system of exploiting animals which also have negative effects on the workers in the system who are supposed to be the people keeping the system alive and going. There is growing increase of slaughterhouse practices and increase of violent crimes. A previous 581 US countries from 1994 to 2002 shows the annual arrest and report average increase with the presence of a slaughterhouse. A new study reports that the presence of a slaughterhouse corresponds to a 166percent increase in arrest for rape.

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Ang Panloob na Pagkatao ng mga Magsasakang Filipino sa mga Piling Barangay ng Rosario, La Union

Maribeth M. Aday, Sheila Patricia P. Guillermo,
Melanie R. Lalata, Trixia R. Paguel and Madelyn P. Niño

ABSTRAK

Ang pananaliksik na ito ay nilayong alamin ang Panloob na Pagkatao ng mga magsasakang Filipino sa mga Piling Barangay ng Rosario, La Union gamit ang pamamaraang Sikolohiyang Filipinong pananaliksik at *Grounded Theory* na nakapaloob sa *Qualitative Research Approach*. Gamit ang Katutubong Pananaliksik, nakalap ang mga datos at nilapatan ng *thematic analysis* upang mapalitaw ang kasagutan sa mga katanungan.

Ang mga temang napalitaw: Ang mga role na ginagampanan ng mga magsasakang Pilipino sa Concepcion at Tabtabungao ay nauukol sa kanilang pamilya at sa kanilang trabaho. Ang pagsasalarawan ng mga magsasaka sa kanilang sarili ay umiikot sa dalawang tema: (1) panloob na pagkataong ukol sa mga role; at (2) pakikitungo sa ibang tao. Ang mga hinahangaan at iniiwasan na katangian sa kanilang kapwa magsasaka at ang mga pagpapaliwanag sa mga katangian na ito ay umiikot sa dalawang tema: (1) personal; at (2) sosyal na aspeto.

Keywords: *magsasaka, panloob na pagkatao*

PANIMULA

Ang panloob na pagkatao ay isang representasyon sa sarili kung saan ang pamantayan, paniniwala, pagpapahalaga at pag-uugali ng isang indibidwal ay nakikita sa mga karanasan at kung saan ang sarili ay nagbibigay kahulugan sa pakikitungo sa ibang tao.

Balangkas ng Pananaliksik

Ang panloob na pagkatao ay isa sa mga representasyon sa sarili ng isang tao. Kung minsan ang mga magsasaka ay hindi nila nailalabas ang kanilang tunay na panloob na pagkatao sa ibang tao sapagkat nagkakaroon ng diskriminasyon sa kanilang parte dahil sa mga positibo at negatibong komento ng iba.

Layunin:

1. Nilayong alamin ang Panloob na Pagkatao ng mga magsasakang Pilipino sa mga Piling Barangay ng Rosario, La Union.
2. Nilalayong alamin ang iba't ibang katangian at pagsasalarawan sa

kanilang sarili at sa kapwa nila magsasaka.

METODO

Mga Kalahok. Sampung magsasakang Pilipino mula sa mga piling barangay ng Rosario, La Union. Ang pinanggalingan ng mga datos na siyang nasa pamamahala ng kanilang punong barangay. Ang mga limang kalahok ay galing sa barangay Concepcion at limang kalahok naman ay galing sa barangay Tabtabungao.

Ang Pananaliksik: Nagtatanung-tanong sa mga punong barangay sa kung saan matatagpuan ang mga magsasaka sa barangay Tabtabungao at Concepcion. Bilang paraan ng panimula at pag-umpisa ng pakikipagpalagayang-loob sa mga magsasaka ang pagtatanung-tanong gaya ng kanilang gawain sa taniman. Ang mga mananaliksik ay nakipagkwentuhan sa mga magsasaka upang makuha ang kanilang loob at nang makuha na nila ang tiwala ng kalahok ay kanila ng inumpisahan ang pakikipagpanayam.

Ang pag-aaral na ito ay isinagawa sa pamamagitan ng pakikipagpanayam. Ang *Aide Memoir* ay naglalaman ng katanungan upang matugunan ang apat na pangunahing katanungan/suliranin. Ang mga katanungan na ito ay verbal na tinanung at sinagot. Ang daloy ng pagtatanong ay depende sa daloy din ng pagkwento ng mga kalahok.

Pag-aanalisa. Ang ginamit na metodo ng pag-analisa ng datos ay *thematic analysis* na kung saan ang mga nakalap na datos mula sa mga kalahok ay pinagsama-sama ayon sa ideyang nailahad sa kanilang kasagutan. Ang *thematic analysis* ay isang metodo na kung saan pagtitipunin at pagsasamahin ayon sa mga temang napalitaw. Isinagawa ang pag-aanalisa ng tatlong beses hanggang sa napalitaw ang mga temang tumutukoy sa panloob na pagkatao ng mga magsasaka.

KINAHINATNAN AT PAGTATALAKAY

Mga Role na Ginagampanan ng mga Magsasaka

Sa pagsusuri sa mga tugon ng mga magsasaka, lumalabas ang iba't ibang *role* ng mga magsasaka ang mga sumusunod.

Karamihan sa mga magsasaka ay nagsabi na sila ay ama/tatay/ padre de pamilya dahil gampanin nilang itaguyod at mabigyan ng magandang kinabukasan ang kani-kanilang mga anak. Ipinapakita lamang ng tulang ito na ang isang ama ay isang mapagmahal sa kanilang pamilya at maalaga. Iniisip lagi ang ikakabuti para sa pamilya.

Ayon kay Baje (2003), ang ama ang kinikilalang haligi ng tahanan. Ito ay dahil na rin sa sila ang inaasahang magtatayo nito at susuporta rito. Sila ang ulo at ang pinakapinanggagalingan ng lakas at buhay ng isang bahay. Ang trabahong ito ay nakaatas sa kanila kaya ito ay kanilang responsibilidad at hindi dapat pinababayaan.

Ang isang magsasaka ay isa rin anak, kapatid at lolo. Bilang isang anak,

kapatid at lolo siya rin ay isang matulungin, mapagbigay at mapagmahal. Ang ibang lolo sa kabila ng kanilang katandaan nagagawa pa rin nilang tumulong sa kani-kanilang pamilya kapag sila'y nangangailangan.

Ayon sa nakasulat sa *Overblog* (2015), "Sabi nga nila, kapatid ang isa pa sa pinakamagandang pinagkaloob sa kanila ng Diyos at ng kanilang magulang. Mahalin ang mga kapatid at pamilya. Isa sa pinakamasarap na pakiramdam sa mundong ito ay ang pagbibigay ng halaga, pagmamahal at pagkakaintindihan mula sa taong minamahal nila.

Ang mga gampanin ng magsasaka para sa trabaho ay ang mga sumusunod:

Ang pagiging magsasaka ay isa sa mga mahahalagang *role* na siyang ginagampanan nila. Ito ay isang marangal na trabaho at malaki ang naitutulong nito sa pagtatanim upang may makain ang mga tao sa araw-araw.

Ang ibang magsasaka ay karaniwang naglilingkod sa bayan bilang opisyal sa kanilang organisasyon at kagawad sa kani-kanilang barangay. Ang pagtitiwala sa kanila ng mga mamamayan bilang isang opisyal ay pinapahalagahan rin ng mga magsasaka.

Bilang magsasaka, ay kanilang ginagampanan ang kanilang pagtatanim sa bukid sapagkat ang mga magsasaka ay ang kanilang ikinabubuhay at kanila itong pinapahalagahan.

Ang mga magsasaka rin ay tumutulong din sa mga gawaing-bahay. Pagdating nila sa kanilang tahanan kung minsan ay nagagawa pa rin nilang tumulong sa mga gawaing-bahay. Kung kaya karamihan sa ibang tao ay nasasabi nilang masipag ang mga magsasaka.

Isang *construction worker* din ang mga magsasaka. Hindi masisisi ang mga

ibang magsasaka na maghanap pa ng ibang pagkakakitaan dahil kung minsan ang kanilang kinikita bilang isang magsasaka ay hindi sapat sa kanilang pang

araw-araw na gastos para sa kani-kanilang pamilya.

Talahanayan 1: Mga *Role* na Ginagampanan ng mga Magsasaka

Tema	<i>Role</i>
Para sa Pamilya	ama/tatay/padre de Pamilya, asawa, anak, kapatid, lolo.
Para sa Trabaho	Magsasaka, kagawad, pagtatanim, opisyal sa kanilang organisasyon, mga gawaing bahay at <i>Construction Worker</i> .

Paglalarawan ng mga Magsasaka sa kanilang Sarili

Ang ilan pa ay pagsusuri sa tugon ng mga kalahok sa mga iba't ibang pagsasalarawan ng kanilang sarili bilang isang magsasaka. Ang pagsasalarawan ng mga magsasaka sa kanilang sarili ay umiikot sa dalawang tema: (1) pagkataong panloob na nauukol sa *role* na kanilang ginagampanan; at (2) ukol sa pakikitungo sa ibang tao.

Pagkataong Panloob na Nauukol sa *Role* na Ginagampanan

Ang pagpaliwanag ng mga magsasaka sa kanilang paglalarawan sa kanilang sarili ay ang mga sumusunod:

Ang Masipag at Nagsusumikap na Magsasaka. Ang uri na taong ito ay ginagawa ang lahat upang guminhawa ang pamumuhay ng kanilang pamilya. Ang mga taong ito rin may layunin sa buhay. May pagtitiyaga, dedikasyon at pagpapasensya.

Ang Responsableng Magsasaka. Ang kanilang obligasyon at pokus sa kanilang trabaho, hindi pinapabayaan ang sinasaka, kung ano ang makakabuti para sapamilya.

Ang Magsasakang Mahirap. Ang mga magsasaka kahit na mahihirap mahalaga ang kanilang papel na ginagampanan sa lipunan kung kaya hindi

dapat sila maliitin at kutyain bagkus sila ay pahalagahan at respetuhin dahil malaki ang kanilang naitutulong sa agrikultura at ekonomiya.

Pagkataong Panloob na Ukol sa Pakikitungo Sa Ibang Tao

Ang pagpaliwanag ng mga magsasaka sa kanilang paglalarawan sa kanilang sarili ay ang mga sumusunod:

Ang Magsasakang Marunong Tumanggap ng Payo. Sa bawat opinyon o ideyang kanilang kagrupo at kapwa magsasaka ay kanilang tinatanggap at hinihingi.

Ang Magsasakang Naninilbihan sa Simbahan. Ang panloob na pagkatao na ito ay nagsisilbi sa Poong Maykapal, sumusunod sa utos ng Panginoon. Sila ang mga may takot at may pananampalataya sa Panginoon.

Ang Mahinahon, Hindi Mapagmataas at Mapagpasensiya na Magsasaka. Hindi nila itinaas ang kanilang sarili. Bagkus, namumuhay sila na isang mapagkumbaba at kahinahunan.

Ang Matulungin na Magsasaka. Ang isang magsasakang matulungin ay tumutulong mula sa loob --- hindi lamang sa materyal na bagay maging sa payo, oras o espiritwal na ikakabuti ng iba ay handang magbigay ng tulong.

Ang Mapagbigay na Magsasaka. Laging inuuna ang kapakanan at pangangailangan ng kanilang pamilya at hindi nila iniisip ang kanilang pansariling interes, ang magsasaka na ito ay mapagbigay. Kung anong meron sa kanila ay pinabahagi sa ibang tao.

Ang Tamad na Magsasaka. Ang uri na ito ay bibihira lamang pumunta sa bukid at magtanim. Kung minsan inuutusan na lamang nila ang kanilang kapwa magsasaka.

Talahanayan 2: Ang Paglalarawan ng mga Magsasaka sa kanilang Sarili

Tema	Pagsasalarawan ng mga Kalahok sa kanilang Sarili
Pagkataong Panloob na nauukol sa <i>role</i> na ginagampanan	Masipag/nagsusumikap, responsable at ginagawa ang obligasyon, pokus sa kanilang trabaho, hindi pinapabayaan ang sinasaka, ginagawa ang nakabubuti para sa pamilya, at mahirap.
Pagkataong Panloob ukol sa pakikitungo sa ibang tao	Marunong tumanggap ng payo, naninilbihan sa simbahan, hindi mapagmataas, mahinahon, mapagpasensiya, matulungin, mapagbigay at tamad.

Mga Hinahangaan at Iniiwasang na Katangian sa Kapwa nila Magsasaka

Ang hinahangang katangian ng kanilang kapwa magsasaka ay patungo sa dalawang tema: (1) hinahangaang pagkatao; (2) at iniiwasang pagkatao.

Ang hinahangaang pagkatao ng mga magsasaka ay nahati sa panloob na pagkatao na naaayon sa sosyal na aspeto o pakikitungo sa kapwa magsasaka at panloob napagkatao sa aspetong personal ay ang sumusunod:

Ang mga magsasakang mapagbigay, magbigayan o *sharing*, laging inuuna ang kapakanan at pangangailangan ng kanilang pamilya at hindi nila iniisip ang kanilang pansariling interes.

Ang isang magsasakang marunong makisama at nagkakaintindihan, isinasantabi ang pagiging makasarili at nakatuon lamang sa pagtulong sa ikakaunlad ng samahan.

Sa sosyal at personal, ang mga hinahangaang panloob na pagkatao ng mga magsasaka ay ang mga sumusunod

Ang mabait na magsasaka hindi gumagawa ng sumasalungat sa kanilang samahan at sa ibang tao.

Ang isang madisiplinang magsasaka ay hindi gumagawa ng kanilang ikakasama at ginagawa nito ang kanilang mga gagawin sa tamang oras.

Marunong maghintay o mapagpasensiya. Ang katangian na ito ng isang magsasaka ay maganda sapagkat sa tagal ng pagtubo ng mga tanim kailangan nila ng may buong pagpapasensiya.

Ang mga magsasaka ay masisipag din. Kumakayod at nagsusumikap upang matulungan ang kanilang mga pamilya at mapagtapos ang kanilang mga anak sa pag-aaral.

Ang mga iniiwasan na pagkatao ng mga magsasaka ay nahahati sa panloob na pagkatao na naaayon sa sosyal na aspeto o pakikitungo sa kapwa magsasaka at panloob na pagkatao sa aspetong personal. Sa sosyal na aspeto ay ang mga sumusunod:

Ang mga magsasaka rin ay mga lasinggero. Pagkauwi ng mga magsasaka

nagkakaroon sila ng konting inuman kasama ng kanilang kapwa magsasaka ngunit kung minsan dahil sa kanilang pagkalasing hindi nila namamalayan na nagkakaroon na sila ng konting alitan ng kani-kanilang kapwa magsasaka.

Ang magsasaka ay madaldal din. Ang pinakamaliit na bahagdan ng mga iniwasang panloob na pagkatao ay ang mga sumusunod: madaldal at nagdadagdag ng kwento, binabalewala, arogante o mayabang, sipsip, mainitin ang ulo, aburido at masungit. Ang mga pag-uugali na ito ay mga hindi magandang kaugalian ng mga magsasaka na kung minsan ay nakakaapekto na sa kapwa nila magsasaka. Maaaring kung minsan ay nakakaapekto na sa pakikipagkapwa at makikisalamuha at pakikipag-interaksyon nila sa iba.

Sa personal na aspeto, ang mga iniwasang panloob na pagkatao ay ang mga sumusunod: Para sa mga magsasaka, ang pagiging makasarili ay iniwasang katangian

ng isang magsasaka sapagkat ito ay nakakaapekto sa kanilang pagsasamahan. May tao na nakikipagkapwa-tao lamang para sa sariling kapakinabangan. Kasama rin dito iyong mga tao na gagawin ang lahat mapabuti lamang ang sarili kahit masagasaan nila ang ibang tao, ito ay ayon kay Villamayor (2014), ito ay isang pagiging makasarili.

Ang magsasakang tamad ay uri ng tao na bibihira lamang pumunta sa bukid at magtanim. Kung minsan inuutusan na lamang nila ang kapwa magsasaka.

Mga Kahulugan ng mga Pagsasalarawan ng mga Magsasaka

Ang mga kahulugan ng mga pagsasalarawan ng mga magsasaka ay nahati sa panloob na pagkatao na naaayon sa sosyal na aspeto o pakikitungo sa kapwa magsasaka at panloob na pagkatao sa aspetong personal.

Talahanayan 3: Hinahangaan at Iniwasang Panloob na Pagkatao na sosyal at personal na aspeto ng mga Magsasaka

Tema		Paglalarawan
Hinahangaang Panloob na Pagkatao	Sosyal	Magbigayan o <i>sharing</i> , tulong-tulong o bayanihan, hindi naglolokohan, marunong makisama at nagkakaintindihan.
	Personal	Mabait, madisiplina, marunong mag-antay o mapagpansensiya at masipag.
Iniwasang Panloob na Pagkatao	Sosyal	Lasinggero, madaldal, nagdadagdag ng kwento, binabalewala, sipsip at aburido.
	Personal	Makasarili, tamad, madamot, arogante o mayabang, mainitin ang ulo at masungit.

Ang mapagbigay na magsasaka ay laging inuuna ang kapakanan at pangangailangan ng kanilang pamilya at hindi iniisip ang kanilang pansariling interes, ang magsasakang ito ay mapagbigay. Kung anong meron sa kanila ay pinabahagi nila sa ibang tao.

Sa personal na aspeto, ang mga hinahangaang panloob na pagkatao ng mga magsasaka ay ang mga sumusunod:

Marunong makisama at palakaibigan ang magsasaka. Sila iyong kahit saan ay kaya nilang makisabay.

Ang uri ng magsasakang mabait ay walang bisyo at hindi gumagawa ng sumasalungat sa kanilang samahan.

Ang uri ng magsasakang ito ay mahinahon at hindi mapagmataas. Hindi niya itinaas ang kaniyang sarili. Bagkus, namumuhay siya nang buong kapakumbabaan at kahinahunan.

Ang magsasaka ay masipag at nagsusumikap. Ang uri ng taong ito ay ginagawa ang lahat upang guminhawa ang pamumuhay ng kanilang pamilya at may layunin sa buhay.

Ang mga iniawasan na pagkatao ng mga magsasaka ay nahahati sa panloob na pagkatao na naaayon sa sosyal na aspeto o pakikitungo sa kapwa magsasaka at panloob na pagkatao sa aspetong personal. Sa sosyal na aspeto, ang mga iniwasang panloob na pagkatao ng mga magsasaka ay ang mga sumusunod: madamot, lasinggero at madaldal.

Ang lasinggero ay negatibong pag-uugali na hindi maiiwasan sa bawat tao. Ang lasinggerong magsasaka ay umiinom ngunit kung minsan hindi. May mga di magandang pangyayari ang nagaganap sapagkat kung minsan sa dahilan ng alak ay panggugulo.

Nagdadagdag ng kwento at laging pinag-uusapan ang kanilang kapwa ay ang mga magsasakang madaldal.

Sa personal na aspeto, ang mga iniwasang panloob na pagkatao ay ang mga sumusunod:

Para sa mga magsasaka, ang pagiging makasarili ay iniwasang katangian ng isang magsasaka sapagkat ito ay nakakaapekto sa kanilang pagsasamahan. May tao na nakikipagkapwa-tao lamang para sa sariling kapakinabangan lamang ang dahilan.

Aroganteng magsasaka ay uri ng tao na hindi marunong makisama at ang mga taong makasarili at madamot na magsasaka sarili lamang nila ang kanilang iniisip.

Ang representasyon ng panloob na pagkatao ng magsasakang masipag at nagsusumikap ay ginagawa nila ang lahat upang guminhawa ang pamumuhay ng kanilang buhay at ng kanilang pamilya. Ang mga magsasaka ay nagtatanim, nag-aani at nag-aararo sa bukid ng buong araw upang may mapakain at may pang buhay sa kanilang mga pamilya.

Mahalagang maunawaan ang tao mula sa perspektibong ito na nagbibigay puwang sa kaugnayan nila sa kanilang pinanggagalingan ng lipunan at kalinangan.

Mahalagang tingnan ang tao batay sa ugnayang itong lipunan-kultura at indibidwal sapagkat kung hindi sila maiintindihan sa loob ng ganitong pamantayan, hindi rin magiging buo ang pagkaunawa ng sinumang mananaliksik sa kakayahan at kalakasan ng isang indibidwal.

KONKLUSYON

1. Ang pangunahing ginagampanan ng mga magsasaka na nauukol sa kanilang pamilya ay ang pagiging ama sa kanilang anak; samantalang ang gampanin nila na nauukol sa kanilang trabaho ay ang pagiging magsasaka. Pinapahalagaan ng mga magsasaka ang kanilang tungkulin bilang isang ama sapagkat ang kanilang anak ang

inspirasyon nila na dahilan ng kanilang pagsisikap. Ang pagiging magsasaka nila ay ang kanilang gampanin sa kanilang trabaho sapagkat ang pagsasaka ang kanilang kabuhayan na siyang pinangbubuhay sa kanilang mga pamilya.

2. Sa paglalarawan ng mga magsasaka sa kanilang sarili ay bilang padre de pamilya, na itaguyod ang pamilya at mabigyan ng magandang kinabukasan ang kani-kanilang mga anak. Sila ay masipag, responsable at ginagawa ang kanilang obligasyon.

3. Sa paglalarawan ng mga magsasaka sa kanilang kapwa magsasaka, ang hinahangaang panloob na pagkatao ng mga magsasaka ay nagbibigayan or mapagbigay, tulong-tulong o bayanihan, marunong makisama, palakaibigan, hindi naglolokohan at nagkakainitindihan. Ang iniwasang panloob na pagkatao ng mga magsasaka ay makasarili, tamad, madamot, arogante o mayabang, mainitin ang ulo at masungit, lasinggero, madaldal, nagdadagdag ng, sipsip at aburido.

4. Ang mga halimbawa ay mga katangian ng mga magsasaka na nagbigay kahulugan sa mga ito. Ang mapagbigay na magsasaka ay laging inuuna ang kapakanan at pangangailangan ng kanilang pamilya at hindi iniisip ang pansariling interes at kung anong meron sa kanila ay ibinabahagi sa ibang tao. Ang pagiging responsableng magsasaka ay pinoprotektahan ang mahahalagang tao sa kanilang buhay. Ang marunong makisama at palakaibigan na magsasaka sila iyong kahit saan ay kaya nilang makisabay. Ang mahilig tumuklas ng mga makabagong paraan para sa ikakabuti ng kanilang mga taniman ay ang mga magsasakang ma-diskarte. Ang pagiging mabait na magsasaka ay ginagawa ang sariling paraan upang mabuhay ang kanilang pamilya at hindi nagbibisyo. Ang isang masipag na magsasaka ay maasikaso sa lahat.

REKOMENDASYON

1. Ang basehan ng *Panloob na Pagkatao ng mga Magsasakang Pilipino (Filipino Farmers' Personality Construct)* na nabuo batay sa pananaliksik na ito ay iminumungkahi ng mga pananaliksik na gamitin bilang positibong pananaw sa pagkatao ng mga magsasaka mula sa barangay Concepcion at Tabtabungao at sa buong bansa upang maipalaganap ang kagandahang loob na taglay nila.

2. Bilang positibong pananaw sa mga magsasaka, mainam na bigyan pa sila ng sapat na halaga o kaukulang pansin dahil sa laki ng mga ginagampanan nilang papel sa pamilya at lipunan.

3. Bigyan ng sapat na kaalaman ang lipunan lalo na ang mga bagong henerasyon ngayon tungkol sa kahalagahan o importansya ng mga magsasaka at ang kanilang trabaho. Ituring silang bayani ng lipunan. Ito ay upang tumaas ang tingin sa mga magsasaka at matiyak na pahalagahan ng bawat isa ang mga produktong pinaghirapang sakahin at anihin ng mga ito.

4. Palawigin ang pag-aaral tungkol sa mga magsasaka upang mas maunawaan pa ang kanilang pinagdaraan na mabigat man ito o hindi. Sa pamamagitan nito ay maaaring masuri ang kanilang suliranin sa iba't-ibang aspeto ng kanilang pamumuhay-personal, sosyal, emosyonal at iba pa na kailangan pang bigyan ng pansin at tugunan.

5. Dapat panatiliin ang mga magagandang panloob na pagkatao ng mga magsasaka upang mapanatili ang magandang pagsasamahan ng mga magsasaka at bigyang pansin upang ayusin ang mga iniwasang katangian ng mga magsasaka.

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Cognitive Attributes at Paggamit ng Tenolohiya ng mga Piling Magsasaka sa Rosario, La Union

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ABSTRAK

Ang Cognitive Attributes ng mga Magsasaka ay may kinalaman sa pag iisip ng isang magsasaka tungo sa paggamit ng teknolohiya kung sila ay may kamalayan sa mga makabagong teknolohiya, kung ano ang kanilang persepsyon at kung ano ang kanilang rason kung bakit sila gumagamit ng teknolohiya. Layunin ng pag-aaral na ito na alamin kung ano ang kanilang kamalayan, persepsyon at rason sa paggamit ng teknolohiya. Sa pamamagitan ng isang sarbey, napag-alaman na maraming gumagamit na magsasaka sa Tay-Ac Rosario La Union.

Keywords: *cognitive attributes, magsasaka, kamalayan, persepsyon, rason*

PANIMULA

Ang Pilipinas ay isang agrikulturang bansa at nararapat lang na bigyang pansin ng pamahalaan ang agrikultura sapagkat dito nakadepende ang ikaangat ng ekonomiya. Binubuo ng halos pitong libong isang-daang mga isla (7,100) kilala ito dahil sa ganda ng ibat ibang kultura, mga lugar na itor dinadayo ng mga torismo. Kilala rin ang bansang ito sa likas na yaman at isa na dito ang agrikultura dahil sa malawak ang kalupaan, maraming ilog at may klimang tropical, matabang mataba ang lupaing pang agrikultura akma ito sa maraming klase ng pananim tulad ng palay, mais, gulay, prutas, halamang ugat at mga pananim na magagamit sa industriya tulad ng abaka, guma, niog, tubo at iba pa. Pinatunayan nina (D. P. Barile, R. Cushman, r. Santos Jr., 1993) ng "Teaching Vocational Agriculture in the Philippines". sa kabila ng biyaya na ipinagkaloob sa atin mga lupain at patuloy na pagtuklas ng makabagong kagamitan at teknolohiya sa pagsasaka ay patuloy din ang mga isyong patungkol sa mga suliranin pag agrikultura sa ating bansa. Banta sa sektor ng agrikultura ang matagal at mapaminsalang panahon ng tagtuyut at tag-ulan na sumasalanta sa ating bansa.

Suliranin parin ang isyo ng patubig ayon sa pagaaral tatlo sa apat ng magsasaka ay walang sariling capital at kaakibat nito ay wala silang sariling lupa na sinasaka. Kung minsan ay hindi sapat ang sustansya ng taglay ng lupa. Kaya kailangan ng lupa maglagay ng pataba. Ang palagian paggamit ng mga magsasaka ng mga kemikal at pistisidyo at iba pang lasong na nagdudulot sa kapinsalaan sa kabukiran ay patuloy na sumisira sa kalusugan ng lupa na kanilang sinasaka pati na ang kapaligiran at upang mapalakas ang lokal na produksyon ng agrikultura patuloy na ang pananaliksik ng mga makabagong pamamaraan ng mga magsasaka gamit ang teknolohiya.

Ang pagsasaka ay isa sa mga kilalang pinakamahirap na trabaho sa buong bansa. Kung wala ang ating mga magsasaka paano na tayong mga taong umaasa sa kanila? Saan natin kukunin ang ating mga kakainin? Imbes na maghanap ng ibang trabaho ang ating mga magsasaka mas pinipili nilang magtrabaho sa kabukiran kahit pa mahirap at maghapon ang kanilang pagtrabaho, kahit umuulan o masunog ang kanilang balat sa tindi ng sikat ng araw. Karamihan sa ating magsasaka ay

naniniwala sa kasabihang “kalabaw lang ang tumatanda” at may paniniwalang “kahit umulan o umaraw eh ayos lang”. Ginagawa nila ng maayos ang kanilang trabaho araw-araw, nagtrabaho sila hindi lang para sa kanilang sarili at sa pamilya para rin ito sa ating kalikasan at sa ating industriya.

Ang pagsasaka ay pinaniniwalaan na isang mabigat na klase ng trabaho. Kinakailangan ng magsasaka ang tiyaga at malawak na pasensya lalong lalo na sa mga pagsubok na pagdaraanang nya. Lubhang marami nang mga pagsubok ang nararanasan o pwedeng maranasan ng mga magsasaka. Kabilang na dito ang mga bagyo na nagdudulot ng pagbaha at pagkasira sa kanilang mga pananim. Maaari din nilang maranasan ang tagtuyot na pwedeng ikamatay ng kanilang mga pananim. Ang mga insekto sa palayan ay nagsisilbi din na malaking problema ng mga magsasaka at maging dahilan ng mababa nilang ani. Higit sa lahat matinding problema ng mga magsasaka ang mga makabagong paraan ng pagsasaka para sa ikakaunlad ng kanilang kabuhayan.

Ang teknolohiya ngayon ay may malaking ambag sa pagpapaunlad ng ating agrikultura sa industriya. Maraming tekniks at metodo na pinakilala para sa posibilidad na makapagpalago ng ani. Isang halimbawa ang paggamit ng agrikulturang biotechnology kung saan ang halaman ay hindi maapektuhan kahit na sa panahon ng tag-tuyot. Iba pang magandang halimbawa ay ang paggamit ng makinarya sa pagsasaka. Ang magsasaka ay maaaring makapag araro ng ekta- ektarya ng mas mabilis na oras kasunod ay ang paglago ng produksiyon.

Ang paggamit ng iba't ibang mga teknolohiya sa pagsasaka ay hindi bago sa kanila. Maraming magsasaka lalo na ang mga Pilipino ay alam na kung paano ito nagpapaunlad sa kanilang sakahan. Hindi

lang kung ano yung alam nila, importante din na ang paggamit ng makabagong teknolohiya ay dapat pag-aralan kung paano ang paggamit nito. Ang katangian ng mga magsasaka ay importante para sila'y makagamit ng mga makabagong teknolohiya sa pagsasaka.

Ang pananaliksik na ito ay bibigyang diin ang *kaalaman* ng mga magsasaka at ang kanilang paggamit ng mga teknolohiyang pang agrikultura. Mahalagang malaman at maintindihan kung paano nakakaapekto sa magsasaka ang kanilang *kaalaman* sa pagpili kung anu- anong teknolohiya ang gagamitin sa pagsasaka, sapagkat ipapakita nito kung ano ang kanilang iniisip tungkol sa makabago at makalumang teknolohiya sa pagsasaka.

Balangkas ng Pananaliksik

Ang salitang cognitive attribute ay nagpapahayag ng kahulugan ayon sa kamalayan, persepsyon at rason kasama rito ang paniniwala, kaugalian, katangian at pag dedesiyon. Ito ang mga uri ng proseso sa pag-iisip. Ito rin ay may kakayahang mapabilis ang trabaho. Galaing ang salitang cognitive sa salitang cognition at eto ay hindi lang isangproceso, pero ito rin ay “mental process. (Neisser, 1980)

Ayon sa teoryang atribusyon ni Saul Mcleod, (2010) ito ay hinggil sa kung paano ang mga ordinaryong tao o ang mga magsasaka ipinaliwanag ang impormasyon tungkol sa teknolohiya na ginagamit ng mga magsasaka ay tinipon at paano ito pinagsama para makagawa ng maayos na desisyon (9Fiske, & Taylor (1991), halimbawa, isang tao ay galit dahil mainit ang ulo may nanyaring hindi maganda/masama.

Isa pang teorya ang pwedeng gamitin para masukat ang cognitive attributes at opinyon ng mga magsasaka gamit ang teknolohiya ay ang teorya ni (Thurston 1986) primary mental abilities, ang konseptong ito ay maaaring gamitin ang kakayahan sa pag-iisip sa paggamit

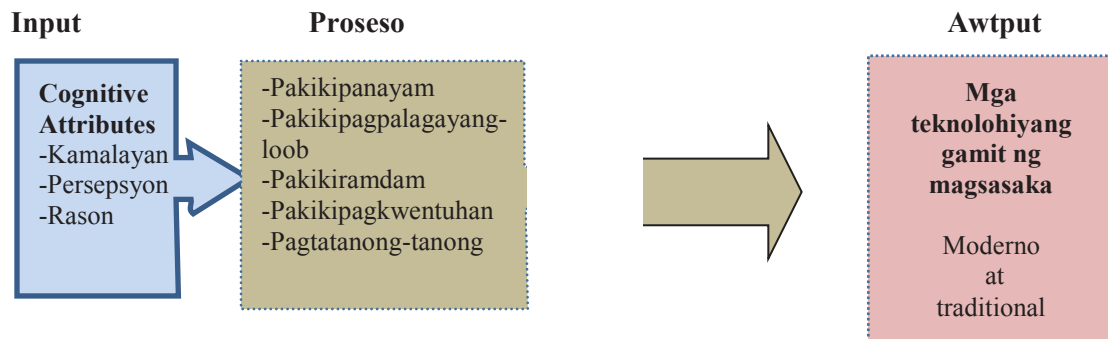
ng iba't ibang kakayahan dahil sa paggamit ng magsasaka sa mga modernong teknolohiya.

Naoobserbahan na dapat ang mga magsasaka ay kailangang gumamit ng teknolohiya sa pagsasaka lalo na sa rural area dahil karamihan ang magsasaka doon ay gumagamit ng sariling pwersa "physical force" para sa pagsasaka. Ang teknolohiya ay isa sa mga nagpapabawas ng pasakit "burdens" sa mga magsasaka sa pagsasaka tinutulungan din itong mapagaan ang trabaho at matapos agad, pero may mga magsasaka na hindi gumagamit ng teknolohiya s kadahilanan sa pananaw nito sa teknolohiya.

Sinusuri ng kamalayan ng panloob ng representasyon nagbibigay-malay (*Cognitive*) teorya pang isip tulad ng kamalayan (*awareness*), pang-unawa (*perception*) kung positibo o negatibo, sumasaklaw sa kanyang damdamin, at pangangatwiran (*reasoning*). Layunin iparating kung bakit ito ang kanilang pagkaintindi at pagkarason. Ang mga pahayagan ay simbolo sa kanilang kamalayan upang kumatawan sa mga kaganapan.

Ayon pa sa isang teorya ni (Bandura,1987) tungkol sa lipunan nagbibigay-malay (*social cognitive theory*) na iniugnay sa pagkakaalam ang tao ay may katangiang-malay una ay ang *-plasticity* na may kakayahan ang tao matututo sa ano mang bagay naibibigay sa ano mang pangyayari, pagkakaibang sitwasyon tulad ng pabago-bagong pamamaraan ng pagsasaka na siyang ginagampanan ng modernong teknolohiya. Isinang-ayonan ni *Bandura* na mula kay *Skinner* (chapter 5.Feist-feist) "ang tao ay maaaring matuto sa pamamagitan ng dirihihan karanasan, pagkakatuto sa pamamagitan ng pagoobserba mula sa iba".

Pangalawa naman ay sa pamamagitan ng *triotic reciprocal causation model* na dito



napapabilang ang pag-asal,(*behavioral*) kapaligiran, (*environment*) at personal na kadahilanan (*personal factor*). Ang tao ay may kapasidad sa kanilang pamumuhay. Na kung saan ay may hanganan sa kanilang adhikain sa pagbabanat-buto o pagtratabaho. Ang magsasaka sa kapanahonan ngayon ay may iba't ibang anyo na aling-sunod sa tradisyonal na kapaligiran.

Nagbibigay-malay o nagbibigay kamalayan ng malay sa isang pinagtibay ni Profesor Don Francisco Ortigas Sr. sa kanyang panayam na pinatibay noong Marso 25, 2009 sa araling Pilipino na naganap na seminar. "Pinamagatan ang teorya ng malam: ang maling alam at ebolusyon ng kamalayan ng malay sa lipunan at pagkatao".

Ang independent variable na nagdadala ng pagbabago ay ang cognitive attributes na kasali sa discussion ng pag- aaral ay ang kamalayan, persepsyon at rason. Ang dependent variablenaman ang nagbabago na kung saan ay ang magsasakang gumagamit ng mga teknolohiya. Ipinapakita sa pigura 1 ang mga bagay na pinag- aaralan.

Paradima ng Pananaliksik

Layunin

Layunin ng pananaliksik na ito na alamin kung ano ang cognitive attributes ng mga magsasaka at ang paggamit nila ng teknolohiya. Ang mga mananaliksik ay nangalap ng datos sa pamamagitan ng pakikipapanayam, pakikitungo at pakikipagpalagayan ng loob sa mga magsasaka. Matapos isagawa ang metodo sa pangangalap ng kasagutan sa mga tanong, inilihad ang mga kasagutan sa pamamagitan ng thematic analysis.

METODOLOHIYA

Desenyo ng Pananaliksik

Qualitative research design ang ginamitsa pananaliksik na ito. Ang nabanggit na disenyo sa pag-aaral na ito ay upang mailarawan at mas maintindihan ang mga magsasaka at ang kanilang cognitive attributes tungo sa paggamit ng teknolohiya sa pamamagitan ng pakikipagpanayam(interview) at pagaanalisa sa mga datos.

Sa pag-aaral na ito, ang mga mananaliksik ay gustong malaman ang cognitive attributes ng mga magsasaka sa paggamit ng teknolohiya. Ang kwalitatibong disenyo ay maaari ring itong makapag analisa sa katangian ng mga magsasaka. Gumamit din ang mag mananaliksik ng thematic analysis upang mapalabas, matukoy at ang tema ng mga kasagutan ng mga magsasaka.

Panggagalingan ng mga Datos

Ang pananaliksik na ito ay nais makita ang *cognitive attributes* at ang teknolohiyang ginagamit ng magsasaka mula sa napiling barangay ng Rosario, La Union. Ang mga

mananaliksik ay nangalap sa departamento ng agrikultura ng Rosario. La Union para malaman kung saan ang may pinakamalaking papulasyon ng magsasaka na gumagamit ng mga iba't ibang teknolohiya. Ang mananaliksik ay gumamit ng *purposive sampling techniques* para makakalap ng datos.

Instrumentong ginamit sa Pagkalap ng Datos

Nagsagawa ng paunang pakikipagpanayam sa bawat magsasaka kung naayon ba sila sa mga nasabing kakayahan. Ang mga mananaliksik ay nakipagpanayam sa mga magsasaka isa-isa. Sa pangangalap ng impormasyon nakipagpalagayan loob, nakibagay, nakisama at ang mga mananaliksik.

At ang huli ay ang pakikipagpanayam sa mga magsasaka para masigurado kung sila sa mga nahahayag na cognitive attributes sa kamalayan, persepsyon at rason.

KINAHINATNAN AT PAGTALAKAY

Moderno at Tradisyunal

Ang nakalap na datos sa ginawang sarbey ay mula sa 10 mga kalahok na nasa pagitan ng edad 50- 70. Batay sa resulta ng nasabing sarbey, halos kalahati (50%) ng mga kalahok ay gumagamit ng modernong pamamaraan at ang iba naman nakagawian na ang paggamit na kung saan ay traditional na pamamaraan (30%). Ang dalawampung porsyento (20%) naman ay parehas ang ginagamit moderno at traditional na pamamaraan. Ang nakalap na kasagutan ay nagmula sa kalahok na kung saan ay pinagtipon ng mananaliksik ang kanilang mga kasagutan upang mapalitaw ang tema. Ginamitan ng mananaliksik ng pormulang $f/N(100)$ upang malaman kung ilang porsyento ang gumagamit ng moderno at tradisyunal na kung saan ay lumalabas makikita ito sa talahanayang nasa ibaba.

Frequency Distribution at Porsyento ng Moderno at Tradisyunal na Ginagamit sa Pagsasaka.

	f	%
a. Modern	5	50
Tractor		
Four Wheels Tractor		
Thresher		
Tractor disc Harrow		
WaterPump		
Inorganic Fertilizer		
Hybrid Seed		
Rotor		
b. Tradisyunal	3	30
Hand Tractor (kuliglig)		
Native Plow (kalabaw)		
Organic		
c. Parehas Moderno at Tradisyunal	2	30
Hand Tractor (kuliglig)		
Native Plow (kalabaw)		
Thresher		
Tractor		
WaterPump		
Rotor		
Kabuuan	10	100

Teknolohiyang ginagamit ng mga Magsasaka

Base sa nakalap na datos mula sa mga magsasaka ng Tay- Ac, Rosario La Union karamihan sa kanila ay gumagamit na ng makabagong teknolohiya gaya ng mga sumusunod; tractors, rotor, thresher, water pump at iba pa. May mga magsasaka din na gumagamit pa ng tradisyunal na sistema na ginagamitan ng hayop dahil itoy kanilang nakagawian at naksanayan na.

Ang mga mananaliksik ay natunghayan ang iba't ibang karaniwang teknolohiyang ginagamit ng mga magsasaka gayun din ang kanilang pananaw sa mga kagamitan at sa paggamit nito. Natunghayan namin ang kahalagahan ng tradisyunal sa moderno. Ang pagsasaka ay di birong trabaho dahil maraming pagdadaan na proseso para magkaroon ng magandang ani at magkaroon ng sapat na kita

Sa Kamalayan ng mga magsasaka sa makabagong Teknolohiya. Base sa nakalap na kasagutan sa mga kalahok sa Tay- Ac Rosario La Union karamihan sa mga magsasaka ay may kamalayan sa makabagong teknolohiya na ginagamit sa pagsasaka, dahil sa kanilang 'committee association' at ang mga iba ay nakapunta sa iba't- ibang lugar at doon nalaman na may bagong teknolohiyang ginagamit na sa pagsasaka

Sosyal

Ang mga magsasakang nalaman na may makabagong teknolohiya ay may kinalamn ito sa relasyon ng mga ito sa ibang tao, sa social media, iba't ibang lugar at sa komunidad o lipunan.

Ayon sa isang kalahok

Oo may alam na kami na i-demo/na introduce na ng association namin, may nakita na din ako sa ibang lugar, tulad sa tarlac nagpunta ako doon nun at may nakita ako don na may bagong ginagamit sa pagsasaka.

Social Factors

Sociology “social relations”. Ayon sa social encyclopedia by (Edwin R.A Seligman at Alvin Johnson, 1930). Pakikisalamuha sa ibang tao upang malaman, maibalita ang mga iba’t ibang pangyayari. Malaman kung may bagong teknolohiyang naimbento sa pagsasaka.

Factors in the social that are important related to social connections, including social participation, social cohesion, social capital, and the collective efficacy of the neighborhood (or work) environment (Ahern and Galea, 2011). Social participation and integration in the immediate social environment (e.g., school, work, and neighborhood)

Sa Persepsyon ng mga Magsasaka sa Moderno at Tradisyunal na Teknolohiya. Base sa mga magsasaka ng Tay-Ac Rosario La Unoin mayroong kagandahan at kapangitan ang modern at tradisyunal na teknolohiya gamit sa pagsasaka.

Sa kagandahan ng moderno sinasabi ng mga magsasaka na high-tech, mabilis matapos ang trabaho sa pagsasaka, oras lang ang bibilangin sa

Sa Rason ng mga Magsasaka kung bakit ginagamit ang mga Makabago at Makalumang Teknolohiya

Sa mga magsasakang gumagamit lang ng modernong teknolohiya dahil sa makakatipid ka ng pera, isa o dalawa lang kasi ang kailangan mong arkilahin at pakainin, bagamat minsan ay magastos ito pa rin ang gusto naming gaitin. Isang halimbawa kapag gumamit ka ng tradisyunal gagamit ka ng kalabaw sa pag aararo at dahil malawak ang iyong sakahin magaarkila ka ng maraming kalabaw at tao para mag araro. Madali din gamitin ang moderno at makakatipid ng oras dahil madaling matapos ang trabaho may

pagtrabaho at mabilis ding umepekto ang synthetic fertilizer, Segundo lang ang hihintayin at makikita mo na ang resulta. Sa kapangitan ng modernong teknolohiya mahal ito pag nasira, mahal ang pagpapagawa, mahal ang gasoline/krudo kaya mabigat din ito minsan sa balsa. Naantala din ang pagtatanim at pagaani kapag nag itoy nasira. Maraming nasasayang/natatpon na palay. Maraming tao ang mawawalan ng trabaho dahil pag gumamit ng makabagong teknolohiya isa o dalawa lang ang kailangan para magtrabaho.

Kagandahan ng tradisyunal base sa nakalap na datos ay “worth it “ kahit pagod, ang organismong pataba ay maganda ang epekto kahit matagal makita ang epekto. Ang tradisyunal ay may kayang gawin na hindi kaya ng modernong teknolohiya. Mayroon ding kapangitan ang tradisyunal mabagal ang pagtrabaho, aabutin ka ng maghapon, ngunit hindi mo pa tapos ang ekta-ektaryang sakahan.

Pisikal

Ang aspetong ito ay kumakatawan sa mga magsasakang nagkakaroon ng kapaguran ng kanilang katawan sa pagsasaka.

Physical Factors

Pisikal importante dito ang kalusugan ng pangangatawan dahil sa paglipas ng panahon, nadadagdagan ang ating taon sanhi nito ang unti-unting paghina ng ating katawan dala ng ating pagtanda

oras ka pang gawin ang iba pang mga bagay-bagay.

Ayon sa mga kalahok

Para kanyak... modern ladta met.

Modern po syempre... sa panahon ngayon... dapat sumunod na sa mga makabagong pamamaraan.

Kapag susunod ka sa tradisyonal ngayon wala kang aanihin. Kung ano ang inissue ngayon ng agriculture/technician natin yun ang sinusunod natin so modern technology.

Ayyyyy! Napintas modern tadta, high breed gamen amin tadta.

(ayyy! maganda ang modern ngayon, high breed na kasi lahat ngayon)

Sa tradisyunal ito'y nakagisnan at nakasanayan na kaya madali nalang itong gamitin para sa kanila. Gamit na namin ito simula noon kaya kahit gumamit kami ng moderno ang magiging resulta ay parehas pa rin walang kaibahan kaya stick lang kami sa tradisyunal, at dahil din sa hindi namin kayang bilhin ang modernong kagamitan ngayon sa pagsasaka, wala kaming budget kaya nagtitiis na lamang kami at magtatampo din ang mga tao kapag gumamait ng modern.

Parehas na gumagamit ng tradisyunal at modernong kagamitan sa pagsasaka. Kapag nasira ang moderno may reserba ka kasi may tradisyunal kang kagamitan.

Ayon sa sa isang kalahok

Gagamit ka nang modern gagamit ka din ng tradisyunal. Hindi mo pwedeng isantabi na lang ang tradisyonal.

Pinansiyal

Ito ay may kinalamansa perang pantustos para sa pangunahing pangangailangan ng mga kalahok. May mga kalahok kami na nakararanas ng kakulangan sa pinansiyal na aspeto dulot nito kaya hindi sila nakakagamit or nakakabili ng makabagong kagamitan sa pagsasaka.

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Isang artikulong nahanap sa pahayagan ng The Philippine Star sa seksiyon ng Business Agriculture/Environment. May pamagat na "Farm Group Bats for Higher DA Budget". Ito ay tungkol sa mga magsasaka na nananawagan sa gobyerno na taasan ang pondo ng Department of Agriculture nang sa gayo'y makabili ito maraming punla, pataba, at mga pasilidad sa irigasyon at makabagong kagamitan/teknolohiya sa pagsasaka.

Ayon sa isang kalahok

Hindi namin kayang bilhin ang modernong kagamitan ngayon sa pagsasaka, wala kaming budget kaya nagtitiis na lamang kami

Dalawang Mukha: Mga Pag-uugaling Pilipino ng mga Estudyante sa CAS

Jeanile J. Bacate, Mary Grace B. Dulay,
Jennifer P. Japson, Rizalyn S. Paraan and Madelyn P. Niño

Abstrak

Ang pananaliksik na ito ay isang quantitative-correlation research na ginamitan ng talatanungan sa pagkuha ng mga datos. Ang mga kalahok ay may kabuuang 207. Gumamit ng Lynch Formula ang mga mananaliksik sa pagkuha ng sample size. Ang mga mananaliksik ay nilayon na alamin ang kaugnayan ng profayl ng mga kalahok sa kanilang pagsasapamuhay sa dalawang mukha ng mga kaugaliang Pilipino. Mas marami ang BS Psychology, ikatlong taong baitang, babae, panganay, ang isa lang ang nasalihan na organisasyon, Romano Katoliko, at ang natapos ng magulang ay hanggang sa sekondarya. Sa limang kaugaliang Pilipino, nangibabaw ang positibong pagsasapamuhay ng mga kalahok. Ang kaugaliang pakikisama lamang ang walang kaugnayan sa isang profayl. Ito ay ang natapos ng magulang. Ang kaugaliang hiya ay may kaugnayan sa baitang at relihiyon habang ang kaugaliang utang na loob ay walang kaugnayan sa profayl na nabanggit. Ang kaugaliang bahala na ay may kaugnayan sa kurso at bilang ng organisasyon. Ang kaugaliang mañana habit ay may kaugnayan sa kasarian, bilang ng organisasyon, kurso at natapos ng magulang.

Keywords: *bahala na, hiya, kaugaliang Pilipino, mañana habit, pakikisama, utang na loob.*

PANIMULA

Pagsusuring Sitwasyon

Ang mga kaugalian ng mga Pilipino ay may mga pinaghalong mabuti at masama. Ang mga kaugalian ay maaaring ipasapamuhay sa positibo o negatibong pamamaraan depende sa piniling desisyon at sitwasyon. Bilang estudyante may limang pangunahing pag-uugali na pwedeng nararanasan o napapasapamuhay sa paaralan, sa bahay o sa komunidad. Ito ay ang kaugaliang hiya, pakikisama, utang na loob, bahala na, *mañana habit* na maaaring maranasan ng mga estudyante sa loob ng paaralan; Maaaring sa limang pag uugali na ito ay mayroong positibo at negatibong naidudulot sa pang araw-araw na pamumuhay.

Karamihan sa mga Pilipino ay pinapahalagahan ang mga kaugalian dahil

ito ang itinuro sa loob ng tahanan, sa paaralan at nakikita sa komunidad.

Pinapahalagahan din ang kaugalian sa loob ng relihiyon.

Sa pangkalahatan nakikita ang iba't ibang kaugaliang Pilipino sa kung paano makisalamuha ang mga tao sa kapwa, sa pamilya at sa loob ng paaralan. Ang kaugalian ay may importanteng papel, hindi lang sa loob at labas ng bahay, komunidad, o paaralan kundi pati rin sa sikolohiya. Iminumungkahi ng mga mananaliksik na bigyan ng pansin ang mga tinatawag na mga negatibo na pag-iisip sa mga Pilipino upang matukoy kung maaaring ito ay maging isang positibong aspeto o negatibong aspeto. Maaari rin natin bigyang pansin ang mas higit na mabuting pamamaraan tungo sa positibong pag uugali ng isang Pilipino lalong lalo na sa estudyante na nag-aaral.

Balangkang ng Pananaliksik

Mula sa pag-aaral nila Enriquez at Marcelino (1984) ang hiya ay masasabing may kagandahang asal dahil ito ay isang kakayahan ng pakikipag kapwa tao. Nagiging negatibo naman ang kaugaliang hiya kapag alam na sa sarili na mali ang ginagawa ay patuloy pa rin itong inuulit gawin.

Ayon kay Jocano (2001) ang kaugaliang bahala na ay nagiging positibo kapag ito ay makatutulong na palakasin ang loob sa panahon ng krisis o pangangailangan. Naipapasapamuhay ang negatibong kaugaliang bahala na kapag madalas na umaasa sa Diyos o di kaya sa salitang bahala na ang mga tao para sa kanilang pang araw-araw na pangyayari sa buhay at hindi na nagsusumikap.

Isinalin ni Kaunt (1961) ang salitang utang na loob na isang obligasyon na dapat bayaran. Naisasapamuhay ito sa negatibong pamamaraan kapag ang mga ginagawa na ng tao ay labag na sa kalooban nila at ginagawa na lang nila ito sa kadahilanang binabayaran lang nila ang obligasyon nila. Ayon naman kay Andres (1994) binigyang kahulugan

niya ang kaugalian na utang na loob bilang pagkilala at pagtanaw sa sariling pagkakautang.

Ayon kay Enriquez (1973, 1978) ang kaugaliang pakikisama ay isang uri ng pakikipagkapwa. Isa itong positibong pagsasapamuhay dahil sa pamamagitan ng pakikipagkapwa ay maaring magkaroon ng pagkakaisa sa isang grupo at dahil dito magkakaroon ng kapayapaan sa kaisipan at sarili at maiiwasan ang gulo. Mula kay Enriquez din (1973, 1978) ay maaaring may negatibo din ang pakikisama kapag patungkol na sa korapsyon at pangunguwalta.

Ayon sa Volcano ECIG (2011) kinilala niya ang *mañana habit* na mayroong positibong epekto para sa Pilipino sa kadahilanang may pagkakataon pa para unahin ang mas importanteng bagay at maari ding mawawala ang tensyon at pagod kapag natutunang tanggapin ang pangyayari. Mula kay Pepoa (2010) para sa kanya ang *mañana habit* ay puwedeng matawag na “*procrastination virus*” sa kadahilanang oras na nasanay ka na sa kaugaliang *mañana habit* mahirap na itong iwasan.

Paglalahad ng Suliranin

Ang pag-aaral na ito ay nakapokus sa kung may kaugnayan ba ang profayl ng mga estudyante sa kanilang pagsasapamuhay ng mga kaugaliang Pilipino na may dalawang mukha. Ano ang madalas na ipinapasamuhay sa mga kaugaliang Pilipino, yung positibo ba o negatibong pag uugali sa mga estudyante ng CAS. Inalam din ng mga mananaliksik ang kasagutan sa mga sumusunod na katanungan.

1. Ano ang personal profayl ng mga kalahok ayon sa mga sumusunod:
 - 1.1 kurso;
 - 1.2 baitang;
 - 1.3 kasarian;

- 1.4 pang ilan sa magkakapatid;
 - 1.5 natapos ng magulang;
 - 1.6 relihiyon;
 - 1.7 bilang ng nasalihanang Organisasyon
2. Alin sa dalawang mukha ng bawat kaugaliang Pilipino ang kadalasang isinasapamuhay nga mga kalahok ayon sa mga sumusunod:
 - 1.1 hiya;
 - 1.2 pakikisama;
 - 1.3 utang na loob;
 - 1.4 bahala na;
 - 1.5 *mañana habit*?
 3. May kaugnayan ba ang profayl ng mga kalahok sa kanilang pagsasapamuhay sa dalawang mukha ng kaugaliang Pilipino?

METODOLOHIYA

PROFAYL	X ²	DF	CV	DESIYON
KASARIAN	3.39	1	3.841	ACCEPT
BAITANG	11.44	1	3.841	REJECT
BILANG NG ORGANISASYON	3.86	4	9.488	ACCEPT
PANG ILAN SA MAGKAKAPATID	4.87	2	5.991	ACCEPT
RELIHIYON	13.18	3	7.815	REJECT

Disenyo ng Pananaliksik

Ang mga mananaliksik ay gumamit ng *quantitative research* kung saan ito ay naglalarawan, tumutuklas at nagpapaliwanag ng isang penomena. Ang mga mananaliksik ay gumamit ng talatanungan kung saan inalam ang kultura ng bawat grupo tungkol sa paggamit nila ng mga kaugaliang Pilipino. Gumamit din ng pakikipanayam sa mga kalahok upang makuha ang mga datos.

Pinanggalingan ng Datos

Ang mga kalahok sa pag-aaral na ito ay ang mga estudyante na kabilang sa College of Arts and Sciences, Agoo La Union taong 2016-2017 sa unang semestre. Sila ay nabibilang sa tatlong kurso: BS Mathematics, BS Psychology at BS Biology. Ang *Lynch Formula* ay isang pamamaraan sa pagkuha ng *sample size*. Ginamitan ng *convenience sampling technique* sa pagpili ng kalahok na ang ibig sabihin nito ang mga napiling kalahok ay ang mga estudyanteng madaling lapitan o mga estudyanteng magkukusang magpa-interbyu.

Talahanayang 6. Kaugnayan ng Kaugaliang Hiya sa profayl ng mga kalahok.

Napag-alaman na mas mababa ang CV kaysa sa chi square value sa mga sumusunod na profayl: baitang, $CV=3.841 \geq x^2=11.44$; relihiyon, $CV=7.815 \geq x^2=13.18$. Ang ibig sabihin ng resultang ito ay "*Reject the Null Hypothesis*" na may kaugnayan ang profayl sa pagsasapamuhay ng dalawang mukha sa mga kaugaliang hiya. Ang

Metodo at Pangangalap ng Datos

Gumamit ang mga mananaliksik ng talatanungan na kanilang sinagutan at sinamahan ito ng pakikipanayam upang makalap ang mga datos. Para sa *pilot testing* ng nasabing sarbey, pinasagutan ito sa (30) na katao. Inalam ang "*reliability*" gamit ang (SPSS) at nakakuha ng .643 na may katumbas na "*acceptable reliability*". Gumawa ang mga mananaliksik ng (50) na talatanungan patungkol sa dalawang mukha ng limang kaugaliang Pilipino.

KINAHINATNAN AT PAGTALAKAY

Profayl ng mga Kalahok

Mula sa BS Psychology, ikatlong baitang, mga babae, Sa bilang ng organisasyon ay mula sa lima pataas, pang-ilan sa magkakapatid ay mula sa 1-2 posisyon, Roman Catholic at sa natapos ng magulang ay mula sa sekondarya ang may pinakamaraming kalahok.

katuturan ng resulta ay, may kinalaman ang baitang at relihiyon sa pagsasapamuhay sa kaugaliang hiya. Ipinapahiwatig ng resulta na kahit na nasa ikalawa o ikatlong baitang ka ay napapairal parin ang kaugaliang hiya sa isang estudyante at kahit na saang relihiyon ka man napapabilang ay dala dala parin ng isang Pilipino ang kaugaliang ito.

Talahanayang 1. Kaugnayan ng Kaugaliang Pakikisama sa profayl ng mga kalahok.

PROFAYL	X ²	DF	CV	DESIYON
KASARIAN	7.85	1	3.841	REJECT
BAITANG	14.81	1	3.841	REJECT
KURSO	7.62	2	5.991	REJECT
BILANG NG ORGANISASYON	31.15	4	9.488	REJECT
PANG ILAN SA MAGKAKAPATID	10.03	2	5.991	REJECT
RELIHIYON	19.21	3	7.815	REJECT
NATAPOS NG MAGULANG	6.99	3	7.815	ACCEPT

Napag-alaman na mas mababa ang CV kaysa sa chi square value sa mga sumusunod na profayl: Sa kasarian, $CV=3.841 \geq x^2=7.85$; baitang, $CV=3.841 \geq x^2=14.81$; kurso, $CV=5.991 \geq x^2=7.62$; bilang ng organisasyon, $CV=9.488 \geq x^2=31.15$; pang ilan sa magkakapatid, $CV=5.991 \geq x^2=10.03$; relihiyon, $CV=7.815 \geq x^2=19.21$. Ang ibig sabihin ng pagiging mas mababa ng CV kaysa chi square value ay “*Reject the Null Hypothesis*” na may kaugnayan ang profayl sa pagsasapamuhay ng dalawang mukha sa kaugaliang

pakikisama. Ang katuturan ng resulta ay may kinalaman sa kasarian, baitang, kurso, bilang ng organisasyon, pang ilan sa magkakapatid at relihiyon sa pagsasapamuhay sa kaugaliang pakikisama. Ipinapahiwatig ng resulta na kahit anu pa man ang kasarian, relihiyon, baitang, kurso, bilang ng organisasyon at pang ilan sa magkakapatid ng mga estudyante ay may katangian parin silang taglay sa kaugaliang ito.

Talahanayang 2. Kaugnayan ng Kaugaliang Utang na loob sa profayl ng mga kalahok.

PROFAYL	X ²	DF	CV	DESIYON
KASARIAN	7.85	1	3.841	REJECT
BAITANG	1.4	1	3.841	ACCEPT
KURSO	26.39	2	5.991	REJECT
BILANG NG ORGANISASYON	59.24	4	9.488	REJECT
RELIHIYON	6.53	3	7.815	ACCEPT

Napag-alaman na mas mababa ang CV kaysa sa chi square value sa mga sumusunod na profayl: kasarian, $CV=3.841 \geq x^2=7.85$; kurso, $CV=5.991 \geq x^2=26.39$; bilang ng organisasyon, $CV=9.488 \geq x^2=59.24$; pang ilan sa magkakapatid; $CV=5.991 \geq x^2=13.31$; natapos ng magulang, $CV=7.815 \geq x^2=36.47$. Ang ibig sabihin ng resultang ito ay “*Reject the Null Hypothesis*” na may kaugaliang ito dahil ang kaugaliang utang na loob ay pagkukusa sa mga bagay na naibibigay o natatanggap.

kaugnayan ang profayl sa pagsasapamuhay ng dalawang mukha sa mga kaugaliang utang na loob. Ang katuturan ng resulta ay may kinalaman ang kasarian, kurso, bilang ng organisasyon, pang ilan sa magkakapatid at natapos ng magulang sa pagsasapamuhay sa kaugaliang utang na loob. Ipinapahiwatig ng resulta na maaaring hindi pinipili ang profayl sa

Talahanayang 3. Kaugnayan ng kaugaliang Bahala na sa profayl ng mga kalahok.

PROFAYL	X ²	DF	CV	DESIYON
KASARIAN	1.13	1	3.841	ACCEPT
BAITANG	0.25	1	3.841	ACCEPT
KURSO	21.7	2	5.991	REJECT
BILANG NG ORGANISASYON	12.72	4	9.488	REJECT
PANG ILAN SA MAGKAKAPATID	5.62	2	5.991	ACCEPT
RELIHIYON	4.39	3	7.815	ACCEPT
NATAPOS NG MAGULANG	6.3	3	7.815	ACCEPT

Napag-alaman na mas mababa ang CV kaysa sa chi square value sa mga sumusunod na profayl: kurso, $CV=5.991 \geq x^2=21.7$; bilang ng organisasyon, $CV=9.488 \geq x^2=12.72$. Ang ibig sabihin ng resultang ito ay “*Reject the Null Hypothesis*” na may kaugnayan ang profayl sa pagsasapamuhay ng dalawang mukha sa mga kaugaliang bahala na. Ang katuturan ng resulta ay may

kinalaman ang kurso at bilang ng organisasyon sa pagsasapamuhay sa kaugaliang utang na loob. Ipinapahiwatig ng resulta na kahit na anung kurso ka napapabilang ay dala dala parin ng isang estudyante ang kaugaliang ito.

Talahanayang 4. Kaugnayan ng kaugaliang *Mañana Habit* sa profayl ng mga kalahok.

PROFAYL	X ²	DF	CV	DESIYON
KASARIAN	4.83	1	3.841	REJECT
BAITANG	2.36	1	3.841	ACCEPT
KURSO	40.83	2	5.991	REJECT
BILANG NG ORGANISASYON	22.93	4	9.488	REJECT
PANG ILAN SA MAGKAKAPATID	2.99	2	5.991	ACCEPT
RELIHIYON	7.77	3	7.815	ACCEPT
NATAPOS NG MAGULANG	11.4	3	7.815	REJECT

Napag-alaman na mas mababa ang CV kaysa sa chi square value sa mga sumusunod na profayl: kasarian, $CV=3.841 \geq x^2=4.83$; kurso, $CV=5.991 \geq x^2=40.83$; bilang ng organisasyon, $CV=9.488 \geq x^2=22.93$; natapos ng magulang, $CV=7.815 \geq x^2=11.4$. Ang ibig sabihin ng resultang ito ay “*Reject the Null Hypothesis*” na may kaugnayan ang profayl sa pagsasapamuhay ng dalawang mukha sa mga kaugaliang *mañana habit*. Ang katuturan ng resulta ay may kinalaman ang kasarian, kurso, bilang ng organisasyon at natapos ng magulang sa pagsasapamuhay sa kaugaliang *mañana habit*. Ipinapahiwatig ng resulta na ang mga profayl ay may

kaugnayan sa kaugaliang ito dahil hindi pinipili ang kung anung kasarian ang isang tao, kung anumang kanilang kurso, kung ilan man ang nasalihang organisasyon at kung anu man ang natapos ng kanilang mga magulang, dahil ang *mañana habit* ay pagpapabukas o pagsasantabi ng mga gawain sa paaralan man o sa bahay.

KONKLUSYON

Mas nangingibabaw and positibong kaugaliang Pilipino na isinasapamuhay ng mga Estudyante ng CAS.

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Factors and Types of Truancy among Secondary School Students in Tubao National High School

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Abstract

School is the main focus of this study. The researchers determined the relationship between the variables under study. Using the lynch formula, ninety eight truant students were chosen as respondents from Tubao National High School. The descriptive-survey design was used and statistical tools were frequency, average weighted mean, percentage and chi-square.

Findings of the study reveals that majority of the respondents were males. Respondents were in the adolescent stage during the conduct of the study, the significant number of truants was from grade nine. Respondents mostly belong to neutral family. The respondents' monthly family income was below the poverty line. Most of the respondents' parents had finished high school. Family/home, within the self, and school factor were neutrally agreed by the respondents as their factor of truancy; however, they disagree that peers are a factor of being a truant. Among the types of truancy, the respondents neutrally agreed that they are indulging with the casual truancy. There is no significant relationship of all categories under personal profile and factors and for the relationship of the personal profile and types, only the year level has significant relationship.

Keywords: *factors of truancy, truancy, types of truancy*

INTRODUCTION

Situation Analysis

School is an agent of socialization as well as an institution set up by the society in order to pass knowledge, skills, values, attitudes and other necessary qualities to the younger generations so that they become productive leaders of tomorrow. Mahuta, (2007) viewed and regarded a school that centers knowledge and it possesses the power to mold and shape the character of individuals in the society. Therefore, it is clear that school is a backbone and life wire of a society. However, present day students do engage in absenting themselves from school without concrete and reasonable reasons. Therefore, in developing countries like Philippines, truancy is one of the problems seriously affecting teaching and learning, general performance and quality of secondary school students.

Thus, a law of the education system in most countries mandates children to attend school for at least eleven years in their life. However, some students do not abide by the law because of some internal and external undesired factors, therefore leading to the prevalence of truancy from primary to tertiary levels in of education. Truancy remains an issue which has drawn the concern of parents, society and the government as it is the forerunner to many social and disciplinary problems among students. When students start to be truant, it implies that school has lost its importance and has failed to attract students to stay in school.

Framework of the Study

The word truancy means “Run away from classes” and the students who always

tend to keep themselves away from studies and avoid attending classes are called truants (Gosain 2013). In another vein, Chukwuka, (2013) defines truancy as absence from school for no legitimate reason. Adekunle, (2015) added that truancy involves intentionally absenting oneself from school without permission, leaving without authorization and dodging of specific lesson periods. Therefore, it is clear that in a situation where a student absenta himself from school without any concrete reason and whereby parents are not aware about it can be regarded as truancy.

There is a theory that proposes that truancy is caused by various aspects of the school. This theory explains truancy as a response to an inadequate education system. It appears that this theory is based on the perception that the schools and the education system in general are lacking, and thus force some learners to reject the very education that is thought to give them a better future. Proponents and supporters of this perspective would therefore argue that what is happening in the schools and the education system in general is what actually makes learners become truants. Inadequacies could be those located in the physical environment, the school climate – inters of the learning and teaching atmosphere – and the curriculum, if it is seen as being irrelevant and not accommodating diversity.

This study consists of one independent variable: personal profile of the respondents. Under personal profile it includes sex, age, year level, monthly income of parents, highest educational attainment of parents and their family structure. The researchers determined if the personal profile (independent variable) is related to the factors and types of truancy in Tubao National High School (Dependent Variable). On the other hand, the arrow represents the directions to emphasize the relationships of variables between the

independent variable and dependent variable.

Statement of the Problem

The study aimed to:

1. find out the factors of truancy experienced by the secondary school students in Tubao National High School; and
2. find out the type of truancy usually experienced by secondary school students in Tubao National High School

METHODOLOGY

Research Design

Descriptive survey was used determine the extent to which different variables are related to each other in the population of interest. Through this method, researchers could ascertain how much variation is caused by one variable in relation with the variation caused by other variable. It was used because it permitted the researchers to study small sample and later generalized the findings to the whole population. Osuala, (2001) viewed that in using a survey research, small sample is studied and the findings generalized for the whole population.

Sources of Data

The respondents of this study' are the students of Tubao National high School. The respondents came from the list of truant students recorded by their Guidance Counselor last school year 2015-2016. To get the sample for every year, the researchers used Lynch formula. The garnered number of respondents from the Lynch formula was 98 out of 131 total populations of truants. The respondents were drawn at random from the population. Their names were put in a box, shuffled well, and then the researchers took one respondent

after the other until they were able to complete the samples. The total number of students enrolled in Tubao National High School was 852, 436 males and 416 females. There was about 15 percent truancy incidence in the school. The frequency which was used to tell if the students are truant for Tubao National High School was three absences per month.

$$n = Nz^2 \times p(1-p) / Nd^2 + z^2 p(1-p)$$

Where: $z = 1.96$ at $\alpha = 0.05$

$p = 0.50$ (proportion)

$d = 0.05$ (sampling error)

$N =$ population

$n =$ sample size

Instrumentation and Data Collection

Data were collected by means of questionnaire. Using a questionnaire was appropriate because it is economical and can ensure anonymity, particularly when dealing with a large sample (Nardi, 2003). The items that are included in the questionnaire are based on factors and types that are likely to contribute to truancy and are derived from the framework of the study. Close-ended questionnaires are used because they are easy to score and can be answered quickly (Neuman, 2000). 5 Likert-scale was used in the questionnaire.

Analysis of Data

Frequency count and percentage were employed to analyze the data for the respondents' profile. Average weighted mean was employed to analyze the factors and types of truancy. The Chi-square was employed to analyze and to interpret the relationship between the variables.

RESULTS AND DISCUSSION

Correlation between Personal Profile and Factors of Truancy

When subjected to chi-square correlation coefficient, the chi square value of 1.52 with the degrees of freedom of 3 is lower than the critical value of 7.82 at 0.05 level of significance. Therefore, the null hypothesis which states that sex of respondents has no significant relationship with factors of truancy is accepted. This indicates that there is no significant relationship between the sex of respondents and factors of truancy. Also, when subjected to chi-square correlation coefficient, the chi-square value of 7.52 with the degrees of freedom of 12 is lower than the critical value of 21.026 at 0.05 level of significance.

Table 1. Correlation between Personal Profile and Factors of Truancy

Variables	χ^2	df	Critical Value $\alpha = 0.05$	Decision
Sex and Factors of truancy	1.52	3	7.82	Accept the Null Hypothesis
Age and Factors of Truancy	7.52	12	21.026	Accept the Null Hypothesis
Year level and Factors of truancy	14.66	9	16.919	Accept the Null Hypothesis
Family Structure and Factors of Truancy	4.61	9	16.919	Accept the Null Hypothesis
Monthly Income and Factors of Truancy	20.11	15	24.996	Accept the Null Hypothesis
Educational Attainment and Factors of Truancy	15.99	15	24.996	Accept the Null Hypothesis

Correlation between Personal Profile and Types of Truancy

When subjected to chi-square correlation coefficient, the chi-square value of 14.69 with the degrees of freedom of 6 is lower than the critical value of 12.592 at 0.05 level of significance. Therefore, the null hypothesis which states that year level of respondents' has no significant

relationship with factors of truancy is rejected. This indicates that there is a significant relationship between the year level of respondents and types of truancy. This implies that when truant students enter secondary school they have strong capacity to indulge in different types of truancy.

Table 2. Correlation between Personal Profile and Types of Truancy

Variables	χ^2	df	Critical Value $\alpha = 0.05$	Decision
Sex and Types of Truancy	1.68	2	5.991	Accept the Null Hypothesis
Age and Types of Truancy	10.10	8	15.507	Accept the Null Hypothesis
Year level and Types of Truancy	14.69	6	12.592	Reject the Null Hypothesis
Family structure and Types of Truancy	5.25	6	12.592	Accept the Null Hypothesis
Monthly income	7.66	10	18.307	Accept the

and Types of Truancy				Null Hypothesis
Educational attainment and Types of Truancy	17.91	10	18.307	Accept the Null Hypothesis

CONCLUSIONS

1. Majority of the respondents are male. Respondents were in the adolescent stage during the conduct of the study. A significant number of truants was from Grade 9. Respondents mostly belong to neutral family. The respondents' monthly family income is below the poverty line. Most of the respondents' parents finished high school.

2. Family/home factor, individual factor, and school factor are sometimes encountered by the respondents as factors affecting truancy; however, they rarely encounter peer as a predictor of being a truant.

3. Among the types of truancy, only the casual truancy garnered an average of 2.83 which the respondents are neutrally experiencing.

4. There is no significant relationship between personal profile and factors of truancy.

5. There is a significant relationship on the year level of respondents and the types of truancy.

RECOMMENDATIONS

The following recommendations are forwarded based on the findings and conclusions of the study:

1. Additional variables may be included in the personal profile of respondents to be correlated with truancy.

2. Additional factors of truancy including environmental factors and social factors may be included to be correlated with personal profile.

3. Since the respondents are only average in casual truancy, authorities in school must implement a program that can help including health inspections every month and early class suspensions when there is a typhoon.

4. School authorities may investigate further why students start experiencing casual type of truancy.

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Farmers Parenting Style and their Children's Social Behavior

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ABSTRACT

The main purpose of this study is to look on the importance of parenting styles on the social behavior of the children. By using the total enumeration sampling technique, this study made use of descriptive research design and involved 46 respondents. Variables of this study were the parenting styles and the social behavior. The respondents were the second year students from the College of Arts and Sciences who belong to farming families. The constructed questionnaires in parenting style and social behavior were employed to gather the needed data. This study used total enumeration sampling technique, Percentage and frequency, average weighted mean and Chi Square were used for the data analysis and interpretation. "Authoritarian" is the highest parenting style used by the farmer parents and the pro-social behavior also is the highest behavior of the respondents rather than anti-social and there is no relationship between the parenting style and the social behavior.

Keywords: *parenting style, social behavior*

Introduction

Situation Analysis

Filipinos are famous when it comes to agriculture. Agriculture is the primary source of income of farmers. Farming is the most important sector in the Philippine society and farmers are the most industrious people. Through the laborious work of farmers, families are able to feed their members. Because of this, farming people are able to eat healthy foods. However, the real situation about farmers is difficult. For them, there is no excuse not to go to the fields and to work, there is no limit to their sacrifices. Sometimes they fail to have enough rest because they need to attend to their farms. To top this, they need to earn money to support their children and to be able to sustain their needs.

Parents are the major influence in their children's lives. Thus, their perception of how children think, and should be raised is crucial in determining children's behavior. Other factors, such as genes, peers, culture, gender, and financial status, are of lesser importance. Studies reveal a correlation between parenting styles and school

competence, delinquency, violence, sexual activity, anti-social behavior, alcohol and substance abuse, depression, anxiety, and self-perception.

The parent-child relationship is an important aspect of the development of their children, where parents are the major influences to their children's behavior. When optimal, parenting skills and behaviors have a positive impact on children's self-esteem, school achievement, cognitive development and behavior.

It is essential to parents to recognize the importance of the development of their children and how this can impact to social behavior and social development. An important aspect of child behavior formation is operant conditioning, an idea popularized by B.F. Skinner. Basically, operant conditioning focuses on the idea that learning certain behaviors involves learning the relationships between one's own behavior and the positive reinforcement or

punishment that prevails. In operant conditioning, learning depends on the temporal proximity of association. Therefore, the response must occur soon after the action, especially in the case of infants, in order for the child to make the association between the consequence and action. Punishment and reinforcement are both effective tools in helping children to perform certain behaviors with greater or less frequency (Saxon, Jill, and Robert S. Siegler.)

Framework of the study

Parenting is a complex activity that includes many specific behaviors that work individually together to influence child outcomes. Although specific parenting behaviour, such as spanking or reading aloud may influence child development, looking at any specific behaviour in isolation may be misleading. The construct of parenting style used the two-capture normal variation in parents' attempts to control and socialize their children. Two points are critical in understanding this definition. First, parenting style is meant to describe normal variations in parenting. In other words, the parenting styles typology by Baumrind should not be understood to include deviant parenting, such as might be observed in abusive or neglectful homes. Second, Baumrind assumes that normal parenting revolves around issues of control although parents may differ on how they try to control or socialize their children and the extent to which they do so. It is assumed that the primary role of all parents is to influence, teach, and control their children. Parenting style captures the important elements of parenting: parental responsiveness and parental demandingness. Parental responsiveness (also referred to as parental warmth, parental supportiveness)

refers to "the extent to which parents intentionally foster individuality, self-regulation, and self-assertion, by being attuned, supportive, and acquiescent children with special needs and demands. Parental demandingness (also referred to as behavioural control) refers to the claims parents make on children to be integrated into the whole family, by their maturity demands, supervision, disciplinary efforts and willingness to confront the child who disobey (Baumrind, 1991, pp.61-62.)

These dimensions include disciplinary strategies, warmth and nurturing, communication styles, and expectations of maturity and control. Based on these dimensions, Baumrind suggested that the majority of parents display one of the three parenting styles.

Authoritarian parenting is a style of parenting whereby children are expected to follow the strict rules established by the parents. Failure to follow such rules usually results in punishment. Authoritarian parents don't explain the reasoning behind these rules. If asked to explain, the parent might simply reply "Because I said so". These parents have high demands but are not responsive to their children. According to Baumrind, these parents "are obedience and status oriented, and expect their orders to be obeyed without explanation".

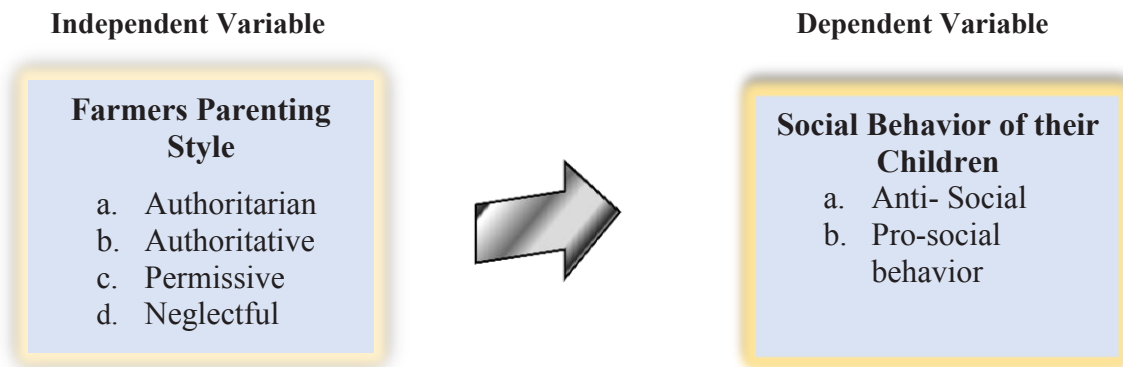


Figure 1. Paradigm of the study

Statement of the Problem

This research study aimed to look into the relationship between the parenting style of farmers and the social behaviors of their children. Specifically, it sought answers to the following problems:

1. What parenting style is most frequently practiced by the respondent farmers?
 - a. Authoritarian
 - b. Authoritative
 - c. Permissive
 - d. Neglectful
2. What is the social behavior of the farmers' children?

- a. Anti-social Behavior/ Violent
- b. Pro-social behavior/Altruism
3. To what extent do the farmers' children exhibit the following social behaviors?
 - a. Anti-social Behavior/ Violent
 - b. Pro-social/Altruism
4. Is there a significant relationship between the farmers' parenting style and the social behavior of their children?

METHODOLOGY

Research Design

This research study made use of the descriptive research design. The descriptive research design attempts to describe the nature of the situation as it exists at the time of the study and to explore the causes of a certain phenomenon. This design involves data gathering needed to describe events, organize, tables and help the researchers to analyze, and to interpret the data gathered.

This design was used to describe, analyze and interpret parenting styles and social behavior of the respondents. The relationship among the variables was also

analyzed and interpreted using proper statistical analysis and tests.

Sources of Data

The current study focused on the children who belonged to the farming families. They were second year college students enrolled in the different curricular programs offered by the College of Arts and Sciences. The period covered by this study was during the first semester of school year 2016-2017. The total population of the 2nd year college of CAS was 285. The survey yielded 46 as the total number respondents

who belong to farming families. Total enumeration was employed as the sampling technique for the 46 participants. The respondents comprised of students from the from the following programs: Seven (7) BS Mathematics, 14 BS Biology, seven (7) AB English, 15 BS Psychology, and three (3) AB Filipino.

Instrumentation and Data Collection

The instrument used to gather the data for this study was a questionnaire. The researchers constructed the items in the questionnaire based from literature on parenting styles and social behaviors. The questionnaire was made up of two parts. The first part consisted of items for parenting style and the second part consisted of items for social behavior. The parenting style questionnaire constructed by the researchers intended to identify the parenting style of the respondents along the following dimensions; Authoritarian, Authoritative, Permissive and Neglectful while the social behaviour questionnaire was intended to measure the aggressiveness and pro-social behaviour of the respondents. The questionnaire was administered to 30 students from the Institute of Agriculture who belong to farming families for the purpose of checking its validity and

reliability. The researchers computed the reliability using the SPSS. Result was .815 which showed that the questionnaire is highly reliable in the parenting style while the computed reliability on social behavior questionnaire showed .796 as highly reliable. The validity was distributed to three validators, then the computed validity was 3.75 which means it is highly valid.

RESULTS AND DISCUSSION

As shown in Table 1, 18 or 39.03 percent of the farmers' children identified the Authoritarian parenting style as the most frequently practiced by their parents. Next to it is the Authoritative parenting style with a frequency of 12 or 26.09 percent followed by Permissive parenting style which shows 12 or 26.09 percent and lastly, the neglectful parenting style with a frequency of 4 or 8.69 percent.

Table 1 Frequency of Parenting Styles

Parenting Style	Frequency	Percentage
Authoritarian	18	39.13%
Authoritative	12	26.09%
Permissive	12	26.09%
Neglectful	4	8.69%
Total	46	100%

Table 2 presents the frequencies and percentages of children's social behaviour

(pro-social behavior and anti-social behaviour).

Table 2. Frequencies and Percentages of Children's Social Behavior

Social behavior	Frequency	Percentage
Pro-Social Behavior	41	89.13%
Anti-Social Behavior	5	10.87%
Total	46	100%

Based from on Table 2, the extent of pro-social behaviour among the respondents is high.

Pro social behavior are those intended to help other people. Pro social behavior is characterized by a concern about the rights, feelings and welfare of other people. The respondents' antisocial behavior is "Moderate" which means that the respondents have a moderate antisocial behavior influenced by the parenting style used by their farmer parents.

Anti-social behavior tendencies mean that a person lacks empathy, which

means the ability to understand the feelings of others, and does not care about how he or she makes others feel. A major risk factor is parenting style, in particular harsh and inconsistent parenting, which research has shown is associated with child behavior problems. Other factors that feed into this directly and indirectly include domestic violence, parental drug abuse, maternal depression, family poverty, parents with low education, stressed families and single parent status.

Table 3 presents the relationship between parenting style and social behaviour. The table above presents the Chi-square computation that shows the relationship between parenting style and social behavior.

Table 3. Relationship between Parenting Style and Social Behavior

Social Behavior/ Parenting Style	Anti-Social Behavior	Pro Social Behavior	Row Total
Authoritarian	4	14	18
Authoritative	1	11	12
Permissive	0	12	12
Neglectful	0	4	4
Total	5	41	46

Observed PS/SB	Expected	O-E	(O-E) ²	(O-E) ² /E
4	1.96	2.04	4.16	2.12
14	16.04	-2.04	4.16	0.26
1	1.3	-0.3	0.09	0.07
11	10.7	0.3	0.09	8.41
0	1.3	-1.3	1.69	1.3
12	10.7	1.3	1.69	0.16
0	0.43	-0.43	0.18	0.42
4	3.57	0.43	0.18	0.42

Chi Square = 13.16

Table 3 it shows the observed and expected relationship between parenting style and social behavior. The computed $X^2 = 13.16$ with a degree of freedom of 3 and the critical value at alpha 0.05 is 7.815. The

computed value is greater than the critical value, thus decision is to reject the null hypothesis which means that there is a relationship between the farmers parenting style and social behavior of the respondents.

CONCLUSIONS

Based on the findings, the following conclusion were drawn:

1. Majority on the respondents receive authoritarian parenting styles from their parents.
2. Majority of the respondents have a pro social behaviour.
3. The respondents manifested pro social behavior interpreted as high and pro social behavior as the most

often used behavior of the respondents.

4. The parenting styles of farmers have a significant relationship to the social behavior of their children.

RECOMMENDATIONS

The following recommendations were formed based from the conclusions:

1. Researchers recommend that the authoritarian parenting style is a good model to use in raising

children because it is reflected in their behavior, even Authoritarian parenting style are stricter rather than the other parenting styles.

2. Since the respondents have a pro social behavior, the researchers recommend that the farmer parents should maintain their authoritarian parenting styles in order to enhance more their children's pro social behavior.
3. The researchers would like to recommend an additional variable to the social behavior and additional respondents for a better look into the

behavior of the students having a farmer parent.

4. Conduct a training program for both parents and children to increase their awareness on the different dimensions of parenting styles and the different kinds of social behaviors.

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Personality and Stages of Adjustment of Parents with Exceptional Children

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Marife A. Viduya and Christine Joy U. Ugay

ABSTRACT

This study made use of descriptive research design and employed convenience sampling technique. It involved 47 respondents. The constructed questionnaire on stages of adjustment and Emotional Profile Index (EPI) was employed to gather the needed data. It made use of average weighted mean and Pearson r using SPSS for the data analysis interpretation.

Findings showed that most of the parents who are females accepted their children even though their children are exceptional because they believe that there is no problem on their child's disability. As a result, the children are treated like any other children. Research has consistently shown that parents with exceptional children have in various ways reached out their children just to be perfect in caring and guiding them. Most of the parents have developed depression, shame and anxiety that triggered stages of adjustment but because of the strength they had, they were all strong in conquering their difficulties during their children's stages of adjustment.

Keywords: *Emotional Profile Index, stages of adjustment*

INTRODUCTION

Situation Analysis

Exceptional children tend to have unusual special care different from children who are born normal. Since they are children with special needs, the indication is that it may challenge the parents to find ways to prepare these children for the future and to handle any problems that may occur during their development. Some parents want their children who have special needs to be physically and developmentally fit despite the birth of the child that may affect their family relationship. The interaction among the family, especially between the parents and their child who is special, is somehow uncommon condition to be studied.

On the other hand, Blacher (1984) found three consistent stages of adjustment. First, parents experience a period of emotional crisis characterized by shock,

denial, and disbelief. This initial reaction is followed by a period of alternating feelings of anger, guilt, depression, shame, lowered self-esteem, and rejection of the child, and over protectiveness. Eventually, parents reach a third stage in which they accept their child.

Research indicates that the birth of a child with a disability, or the discovery that a child has a disability, can have profound effects on the family. This prompted the researchers to investigate the personality and stages of adjustment of parents with exceptional children and their desire to help them accept and understand their children so that they will become well-adjusted and well-developed children.

Framework of the Study

There is an abundance of theories like attachment theory, Goleman's emotional intelligence, development of identity, and Erikson's theory as well as educational views that could explain the personality and social adjustments of parents

with exceptional children. According to Goleman 2006, emotional intelligence is a type of social intelligence that affords the individual the ability to monitor his own and others' emotions, to discriminate among them, and to use the information to guide his thinking and actions.

On the other hand, Marcia (2002), contends that identity is internal, self-constructed, dynamic organization of drives, abilities, and individual history.

Erikson believes that individuals have to be confronted with troubles before they arrive at an identity. This, he refers to the individual as a means to know himself

better, prepare for his future and realize his dreams and ambitions. The perception of self includes how others see them, and the importance they attach to their values and accomplishments.

The attachment theory as formulated by psychiatrist and psychoanalyst John Bowlby describes the dynamics of long-term relationships between humans especially as in families and life-long friends.

The aforementioned theories and views, then, were used by the researchers to back up their observations on the personality and stages of adjustment of parents with exceptional children.

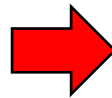
Research Paradigm

Independent Variables

- a. Personality trait/s as measured by Emotional Profile Index
- b. Personal Profile
 - a. Age
 - b. Monthly Income
 - c. Highest Educational Attainment
 - d. Number of children

Dependent Variable

- Stages of adjustment
 - 1. Emotional crisis
 - 2. Alternating feelings
 - 3. Acceptance of child



Statement of the Problem

1. What are the personality traits of the parents as measured by EPI?
2. What is the personal profile of the parents as to: age, monthly income, highest educational attainment, number of children?
3. What are the stages of adjustment of the parents as to: emotional crisis, alternating feelings, acceptance of the child?
4. Is there a significant relationship between personality and stages of adjustment of the parents?

5. Is there a significant relationship between profile and personality of the parents?
6. Is there a significant relationship between profile and stages of adjustment?

METHODOLOGY

Research Design

This study used the descriptive method of research. Descriptive research is used to describe the characteristics of a population or phenomenon being studied. Descriptive research is either quantitative or qualitative. In this study, it intended to describe the personality and stages of adjustments of the parents with exceptional children. The researchers used Personal Profile questionnaire to determine the profile of the respondents.

Sources of Data

The researchers used purposive sampling technique which is a non-probability sampling technique and it occurs when “elements selected for the respondent are chosen by the judgment of the researcher. A purposive sample (also known as judgment, selective sampling) in which the researcher relies on his or her own judgment when choosing members of population to participate in the study. Researchers often believe that they can obtain a representative by using a sound judgment, and willingness to participate in the study.

RESULTS AND DISCUSSION

Table 1 shows the summary of stages of adjustments of the respondents. It can be cleaned on the table that among the three stages of adjustment, “acceptance of

The researchers conducted pilot test in Agoon East Central School to the parents with exceptional children to know the reliability of the test questionnaire that they used. Researchers got 30 respondents who are parents with exceptional children.

The parents have exceptional children such as hearing impaired, low IQ, fast learner, deaf and physical abnormalities. They are from San Fernando and their children are enrolled at San Fernando SPED Center.

Instrumentation and Data Collection

Researchers used a non-standardized and standardized test to gather the needed data. The non-standardized instruments were the constructed questionnaire which included the personal profile and stages of adjustment such as emotional crisis, alternating feelings and acceptance of the child.

Researchers gave a validation copy to three experts in validation. On the other hand, the standardized instrument used to determine the personality of the respondents was Emotional Profile Index (EPI) which described the emotional traits of the respondents.

the child” rated by the respondents as first with an average weighted mean of 3.89 described as very high.

Table 1. Summary of Stages of Adjustment

Stages of Adjustment	AWM	Description
Emotional Crisis	1.44	Hindi Kailanman
Alternating Feelings	1.16	Hindi Kailanman
Acceptance of the child	3.89	Palagi

Legend:

1- 1.74

1.75- 2.49

2.50- 3.24

3.25- 4.0

Hindi kailanman V. Low

Minsan Low

Madalas High

Palagi V. High

While the emotional crisis was rated as second with a weighted mean of 1.44 described as very low, lastly, the alternating feelings got a weighted mean of 1.16 with

descriptive equivalent of very low. This implies that the respondents are in the stage of acceptance of the child.

Table 2. Correlation of Stages of Adjustment & their Personality

		EC	AF	AC
trustful	Pearson Correlation	-.173	.018	.010
	Sig. (2-tailed)	.245	.907	.949
dyscontrolled	Pearson Correlation	-.073	-.379**	.061
	Sig. (2-tailed)	.624	.009	.686
timid	Pearson Correlation	.000	-.158	.157
	Sig. (2-tailed)	.998	.290	.292
depressed	Pearson Correlation	.164	.245	.046
	Sig. (2-tailed)	.272	.097	.759
distrustful	Pearson Correlation	-.043	-.050	-.170
	Sig. (2-tailed)	.773	.741	.254
controlled	Pearson Correlation	-.035	-.153	.047
	Sig. (2-tailed)	.813	.303	.756
aggressive	Pearson Correlation	.119	.102	-.020
	Sig. (2-tailed)	.426	.497	.896
gregarious	Pearson Correlation	-.086	.180	-.107
	Sig. (2-tailed)	.563	.226	.476

Dyscontrolled and Alternating Feelings

The computed value of emotional dimension dyscontrolled and alternating feelings is $-.379^{**}$. Therefore, there is no significant relationship between the

dyscontrolled and alternating feelings. Based on their EPI it implies that the respondents tend to be unadventurous. Respondents are reluctant to try new things or have new experiences, not impulsive and tend to withdraw from the society.

Table 3. Correlation of Profile of Respondents & their Stages of Adjustment

		EC	AF	AOTC
AGE	Pearson Correlation	.333(*)	.318(*)	-.276
	Sig. (2-tailed)	.022	.029	.060
MI	Pearson Correlation	-.036	.001	-.132
	Sig. (2-tailed)	.809	.992	.375
HEA	Pearson Correlation	-.153	-.157	.075
	Sig. (2-tailed)	.305	.293	.615
NOCHIL	Pearson Correlation	.362(*)	.376(**)	-.248
	Sig. (2-tailed)	.013	.009	.093

Age and Emotional Crisis

Therefore, the null hypothesis which states that there is a significant relationship between age and emotional crisis is rejected. It indicates that the age of the respondents

can affect the emotional crisis such as shock, denial and disbelief.

Age and Alternating Feelings

Therefore, there is a significant relationship between respondents' age and alternating feelings which led to the

rejection of the null hypothesis. It implies that the age of the respondents can affect the alternating feelings such as anger, guilt and depression.

Number of Children and Emotional Crisis

It implies that the respondents who have greater number of children can affect the emotional crisis such as shocks, denial and disbelief.

Number of Children and Alternating Feelings

Therefore, the null hypothesis which states that there is a strong significant relationship between number of children and alternating feelings is rejected. It indicates that the respondents who have greater number of children can affect their alternating feelings such as anger, guilt and depression.

Table 4. Correlation of Profile of Respondents & their Personality

PROFILE		EPI							
		Tr	Dy	Ti	De	Di	Co	Ag	Gr
Age	Pearson Correlation	.273	-.015	.082	-.243	.087	.061	-.278	.235
	Sig. (2-tailed)	.063	.919	.583	.100	.560	.685	.059	.111
Gender	Pearson Correlation	-.044	-.005	.337*	-.224	.038	.337*	-.249	-.091
	Sig. (2-tailed)	.770	.972	.020	.130	.802	.021	.091	.543
MI	Pearson Correlation	-.053	.013	.148	-.147	-.095	.393**	-.277	.057
	Sig. (2-tailed)	.722	.929	.321	.325	.524	.006	.059	.702
HEA	Pearson Correlation	.158	-.026	-.031	.080	-.372*	.132	-.244	.342*
	Sig. (2-tailed)	.289	.864	.837	.592	.010	.376	.098	.018
#C	Pearson Correlation	-.102	.071	-.180	.114	.091	-.047	.101	.093
	Sig. (2-tailed)	.497	.634	.225	.446	.544	.752	.499	.533

Gender and Timid

This implies that females are protective of their children who are exceptional. In this situation female respondents do not want their children to be harmed that is why mothers want protection and security for their children.

Gender and Controlled

It means that mothers want their child to go to SPED Center Schools, learn in a good environment to have a good future. Mothers want their children to have a better or normal life.

Monthly Income and Controlled

A positive significant relationship exists between monthly income and emotional dimension controlled (.393**). Therefore, the null hypothesis which states that there is a significant relationship between monthly income and emotional dimension, controlled. It implies that the income of the respondents can help to

support and satisfy the needs of their children.

Highest Educational Attainment and Distrustful

The computed value of highest educational attainment and distrustful is -.372*. Therefore, there is no significant relationship between the highest educational attainment and emotional dimension distrustful. This implies that regardless of their educational attainment, they still accept their children with exceptionalities.

Highest Educational Attainment and Gregarious

Moreover, there is a direct significant relationship (.342*) between the highest educational attainment of the respondents and emotional dimension which led to the rejection of the null hypothesis. This means that if the parents had their education, it is easy for them to be friendly, and socialize because they are educated.

CONCLUSIONS

Based on the summary findings, the following conclusions were drawn:

1. The respondents are high in being trustful but low in being dyscontrolled and distrustful. The female respondents are high in being timid and low in being gregarious. However, the male respondents are low in being controlled but high in being gregarious.
2. Most of the respondents are female who are 41 and above. Their income (5,000 below) indicates that they belong to the poverty level and most of the respondents are undergraduate.
3. The respondents fully accept their children even they are exceptional.
4. There is no significant relationship between emotional dimension,

RECOMMENDATIONS

Based on the findings and conclusions of the study, the following recommendations are hereby forwarded:

1. Future researchers may conduct a seminar to the parents of children with exceptionalities, to enhance their dyscontrolled and distrustful personalities.
2. Researchers may get father respondents to know if the personality of the husband is the same with the female respondents.
3. The researchers need to study the stages of adjustment of male or the husband of the respondents to know the stages of adjustment they belong to.

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dyscontrolled and the stages of alternating feelings.

5. The personality, and gender of the respondents' parents affect their timid and controlled or well organized personality; monthly income affects their controlled personality. At the same time, their highest educational attainment affects the acceptance and friendship of the parents.
6. There is a significant relationship between the profile and stages of adjustment of the parents, the respondents' age and alternating feelings, the number of children and emotional crisis and there is a strong relationship between the number of children and alternating feelings.

4. The respondents must undergo team building to enhance their personality.

5. The respondents must know family planning to avoid conflict in the family so that it can avoid anger, guilt, depression, shame, lowered self-esteem, rejection of the child and over protectiveness to their children and also to avoid favoritism. The researchers need to know the parenting style of the respondents to be able to understand the situation between the parents and their children.

6. Parents are encouraged to enter school again because age is not a basis of education and through education there is a continuous process of learning.

Personality Traits and Adjustment Level of the Thai Exchange Students of DMMMSU- SLUC CAS

Julius T. Balicao, Joyce J. Canlas, Ingrid Lara C. Flores, Alvin R. Valdez and Madelyn P. Niño

ABSTRACT

The study attempted to explore the link between personality traits and adjustment levels in search for factors that may facilitate or delay cross cultural adaptation. Using purposive sampling technique and standardized tests, the researchers gathered the data using the International Personality Item Pool- Five Factor Model (IPIP-FFM) and Bell's Adjustment Inventory (BAI). Percentages, weighted means, and t-tests were used in the analysis of data. Generally, the Thai exchange students shows introversion, high agreeableness, low conscientiousness, high emotional stability and low openness to experience. They have an average interpretation in Social adjustment while unsatisfactory in Home, Health and Emotional Adjustments. Moreover, extroversion and tough minded traits showed a significant difference in terms of Home adjustment.

Keywords: *personality, traits, adjustment, levels, Thai, exchange, students*

INTRODUCTION

Situation Analysis

Due to globalization, the national boundaries of education have expanded all over the world. With the advent of ASEAN integration all over South East Asia, educational institutions from the member countries are encouraged to accept foreign students from neighbouring countries not only to foster cultural and academic understandings but also to highlight economic and industrial exchange. The promising positive effects of the program is alluring to most international students.

In connection to this, DMMMSU-SLUC College of Arts and Sciences (CAS) caters and welcomes globalization and internationalization at its doors, the presence of exchange students, specifically Thais has become obvious to the community. The college collaborates through a Memorandum of Understanding (MOU) with three (3) universities in Thailand. Some of the specifications of the MOU are involvement of students and faculty through the Exchange Students or Faculty Program and offering training and short courses to the members of the above mentioned schools. The above stated specifications paved the Thai students' enrolment in the college this first semester of School Year 2016-2017. These students are

required to mingle with other students of the college and at the same time immerse themselves in the culture of the Filipinos.

Although the promise of globalization is quite interesting to many aspiring students and future professionals, the threat of identity crisis is at stake. Arnett (2002) described the influence of globalization on psychological functioning, emphasizing identity issues as the central psychological consequence of globalization, occurring as individuals develop a bicultural identity through the process of acculturating to a world of interacting cultural traditions. Some of the reasons a person might have to accept the challenge might be the desire to experience a new learning environment, love for adventure and of course a better work placement after graduation.

If so, what could be the effects of globalization to the psychological being of a person in a new learning environment? How does a sojourn student adjust to his new society? What are their personality traits? Is there a specific personality type that is good for adjustment? Is adjustment affected by personality? These inquiries led the researchers to conduct proper study about the situation of the Thai exchange students at DMMMSU-SLUC CAS.

Framework of the Study

Personality is defined as the being of a person. Ypofanti, Zisi, Zourbanos, Mouchtouri, Tzanne, Theodorakis & Lykaros (2015) described personality as a system of distinctive characteristics and developmentally dynamic procedures that influence psychological functioning of every individual. It has even been suggested as a mediator of the environmental stressors on the onset and development of an illness.

Allport (1937) believes that personality is biologically determined at birth, and shaped by a person's environmental experience. According to Gordon Allport's theory (1937), traits are determining tendencies or predispositions to which an individual responds. These traits are relatively general and enduring responses that produce fairly broad consistencies in behaviour.

Moreover, Komin (1991) studied the Thai personality and her work became the foundation of Thai Psychology today. Traits were clustered and were ranked according to their importance in influencing Thai people's behaviors. Komin's study revealed that: (a) Thais are ego-oriented, characterized by being independent, with a high level of self-esteem, (b) they have *bunkhun* value which is 'a psychological bond between someone who, out of sheer kindness and sincerity, (c) they place a high value on a group of other directed social interaction values, (d) they were situation-oriented rather than principle- or law-oriented, (e) they usually engaged in merit making and numerous other religious ceremonies and rituals, (f) they value education as a means of increasing their social status, gaining increased prestige, or raising their salary, (g) they motivate cooperative behaviors in the community and reinforces a sense of neighbourliness, (h) they are easy going and carefree, and view life as something to be enjoyed, and (i) they believe in achievement through hard work.

The main problem a sojourner faces is adjustment. This adjustment is of two types' viz. adjustment to external conditions and adjustment becomes necessary, as a person grows older. Adjustment is a very significant factor in determining the degree of achievement of

students. Bell (1934) developed the "Bell Adjustment Inventory" which consists of four (4) fields of adjustment namely: home, health, social and emotional factors.

Nema & Bansal (2015) on their research regarding adjustments of adolescent girls, found that social adjustment is the highest importance followed by their emotional adjustment, whereas home and health adjustments are lesser important. Moreover, they discussed that social adjustment should be taken into consideration because respondents stay away from family and relatives. Students are very highly attached with mates and seek the missing family in their friends.

Ali, Saif & Khosravi (2008) state that emotional adjustment plays a considerably important role in providing a person with psychological and physical health, because it enables him or her to make progress gradually based on new environment conditions and behaviours. While McDonald (1985) as cited by Gharacheh, (2011) believes that emotional adjustment is not provided unless the person learns to react properly to environment. Thus, emotional adjustment can be generally defined as person's psychological health, life satisfaction and finally coordination between emotions, thoughts and activities.

There has been a lot of inconsistencies about personality and adjustment results over the past years. Researchers argue about the type of personality and what trait is important in sojourner adjustment. According to Pierce, Sarason and Sarason (1996), the role of personality characteristics, personal relationships and situational parameters are combined to produce a robust coping style. Ward, Leong & Low (2004) discussed that the cross-cultural literature contains much evidence and armchair theories about adaptive personality qualities and the acculturative experience. Authoritarianism, rigidity, and ethnocentrism, have been assumed to impede psychological adjustment during cross-cultural transition (Locke & Feinsod, 1982), whereas extraversion and sensitivity, the embodiments of the "universal communicator," are thought to facilitate adaptation (Gardner, 1962). Despite extensive theorizing, however, empirical evidence has been mixed. There has been little

convergence in research that has examined the predictive influence of personality on sojourner adjustment (Church, 1982; Ward, 1996), and in those rare instances where a degree of consistency has been observed, it has been limited to relatively few trait domains.

Statement of the Problem

The objectives of the study are the following: 1) to explore the varying personality traits of the sojourner students, 2) to search for the link between adjustment and personality, 3) to help expand awareness of the DMMMSU community with regards to the difficulties experienced by exchange students, and 4) to help improve the host university's acceptance and to guide them with their endeavours in understanding the sojourners coping.

METHODOLOGY

Research Design

The researchers used descriptive research through Ex Post Facto Quasi Experimental Design. Total enumeration of all the Thai Exchange Students enrolled for the first semester of School Year 2016-2017. The whole population were given a chance to participate in the study, provided that they were exchange students of the Bachelor of Arts in English Language of DMMMSU-SLUC CAS. Regardless of their gender, socio-economic status, age and religion, each student took the personality test using the "International Personality Item Pool - Five Factor Model" (IPIP-FFM) by Goldberg to determine their personality profiles.

The second set of examination was conducted after the three months' residency of the participants to ensure that they have already passed the "Honeymoon Phase" as stated in the "U Curve" Theory of Adjustment. Every participant took the test for the Bell's Adjustment Inventory to explore their level of adjustment in the four areas which included home, health, social and emotional.

Percentages, weighted means and T-test for independent samples were used to analyze the data. Alpha level (α) set at 0.05, two-tailed was used as a basis in determining the significance of the data. All data were treated

statistically using the Statistical Package for Social Sciences (SPSS) program.

RESULTS AND DISCUSSION

Personality Traits of the Thai Exchange Students of DMMMSU-SLUC CAS

Table 1 shows the distribution of the personality traits of the respondents based on the International Personality Item Pool – Five Factor Marker (IPIP-FFM). The IPIP-FFM results are as follows: 79 percent of the students fall under low openness, 68 percent on high emotional stability, 63 percent fall under low extroversion (Introversion) and low conscientiousness, 53 percent out of the 19 Thai students show high agreeableness.

Based on the above-mentioned results it can be deduced that the Thai exchange students were mostly introverts which means that they are less sociable, lonesome and reserved. Introverted students are associated with loneliness and isolation, they would have lesser emotional energy to invest in their studies and experience lesser confidence in their coping ability.

The high agreeableness of the Thai exchange students means that they show trust, straightforwardness, altruism, compliance, modesty, and tender-mindedness. Agreeableness reflects individual differences in peoples' interest in needs and well-being of others (Topic, et.al (2012).

On conscientiousness, a result of 63 percent revealed that most of the respondents have low conscientiousness that makes the students tend to show negligence, laziness, disorganization, tardiness, and aimlessness.

On emotional stability and openness to experience, the students are more emotionally stable characterized by calmness, not neurotic and not easily upset, on the other hand, they show low openness to new experiences which means they are down to-earth, uncreative, conventional, prefers routine, uncurious and conservative.

Table 1. The Big Five Personality of the Thai Exchange Students (N=19)

Personality Trait	%
Introversion	63
Extroversion	37
High Agreeableness	53
Low Agreeableness	47
High Conscientiousness	37
Low Conscientiousness	63
High Stability	68
Low Stability	32
High Openness	21
Low Openness	79

The Adjustment Level of the Thai Exchange Students of DMMMSU-SLUC CAS

Table 2. Adjustment Level of the Thai Exchange Students

Adjustment Scales	WM	DR
Home	12.21	Unsatisfactory
Health	13.53	Unsatisfactory
Emotional	16.74	Unsatisfactory
Social	16.53	Average

Table 2 shows the adjustment levels of the Thai exchange students where emotional adjustment got a weighted mean of 16.74, health adjustment with 13.53 and home adjustment with 12.21 which all fall under the descriptive rating of “unsatisfactory”. On the other hand, they got a weighted mean of 16.53 in social adjustment indicating a descriptive rating of “average” level of adjustment.

Average social adjustment means that the person has already incorporated himself in the host country. It is a good sign because developing social ties is one of the fundamental factors that help sojourners adjust to a new culture. These feelings of belonging and acceptance, therefore could greatly benefit one’s psychological well-being in the relocation process. Nema and Bansal (2015) discussed that social adjustment

should be taken into consideration because respondents stay away from family and relatives. Students are very highly attached with mates and seeks the missing family in their friends.

Table 3. Personality and Mean Adjustment Level of the Thai Exchange Students

Personality	Adjustment	Home	Health	Social	Emotional
		WM	WM	WM	WM
Introversion		13.67	10.43	16.71	14.71
Extroversion		9.71	15.33	16.75	17.58
High Agreeableness		14.10	13.60	18.00	18.10
Low Agreeableness		10.11	13.44	15.33	14.78
High conscientiousness		11.71	11.43	15.14	14.14
Low Conscientiousness		12.50	14.75	17.67	17.92
High Stability		11.92	12.92	15.15	16.31
Low Stability		12.83	14.83	20.17	17.00
High Openness		12.25	10.25	18.25	13.75
Low Openness		12.20	14.14	16.33	17.27

Legend:

WM -Weighted Mean

The Adjustment Level and Personality of the Thai Exchange Students of DMMMSU-SLUC CAS

Table 3 shows the result indicating that extroverted students with an WM of 9.71 have a significantly lower average weighted mean in home adjustment than the introverted ones with an WM of 13.67. This means that the extroverted Thais adjusted better than the

introverted ones in the Home setting. Result also indicates that high agreeable students with an WM of 14.10 has significantly lower home adjustment level than the low agreeable students with an WM of 10.11. This means that the low agreeable Thais adjusted better than the high agreeable ones in the home setting

Table 4. Adjustment level and Personality traits of the Thai exchange Students

Adjustment	Home	Health	Emotional	Social
Personality	α	α	α	α
Extroversion	.049*	.057	.99	.23
Agreeableness	.039*	.95	.34	.15
Conscientiousness	.71	.21	.38	.11
Stability	.68	.50	.82	.78
Openness	.98	.19	.58	.21

*significant at .05 alpha level

Table 4 shows that the home adjustment levels of the extroverted and introverted Thai students yielded a .049 p value which means that there is a significant difference between the adjustment levels of the extroverted and introverted; and the Thai students with high agreeableness and those with low agreeableness have a p value of .039 which indicates significant difference between the home adjustment levels of the two groups in agreeableness.

The reason behind the extrovert's better home adjustment is explained by Topic et.al (2012) who posted that extroverts would find it easier to socialize, to make friends and to be energized by time spent with others because they are affectionate, a joiner, talkative, fun loving, active, passionate. Tan & Winkelman (2015), also cited the contribution of extraversion to coping ability and suggested that the more introverted the student, the poorer the coping ability.

Tough minded are risk-takers. Although following the rules and regulations is a must, these people tend to enjoy more their sojourn experience by violating some rules that are set, specifically in home settings. Based on the researchers' observations on the respondents at home, those identified to be less agreeable students were the ones who got home late even if there is a curfew hour at ten O'clock in the evening. Moreover, because of their tough mindedness, they were

able to explore the host country better. The Thais reflect a capacity to be different from and to disregard others, to be a loner and to be risk-taker. Those who are tough-minded would tend to value non-conformity, but it may either be that because of non-conformity, these people tend to express themselves freely at their residence in which they cannot do outside.

To further validate the result of the data the Thai students were interviewed by the researchers about the things that they like and hate in their stay in the Philippines specifically in Agoo. Responses indicated that they focused in the home and social aspects.

CONCLUSIONS

The Thai students are introverted, highly agreeable, have high emotional stability; showed low openness to experience and have low conscientiousness. The respondents had a hard time adjusting in home, health and emotional aspects, on the other hand, the Thai exchange students showed good adjustment in the social aspect. There is a significant effect of personality on the adjustment level of the Thai students specifically on the home adjustment level of the introverted and the extroverted and of the high agreeable and the low agreeable.

RECOMMENDATIONS

The researchers recommend (1) a personality development seminar, (2) a five-day pre-exposure orientation seminar, (3) a one-on-one Filipino- Thai buddy system, (4) further study along this line is recommended

with more number of respondents and other variables that may be related to adjustment levels such as improvements of structures which were recommended by the Thais.

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Personality, Emotional Quotient and Financial Decision Making Skills of the BS Psychology Students with Farmer Parents

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ABSTRACT

This study analyzed the personality, emotional quotient and financial decision making skills of the BS Psychology Students with farmer parents and the relationship of the variables under study.

The descriptive-correlation design was used in this study. The instrument used to gather data was a questionnaire administered to fifty-six (56) students. Weighted Means, Pearson Product Moment of Correlation, and Kendall Tau were used as statistical tools to treat the data.

Findings show that the personality traits of the respondent have an average Sten Score which means that they have stable personality; their emotional quotient was found to be low; and their financial decision making skills were high. There was a significant relationship between the respondents' personality traits and emotional quotient; however, respondent's personality traits and financial decision making skills have no significant relationship, while emotional quotient and financial decision making skills have a significant relationship.

Keywords: *personality, Emotional Quotient, financial, skills.*

INTRODUCTION

Situation Analysis

As the society is developing more and more today, living standard becomes better and better. Therefore, money is an important thing in life. People need money to keep themselves healthy. If people get ill and do not have enough money, they cannot go to the hospital for check-up and to buy the medicine they need. Secondly, people need money to raise their living standard. They use money to buy food, to provide nourishments to their bodies. Finally, money also affects lots of people's lives. If they have money, they can learn more than others because they can buy many things such as books, newspapers and computers to research and gain a lot of knowledge and information better.

According to Wycoco (2012), money is a tool necessary to have life's necessities; many things are related with money. If people have money, they feel more confident and comfortable to solve many difficult problems in

their lives, especially in the areas of health, daily needs, and education.

Many college students are living on the edge of financial crisis and many of them do not possess the knowledge needed to manage their money. While they are studying in the university, they are constantly accumulating debt, through student loans. They may not realize how their current debt can negatively affect their future credit rating (Bowe & Lago, 1997).

Moreover, individuals are regularly exposed to financial decisions and behaviors in their daily life. Many personal characteristics may lead people to behave in a particular manner with regard to financial decision making. Everyone experiences emotions, both bad and good, and yet too few people realize how they affect them financially. According to Sullivan (2013) emotions can influence financial decisions in surprisingly predictable ways.

People tend to be overconfident of their own knowledge and decisions. They extrapolate recent trends while dismissing the past, and they refuse to accept losses gracefully by hanging on to their loser far too long.

Money is something that everyone needs and wants, but not everyone has. Money is the most basic requirement of life. Without which one cannot fulfill his basic needs and requirements for daily routine. It is important for people of all ages to be capable of making effective financial decisions. It helps the people especially the students how to value money and how to spend it right.

Framework of the Study

Personality is a patterned body of habits, traits, attitudes and ideas of an individual as these are organized externally into roles and statuses and as they relate internally to motivation, goals and various aspects of selfhood. According to Park and Burgess (2002), personality is the sum and organization of those traits which determine the role of the individual in the group. While according to Linton (2006), personality embraces the total organized aggregate of psychological processes and status pertaining to the individual.

Emotional Quotient (EQ) encompasses social intelligence and emphasizes the effect of emotion on one's ability to view situation objectively.

Emotions can influence financial decisions in surprisingly predictable ways. People tend to be overconfident on their

knowledge and decisions, extrapolate recent trends while dismissing the past. They refuse to accept losses gracefully by hanging on to losers far too long, and so on. Even experienced investors are not immune (Garvey & Murphy, 2004).

According to Panday (2012) decision making is a choice between two or more alternatives. Declemente (2014) defines decision making on the other hand as the cognitive process resulting in the selection of a brief or a course of action among several alternatives. Stooner defines it also as the process of identifying and selecting a course of action to solve a specific problem. Mathew, Akrani, Trewatha and Newport (2011), mentioned that decision making involves the selection of a course of action from among two or more possible alternative courses of action, to attain a goal or goals. (Turban, 2008) also gives a definition to decision making. There should be two or more choices in order for decision making to happen. Having only one alternative will not yield to a decision.

Financial decision making is recognized as being influenced by one's social and economic circumstances and family peers. Previous research finds that interactions with peers, family, culture and media shape the financial knowledge of young people, particularly their attitudes as consumers.

Research Paradigm

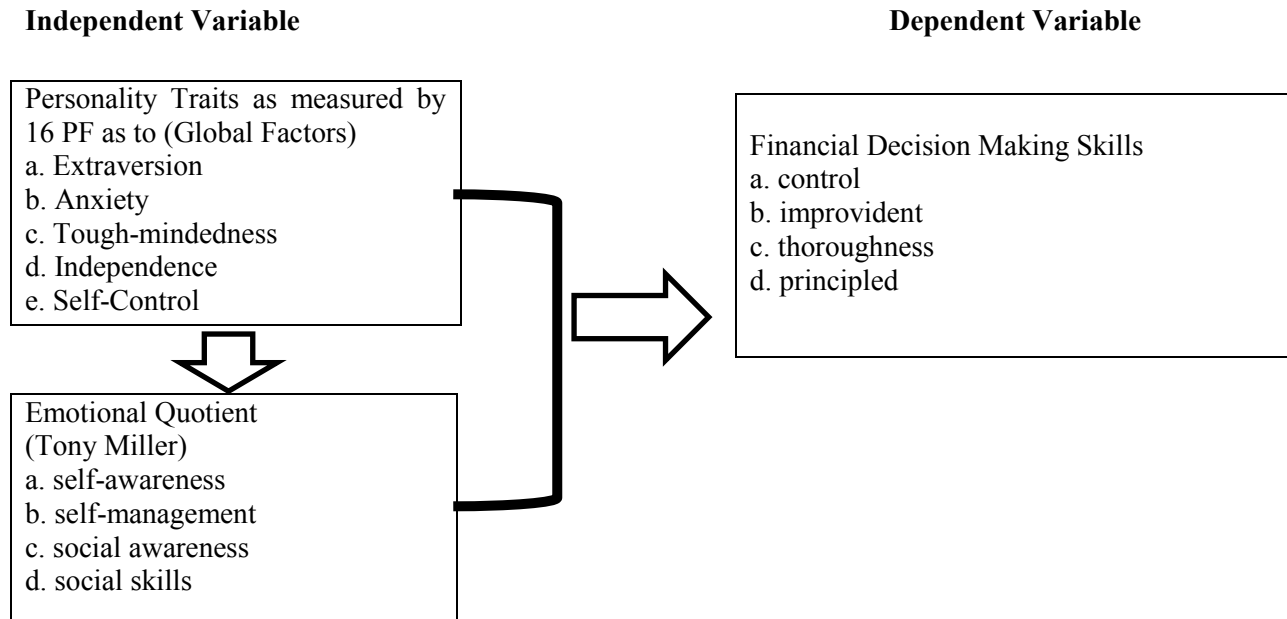


Figure 1: The Research Paradigm

The research paradigm shows the interplay of the two variables which is independent variables and dependent variables and on what is the relationship between the personality, emotional quotient and financial decision making skills.

Statement of the Problem

The main objective of the research study is to determine the personality, emotional intelligence, and financial decision making skills of psychology students with parents who are farmers and the relationship of these variables to each other.

METHODOLOGY

Research Design

The research design used in this study is the descriptive design method. The descriptive design helped the study to find out if there is a relationship between personality, emotional quotient and financial

decision making skills of BS Psychology students with farmer parents.

Instrumentation and Data Collection

In this study the researchers used a questionnaire and test as the main tools in gathering data.

In measuring the personality of the respondents, the 16 Factor Test was used. The 16 Factor Test is a personality test that consists of two major factors which are the primary and the global factors. Primary factors were further classified into only five (5) main factors, or traits which are called the global factors that include extraversion (EX), independence (IN), self-control (SC), (TM) tough-mindedness and anxiety (AX). The obtained validity coefficient was .76 (16 PF Fifth Edition with updated Norm, 2002).

The Emotional Quotient Self-score questionnaire was designed to help the individuals evaluate aspects of their emotional intelligence. Emotional Quotient is a term used to described the way in which

individuals handle both their own emotions and those of others. The questionnaire explained four factors including self-awareness, self-management, social awareness and social skills.

On the other hand, for financial decision making skills, the researchers constructed a questionnaire regarding financial decision making. The questionnaire consisted of 40 questions that were answerable by 1-4 with the following descriptive ratings: (1) Never, (2) Seldom, (3) Often, and (4) Always. The questions were about how they used their knowledge and skills to manage money effectively. The questions consisted of different levels of characteristics which include, (1) control, (2) uncontrolled, (3) thoroughness (4) principle.

Data Analysis

With the data collected from the respondents, the researchers used some statistical tools to interpret the data.

To determine the personality traits of the respondents, the researchers used the 16PF 5th edition where the data was interpreted using the manual.

The researchers adopted a questionnaire from psychology websites to assess the respondents' Emotional Quotient. The total number in section one gives the total for self-awareness, section two for self-management, section three for social-awareness and section four for social-skill. Results of the test per section were converted to a 1-10 score. This can be found on the appendix F. Scores ranging from 1-5 has a descriptive of low and 6-10 has a descriptive interpretation of high

As for Financial Decision Making Skills, the researchers used the average weighted mean (AWM) to analyze and interpret the data and the following scale was used.

As to the correlation of variables, the data were organized and analyzed using the Pearson Product Moment of correlation and Kendall Tau. This is to determine the significant relationship between the respondents' personality and emotional intelligence, personality and their financial decision making skills; likewise, the relationship between the respondents' emotional intelligence and their financial decision making skills.

To aid the researchers in their computation, the Statistical Package for Social Sciences (SPSS), a computer based program designed to analyze if a relationship exists between the personality, emotional intelligence, and financial decision making skills of the BS Psychology students.

RESULTS AND DISCUSSION

The following were the salient findings of the study.

1. The respondents got an average sten score of five for global factors for extraversion, while for anxiety; the respondents obtained a mean sten score of four. On the other hand tough-mindedness of the respondents gained a mean sten score of six. However, for independence, their mean sten is five sten score and for self-control they got a mean sten score of five.
2. The psychological profile of the respondents as to Emotional Quotient is low with an obtained (AWM = 4.85). As to the four (4) factors, they are low in Self-awareness with an (AWM = 4.26), self-management with an (AWM = 4.39) on the other hand, they got a high descriptive score for social awareness (AWM =5.10) and social skills (AMW=5.96)
3. As to financial decision making skills, the respondents rated control (AWM =2.80), Thoroughness (AWM =2.55), and, principle (AWM= 2.13) as high while rated improvident (AWM= 3.02) as low.

4. There is a significant relationship between self-management and extraversion with a value of .246.
5. There is no significant relationship between personality and financial decision making skills.
6. There is a significant relationship between self- awareness and controlled (.423), self-awareness and improvident (.327), self-awareness and principle (.520), self-management and improvident (.313), self-management and thoroughness (.328), self-management and principle (.297), social-awareness and thoroughness (.264), social-management and improvident (.312), social-management and thoroughness (.409), and social-management and principle (.352).

CONCLUSIONS

The following are the conclusions derived based on the findings in the study.

1. The respondents have a stable personality trait; they are good in handling life and emotions.
2. The BS Psychology students with farmer parents have low self-awareness and self-management.
3. The financial decision making skills of the respondents are high, therefore they are good in planning, and organizing and directing. They agree that saving money is important.
4. There is a significant relationship between personality traits and emotional quotient in extraversion and in self-management of BS Psychology students with farmer parents.
5. There is no significant relationship between personality traits and financial decision making skills of BS Psychology students with farmer parents.
6. There is a significant relationship between emotional quotient and financial decision making skills in terms of self- awareness,

self- awareness and improvident, self-awareness and principle, self- management and improvident, self- management and thoroughness, self- management and principle, social-awareness and thoroughness, social-management and improvident, social-management and thoroughness, and social-management and principle.

RECOMMENDATIONS

Based from the findings and conclusions derived in this study, the researchers recommend the following:

1. The respondents are recommended to uphold their personality traits by having a positive outlook and by expanding their interests.
2. A seminar workshop on emotional management may be conducted to the respondents for them to have better emotional management.
3. The respondents are recommended to sustain their skills in financial decision making.
4. Future researchers are encouraged to study the students with farmer parents to have a wider comparison if there is a relationship between personality and emotional quotient.
5. Since there is no significant relationship between the personality traits and financial decision making skills of the respondents, the respondents are recommended to attend a seminar which may be conducted by the school so that they can determine the factors that may affect their financial decision making.
6. Future researchers are encouraged to add more financial decision making skills to have a wider comparison between the relationship of emotional quotient and financial decision making skills.

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Problems, Personality Traits, Self-esteem and Coping Mechanisms of Persons with Disability in Agoo, La Union

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ABSTRACT

This study determined the relationship between disability profile, personality traits, self-esteem, problems and coping mechanisms. The study made use of descriptive research design. There were 81 persons with disability who were chosen randomly from the different barangays of Agoo, La Union. The data were gathered through the profile, problems, personality traits, coping mechanisms and were rated as highly valid by evaluators. Chi-square Test Correlation, frequency count, percentage, rank and average weighted mean were the statistical instruments used. The respondents were found to vary in their profile, low in Openness to Experience, Extraversion, Neuroticism, high in Conscientiousness and Agreeableness, and they have severely low self-esteem. Moreover, there is a significant relationship between profile, personality traits, self-esteem and coping Mechanisms.

Keywords: *coping mechanisms, personality traits, self-esteem, persons with disability*

Introduction

Situation Analysis

Disability is one of the umbrella term that covers impairments, movement limitation, and sharing boundaries.

Disability is one of the hardest effects in the whole planet, because persons with disability seriously don't understand why a lot of individuals are "normal" in which they are not. They know that their body disability restricts some of their performance. All they know is that they are dissimilar and those dissimilarities limit them greatly in their lives (Burcaw, 2013). This really creates remarkable puzzle and frustration for these people.

People with disabilities might place additional pressure on themselves to try to meet the society's impossible standards. Individuals with any form of disability have at one time or the other face, the problem of interacting with people in the society, who are sometimes subjected to marginalization, prejudice or discrimination which limit their fullest possible participation in the life of the group (Santos, 2014). These burdens cause the persons with disability to have a negative outlook towards themselves which distort roles and

interpersonal relationships. It is mentioned in a national academic book that negative stereotypes and unfair notion have harmful consequences for the individual in all aspects.

In the Philippines, there are 1,443,000 people with disability comprising 1.57% of the total population (Philippine Statistic Authority, 2013). In this case, the government gives full support to the improvement of the total well-being of disabled persons and their integration into the mainstream of society by implementing Republic Act 9422 or known as the Magna Carta for Disabled Persons (<http://www.ncda.gov.ph/disabilitylaws/republic-acts/republic-act-7277>). This Act gives equal opportunity for employment, access to quality education, national health program, auxiliary social services, telecommunications, accessibility, on political and civil rights.

But Despite all these perks, the National Council on Disability Affairs claimed that, they still encounter problems toward social barriers such as poverty and discrimination. It needs to be addressed and social support mechanisms should be provided to ensure that no matter what a person's

disability is he or she is able to share his/her abilities in an inclusive society.

Framework of the Study

Personality is a set of enduring traits and characteristics that relates to a person's emotions, motivations, interpersonal interactions, and attitudes. It is a pattern of relatively permanent traits and characteristics that give both consistency and individuality to a person's behavior.

Personality traits are distinguishing characteristics of individuals. This refers to their readiness to think or act in a similar fashion in response to a variety of different stimuli. Traits may be unique, common to some group, or shared by the entire species, but their patterns are different from each individual. Thus, each person, though like others in some ways, has a unique personality, and one of these traits is self-esteem.

Self-esteem refers to a person's beliefs about his/her own worth. It is important because it heavily influences people's choices and decisions. In other words, self-esteem serves as a motivational function by making it more or less likely that people will take care of themselves and explore their full potential. Moreover, self-esteem will assist individuals in bringing out their best side and will help them cope better in every situation most especially in frustrating situations and discouraging conditions.

Self-esteem is a state of mind. It can be calculated clearly or absolutely. Self-esteem depends on many factors -- how they were raised, parental attitudes, and life experiences (Bunmi, 2009).

Individuals with high self-esteem have a clean intellect of what their private qualities are. They think well of themselves, have appropriate goals, use feedback mechanism to enhance themselves and gain successfully with difficult situation. People with low self-esteem, on the other hand, have less understandable self-conceptions. They think poorly of themselves, often go for unrealistic goals or shy away from goals, tend to be negative about the

future, and remembering their past experiences negatively.

Self-esteem and personality are likely to share common developmental roots because they are moderately heritable, with about 30 percent of the variance due to genetic differences. In addition, self-esteem and personality may directly influence each other. For example, self-esteem may play a critical role in shaping personality processes. Individuals' beliefs about themselves influence how they act in particular situations, the goals they pursue in life, how they feel about life events and relationship partners, and the ways in which they cope and adapt to new environment (Health Voices, 2009).

Coping mechanisms can be described as "survival skills". They are strategies that people use in order to deal with stresses, pain, and natural changes that they experience in life while maintaining their emotional being.

Folkman and Lazarus (2000) define coping as constantly changing cognitive and behavioral efforts to manage specific external and/or internal demands that are appraised as task or demanding. People learn from others' ways to manage their stresses. There are negative and positive coping mechanisms. Many people use their coping mechanisms to benefit them in a positive way. However, people are not always able to cope with the difficulties they face in life.

Coping responses are partly controlled by personality, and also partly by the social environment, particularly the nature of the stressful environment. Personality and coping are involved directly or indirectly in the production and maintenance of various kinds of adjustments. Thus, personality traits could influence the types of coping style used. Personality influences stress exposure, reactivity, and appraisals. It is impossible to disentangle the effects of personality in coping from the effects of stress. Personality may also influence the range, order, and persistence of coping strategy use.

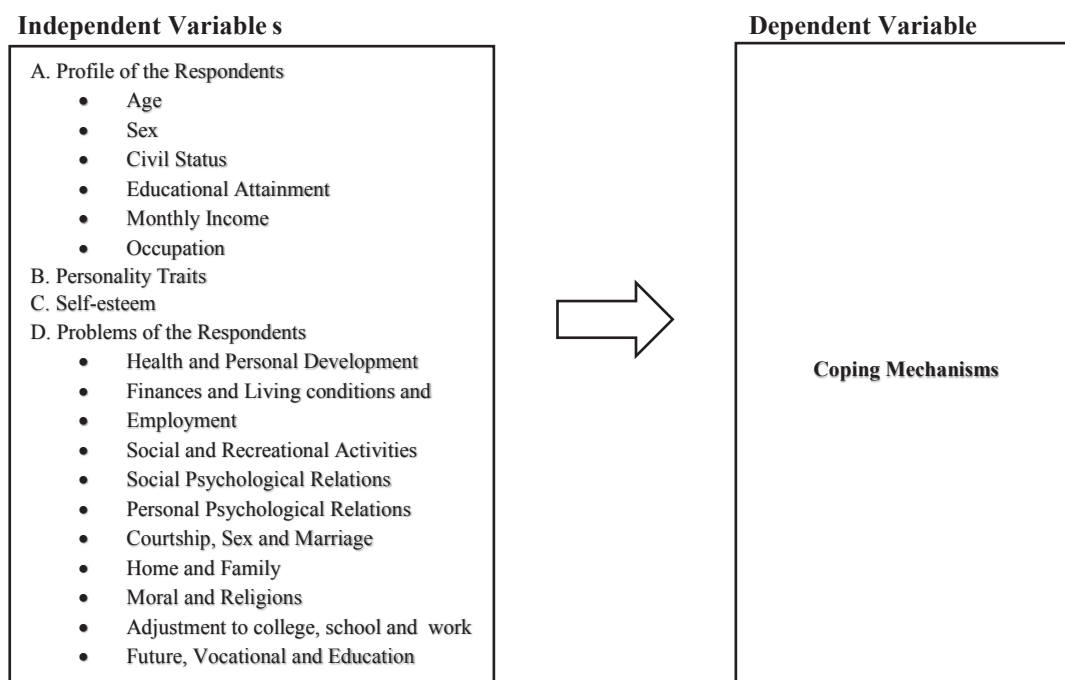


Figure 1. Research Paradigm

Statement of the Problem

This study determined the disability profile, psychological traits, and coping mechanisms of persons with disability from the barangays of Agoo, La Union

1. What is the profile of the respondents in terms of age, sex, civil status, educational attainment, monthly income, and occupation?
2. What are the psychological traits of the respondents in terms of Big Five

Personality Traits, self-esteem and problems?

3. What are the coping mechanisms of the respondents?
4. Is there a significant relationship between the following:
 - a. Personal profile and coping mechanisms
 - b. Personality traits and coping mechanisms
 - c. Self-esteem and coping mechanisms
 - d. Problems and coping mechanisms

METHODOLOGY

Research Design

The study made use of descriptive research design. It involved the description, recording, analysis, and interpretation of the present nature, composition, or processes of phenomena.

This method helped the researchers to describe, record, analyze, and interpret the respondents' personal profile, psychological traits and coping mechanisms.

Sources of Data

This study involved 81 persons with disability particularly physical disability such as polio, orthopedic and partially blind, ages twenty to fifty-nine (20-59 years old) randomly chosen from the barangays of Agoo, La Union.

Instrumentation and Data Collection

The psychological traits of the respondents were assessed through the Big Five Personality and Sorensen Self-esteem questionnaire, respectively. Their problems were identified using Mooney Problem Checklist and a validated questionnaire for their coping mechanism.

Analysis of Data

Chi-square, frequency count, percentage, and average weighted mean were used in analyzing data. Psychological Test Manuals were used for the interpretation of their psychological traits.

RESULTS AND DISCUSSION

Personality Traits of the Respondents

The respondents tend to be self-disciplined and careful (high, conscientiousness), courteous and forgiving (high, agreeableness), calm and composed (low neuroticism).

However, they tend to be quiet and reserved (low, extraversion) and have narrow interest and uncreative (low, openness to experience).

Table 1. Personality Traits and Coping Mechanisms

		HPD	FLE	SRA	SPR	PPR	CSM	HF	MR	ACW	FVE
Openness	Asymp. Sig. (2-sided)	.653	.346	.603	.485	.081	.100	.672	.803	.495	.171
	Df	3	3	4	3	3	3	3	2	12	4
	Value	1.629	3.308	2.736	2.445	6.720	6.247	1.544	.438	11.40 ₁	6.409
Conscientiousness	Asymp. Sig. (2-sided)	.737	.438	.004	.874	.347	.151	.866	.071	.993	.687
	Df	3	3	4	3	3	3	3	2	12	4
	Value	1.266	2.715	15.39 ₀	.696	3.304	5.296	.732	5.296	3.304	2.268
Extraversion	Asymp. Sig. (2-sided)	.417	.836	.908	.681	.421	.378	.773	.220	.048	.444
	Df	3	3	4	3	3	3	3	2	12	4
	Value	2.838	.857	1.009	1.505	2.815	3.091	1.117	3.031	21.19 ₄	3.730
Aggressiveness	Asymp. Sig. (2-sided)	.242	.860	.669	.695	.952	.080	.585	.097	.509	.718
	Df	3	3	4	3	3	3	3	2	12	4
	Value	4.183	.755	2.363	1.446	.342	6.767	1.941	4.660	11.23 ₂	2.09
Neuroticism	Asymp. Sig. (2-sided)	.245	.283	.155	.408	.045	.058	.385	.024	.850	.957
	Df	3	3	4	3	3	3	3	2	12	4
	Value	4.161	3.812	6.655	2.893	8.051	7.496	3.044	7.487	7.112	.656

Legend: $\alpha = 0.05$ Significant

Self-esteem of the Respondents

The have respondents have very low self-esteem (58.02 % with a descriptive rating of “severely low self-esteem”). This revealed that persons with disability in Ago, La Union think, judge and evaluate themselves very negatively. They also often feel depressed, anxious, guilty,

ashamed, frustrated and angry which causes them to focus their attention on loss, insecurity, personal shortcomings, lack of personal control, hopelessness, self-worthiness and minimized attention to positive successes.

Table 2. Self-esteem and Coping Mechanisms

		HPD	FLE	SRA	SPR	PPR	CSM	HF	MR	ACW	FVE
Self-Esteem	Asymp. Sig. (2-sided)	.713	.043	.871	.680	.978	.761	.094	.840	.066	.237
	Df	12	12	16	12	12	12	12	8	48	16
	Value	8.883	21.5	9.920	9.27	4.26	8.307	18.77	4.18	63.545	19.6

Legena: $\alpha = 0.05$ Significant

Problems of the Respondents

The problems most encountered by the respondents include the need of money (financial) for better health care, the need to improve their appearance and vision (physical and health).

Problems and Coping Mechanisms

The problems and coping mechanisms of the respondents fall under “Moral and Religions” which has the highest weighted mean of 4.00 with a descriptive rating of “Often used”. This implies that the respondents often used spiritual and moral mechanisms to cope with their situation and they find solace in God.

Table 3. Problems and Coping Mechanisms

Problems	Coping Mechanisms		
	Asymp. Sig. (2-sided)	df	Value
Health and Physical Development	.391	21	22.156
Finances and Living Conditions and Employment	.476	24	23.743
Social Recreational Activities	.986	28	14.198
Social Psychological Relations	.271	18	21.170
Personal Psychological Relations	.674	18	14.823
Courtship, Sex and Marriage	.899	12	6.324
Home and Family	.560	15	13.551
Moral and Religion	.184	8	11.330
Adjustment to College, School and Work	1.000	72	27.707
Future, Vocational and Education	.729	12	8.691

Legend:

$\alpha = 0.05$ Significant

Profile and Coping Mechanisms

The respondents’ profile has a significant relationship between their coping mechanisms. There is a significant relationship between their age, civil status and occupation and their coping mechanisms in financial living conditions and employment. There is a significant relationship also between their

educational attainment and their home and family coping mechanisms. Their occupation is also a significantly related to their courtship, sex and marriage coping mechanisms.

Personality Traits and Coping Mechanisms

Results suggest that the big five

personality traits specifically high in conscientiousness, while low in neuroticism and extraversion were found to be significantly related to coping responses. The persons with disability who are high in conscientiousness, and low in neuroticism and extraversion indicates that they are polite, introverted, quiet, composed and calm, They engage more likely to problem-focused coping and relatively to emotion-focused coping when they encounter problems in the areas of social and recreational activities, personal psychological relations, moral and religion, and lastly in adjustment to college, school and work.

CONCLUSIONS

1. The respondents vary in their profile.
2. They have extreme personality traits and poor self-esteem.
3. Most of their problems include finances.
4. They extensively use spiritual mechanisms to cope with their situations.
5. Their profile and psychological traits are significantly correlated with their coping mechanisms.

Self-esteem and Coping Mechanisms

There is a significant relationship between the self-esteem of respondents and their coping mechanism as to finances, living conditions, and employment. They believe that they have the ability to manage a stress and use more problem-focused coping strategies than those with lower self-esteem who see the situation as beyond their control.

Problems and Coping Mechanisms

In terms of the problems and coping mechanisms of the respondents, there is no significant relationship. This implies that their coping mechanisms are not always related to their problems since some of the persons with disabilities cope up with their problems through denying or avoiding.

RECOMMENDATIONS

Based on the conclusions, the following recommendations are given.

1. The government can use this study as a basis in formulating a Livelihood Program for Persons with Disability.
2. The government should include the persons with disability as the beneficiaries of the Pantawid Pamilyang Pilipino Program (4Ps).
3. The government and the institutions can use this study as a basis in formulating Self-esteem Enhancement Seminar and Stress Management Seminar for Persons with Disability.
4. There should be more researches regarding the conditions of persons with disability which include other variables to be explored like psychological well-being.

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Understanding Women's Experiences of Domestic Abuse

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ABSTRACT

The goal of this study was to provide a better understanding of women's stories and to gain more insights of their sources of strength and resilience, profile, level of self-esteem, and emotional profile index. Eight women who were identified as victims of domestic abuse and are still living in abusive relationship participated in the study.

The study revealed that majority of the victims are married, college graduates, and have low economic status. The emotional profile of the respondents revealed that they are high in dimensions such as timid, depressed, distrustful, and aggressive.

Further, the respondents scored low in the dimension trustful, dyscontrolled, and gregarious. In general, the level of their self - esteem is low; however, their level of resilience was moderately resilient in the aspects of physical, emotional, spiritual, and social.

Keywords: domestic abuse, emotional profile, personal profile, resiliency, self - esteem

INTRODUCTION

Situation Analysis

People who live or work together are bound to experience irritations, disappointments, and disagreements. They will at times misunderstand one another, or misperceive the facts. Intimate relationships are a potent of anger because such relationships are important but feeling intensely angry can cause political and domestic violence (Firestone, 2012).

Violence inside the family is known as domestic violence (Abulon, 2014). Domestic violence is gender-based violence (Anderson, 2012). It constitutes a pattern of abusive behaviour that includes the use or threat of violence and intimidation for the purpose of gaining power and control over another person (Psych Central, 2016).

A lot of people equate domestic violence with beatings. Wife beating is the most common form of domestic violence. Domestic abuse or violence also includes sexual abuse or any action forcing the partner to perform sexual acts against her will. Psychological or emotional abuse is an act intended to degrade, humiliate, or demean, both in public or private.

Violence against women is rooted in a "patriarchal" system practiced thousands of years ago. In this system, women seem innately inferior to men. The tendency of men to devalue women and to see them as "property" leads to cruelty against women.

Historically, patriarchal system was practiced in the Philippines. It viewed a woman to be submissive to man (Abulon, 2014). In the Philippine society, both genders agree that being male means having more privileges, freedom, and power. Engrained patriarchal culture in Filipino families, mostly Catholic and Islamic view the father as the head of the family. Traditional sex role definitions assigning homemaking to women and financial provision for the family to men still persist (Delfin, 2008).

According to the Gabriela Women's Party (2014), one Filipina is a victim of domestic abuse every two hours. The National Demographic Health Survey revealed that one in five women aged 15 - 49 have experienced physical violence while 15 - 14.4 percent of married women have experienced physical abuse from their husbands.

Domestic violence affects people from all social, racial, and financial backgrounds. It affects men and women especially women, old

and young, heterosexual couples, and homosexual couples alike.

Framework of the Study

The term resilience reflects the ability of individuals to maintain relatively stable mental function throughout the course of events (Kara Ballenger-Browning, MPH & Douglas C. Johnson, PhD, 2010).

Research has suggested that protective characteristics within women, such as a sense of hope, their relationships with others and social support, can buffer the adverse effects of domestic abuse (Khatoun, Majda & Tarannum, 2009).

Tuttle, Zollner (2000) proposed an integrative conceptual model, comprising a psychological and environmental framework in an attempt to describe the complexity of factors involve in domestic abuse and woman's resilience, agency, and power. They proposed that optimism, self-esteem, and physical health may converge in abused women to promote resilience.

Living in an abusive relationship can slowly but surely decrease and damage self - esteem and sense of identity. Self - esteem is a way of thinking, feeling, and acting that implies levels of acceptance, respect, trust, and belief in oneself (Leichhardt Women's Community Health Centre, 2006).

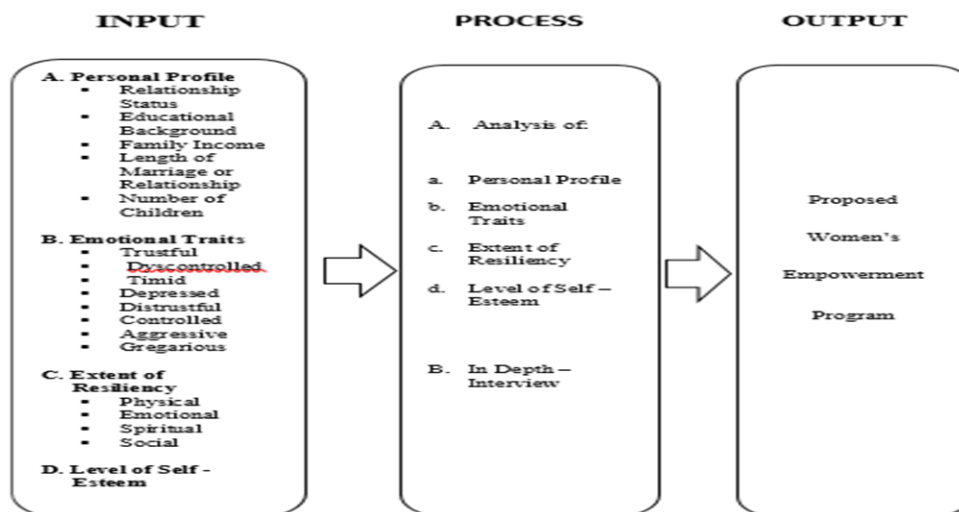
Women in abusive relationships demonstrate lower self - esteem, negative self - concept, and misrepresentations about themselves, others, and the world (Cordero 2014).

According to Firestone (2012), women do not leave because of fear and self - esteem. They fear that they cannot make it alone without their batterer.

According to Collison (2016), It is possible that once a woman's self - esteem lowers to a certain level, she will not feel able or confident enough to leave an abuser.

Meyer (2016) revealed that victims of abuse stay because of love. The love and affection the victim receives during this time only binds them more deeply to the abuser.

Research Paradigm



study and explores a particular phenomenon (Alecso, 2011).

Statement of the Problem

This is a study of selected abused women. Its purpose is to describe the personal profile and emotional characteristics of the respondents and to find out the level of resilience and self - esteem in understanding women's experiences of domestic abuse.

1. What is the personal profile of the women who experienced domestic abuse in terms of relationship status, educational background, family income and length of marriage or relationship and number of children?
2. What are the common emotional characteristics of the women respondents based on the emotional index profile?
3. What is the extent of the respondents' resiliency as to physical, emotional, spiritual and social factors?
4. What is the level of self - esteem of women respondents?

METHODOLOGY

Research Design

The research method used in this study was descriptive. This method describes the nature of a situation as it exists at the time of the

Sources of Data

This study focused on women who experienced physical, social, financial, and psychological abuse from their partner. A purposive sampling technique was utilized giving the following criteria: a.) they are still living with their partner; and b.) they are residing in Agoo, La Union.

The researchers used a series of questionnaire and an in - depth interview to know the details, and to have a better understanding of the life of the respondents. Each participant was informed that the interview is recorded.

Instrumentation and Data Collection

There were four questionnaires used in this study. The first questionnaire was composed of items regarding the personal background of the respondent. The second questionnaire included the items on Emotional Profile Index (EPI) which described the emotional traits of the respondents. The third questionnaire is a constructed questionnaire on resiliency and was content validated by five psychology professors. The fourth questionnaire is composed of 58 items on self - esteem which is lifted from Ryden, M. B. (1978) an adult version of the Coopersmith Self Esteem Inventory.

RESULTS AND DISCUSSION

Emotional Profile

In order to assess the emotional traits of the respondents, the emotional profile index was used.

Table 1. Respondents' Emotional Profile

Dimensions	Percentile	Description
Trustful	27	Low
<u>Dyscontrolled</u>	13	Low
Timid	65	High
Depressed	99	High
<u>Dystrustful</u>	53	High
Controlled	48	Average
Aggressive	65	High
Gregarious	25	Low

Legend: 60 above = High 40-59 = Average 39 below = Low

Results showed that women who experienced abuse scored low on following dimensions; Trustful (Tr = 27 percent), Dyscontrolled (Dy = 13 percent) and Gregarious (Gr = 25 percent). This implies that women who experienced abuse tend to be unaccepting, distrustful, disobedient, not very gullible but if gullible do not take face value (Tr). They are also reluctant to try new things or new experiences or not adventurous. They tend to be not impulsive and withdrawn from social contacts (Dy). They are also unsociable, unfriendly, unaffectionate and introverted (Gr).

Moreover, the respondents obtained high score on the dimensions Timid (Ti = 65

percent), Depressed (De = 99 percent), Dystrustful (Di = 53 percent) and Aggressive (Ag = 65 percent). They are depressed, sad, gloomy, and dissatisfied with aspects of life, they feel deprived and probably pessimistic (De). They are also stubborn, resentful, sarcastic, overly critical and tend to reject people and ideas. They are perceived by others as hostile, passive aggressive (Di), quarrelsome, and aggressive. They say whatever is on their mind. They have a lot of anger and express it overdy. They off team with people around, and people describe them as rebellious (Ag). Further, the women respondents scored average on Controlled (Co = 48%).

Extent of Resiliency

To assess the extent of the respondents' resiliency and to understand how they bounce back after experiencing traumatic life event, the

constructed questionnaire on resiliency with 3.91 content validity was used to gather the data.

Table 2. Respondents Extent of Physical Resiliency

Physical Resiliency	WM	DR	ER
1. I sleep so as to rest my body and mind after a stressful day brought about by my husband.	2.38	S	(S)
2. I try to make myself better by eating healthy foods.	2.75	O	(M)
3. I take a vacation break.	2.63	O	(M)
4. I moderately drink and smoke.	1.88	S	(S)
5. I treat myself at the parlor and saloon.	2.5	O	(M)
6. I go back to my parent's house together with my kids once in a while	3.13	O	(M)
7. I exercise every day to be physically fit and to have strength needed to face the problems I encounter. (e.g. Zumba dance)	2.38	S	(S)
8. I keep myself busy and not let the problem bother me. (e.g. household chores)	3.36	A	(H)
9. I tend to cure the bruises in my body and have a physical medical check-up to the clinic or hospital if necessary.	2.5	O	(M)
10. I don't forget to take my vitamins as supplement to make myself healthy.	2.36	O	(M)
Overall Mean	2.59	Often	(M)
<i>Legend: 3.25 to 4 Highly Resilient</i>			<i>*ER=Extent of Resiliency</i>
<i>2.50 to 3.24 Moderately Resilient</i>			
<i>1.75 to 2.49 Slightly Resilient</i>			
<i>1.00 to 1.74 Low Resiliency</i>			

Table 2 shows the physical capacity of the women who experienced abuse to become stronger again after the stressful situation. Most

of the respondents go back to their parents with their kids.

Extracts

- “Agawid ak jay balaymi ken agkamang ak kenni kabsat ko nga lalaki” - Amor.
- “Bumabalik ako sa bahay ng magulang ko para makalimutan ang sitwasyon.” - Arriane.
- “Umuwi ako sa amin tapos humihingi ako ng tulong sa mga parents ko” - Irene.

Some of the respondents keep themselves busy and do not let problems bother them. In the study of Airman (2014), one of

the tools to have effective and good physical fitness is to have a good nutrition because it increases the energy of the body.

Table 3. Respondents' Extent of Emotional Resiliency

Emotional Resiliency	WM	DR	ER
1. I look at my kids and draw strength from them.	3.75	A	(H)
2. I express my pain through crying.	3.13	A	(H)
3. I treat trials and problems as tests to make me strong.	3.25	A	(H)
4. I think positive things so that I will not get depressed.	3.38	A	(H)
5. I talk to someone whom I trust to vent my emotions so that I will be able to release what I am going through.	3.5	A	(H)
6. I shout at the top of my voice.	3.25	A	(H)
7. I reflect and evaluate the situation in order to solve problems.	2.63	O	(M)
8. I write down what I feel and burn it.	1.63	N	(L)
9. I think about the happy memories that I and my husband/boyfriend had once shared.	2.75	O	(M)
10. To find meaning in my life when I suffer pain	3.13	O	(M)
Overall Mean	3.04	Often	(M)

*Legend: 3.25 to 4 Highly Resilient
2.50 to 3.24 Moderately Resilient
1.75 to 2.49 Slightly Resilient
1.00 to 1.74 Low Resiliency*

**ER=Extent of Resiliency*

Table 3 shows the emotional capacity of the respondents who experienced abuse to become stronger again after a stressful situation.

Most of the respondents shout at the top of their voice, express their pain through crying.

Extracts

“Umiyak ako ng bongga”

– Claudia

“Agsangsangitak ken ag-agasak jay sugat ko”

– Anne

Table 4. Respondents' Extent of Spiritual Resiliency

Spiritual Resiliency	WM	DR	ER
1. I go to church whenever I can.	3.25	A	(H)
2. I pray that my husband will change and that our relationship will be fine.	3.5	A	(H)
3. I regularly pray for God's help for my situation to get better.	3.75	A	(H)
4. I attend religious activities often to strengthen my faith.	3	O	(M)
5. I meditate bible verses to strengthen me up.	2.63	O	(M)
6. I join religious organizations to help others and myself.	2.75	O	(M)
7. I'm able to find purpose in my everyday life experience with God's guidance and use them to face my problem.	2.75	O	(M)
8. I read inspirational books to get spiritual enlightenment that I can use to face my problems.	3.13	O	(M)
9. I seek spiritual guidance and strength from spiritual leaders.	2.75	O	(M)
10. I listen to Christian songs to uplift my spirit.	2.75	A	(H)
Overall Mean	3.03	Often	(M)

*Legend: 3.25 to 4 Highly Resilient
2.50 to 3.24 Moderately Resilient
1.75 to 2.49 Slightly Resilient*

**ER=Extent of Resiliency*

Extent of Spiritual Resiliency means that the women who experienced abuse seek help to God to overcome the pain brought by their partner. Table 4 presents the spiritual resiliency of the respondents; the overall mean is 3.04 which implies that women who experienced abuse is moderately resilient.

Table 5. Respondents' Extent of Social Resiliency

Social Resiliency	WM	DR	ER
1. I go out with close friends. (things like <u>videoke</u> , dine out, window shopping)	2.88	O	(M)
2. I visit my parents to seek help or advice.	3.25	A	(H)
3. I spend more time with my work and co-workers	2.38	S	(S)
4. I smile at people.	3.62	A	(H)
5. I talk about my situation to a respected friend.	3.25	A	(H)
6. I regularly browse my social accounts like <u>facebook</u> for leisure time.	2.88	O	(M)
7. I go out and build a stronger bond with my kids.	3.5	A	(H)
8. I talk to people with the same problem.	2.88	O	(M)
9. I attend social gatherings like birthday, family reunion, class reunion and fiesta.	2.88	O	(M)
10. I join different activities like sports and programs implemented in our barangay or community.	2.13	S	(S)
Overall Mean	2.97	Often	(M)

*Legend: 3.25 to 4 Highly Resilient
2.50 to 3.24 Moderately Resilient
1.75 to 2.49 Slightly Resilient
1.00 to 1.74 Low Resiliency*

**ER=Extent of Resiliency*

Table 5 shows the respondent's capacity in social context to become stronger again after the abuse has been experienced. Most of the

participants visit their parents to seek help or advice, smile at people, and talk to a respected friend about the situation.

Extract

"Umiinom ako ng alak at nag vivideoke kasama yong mga katrabaho ko para makalimot"
- Clara.

Khatoon, Majda and Tarannum (2009) emphasized that environmental factors can decrease distress or can increase resilience.

Receiving social support can buffer the adverse effects of domestic abuse.

Respondents' Level of Self – Esteem

To address the problem number four which is the respondents' level of self-esteem, the researcher made used of Ryden, M.B. adult

version of the Coopersmith Self –Esteem Inventory in order to measure the respondents' level of self – esteem.

Table 6. Mean Score and Raw Score of Level of Self Esteem of the Respondents.

Raw Score	DS
33	SBa
32	SBa
29	SBa
34	SB
26	SBa
39	A
26	SBa
20	SBa
Overall Mean	29.9
	SBa

SBa: Significantly Below Average, SB: Somewhat Below, A: Average, AA: Average Above SAA; Significantly Above Average

Table 6 shows that the self - esteem of the respondents has a mean total of 29.9 with a descriptive rating of Significantly Below average. This implies that an abusive relationship can severely affect a woman's self - esteem.

Extracts

- “Natakot akong magsumbong baka anong gawin niya sa amin ng mga anak ko” – Anne.
 “Nagka -phobia ako, once na narinig ko na may kalabog natatakot na ako. Nahihiya ako kapag pinagsasabihan niya ako sa harap ng ibang tao” – Claudia.
 “Itaytayak latta toy bagbagikon ta mabutengak nga panawan isuna” –Rosalinda.

In a study done by Khatoun, Majda and Tarannum (2009), it was revealed that low self - esteem can cause women to doubt themselves

which can promote maintaining relations with the abuser.

CONCLUSIONS

Based on the findings of the study, the following conclusions are drawn:

1. Most of the respondents are married and college graduates. Most of the respondents have a family income of 5, 000 - below and has a length of marriage of ten years and above. They have an average number of children.
2. The respondents' emotional profile is depressed.
3. The respondents have a moderate extent of resiliency.
4. The respondents have low level of self - esteem.

RECOMMENDATIONS

Based on the findings and conclusions of the study, the following suggestions and recommendations are hereby forwarded.

1. Pre-Marriage Counselling Seminar must be implemented by LGU's as one of the requirements before entering marriage.
2. It is recommended that the respondents must undergo stress management seminar.
3. Women Empowerment Program should be implemented.
4. Seminars on self - esteem enhancement and information drive about violence against women should be done by LGU's.

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BS MATHEMATICS

Analysis on the Graphs of Constellations

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Abstract

Constellations may be hard to visualize because of the number of their stars and the shape they form through their connections. They form paths and shapes that can relate to graphs, which deal with series of vertices and edges.

This paper analysed the graphs of constellations and a descriptive basic research was employed in the analysis of the graphs of constellations. TikZ, a graphing package for LaTeX software, was used to simplify and redraw the constellations. With this, properties of the graphs were determined in terms of the number of vertices, number of edges, number of faces, maximum and minimum degrees, Hamiltonicity, existence of Eulerian graphs, cycles, trees, pendants, and isolated vertices. Properties were summarized in tabular form to facilitate clearer understanding of the graphed constellations. Also, real life applications were determined in relation to the topic.

Through the study, a total 89 constellations were graphed using TikZ, two relevant properties were provided based on observations on the graphs, and two practical applications were also presented.

Keywords: *Constellations, TikZ, planarity, symmetry, Hamiltonian, Eulerian*

INTRODUCTION

Situation Analysis

Mathematics has played a very important role in building modern civilization by perfecting all sciences. Even though people have only a vague idea that all progress made by a man in the result of scientific progress, they are strongly in favour of scientific and industrial education (Sidhu, n.d). For such research, many educated people regard mathematics as the most highly developed science, a paradigm for lesser sciences to emulate (Resnik, 1997).

In relation to the importance of Mathematics, Graph Theory is a branch of mathematics concerned with networks of points connected by lines. This subject has had its beginnings in recreational math problems, but it has grown into a significant area of mathematical research with applications in chemistry, operations

research, social sciences, and computer science (Carlson, 2016).

Constellation is a definite area of the celestial sphere with internationally agreed boundaries, and the areas fit together to make up the sky. The maps show major constellations of the sky and the faintest stars are those with small dots; these should just be visible to the naked eye from built-up areas. In total, the sky contains 88 constellations. Most of these were named in ancient times. Originally, the constellations were defined informally by the shapes made by their star patterns. Eugene Delporte originally listed the “88 modern constellations” on behalf of the IAU Commission. Many of these were recorded by Babylonian astronomers before 200 BC. Between 16th and 18th centuries AD, when explorers began venturing into the south hemisphere, new parts of the celestial sphere came into view, and more constellations were added to ancient ones (Muirden, 1995).

Constellations help by breaking up the sky into more manageable bits. When looking at the stars and seeing that they are connected to other stars, they form a path and a shape that can relate in graphs, which deal with the series of dots and lines.

The researchers redrawn and simplified the 89 constellations to make it easier to understand, TikZ has been developed and introduced. It is a computer program that uses tandem of languages for producing vector graphics from a geometric/algebraic description, and it is probably the most complex and powerful tool to create graphic elements in LaTeX. On the other

hand, LaTeX is another computer software that works along with TikZ, and it is through LaTeX where codes are encoded on which graphs are displayed/shown in TikZ.

The eagerness of the researchers to introduce a new concept in Graph Theory has led them in choosing this topic on the analysis of the graphs of constellations. Moreover, the researchers want to encourage readers and other researchers to explore more in this study, and to learn more information about constellations because mathematics is not only focused on numbers but also on other things--everything around the universe.

Statement of the Problem

This study, analysis of graphs of constellations sought to answer the following problems:

1. What are the different graph representations of the 89 constellations using TikZ package?

2. What properties can be formulated from the graphed constellations?
3. What real life applications can be determined in relation to the graphs of constellations?

METHODOLOGY

Research Design

This study employed pure basic research under descriptive research design because it dealt with the analysis of the graphs of constellations and it utilized systematic analysis about the graphs of constellation. This study aimed to introduce some simple concepts associated with the design and to describe and analyse the constellation to represent and solve mathematical graph problems and how they interpreted and illustrated these graphs of constellations.

The goal of the researchers is to help others understand, predict future outcomes, improve future research, practice and raise new information. The researchers conducted the study through library work and internet explorations. The concepts were

elaborated through the use of reliable sources such as books, journals, articles about graphs, published and unpublished related studies and the researchers' knowledge on Graph Theory.

Consequently, this study was developed because of the confidence of the researchers to introduce a new concept in Graph Theory. Results are intended to actuate the desire of other researchers to continue to explore more on this topic.

Sources of Data

Pure basic research under descriptive research design study the graphs of constellations and as a precursor, the researchers analyzed the properties of simplified graphs of constellations generated

using TikZ, a graphing software, and the conceptual definition of the graphs of constellations mainly from books, published papers, dissertation about related topics, and the World Wide Web to intensify relevant

RESULTS AND DISCUSSION

Some constellations are very hard to visualize because of the number of stars and the shape they form through their connections. Thus, the researchers came up with the idea to redraw them to provide clear illustrations with the number of vertices (stars) and edges (connections) remaining the same.

The different constellations are redrawn/illustrated using computer application TikZ. Properties of each graphed constellations in terms of the number of vertices and edges, planarity, existence of cycles, trees, leaves, and isolated vertices were discussed after each graph. It is also determined if the graphs are Hamiltonian or Eulerian.

In preparation for the graph representation of constellation, TikZ package is utilized. TikZ is a tandem of languages for producing vector graphics from a geometric/ algebraic description, and it is probably the most complex and powerful tool to create graphic elements in LaTeX. In making a graph, there are three (3) steps that must be done and followed.

Graph Representations of the 89 Constellations using TikZ Package

To start drawing a graph of constellation, the researchers followed the following steps:

1. Opening and Familiarization of TikZ. Open the program TikZ press *ctrl + n* button for new document.
2. Encoding the prepared codes for the graph representation of a constellation for the individual codes for each constellation. The code starts with the `\document`

studies about the topic. The researchers also used on-line to have more information that can solve any problem in the graphs of constellation, which can lead the researchers to achieve their objectives.

`class{article}`, it defines the type of document to generated in LaTeX. Followed by declaring the package to be used using the command `\usepackage{}` in generating the graph representation, in this case the TikZ package will be utilized. The actual code for TikZ package will start between the command lines `\begin{document}` and `\end{document}`. The command line to generate the graph representation of each constellation starts with the command `\begin{tikzpicture}`, followed by the definition for the styles of the graph such as the size (scale) of the graph, orientation of the graph, the shape of its node (vertex) and its color. The command `\node` defines the properties for the vertex such the coordinate (x,y) of the vertex and the name of the vertex (v_i) for $i=1,2,..n$, where n is the number of vertices. The command `\end{tikzpicture}` signifies the ending for the TikZ package.

3. Running the text code using TikZ package to generate the graph representation. After encoding the code, save the file according to the name of the constellation and press the function buttons on the keyboard, *f2, f3, f4, f6, f8 and f7* successively will generate the graph representation into the built-in view part of the program. The graph represents the constellation horologium that the researchers made by the use of TikZ. Based from the graph representation of Horologium and the definitions of known classifications and properties of graphs such Hamiltonians, semi-Hamiltonians, Eulerian and semi-Eulerian, cycles, tree, pendant and symmetric property, it is observed that the graph representation Horologium has seven (7) vertices and six (6) edges, 1 face, the

maximum and minimum degree of vertex is two (2), the graph is Semi- Hamiltonian and Eulerian, and the graph is symmetric. It has

Properties on the Graphs of Constellations

Property 1. The graphs generated from the constellations has a maximum number of 35 vertices and the degree of every vertex lies from 0 to 6.

- (i) From the 89 constellations, the graphed Equuleus is the simplest with only (three) 3 vertices while the graphed Sagittarius was the most complex with 35 vertices, has the least number of vertices with $n=3$ and the most complex graphed with highest number of vertices is the cycle Sagittarius with a total number of vertices 35.
- (ii) For the degree of vertex, observe that there are graphs with isolated vertex. Hence, the minimum degree is 0. Furthermore one of the vertices of the graph has the maximum degree of 6. That is, vertex 11 in the graph of Pavo.

Property 2. All Hamiltonian and Eulerian graphs generated from the constellations are symmetric

All graphs generated from constellations which are Hamiltonian and Eulerian are also symmetric with respect to the horizontal, vertical or both axes.

Real life Applications of the Graphs of Constellations

A. proposed application: On tourist attraction

no cycle; it is considered as a tree with two (2) pendants and no isolated vertices.

In the Peruvian Desert, about 200 miles south of Lima, there lies a plain between the Inca and Nazca. Along this plain lie the famous figures known as Lines of Nazca Peru. The figures come in two types: biomorphs and geoglyphs. The biomorphs are some 70 animal and plant figures that include a spider, hummingbird, monkey and a 1,000-foot-long pelican. The biomorphs are grouped together in one area on the plain. Some archaeologists believe they were constructed around 200 BC, about 500 years before the geoglyphs.

B. Hall Lightning Design

A hall is a part of a building. It is a space of which bulk of people usually meet and greet. A well- lighted hall could be an asset that construction take into consideration. The lighting system should go with the design of the ceiling. Symmetry usually observed on its design and construction, for example, if a hexagonal ceiling is constructed. Graph representation of Fornax and Telescopium could be considered for the lighting system, since the graph representation of these constellations are symmetric implying a balance lighting system.

C. On chandelier design

One practical application of graph constellation is chandelier designs. Chandeliers designs can be made up involving graphs of constellations.

The chandelier designs are derived from graphs of constellations. The bulbs in the right figure serve as vertices and the connections serve as edges. This designs can be based on the redrawn graphs of constellations especially those that are symmetric and don't have isolated vertices. This would facilitate balance when installing the chandeliers. A total of 27 graphed

constellations that are symmetric and don't have isolated vertices can be used as a chandelier design. Some of the chandelier

designs and the redrawn graphs are illustrated below by the researchers.

constellations can be considered for additional aesthetic value.

CONCLUSIONS

By observing the graphs of constellations, the researchers observed some properties and came up with the following:

1. Graphs can be redrawn without losing their properties. Using a graphing software such as TikZ ensures the accuracy and simplicity of the graphs generated.
2. There are two properties formulated by the researchers based on their observations on the graphs. The summary table made by the researchers have been of great help in identifying the properties and even the relationships that exist among these properties.
3. Two practical applications that deal with the different aspects of life are presented.

RECOMMENDATIONS

Based on the conclusions of this study, the following are recommended:

1. Future researchers may consider using another software, Graph-TeX to generate the graphs of the 89 constellations.
2. Create computer software showing the constellations, their classifications based from their properties and their graphs. Additional properties particularly on the concept of chromatic number could be considered as a study.
3. Constellation chandeliers can be modelled and presented using 3d rendering softwares for visualization. Graph coloring in generating the graphs of

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Collatz-Like Functions and their Graphs

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ABSTRACT

This study dealt with the formulation of Collatz-like functions and their graphs and the introduction of some properties regarding Collatz-like functions. The Collatz-like functions were derived from the Collatz Conjecture where any value of n will always reach 1 when the function $\frac{3n+1}{2}$ is used for even numbers and $\frac{n}{2}$ for odd numbers. In this paper Collatz-like functions were derived and some properties of each of these functions were determined. A computer program was also developed which can generate the graphs of the six Collatz-like functions for some values of n .

Keywords: Collatz Conjecture, Collatz-like functions, graphs, sequence, computer program

INTRODUCTION

Everything here on earth is surrounded by mathematics: the amount of groceries, the size of shoes, temperature, magnitude, and distance of house from school. There is math in making a building, angles in photo shoots, and even in dividing inheritance. There are numbers, symbols, variables and operations everywhere.

One of the branches of mathematics is Number Theory that deals with the study of integers, their properties, and the relationship between them. It is focused on the different sets of numbers and their functions (Dunham, 2013).

However, most of the topics in Number Theory deals with the set of positive whole numbers 1, 2, 3, 4, 5, 6, 7, . . . , which is often called the set of natural numbers denoted by \mathbb{N} . Around 600 B.C., Pythagoras and his disciples made thorough studies of the integers. They were the first to classify integers in various ways: even numbers 2, 4, 6, 8, 10, . . . ; odd numbers 1, 3, 5, 7, 9, 11, . . . ; prime numbers 2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, . . . ; composite numbers 4, 6, 8, 9, 10, 12, 14, 15, 16, . . . , and so on (Apostol, T. M., 1976).

One of the topics in Number Theory is the Collatz Problem which is also known as Collatz Conjecture, named after Lothar Collatz. The Collatz Conjecture is a hypothesis based on

the iteration of the $3n + 1$ function, which is defined as follows:

$$C_n = \begin{cases} \frac{3n+1}{2} & \text{if } n \text{ is odd} \\ \frac{n}{2} & \text{if } n \text{ is even} \end{cases}$$

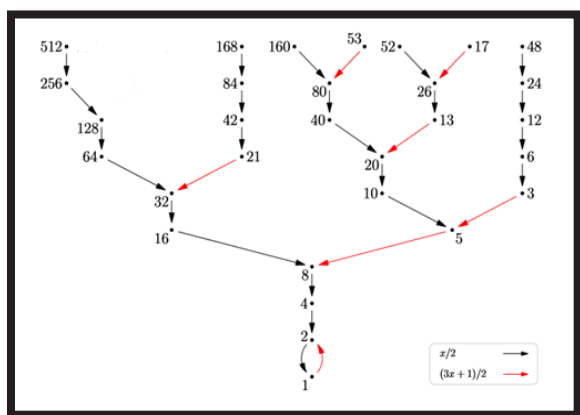
The Collatz Conjecture states that given a number $n \in \mathbb{N}$, repetitive application of the function C_n will eventually result in the periodic sequence $\{1, 2, 1, 2, 1, \dots\}$. Furthermore, this is the only repeating cycle which exists. The Collatz problem is also known as the $3n + 1$ problem, $3x + 1$ mapping, Syracuse problem, Kakutani's problem, the Hasse's Algorithm, the Ulam's problem and the Hailstone Numbers. They are all concerned with the behaviour of the iterates of the function which takes odd integers n to $\frac{3n+1}{2}$ and even integers n to $\frac{n}{2}$. The Collatz Problem asserts that, starting from any positive integer n , repeated iteration of this function eventually produces the value 1 (Lagarias, n.d.).

Some researches in Collatz Conjecture collect experimental data from which they often make conjectures on the Collatz Problem. Many researchers analyzed the Collatz Problem from different mathematical perspectives which procure equivalent conjectures that, if proven, would also prove the Collatz Conjecture.

In the study of Laarhoven (2009) entitled “The $3n + 1$ conjecture”, he looked at various approaches to this problem. He also looked at the infinite Collatz Digraph, its adjacency matrix, and its eigenvectors to learn more about the $3n + 1$ conjecture, as well as the consequences of the existence of other cycles of divergent trajectories. He also investigated the Collatz Modular Digraphs to observe properties of the $3n + 1$ conjecture when applied to congruence classes.

Another study that deals with the “ $3n + 1$ ” was conducted by the Monks siblings in 2012 about the “Strongly sufficient sets and the distribution of arithmetic sequences in the $3x + 1$ graph”. They further investigated the concept of sufficiency by constructing sufficient sets of arbitrarily low asymptotic density in the natural numbers. They determined the structure of the groups generated by the maps $x \rightarrow \frac{x}{2}$ and $x \rightarrow \frac{3x+1}{2}$ modulo b for b relatively prime to 6. They studied the action of those groups on the directed graph associated to the $3x + 1$ dynamical system and from those they obtained information about the distribution of arithmetic sequences.

The Collatz graph is a directed graph where each vertex represents an iteration of n and may be simplified in order to exploit general properties of Graph Theory with the desire to prove the Collatz conjecture (Stroup, 2006).



function given some values of n where n is any positive integer.

Data Gathered

The researchers generated and analyzed Collatz-like functions and their properties. The intention of this study is to introduce Collatz-like functions, sketch their graphs, and derive some of their properties. In order to fulfil the objectives of the study, the researchers gathered reliable and related data from different sources that include published materials like books, journals, magazines, research articles. Conditions for some generated Collatz-like functions were identified to satisfy the Collatz-conjecture.

The computer program called “Collatz-like” was developed through Javascript. The main function of the computer program is to generate the graphs of Collatz-like functions from some positive integers n .

RESULTS AND DISCUSSION

Collatz-like Functions and their Corresponding Graphs

The following functions were derived from the Collatz Cojecture which is defined as follows:

$$C_n = \begin{cases} \frac{n}{2} & \text{if } n \text{ is even} \\ \frac{3n+1}{2} & \text{if } n \text{ is odd} \end{cases}$$

These are the functions that were derived to generate a given value of n that will also reach 1.

Function 1.

$$F_n = \begin{cases} \frac{n}{2} & \text{if } n \text{ is even} \\ \frac{n+1}{2} & \text{if } n \text{ is odd} \end{cases}$$

The function is similar to the Collatz Function only that the number 3 is eliminated in the case where n is odd. By utilizing this function for any given positive integer n , the function proves that the iterations would eventually result to 1.

Given that the positive integer n is even, the first iteration is $\frac{n}{2}$, and if the given positive integer n is odd, the function to be used is $\frac{n+1}{2}$. The conditions for the next iterations depend upon the result of the previous iteration. Then, the iteration process continues until the function value reaches 1.

Some examples of the iterations on this paper were randomly selected from any positive integers n . When the starting value n was even, then the expression used is $\frac{n}{2}$. When the initial value of n was odd, then $\frac{n+1}{2}$ is used. The next definition of the function to be used depends on the result of the first iteration.

Example: For some values of n , the following examples illustrate Function 1.

- a) Consider $n = 23$. Since 23 is an odd number then the function to be used is $\frac{n+1}{2}$. Substituting 23 to the function, $\frac{23+1}{2} = 12$.

The result is 12 which is an even number. Therefore, the function to be used for the next iteration is $\frac{n}{2}$.

Substituting 12 to the function, $\frac{12}{2} = 6$.

Since the result is 6 and it is even so the function to be used is $\frac{n}{2}$.

Substituting 6 to the function, $\frac{6}{2} = 3$.

Because 3 is odd, therefore the function to be used is $\frac{n+1}{2}$.

Substituting 3 to the function, $\frac{3+1}{2} = 2$.

Since 2 is even so the function to be used for the next iteration is $\frac{n}{2}$.

Substituting 2 to the function, $\frac{2}{2} = 1$.

Because the function value reaches 1 already, the sequence of the results of the iterations is 23, 12, 6, 3, 2, 1 and the length from 23 to 1 is $l(n) = 6$.

Figure 2 below is a sample of the graph of Collatz-like *Function 1* formed by iterating the function F_n until it reaches 1.

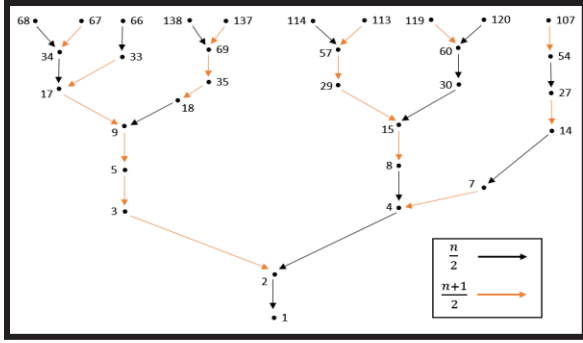


Fig. 2. Graph of the Collatz-Like *Function 1* for some n

Function 2.

$$F_n = \begin{cases} \frac{n}{2} & \text{if } n \text{ is even} \\ \frac{n+3}{2} & \text{if } n \text{ is odd but not divisible by 3} \\ \frac{n}{3} & \text{if } n \text{ is divisible by 3} \end{cases}$$

Function 2 is similar to the first function except for some conditions on divisibility by 3. The sequence of the function to be used is dependent on the quotient until it reaches 1. For example, if $n = 33$, then the first iteration is $\frac{n}{3}$. Thus, $\frac{33}{3} = 11$. Since 11 is odd and not divisible by 3, then the next iteration uses $\frac{n+3}{2}$. The process of iteration using the appropriate conditions continues until the result is 1.

Figure 3 in the next page shows the graph of the Collatz-like *Function 2* formed by iterating the function F_n for some values of n until it reaches 1.

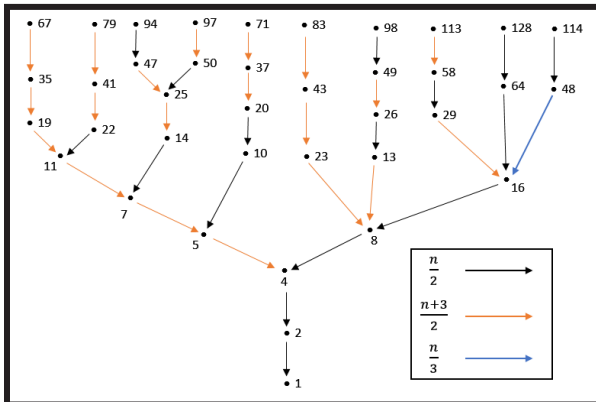


Fig. 3. Graph of the Collatz-like *Function 2* for some n

Function 3.

if n is even

$$F_n = \begin{cases} \frac{n}{2} & \text{if } n \text{ is odd but not divisible by 5} \\ \frac{n+5}{2} & \text{if } n \text{ is divisible by 5} \end{cases}$$

If n is divisible by 5, use the definition of the function $\frac{n}{5}$ in order that the iterations eventually lead to 1. Further, the cycle 1, 2, 1, 2, 1... will be obtained.

If the condition $\frac{n}{5}$ is not included in the condition of *Function 3*, then the iterations becomes infinite. For example, if $n = 25$, then $\frac{25+5}{2} \rightarrow \frac{15+5}{2} \rightarrow \frac{10}{2} \rightarrow \frac{5+5}{2} \rightarrow \frac{10}{2} \rightarrow \frac{5+5}{2} \rightarrow \frac{10}{2} \rightarrow \frac{5+5}{2} \rightarrow \frac{10}{2} \rightarrow \frac{5+5}{2} \rightarrow \frac{10}{2} \rightarrow \frac{5+5}{2} \rightarrow \frac{10}{2} \rightarrow \frac{5+5}{2} \rightarrow \frac{10}{2} \rightarrow \frac{5+5}{2} \rightarrow \frac{10}{2} \rightarrow \dots \rightarrow \infty$. Observe that the iteration follows the cycle 10, 5, 10, 5... and will never reach a value equal to 1.

Figure 4 in the next page reflects the graph of Collatz-like *Function 3*. The numbers 69, 74, 73, 78, 83, 88, 80, 93, 98, 108 and 100 are the given initial values of n . The black arrow indicates that the function $\frac{n}{2}$ is used, the red arrow indicates that $\frac{n+1}{2}$ is used, and the blue arrow indicates that $\frac{n}{5}$ is used.

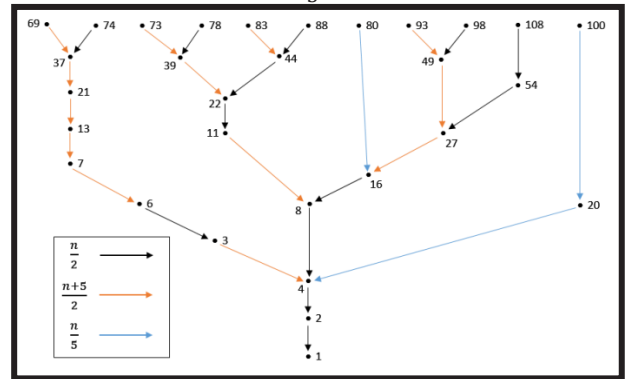


Fig. 4. Graph of the Collatz-like *Function 3* for some n

Function 4.

$$F_n = \begin{cases} \frac{n}{2} & \text{if } n \text{ is even but not divisible by 7} \\ \frac{n+7}{2} & \text{if } n \text{ is odd but not divisible by 3 or 7} \\ \frac{n}{7} & \text{if } n \text{ is divisible by 7} \\ \frac{n}{3} & \text{if } n \text{ is divisible by 3 but not by 7} \end{cases}$$

In *Function 4*, the researchers established four conditions in order that the iterations eventually lead to 1. The

following examples illustrate that the functions values reach 1 using the appropriate conditions of the function.

Figure 5 reflects the graph of Collatz-like *Function 4*.

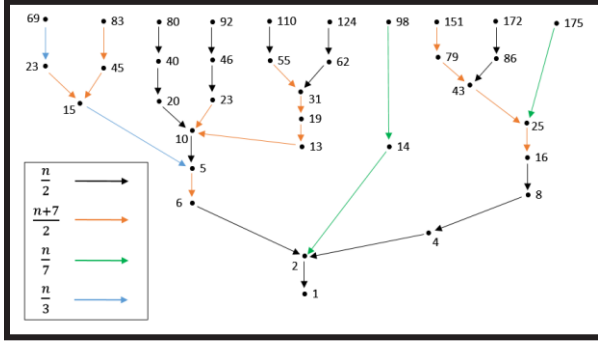


Fig. 5. Graph of the Collatz-like *Function 4* for some n

Function 5.

$$F_n = \begin{cases} \frac{n}{2} & \text{if } n \text{ is even but not divisible by } 3 \\ \frac{n+9}{2} & \text{if } n \text{ is odd but not divisible by } 3 \\ \frac{n}{3} & \text{if } n \text{ is divisible by } 3 \end{cases}$$

The conditions set for function 5 guarantee that the results of the iterations will eventually reach 1.

Example: For some values of n , the following examples illustrate Function 5.

If $n = 27$, then $\frac{27}{3} \rightarrow \frac{9}{3} \rightarrow \frac{3}{3} \rightarrow 1$. The sequence is 27, 9, 3, 1 where the length to 1 is $l(n) = 4$. For this example the formula $\frac{n}{3}$ was used in iterating to reach 1.

The graph edges are drawn as arrows and there are no multiple edges. Also, the graph has no loops after reaching 1.

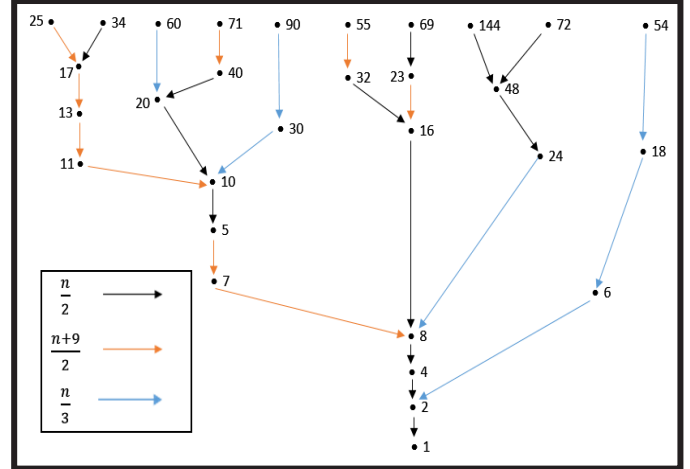


Fig. 6. Graph of the Collatz-like *Function 5* for some n

Function 6.

$$F_n = \begin{cases} \frac{n}{2} & \text{if } n \text{ is even but not divisible by } 11 \\ \frac{n+11}{2} & \text{if } n \text{ is odd but not divisible by } 11 \\ \frac{n}{11} & \text{if } n \text{ is divisible by } 11 \end{cases}$$

The conditions for *Function 6* were established to guarantee that the process of iteration will reach 1. The condition to be used in each iteration is dependent on the value of n .

Example: For some values of n , the following examples illustrate Function 6.

a) If $n = 55$, then $\frac{55}{11} \rightarrow \frac{5+11}{2} \rightarrow \frac{8}{2} \rightarrow \frac{4}{2} \rightarrow \frac{2}{2} \rightarrow 1$. The sequence is 55, 5, 8, 4, 2, 1 and the length to 1 is $l(n) = 6$.

The graph that was formed is a directed and tree graph. The graph edges are drawn as arrows and there are no multiple edges. Also, the graph has no loops after reaching 1.

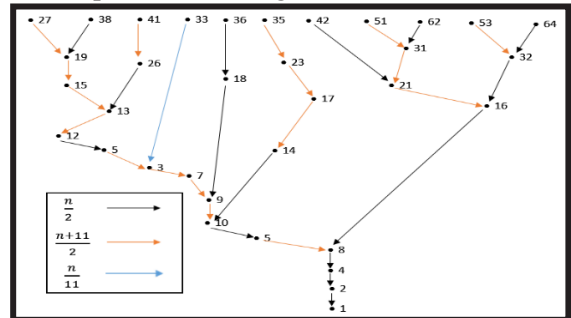


Fig. 7. Graph of the Collatz-like *Function 6* for some n

Properties of the Collatz-like Functions

Function 1

Property 1.1 As the function reaches 1, the results of the succeeding iterations are all 1.

Property 1.2 For every given $2 \leq n \leq 2000$ the path will always pass through the sequence 2,1.

Property 1.3 Let n_1, n_2 be two consecutive integers such that n_1 is odd and n_2 is even. Then, for $n_1, n_2 \geq 3$, then the iterations produced by these numbers will lead to the same path going to 1, except on their first iterations.

Conjecture 1 The total number of n where $n \geq 2$ with the same length is $2^k - (2^{k-1})$ and the range of n is $2^{k-1} + 1 \leq n \leq 2^k$, where $k \geq 1$.

Function 2

Property 2.1 Suppose that $k \in \mathbb{Z}^+$, for any $n \in \{3, 3^2, 3^3, \dots, 3^{k-1}, 3^k, \dots\}$. The length of n is given by $l(n) = l(3^k) = k + 1$.

Property 2.2 For every $n \geq 3$ and n is a multiple of 3, the results of all second iteration are consecutive positive integers.

Property 2.3 For all n , there will be a cycle on the path $1 \rightarrow 2 \rightarrow 1$, after reaching 1.

Property 2.4 For every $2 \leq n \leq 66$ and except for $n = 3, 9$, and 27 where $j \geq 1$ the path will always pass by the 2, 1 sequence.

Function 3

Property 3.1 Suppose that $k \in \mathbb{Z}^+$, for any $n \in \{5, 5^2, 5^3, \dots, 5^{k-1}, 5^k, \dots\}$. The length of n is given by $l(n) = l(5^k) = k + 1$.

Property 3.2 For every $n \geq 5$ and n is a multiple of 5, the result of all

second iterations are counting numbers in chronological order.

Property 3.3 For all n , there will be a cycle on the path $1 \rightarrow 3 \rightarrow 4 \rightarrow 2 \rightarrow 1$, after reaching 1.

Property 3.4 For every $1 \leq n \leq 66$ and except for $n = 5$ and 25, the path will always pass by the 2, 1 sequence.

Function 4

Property 4.1 Suppose that $k \in \mathbb{Z}^+$, for any $n \in \{7, 7^2, 7^3, \dots, 7^{k-1}, 7^k, \dots\}$. The length of n is given by $l(n) = l(7^k) = k + 1$.

Property 4.2 For every $n \geq 7$ and n is a multiple of 7, the results of all second iteration are counting numbers in chronological order.

Property 4.3 For all n , there will be a cycle on a path $1 \rightarrow 4 \rightarrow 2 \rightarrow 1$, after reaching 1.

Function 5

Property 5.1 Suppose that $k \in \mathbb{Z}^+$, for any $n \in \{9, 9^2, 9^3, \dots, 9^{k-1}, 9^k, \dots\}$. The length of n is given by $l(n) = l(9^k) = l(3^{2k}) = 2k + 1$.

Property 5.2 For every $n \geq 9$ and n is a multiple of 9, the results of all third iterations are counting numbers in chronological order.

Property 5.3 For all n , there will be a cycle on a path $1 \rightarrow 5 \rightarrow 7 \rightarrow 8 \rightarrow 4 \rightarrow 2 \rightarrow 1$, after reaching 1.

Property 5.4 For $1 \leq n \leq 66$ and except for $n = 3, 9$, and 27, the path will always pass by through the sequence 2, 1.

Function 6

Property 6.1 Suppose that $k \in \mathbb{Z}^+$, for any $n \in \{11, 11^2, 11^3, \dots, 11^{k-1}, 11^k, \dots\}$. The length of n is given by $l(n) = l(11^k) = k + 1$.

Property 6.2 For every $n \geq 11$ and n is a multiple of 11, the result for all second iterations are counting numbers in chronological order.

Property 6.3 For all n , there will be a cycle on a path $1 \rightarrow 6 \rightarrow 3 \rightarrow 7 \rightarrow 9 \rightarrow 10 \rightarrow 5 \rightarrow 8 \rightarrow 4 \rightarrow 2 \rightarrow 1$, after reaching 1.

Property 6.4 For $5 \leq n \leq 66$ and except for $n = 11$, the path will always pass by at 8,4,2,1 sequence.

Computer Program

The *Graph Generator: Collatz-Like* computer program was developed that generates the graph of the Collatz-like functions based on some given values of n . The program also shows the sequence of n until 1. The maximum value of n that can be manipulated using the program is 10^{100} .

CONCLUSIONS

The following are the conclusion of the study based on the findings:

1. There are 6 new Collatz-like functions generated.
2. A set of properties was derived for each new Collatz-like function.
3. The computer program has essential features that graphically illustrate the

sequences of n up to 1 of the Collatz-like functions.

RECOMMENDATIONS

The study recommends the following:

1. For future researchers, they may verify the Collatz-like functions generated in this study. They may also discover new functions similar to the Collatz Conjecture.
2. Future studies on Collatz-like Functions may endeavour to generate more properties of the six formulated functions that were introduced in this study.
3. The Graph Generator: Collatz-Like computer program can be used as a supplementary instructional material in Graph Theory and Number Theory. An improved version of this program that serves more functions other than generating graphs (i.e. solving for $l(n)$, classifying the generated graphs, etc.) could be developed.

Future studies on Collatz Conjecture may find possible practical applications of the functions to assist non-mathematics enthusiasts in recognizing that math is integrated in almost all real-life situations.

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Cover Times of Special Non-Planar Graphs

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ABSTRACT

This study dealt with the cover times of special non-planar graphs. From the general bounds provided by Alleliunas et al., the researchers derived a formula on complete graph K_n , flower snark graph f_n , and complete bipartite graph $K_{n,n}$. In addition, the researchers generated a new formula for the exact cover time of complete bipartite graphs. Furthermore, the researchers generated equation using cubic interpolation to model the relationships of vertices and cover times of complete graph and complete bipartite graph. Lastly, the researchers developed a computer based application named "Random Walk Simulator" to simulate the cover times of some special non-planar graphs.

Keywords: cover time, cubic interpolation, general bounds, random walk simulator, random walk.

INTRODUCTION

Mathematics is fundamental in physical and biological sciences, engineering and information technology, in economics and increasingly, in the social sciences. The patterns and structures in mathematics are universal. It is perhaps possible to imagine a universe in which the biology and physics are different; it is much more difficult to imagine a universe in which mathematics is different (Hutchinson, 2010).

One of the fields in Mathematics that have many real life applications is Graph Theory, which is the study of points and lines. In particular, Graph Theory is a branch of mathematics concerned about how networks can be encoded and how their properties can be measured. It has been enriched in the last decades by growing influences from studies of social and complex networks (Rodrigue, 2016).

In these times, Graph Theory is used for finding communities in networks where people want to detect hierarchies of substructures. It is also used for ranking or ordering hyperlinks or by using GPS to find the shortest path home (Dooren, 2009.).

There are many phenomena from biology and economics to computer science

and physics that are so complicated that instead of trying to understand them in complete detail, one tries to make probabilistic statements instead. For example, if one wishes to analyze how a disease is likely to spread, one cannot hope to take account of all the relevant information, such as who will come into contact with whom, but one can build a mathematical model and analyze it. Such models can have unexpectedly interesting behavior with direct practical relevance (Gowers, 2008).

Random events that are thought to be impossible to calculate are made possible by mathematics and the procedure usually falls under probability. Mathematicians, statisticians and scientists often use probability to attempt predicting real world behaviors and outcomes of certain people and scenarios. Almost every possible activity and outcome has a probability. For example, in a card game, some might wonder about the probability one will get a royal flush. In a bingo game, what will be the chances that one will precede its opponents in completing the cards? These things can be modeled and estimated

effectively with probability and statistical methods (Gordon, 2013).

Relations between the two subjects are vast but one of the most common is the topic called Random Walks on a Graph. Random walk is a randomized process in which, starting from a specific point on a graph, called a vertex, and at each step moves to the next neighbor. A neighbor is chosen randomly and determined by a random event or process (Khan et al, 1989).

For example, imagine a rook on a 2x2 chess board; from any square on the board, the rook has two available moves. If the successive choices are made by tossing a coin, what is the expected number of moves until the rook has visited each square on the board? (Emmerson, n.d.).

In this study, the researchers explore their knowledge to introduce new concepts in Graph Theory and Probability. This study is important because it may help other students become more engaged in mathematics. The new ideas to be introduced may be used by other students who are conducting their studies.

Statement of the Problem

This study aimed to answer the following problems:

1. What formula could be derived from the expected number of steps to visit all vertices when a random walk is performed on special non-planar graphs: Complete Graph, Snark Graph and Complete Bipartite?

Cover time is the expected number of times or number of steps to visit all vertices in a graph when a random walk is performed. Since cover time is a random variable, the researchers can study its expectation, variance and even exact distribution for different types of graphs. To compute the cover time of a certain graph, the graph should be connected, and undirected (Hopcroft, 2008).

Hence, in this study, more clarifications on cover times and their properties on some undirected and connected graphs specifically on special non-planar graphs are made.

Also, the researchers analyzed properties and theorems to provide important results for given objectives. The researchers chose the topic on cover time

2. What equation can model the relationship of vertices and cover times of special non-planar graphs?
3. What real life applications could be determined on cover times of special non-planar graphs?
4. What computer based application could be developed to simulate the cover times of special non-planar graphs?

METHODOLOGY

Research Design

In this study "Cover Times of Special Non-planar Graphs", the researchers gathered the necessary data utilized for the applications of a descriptive method. Descriptive method of research is the most appropriate method in this study since it

aims to interpret data accurately. The purpose of using descriptive method is to describe the cover times of random walks of special non-planar graphs and to explore the cause or causes of the particular condition. This would also help the researchers to

formulate an equation relating the vertices and cover time of the graphs. The researchers would be able to generate a formula for special non-planar graph with the use of exploratory research since it intends to explore the research questions and to determine the nature of the problem.

Data Gathered

This study analyzed properties as well as search for the conceptual definitions of terms regarding special non-planar graphs mainly from published papers, theses and dissertations about related topics and eBooks. The researchers used their knowledge and utilized their sources to come up with new concepts and developments of this study. This includes

Though, the exploratory research does not provide conclusive solutions, it gives the researchers directions as a result of new data and insights. The researchers conducted the study and used related articles through library works and internet exploration.

not only analysis but a broad imagination and a sense of patience. This study was developed through an expository research. The eagerness of the researchers to introduce additional concepts in Graph Theory would be a great factor to trigger other researchers to explore more on this study.

RESULTS AND DISCUSSION

The following statements hold true on cover times of random walk on special non-planar graph, below

1. Derived formulas:

- a. Complete Graphs
General bounds: $C(K_i) \leq i^2(i - 1)$, $i =$ number of vertices
- b. Complete Bipartite Graphs
General bounds: $C(K_{i,i}) \leq 4i^3$, $i =$ number of vertices
Exact cover time: $C(K_{i,i}) = 1 + 2i \sum_{k=1}^{i-1} \frac{1}{k}$, $k = 1, 2, 3, \dots$
- c. Snark Graphs
General bounds: $C(J_{2i+1}) \leq 48(2i + 1)^2$,
 $i =$ number of vertices

2. Equations relating to the cover time and vertices of the given graphs were derived using cubic spline interpolation.

- a. Complete Graph
 $C(K_i) \approx -1(10)^{-6}x^3 + 0.004x^2 + 5.156x$, where $x =$ number of vertices
- b. Complete Bipartite Graph
 $C(K_{i,i}) \approx -1(10)^{-5}x^3 + 0.016x^2 + 9.0189x$, where $x =$ number of vertices

3. Real life applications

- a. Game Designs Involving Random Process
This game design can generate random patterns to make the game more unpredictable.
- b. Trips to the City
This determines the expected number of trips to visit all the stations of the two cities.

4. The developed program

The computer-based application called random walk simulator was developed that determines the average cover time of the given graph based on the specified range of trials.

CONCLUSIONS

The following conclusions were made based on the findings of the study:

1. Four formulas were derived that determine the general bounds of special non-planar graphs, namely: complete graph, complete bipartite graph, and flower snark graph and the exact cover time for complete bipartite graph.
2. Two equations were generated to model the relationship between the cover time and vertices of special non-planar graph specifically complete graphs and complete bipartite graphs.
3. There are two real life applications on cover time of random walk on special non-planar graphs. These are (1) Game Designs Involving Random Process and (2) Trips to the City.
4. The Random Walk Simulator can be used as a tool to identify the exact cover times for complete graph and complete bipartite graphs using the data gathered by the simulator.

RECOMMENDATIONS

Based on the findings and conclusions of this research study, the researchers recommended the following:

1. The use of an exact theoretical function to generate the exact cover time of random walk on snark graphs on future studies.
2. Conduct a study on the cover time on other special graphs.
3. Develop other applications that would simulate random walk much faster.
4. Materialize the proposed game application of the researchers.

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Discovering Intimate Pairs and their Properties

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ABSTRACT

This research dealt mainly with the establishment of new concept in the field of number theory entitled “Intimate Pairs and their Properties”. Developed properties, propositions, and conjectures were based on the existing properties of abundant numbers, amicable numbers, deficient numbers, and perfect numbers. The researchers conducted extensive reviews and deep understanding on the study and came up with an algorithm that is necessary to generate computer program capable to identify intimate pairs of certain integers. Moreover, the program lets the user set a certain range and show all intimate pairs within that range. Another program was created to check and verify the found intimate pairs by the first program. This second program shows details of the inputted numbers and classifies them according to their characteristics. Lastly, the Intimate Pairs concept helped the researchers in making a memory game application named “Find my Pair”.

Keywords: *abundant numbers, amicable pair, deficient number, intimate pair, perfect number*

INTRODUCTION

Situation Analysis

Number Theory is one of the most important branches of Mathematics that deals with the properties and relationships of numbers, specifically the positive integers. It is widely applied in practical ways on people’s daily lives. For the past generations, mathematicians who existed centuries ago had no concrete idea of its use. However, from time to time, the vagueness of its relevance was cleared. This drew to the realization of mankind to its beauty.

Moving forward, Eves (2009) cited the quote of Leopold Krenocker, “Number theorists are like lotus- eaters, having tasted this food they can never give up”. These mathematicians tried to unleash the secrets of mathematics so they pushed their limits to comprehend and elaborate their researches. Although it took a long time to discover the importance of Number Theory in the world, these discoveries led mankind to more technological or the so called industrial era. In this era, applications of numbers help people to develop and invent technological

devices such as cellular phones, tablets, smart phones, iPods, laptops, computers and other helpful technologies to aid human needs. Through these applications, people’s lives become easier (Jiang, 2014).

Another use of Number Theory is on cryptography. This refers to the writing and deciphering of secret messages or ciphers in order to preserve the privacy of communications. The word cryptography was originally derived from the Greek word *kryptos* meaning to hide. In essence, cryptography is the study of procedures that allow messages or information to be encoded (obscured) in such a way that it is extremely difficult to read or understand the information without having specific key. In the 1980s, a number of cryptographers almost simultaneously announced that they had found methods of writing ciphers in such a way that they could be sent across public channels while still remaining secrets. (Menon, 2015)

Also, due to today's modernization the so called "Cyber Age". Number Theory is widely used particularly in computer programming to convert the human language into machine language. For instance, ATM PIN (automated teller machine- personal identification number), lock codes and many others are generated by computer program in which the algorithm was based from classic arithmetic series (Parvathi, 2015). Similarly, in telecommunications, the theory of Diophantine is linked to the analysis of interference channels and physical layer network coding, (A.Sakzad 2014).

On the other side, the two most classic theoretical numbers that arise over the past centuries are amicable pair and perfect numbers which were presented by two great mathematicians in their respective eras namely Pythagoras and Euclid. (Al Bassan, 2008)

As per definition, A and B are said to be amicable number if the summation of proper divisor of the first integer is equal to the second, and vice versa then the identified integers are said to be amicable pair. The mentioned pair was originally found by Pythagoras. Years later, so many mathematicians were engaged with it and they tried to look for different Amicable Pairs. The Amicable Pair (17,296 and 18,416) is often attributed to Fermat, but was actually discovered by the Arab al-Banna in the late thirteenth or fourteenth century. The pair 9,363,584 and 9,437,056 was found by Descartes. (W.Dunham, 1996). Also, remarkable Amicable Pairs, 59 in all, were found by Euler. Among them are the pairs (6,232; 6,368) and (10,744; 10,856). Long after Euler, a sixteen-year old Italian youth found a smaller, overlooked pair of amicable numbers, namely 1184 and 1210. Additionally, E. Escott (1991) wrote a long paper dedicated to the Amicable Pair, offering an inventory of 390 different pairs. (Tattersel 1999)

Furthermore, during the ninth century an Arab mathematician named Thābit Ibn Qurra developed a theorem intended to generate amicable pair. The mentioned theorem states that if $p = 3(2^{n-1} - 1)$, $q = 3(2^n - 1)$, $r = 3(2^{2n-1} - 1)$, where $n > 1$ is an integer and p, q , and r are prime numbers, then $2n(p \times q)$ and $2(n \times r)$ are a pair of amicable numbers. This formula gives the pairs (220, 284) for $n = 2$, (17296, 18416) for $n = 4$, and (9363584, 9437056) for $n = 7$, but no other such pairs are known. Numbers of the form $3(2^n - 1)$ are known as Thabit number. (J. P. Hogendijk 1985). Restrictions for Ibn Qurra's formula to work: two consecutive Thabit numbers must be prime; this severely restricts the possible values of n . Next, the mentioned theorem was further improved and generalized by Euclid. This is known as Euler's rule. W.Dunham (1996) It states that if: $p = (2^{(n-m)} + 1)(2^m - 1)$, $q = (2^{(n-m)} + 1)(2^n - 1)$, $r = (2^{(n-m)} + 1) * 2^{m+n} - 1$ where $n > m > 0$ are integers and p, q , and r are prime numbers, then $2^n pq$ and $2^n r$ are a pair of amicable numbers. Thābit Ibn Qurra's theorem corresponds the case $m = n - 1$. Euler's rule generates additional Amicable Pairs for $(m, n) = (1, 8), (29, 40)$ with no others being known. (Yan 1996)

Meanwhile, perfect number was also discovered by Pythagoras. It is defined as a positive integer that is equal to the sum of its positive proper divisor for example integer $A = 6$ having aliquot parts $S(A) = (1 + 2 + 3 = 6)$. But in time, it was elaborated by different mathematicians like Euclid and he formulated a conclusion that even perfect numbers are a power of two times Mersenne prime given by the formula $2^k - 1(2^{k-1})$ where $k > 1$, $(2^k - 1)$ is a Mersenne prime, this method applies only to even perfect numbers.

Consequently, through merging of ideas, new concept in arithmetic was generated by the researcher a

dissertation entitled “Discovering Intimate pairs and their Properties”. The word “Intimate” means having a very close relationship: very warm and friendly as stated in Merriam-Webster dictionary but it was defined differently in this study. In the overview of this research, intimate pair was mainly connected with the classic theoretical numbers such as the amicable pair along with abundant, deficient and perfect number.

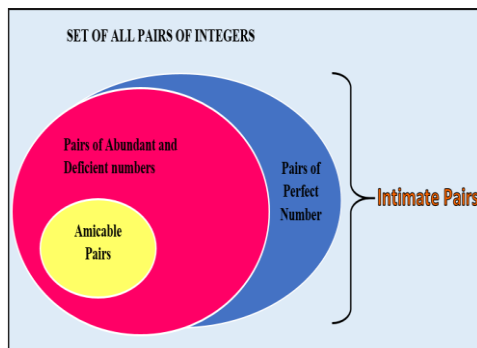


Fig 1. Venn Diagram of Intimate Pairs and its subsets

Statement of Objectives

This study sought to:

1. generate propositions and provide conjectures on Intimate Pairs.
2. develop a computer program which can identify Intimate Pair/s within a

certain range, using C++ computer language; and

3. find possible applications of Intimate Pairs in the fields of mathematics and other areas.

METHODOLOGY

Research Design

Pure mathematics research deals with the fundamental or basic concepts in mathematics. Simply, it is the study of entirely abstract concepts. It is not about applications; it is all about new ideas which may be relevant for future use.

In line with that, the introduction and study of Intimate Pairs provide readers with a new logic in Number Theory that requires critical thinking that is why it is classified as pure math research. Also, this research seeks to justify the properties using

logical reasoning. The term Intimate Pair refers to the pair of two distinct composite numbers wherein the summation of aliquot parts of the particular pair is equal to their sum.

Sources of Data

To accomplish the research, concepts and theories in mathematics are much needed. The researchers visited different libraries of various schools including the following: University of

Cordillera (UC), University of Baguio (UB), Saint Louis University (SLU) and University of the Philippines (UP). Additionally, facts from internet, fresh math updates in magazines, research papers and encyclopedia were very much helpful as supplements for the study.

Moreover, the group conducted regular experiments on the different types of

numbers to discover new properties and propositions of Intimate Pairs that greatly helped the researchers in discovering algorithm that can generate new sets of pairs. The gathered data and results were then relayed to the thesis adviser for further verifications of its factuality.

RESULTS AND DISCUSSION

Generated Properties, Propositions and Conjectures

Property 1: An intimate pair can be formed by any pair of distinct perfect numbers.

Proposition 1: For any $n \geq 2$ such that n is the number of perfect numbers substituted on the formula $\frac{n!}{2^{(n-2)!}}$, the result will be the total number of unique intimate pairs generated by perfect numbers.

Conjecture 1: Using the existing formula for generating perfect numbers which is $(2^{n-1})(2^n - 1)$ where n is a prime and $(2^n - 1)$ is a Mersenne prime, the resulting integers from the two distinct prime numbers n form an intimate pair.

Property 2: Any amicable pair is an intimate pair.

Conjecture 2: Using the existing formula of amicable number, given an integer p, q and r such that $p = 3(2^{n-1}) - 1$, $q = 3(2^n) - 1$, and $r = 9(2^{2n-1}) - 1$ where n is an integer greater than 1, then if p, q , and r are primes, $2^n pq$ and $2^n r$ form an intimate pair.

Property 3: If the abundance and deficiency of two distinct number are equal then the two numbers are said to be an intimate pair.

Proposition 3: No Intimate Pair is a pair of two deficient numbers

Proposition 4: A pair consisting of a perfect number A and an abundant number B cannot be an Intimate pair.

Proposition 5: A pair consisting of a perfect number A and a deficient number B cannot be an Intimate pair.

Proposition 6: A pair consisting of a perfect number A and a prime number B cannot be an Intimate pair.

Proposition 7: A pair of a number of the form p^n (where p is any prime) and a perfect number is not an intimate pair.

Property 4: Integer P^n is an Intimate Pair with any number having an abundancy of $P^n - \{P^{n-1} + P^{n-2} \dots P^1 + 1\}$ for all P^n where P is prime number and n is any integer.

Property 5: An integer of the form 2^n (where n is any integer) and a number having an abundance of 1 can form an intimate pair, if there exist.

Property 6: Any perfect number N multiplied by any prime number P where P and N are relatively prime will give a product which is an Intimate Pair with any number having a deficiency of $2N$.

Conjecture 3: There are co-primes intimate pairs

Conjecture 4: In any range R the frequency F decreases as interval I approaches $Max(B)$ for every 5 consecutive segments.

The Generated Computer Program in Finding all Intimate Pairs within Specified Range

The manual of steps were the primary tools of the researcher in developing their computer program using C++ language.

The first program consists of the following steps :

- a. Identify A minimum and B maximum denoted as min. (A) & max. (B) with an element $\{n_a, n_{a+1}, n_{a+2}, \dots, n_{a+m}, n_b\}$
- b. Insert integer
- c. Find all the divisor of chosen integer
- d. Get the summation of all aliquot parts
- e. Do the same to other integer within the range
- f. If any integer is equal to the sum of aliquot divisors of the first Integer then the output shall be displayed else, it shall be disregarded
- g. All outputs are said to be the pair/s of certain integer in the specified range.

Next, algorithm is for the secondary program to check the authenticity of the pair including its classifications and type:

- a. Identify range
- b. Get the first element and then pair with the second, n_a & n_{a+1}
- c. Add $n_a + n_{a+1} = N$
- d. Extract the aliquot parts of each elements
 - d.1 If the total of aliquot parts of the first element is equal to itself and same case to the next integer, then the 2 integers are said to be the Pair of Perfect Numbers.
 - d.2 If the total of aliquot parts of the first element is equal to the second and vice versa then the 2 integers are said to be an Amicable Pair.
- e. Sum up all the extracted aliquot parts of each element
- f. Compare the summation of all aliquot parts with N
- g. If N is equal to the sum of the aliquot parts, then n_a & n_{a+1} will be recorded to initial output. Else, it shall be ignored.
- h. Repeat the process to the succeeding elements until reaching the max. (B)

Applications of Intimate Pair

- The idea of Intimate number can be used by computer programmer or game applications developer in developing new and unique applications for students. The researchers coded one game application using Visual Basic as programming language. This recreational mind game involving intimate pairs will serve as a guide to future researchers to make more possible applications of the study.
- Properties of intimate pairs can be a key to generate perfect numbers within a certain range. Also, it can prove the uniqueness of a perfect number to the same range.

CONCLUSIONS

1. Using the different properties of intimate pair, perfect numbers, amicable numbers, abundant and deficient numbers, different propositions and conjectures were generated as:
 - a. Intimate pair can be generated through a computer program in a specific range. However, the output is limited due to narrow screen.
 - b. Perfect numbers can be paired with any other perfect number to form an intimate pair for it has no deficiency nor abundancy since perfect number has sum of aliquot parts equal to itself.
 - c. deficient number needs certain abundant number having equal abundancy to its deficiency to form an Intimate Pair.
2. Amalgamating the result of the study, a computer program was developed to generate all the

Intimate Pairs in the specified interval. Also, it is possible to find the Intimate Pair of a certain integer in specific range. Furthermore, another program was generated to check the authenticity of a certain pair and it will show the details of each integers like the aliquot parts, its own sum and type whether it is perfect, deficient or abundant number. However, the intimate pair computer program generator has limitations, it can only process an interval from 1-200000 and maximum of two million for the main program, and five million for the second program intended for checking.

4. The concept of Intimate pair inspired the researchers in creating

game application “Find My Pair”. This game application enhances the memory of the player and it improves the speed in thinking since it has time limit.

RECOMMENDATIONS

Based on the findings and conclusions of the study, the following are recommended:

1. The next generations of the researchers maybe encouraged to search for more properties and propositions involving intimate pair
2. To develop propositions and make a strong theorem out of it.
3. The discovery of other noticeable properties and behaviors between Intimate Pair and other existing concept in number theory like sociable numbers, weird numbers happy numbers, kaprekar's constant, mersenne prime, semi perfect, friendly numbers, triangle numbers and many others may be done.
5. Development of a certain formula to generate intimate pair is encouraged.
6. Generate computer program to find intimate pair infinitely.
7. To use a high-technology computer unit using the computer program that was developed by the researchers.
8. To upgrade the two (2) programs made by the researchers through integrating Graphic User Interface (GUI).
9. Find pairs of odd perfect numbers.
10. Find patterns of abundant and deficient numbers.
11. Find more subsets of intimate pair.
12. Find the highest existing intimate pair.
13. To study the gap in between the pairs.
14. Future researchers may also find other applications of this concept in real life and other field of science; finding such could be a great contribution in the field of mathematics.

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On Fractal Sequences

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ABSTRACT

A fractal sequence is an integer sequence where one can remove the first occurrence of every integer and end up with the integer as before. This research dealt with the formulation of decimation rules to show self-similarity of some fractal sequences like the base-n Morse-Thue sequences, the Rabbit sequence, the Fibonacci sequence modulo 6 and some other signature and periodic sequences; presentation of some properties of the studied fractal sequences; and, creation of weave designs and color patterns by applying these fractal sequences. The weave designs and color patterns were created with the aid of WeaveIt Pro™ software.

Keywords: color patterns, decimation rules, fractal sequences, weave designs

INTRODUCTION

Situation Analysis

Mathematics has always fascinated humans with its beauty through its many applications to nature and real-life situations. It may not be obvious as it seems, but mathematics plays a very important role in understanding the beautiful images in nature and even the simplest elements of human activities. Considered as the queen of sciences by Carl Friedrich Gauss, mathematics is indeed an inevitable part of everyday living and its applications extend beyond human comprehension.

One of the concepts in mathematics that interests many researchers is fractals. As defined in the Merriam-Webster dictionary, a

Statement of the Objectives

Specifically, this research was conducted to answer the following problems:

1. What decimation rules could be formulated in some fractal sequences in order to show their self-similarity?

fractal is any of various extremely irregular curves or shapes for which any suitably chosen part is similar in shape to a given larger or smaller part when magnified or reduced to the same size. The study of fractals dates back to 1975 through Benoît Mandelbrot, who described fractals as being geometric shapes that when divided into parts, each part would be a smaller replica of the whole shape. He came up with the term "fractal" as the new scientific term for this mathematical expression. The word was coined from the Latin word "fractus" which means "broken" or "fractured".

2. What additional properties of fractal sequences could be derived?
3. What different weave designs and color patterns could be created by applying fractal sequences

METHODOLOGY

Research Design

This study was based on pure basic research design which used full research and systematic analysis in order to introduce new concepts and discoveries on fractal sequences.

The researchers obtained necessary information through library work and internet explorations. The answers to the statement of the problem were provided through a thorough analysis of some fractal sequences listed in the Online Encyclopedia of Integer Sequences and with the

aid of free computer software known as WeaveIt Pro™.

Moreover, this study developed through expository research that includes a wide ranging knowledge of different mathematical concepts to provide additional properties, formulate decimation rules that remove the values in some fractal sequences to show their self-similarity, and to apply some fractal sequences to create or make weave designs and color patterns. Explorations about fractal sequences were presented for further discussions and clearer understanding of the discovered properties.

Sources of Data

The concepts on the analysis of fractal sequences were studied using pure research in mathematics. The definitions of terms were based from mathematics books, journals, and the like, and with the aid of the internet. The fractal sequences considered in the creation of fractals decimation rules and weave designs were mainly based on the Online Encyclopedia of Integer Sequences. However, some sequences were derived using modular reduction, worked out by the researchers. In order to create new weave designs and color patterns, the researchers used a free computer software known as WeaveIt Pro™.

Results and Discussion

The self-similarity property of fractal sequences can be exhibited through the so-called fractal decimation rules. It can be done either by performing a series of usual arithmetic operations like addition or subtraction, striking out of values at their first occurrence, removing every element placed in the even (or odd) positions in the sequence, replacing certain values or blocks of numbers of the original sequence by other integers, or reducing each value in the sequence into remainders modulo an integer n . Other operations or rules that can be applied to produce the original sequence were presented in this chapter before the discussion of fractal sequences for which the said operations

will be used. In this study, one or more steps enumerated herein were used depending on the fractal sequence being considered. Upon analyzing fractal sequences being considered and understanding some existing properties of the sequence, additional properties were determined and illustrated through examples. Also, the steps on the creation of new weave designs and color patterns were presented in the latter part of this chapter.

a. Decimation Rules

The Rabbit Sequence

The rabbit sequence is given by

1 0 1 1 0 1 0 1 1 0 1 1 0 1 0 1 1 0 1 0 1 1 0

The researchers considered this sequence and presented a decimation rule different from the rules discussed by Griswold (2004) to show that this sequence is self-similar.

Here is the set of rules formulated by the researchers.

1. Consider the rabbit sequence given by

1 0 1 1 0 1 0 1 1 0 1 1 0 1 0 1 1 0 1 1 0

Underline 0,1 pairs and replace them by 0s.

1 0 1 1 0 1 0 1 1 0 1 1 0 1 0 1 1 0 1 1 0

↓

1 0 1 0 0 1 0 1 0 0 1 0 0 1 0

2. Given the new sequence formed in (1), consider terms consisting of two consecutive 0s. Replace the first of these 0s by 1 as shown below.

1 0 1 0 0 1 0 1 0 0 1 0 0 1 0

↓

1 0 1 1 0 1 0 1 1 0 1 1 0 1 0

The new sequence formed is the original Rabbit sequence. ■

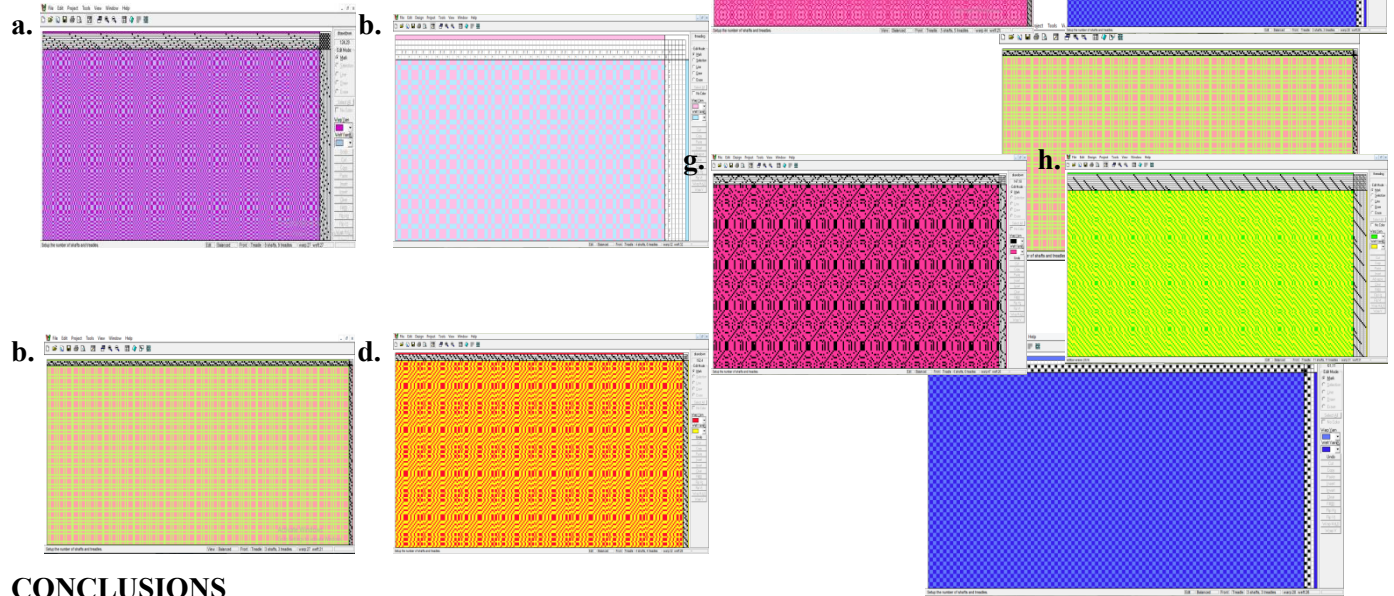
Properties.

- The numbers in the Fibonacci sequence modulo 6 are complete.
- The Fibonacci sequence modulo 6 contains a squareful integer.
- The Base-5 Morse-Thue sequence contains a squareful integer.
- The base- n Morse-Thue sequences do not contain elements or any subsequence that repeats 4 or more times.

e. The Rabbit sequence is cube-free and squarefree.

f. The Morse-Thue sequences, the Fibonacci sequence modulo 6 and the signature sequences discussed in this study are not primefree sequences. On the other hand, the Rabbit sequence is the only primefree sequence presented in this study.

Weave Design and Color Patterns



CONCLUSIONS

After the extensive research on fractal sequences, here are the conclusions of the study conducted by the researchers:

1. The researchers found decimation rules of fractal sequences and other sequence to show their self-similarity. The decimation rules include striking out every odd number

RECOMMENDATIONS

After undertaking the extensive study of fractal sequences, the following are recommended:

value, lower trimming, upper trimming and others.

2. There are 6 new properties derived from some fractal sequences and other sequences. Existing properties were studied to arrive at the new properties.
3. There are new weave designs and color patterns created by the researchers. These designs can be used in tilings, weaving, designing of accessories like bracelets, paintings, arts and the like.
1. Future researchers may consider other fractal sequences listed in the Online Encyclopedia of Integer Sequences and formulate new decimation rules to exhibit their self-similarity.

2. More properties of fractal sequences could be formulated in relation to other fractal or non-fractal sequences.
3. The future researchers may create new weave designs and color patterns that shows more variation in colors and styles. They may also create their own computer program to aid them in the creation of the weave designs and color patterns.

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On Friendly Pairs

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ABSTRACT

A friendly pair is a pair of positive integers m and n , in which the quotient of the sum of all the divisors of n over itself is equal to the quotient of the sum of all the divisors of m over to itself. In simple definition, a friendly pair is a pair of positive integers having the same abundancy index. This research primarily dealt with the formulation of new potential propositions and additional properties of friendly pairs. Moreover, the researchers with the help of a computer programmer, developed a program using python programming language that could generate friendly pairs within an interval, compute the abundancy index of all the positive integers within that interval, and classify the generated friendly pairs. Lastly, the researchers provided applications of friendly pair to other fields of Mathematics and in real life situations.

Keywords: *abundancy index, divisor, friendly pair, Python programming language*

INTRODUCTION

Situational Analysis

Mathematics is a science that deals with arithmetic sequences, calculations and different patterns of numbers. It has different branches such as Algebra, Geometry, Calculus, Graph Theory, and Number Theory. One of the fields of mathematics that is of great importance in the field of research is Number Theory. By definition, it is a branch of mathematics concerned with the properties of the positive integers 1, 2, 3, 4... (Hefferson, 2003). Number Theory, by its application, serves as an instrument for encryption design schemes which are widely used for government and business purposes. It also serves as a concept on computer programming for factoring large numbers, determining primes, testing conjectures, and solving numerical problems once considered out of reach.

One of the great contributors in Number Theory, who is also a famous mathematician, is Leonhard Euler. He formulated the symbol $\sigma(n)$, where n is a positive integer which is now called the sigma function. It denotes the sum of the divisors of the number including itself. After introducing this notation, Euler shows the characterization of a pair m and n called amicable pairs as $m = \sigma(n) - n$ and $n = \sigma(m) - m$ and come up with an equation $\sigma(n) = \sigma(m) = m + n$ where m and n are positive integers (Sandifer, 2005).

As an example, consider the pair of numbers $m = 220$ and $n = 284$. The divisors of $m = 220$ not including itself are 1, 2, 4, 5, 10, 11, 20, 22, 44, 55 and 110, and the sum of these divisors is 284, which is n . On the other hand, the divisors of $n = 284$

are 1, 2, 4, 71 and 142 and the sum of these divisors is 220, which is m . This pair of numbers, m and n in which the sum of the divisors of 220 excluding itself is equal to 284, and the sum of the divisors of 284 excluding itself is equal to 220, is called amicable pair.

When Euler involves himself in finding amicable numbers, only three pairs were known for the last 2 millenniums, starting from the time of the great mathematicians Pythagoras, Pierre de Fermat and Rene Descartes. Eventually, Euler, with his number- theoretic function, $\sigma(n)$, found as many as 58 amicable pairs all by himself and this was written in 1750 paper entitled “De numerisamicabilibus” (Dunham, nd.).

The sigma function is now used to analyze the classification of numbers. Through this, a number n is defined as *abundant* if $\sigma(n) > 2n$, *perfect* if $\sigma(n) = 2n$ and *deficient* if $\sigma(n) < 2n$. Certainly, all primes p are deficient since the only divisors are 1 and the prime p itself and $\sigma(p) = 1 + p$ which is less than $2p$. On the other hand, 120 is abundant since the sum of its divisors, $\sigma(120) = 360$ is greater than $2(120)$. These examples lead to the natural measure of abundancy or deficiency of numbers called the *abundancy index* - the ratio of the divisors of a number to itself, denoted by $I(n)$. In symbols, $I(n) = \frac{\sigma(n)}{n}$, for any positive integer, n . For example, $I(13) = \frac{\sigma(13)}{13} = \frac{1+13}{13} = \frac{14}{13}$; $I(8) = \frac{\sigma(8)}{8} = \frac{1+2+4+8}{8} = \frac{15}{8}$, and, $I(28) = \frac{\sigma(28)}{28} = \frac{1+2+4+7+14+28}{28} = \frac{56}{28} = 2$. From the formula $I(n) = \frac{\sigma(n)}{n}$ one can easily see that perfect numbers have an abundancy index $I(n) = 2$; deficient numbers have an abundancy index of $I(n) < 2$; and abundant numbers have an abundancy index of $I(n) > 2$ (Laatsch, 1986).

When two numbers have an equal abundancy index then the numbers are said to be *friendly pairs*. For example, the

numbers 6 and 28 are friendly pair because they have equal abundancy index of 2. That

$$I(6) = \frac{\sigma(6)}{6} = \frac{1+2+3+6}{6} = \frac{12}{6} = 2 \text{ and } I(28) = \frac{\sigma(28)}{28} = \frac{1+2+4+7+14+28}{28} = \frac{56}{28} = 2.$$

The concept of friendly pairs was first introduced by C.W. Anderson and Dean Hickerson with the help of Greening (1977) in their book, “Friendly Integers”. The problem that arises in their book is the natural density of the friendly integers. The natural (asymptotic) density $d(T)$ of the set T of natural numbers is $d(T) = \lim_{n \rightarrow \infty} \frac{|T \cap [1, n]|}{n}$ (given the limit does exist) (Nasso, 2000). Anderson and Hickerson conjectured that the natural density of friendly numbers is 1 which means that counting the friendly integers is the same as counting the natural numbers. However, no proof has been shown about this claim in their published work.

Another problem on friendly pairs that was observed was the confusion on the use of the terms friendly pairs and amicable pairs. In French, the word amicable means friendly. According to Jeffrey Ward (2008), a number that is considered amicable is not necessarily friendly. So the two terms cannot be used interchangeably. Hence, this study will help settle the confusion on the concepts between the two pairs. Ward also able to claim that the integer 10 has a friendly pair. Motivated by this, the researchers are also determined to introduce new concepts on how two positive integers become “friends” without the underlying concept of amicable numbers.

Moreover, because of the confusion between amicable pairs and friendly pairs, the method on finding friendly pairs has remained unknown or has not been published. Consequently, studies on the properties and behaviors of friendly pairs are limited in Mathematics literatures. Hence, the researchers have become even more curious to explore these kinds of numbers to contribute in the discovery of new knowledge about friendly pairs. As an aid in

studying the properties, a computer program was developed which lists all the friendly pairs with just a given limit. There are infinitely many friendly numbers according to Gachimu (2012); however, the researchers considered only a finite numbers of pairs up to 500. One of the many programming language developed in this days is the python programming language, a free software designed for mathematical calculations which is the suitable language for listing friendly pairs. The program that

would be developed through python can also be used as a tool to formulate propositions or properties of friendly pairs aside from the properties derived from different kinds of divisor - related numbers such as that of amicable numbers and to other numbers as well. The researchers are highly driven to create such computer program and find important applications of friendly pairs to other branches of mathematics and to real-life situations.

Statement of the Objectives

This study specifically aimed to:

1. formulate propositions or properties on friendly pairs of numbers;
2. create a computer program that will generate friendly pairs using Python programming language; and
3. find its applications to other branches of mathematics and to everyday life.

METHODOLOGY

Research Design

This study used a descriptive research method, specifically that of pure research design, aimed to explore a set of numbers known as friendly pairs. The researchers conducted different searches and made a thorough analysis on the properties of friendly pairs of numbers.

Sources of Data

In order to study the properties and applications of friendly pairs, books, journals and

articles in number theory and other related fields were used, aside from the information available in the internet.

To understand the Python programming language, the researchers studied some online tutorials in the Youtube and also consulted a computer expert to ensure validity and usability of the developed computer program.

RESULTS AND FINDINGS

The researchers presented the different propositions and properties formulated and established based on the existing properties of friendly pairs.

1. Formulated Propositions and properties

These are the propositions formulated by the researchers:

1. For any friendly pair (m, n) , the sum of the reciprocals of the positive divisors of m is equal to the sum of the reciprocals of the positive divisors of n ..
2. For any friendly pair (m, n) , there exist positive integers r and s such that $m = ps$ and $n = qs$ where $\gcd(\sigma(m), m) = p$ and $\gcd(\sigma(n), n) = q$, and $\frac{r}{s}$ is the abundancy index of m and n .
3. Let (m, n) be a friendly pair, where $\frac{r}{s}$ is the abundancy index of m and n . If k is a coprime to m and n such that (km, kn) is the friendly pair, then the abundancy index of km and kn is equal to $(\frac{\sigma(k)}{k})(\frac{r}{s})$. That is, $I(km) = I(kn) = (\frac{\sigma(k)}{k})(\frac{r}{s})$.
4. Given a friendly pair (m, n) with abundancy index $I(m) = I(n) = \frac{r}{s}$ and a prime number k , the abundancy index corresponding to the friendly pair (km, kn) is $I(km) = I(kn) = (\frac{k+1}{k})(\frac{r}{s})$. If k is a prime then the abundancy index of the friendly pair generated from a perfect number is $2(1 + \frac{1}{k})$.
5. Let m and n be perfect numbers. If k is a prime that is coprime to m and n then the abundancy index corresponding to the friendly pair (km, kn) is $2(1 + \frac{1}{k})$.
6. Suppose that (u, v) and (m, n) are friendly pairs such that $\gcd(\sigma(u), u) = m$ and $\gcd(\sigma(v), v) = n$. Let k be coprime to m and n . Then, $u = kn$ and $v = km$.
7. Suppose that (m, n) is not a friendly pair such that $\gcd(\sigma(u), u) = m$ and $\gcd(\sigma(v), v) = n$ for a friendly pair (u, v) . Then, (u, v) is said to be a primitive friendly pair.
8. Any friendly pair (m, n) that gives an abundancy index j , where j is positive integer is a pair of multi-perfect numbers.
9. No friendly pair is also an amicable pair.
10. Every friendly pair (km, kn) , k is coprime to both m and n , generated from an abundant friendly pair (m, n) is always abundant.

With the use of some existing properties of friendly pairs and also with the presented propositions, these are additional observable properties found out by the researchers:

1. All friendly pairs are composite numbers.
2. For every friendly pair (m, n) , the sum of the proper divisors of n denoted by $S(n)$ is equal to $n[I(m) - 1]$.
3. If (m, n) and (u, v) are friendly pairs such that u and v are coprimes to both m and n , then (mu, nu) and (mv, nv) are also friendly pairs.
4. For each friendly pair (m, n) , m and n are either abundant numbers if $I(m) > 2$, deficient numbers if $I(m) < 2$, or a perfect numbers if $I(m) = 2$.

2. The developed program

By the help of a programmer, the program that the researcher developed, generate the friendly pairs including the abundancy index with the classification of each number if it is abundant, deficient or perfect, within the interval entered.

3. Applications of Friendly Pairs

The researchers relate the concept of friendly pair to the following:

- a) Finding odd and Perfect Numbers
- b) Friendly Pairs on RSA Cryptosystem
- c) Friendly Pairs on Modular Designs
- d) The Friendly Pair Game

CONCLUSIONS

After an extensive research on friendly pairs, these are the conclusions of the study:

1. There are ten propositions on friendly pairs found out by the researchers in this study. These propositions are useful in finding friendly pairs and computing their abundancy index. The researchers also found additional four properties on friendly pair.
2. The computer program developed by the researchers with the help of a

computer programmer which could generate friendly pairs can be used in identifying pairs within an interval as well as the classification of the generated friendly pairs either it is abundant, deficient or perfect.

3. The researchers' findings in relation to friendly pairs could be used as a feature for finding odd and perfect numbers, finding pairs on RSA cryptosystem, friendly pairs on modular designs and the friendly pair game.

RECOMMENDATIONS

After undertaking a thorough study of friendly pairs the following are recommended for the future researchers:

1. Look for more properties that could be utilized for verifying friendly pairs in order to make finding friendly pairs easier. It can also be considered to conduct a study on friendly pairs in relation to the following topics:

- a. Abundant numbers
- b. Deficient numbers
- c. Perfect numbers
- d. Existence of odd perfect numbers

2. Find a technique in finding two numbers that form a friendly pair. This will aid future researchers to develop a computer program that inputs positive integer and find its friendly pair, if it exists.

3. Develop a program that encrypts and decrypts an RSA cryptogram which uses a friendly pair, improve the modular designs created and add more innovations to the developed game.

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On Graphs Derived from Modular Origami

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ABSTRACT

This study deals with graphs derived from modular origami. It aims to develop propositions, identify different graphs coming from the crease patterns of modular origami, and to develop a LAN based Supplemental Instructional Material (SIM) on graphs derived from modular origami.

The researchers conducted this study with the following conclusions: 9 propositions and 5 observations were generated by the researchers, 15 graphs G and its dual graphs G^ were identified, and the Supplementary Instructional Material (SIM) was developed that highlights the results of this study.*

Keywords: *Modular origami, crease patterns, supplementary instructional material*

INTRODUCTION

Situation Analysis

Mathematics is a broad discipline that is connected to every discipline. It is a very broad discipline because in numbers alone, we can tackle many topics such as functions, binary operations, limits, derivatives, theorems, integrals, Euclidean algorithm, and many more. And for this fact, mathematics was divided into different topics such as algebra, trigonometry, calculus, geometry, graph theory, and others.

Frequently, people usually do not notice but all the things around, even those that are part of their daily experiences and scenarios have always been connected to mathematics. One interesting hobby or recreational activity of many people around the world from the ancient times up to the present which can be connected to mathematics is the art of paper folding, popularly known as origami.

Origami is known as the ancient paper folding that was popularized in Japan

(Dacorogna, et.al, 2010). The Japanese word "origami" itself is a compound of two smaller Japanese words: "ori", meaning fold, and "gami", meaning paper. Origami was a popular pastime for Japanese children for many centuries (Liz Newton, 2009).

In origami, a flat sheet square of paper is being transformed into a finished sculpture through folding and sculpting techniques. In traditional origami, constructions are done using a single sheet of colored paper that is often square.

There are different kinds of origami. These include action origami, wet folding, pure land origami, and modular origami.

From the word action, the subjects of action origami are not only still life but also moving objects. In this type of origami, the models produced can be moved in various clever ways. Some action origami includes origami that

flies, requires inflation, and uses the kinetic energy of a person's hands which is applied at a certain region on the model to move another flap or limb.

On the other hand, wet folding is an origami technique that involves the use of gentle curves rather than geometric straight folds and flat surfaces to produce models. The paper is dampened so it can be molded easily and the final model keeps its shape when it dries.

In pure land origami, only simple mountain or valley folds may be used, and all folds must have straightforward locations. It was developed by John Smith in the 1970s to help inexperienced folders or those with limited motor skills (Smith, 1980 as cited by Gelder, 2008).

In modular origami, a number of individual "units," each folded from a single sheet of paper, are combined to form a compound structure. In other words, modular origami consists of putting a number of identical pieces together to form a complete model. Normally the individual pieces are simple but the final assembly may be tricky (Wolfram, 2017).

As the art of paper folding became known to people in almost all parts of the world, mathematicians later on found that origami has certain significance in the fields of engineering, designs, mathematics, and other fields. In engineering and designs, a number of technological advances have come from insights obtained through paper folding. For example, techniques have been developed for the deployment of car airbags and stent implants from a folded position. The principles of origami are also used in packaging and other engineering applications. Origami is an extremely rich art form, and constructions for thousands of objects, from dragons to buildings to vegetables, have been made possible because of it.

As more and more complex origami patterns were designed, the art began to receive interest from mathematicians. Many mathematical shapes can also be constructed, especially using modular origami. Also, origami can be used to construct various geometrical designs not possible with compass and

straightedge constructions. For instance paper folding may be used for angle trisection and doubling the cube (Fieldman, n.d.).

As a matter of fact, there are lots of books, articles, and journals that discuss about origami and how it is linked with mathematics and even come up with few axioms that were credited to Huzita and Justine Hatori (Liz Newton, 2009). The following axioms are applied to all kinds of origami and the axioms one to six were developed by Huzita and the remaining axiom was developed by Justin Hatori (Alperin, et.al, 2006).

Axiom 1. Given two vertices v_1 and v_2 we can fold a line connecting them.

Axiom 2. Given two vertices v_1 and v_2 , we can fold v_1 onto v_2 .

Axiom 3. Given two edges e_1 and e_2 , we can fold e_1 onto e_2 .

Axiom 4. Given a vertex v_1 and an edge e_1 , we can make a fold perpendicular to e_1 passing through the vertex v_1 .

Axiom 5. Given two vertices, v_1 and v_2 and an edge e_1 , we can make a fold that places v_1 onto e_1 and passes through the vertex v_2 .

Axiom 6. Given two vertices v_1 and v_2 and two edges e_1 and e_2 , we can make a fold that places v_1 onto edge e_1 and places v_2 onto e_2 .

Axiom 7. Given a vertex v_1 and two edges e_1 and e_2 , we can make a fold perpendicular to e_2 that places v_1 onto e_1 .

These axioms when carefully considered lead to the creation of graphs. In mathematics, graphs are the major concern of one of its fields which is the Graph Theory. Graph theory is the study of graphs, which are mathematical structures, used to model pair wise relations between objects.

It can be said that the crease patterns generated by every single paper folded can be related with some graphs in Graph theory. By

opening up a folded paper, one can take notice that the creases formed can be mapped with the structures of some graphs in Graph theory.

In mathematics, a graph is made up of vertices, nodes, or points which are connected by edges, arcs, or lines. A graph may be undirected, meaning that there is no distinction between the two vertices associated with each edge, or its edges may be directed from one vertex to another.

To date, there are no existing properties that relate the characteristics of graphs derived from the crease patterns generated by folding a paper. Thus, the researchers considered this challenge as a motivation to push through and to conduct a thorough research on graphs derived from modular origami.

This study focused on the use of modular origami that utilizes a maximum of 20 papers in creating a model. In modular origami, all the square papers folded follow a single pattern.

The researchers investigated on the patterns generated known as crease patterns, and compared it with some graphs in Graph theory. They also developed several propositions and

Objectives of the Study

This study aimed to determine different types of graphs that can be derived from the crease patterns of modular origami.

Specially, this study aimed to fulfil the following objectives:

observations that map the crease patterns of modular origami to various graphs in Graph theory.

The researchers believe that the results of this study can contribute to the generation of new knowledge in mathematics which can serve as additional information for educators and other professionals through the developed LAN based supplementary instructional material (SIM). This LAN based SIM includes step by step procedures on how to make models of modular origami that are involved in this study. Most importantly, results of the study were integrated in the SIM to disseminate the generated new knowledge as results of the exploration conducted by the researchers using technology as the key platform.

This study may also provide a motivation and inspiration to everyone, even the non-mathematics enthusiasts, to recognize that mathematics has some various practical applications to almost all fields, including arts. Further, results may serve as baseline information for future researchers who will conduct studies similar or related to the present study.

- a) Determine propositions of graphs and their dual generated by modular origami.
- b) Identify different graphs coming from the crease patterns of modular origami.
- c) Develop a LAN based Supplemental Instructional Material (SIM) on graphs derived from modular origami.

METHODOLOGY

Research Design

This research study is a pure descriptive research which focused on graphs generated by the crease patterns of modular origami.

In this study, the researchers conducted a comprehensive and thorough exploration on the crease patterns generated by the

folded paper in modular origami. Through the results of the investigation, the researchers determined different various propositions and observations regarding some graphs that were generated by modular origami. This study also aimed to show some crease patterns similar to different types of graph in graph theory. It explained further the concepts regarding the link between modular origami and graph theory.

From the result of the exploration, the researchers developed a supplementary instructional material on graphs generated by modular origami. The instructional material is a LAN based application which can be installed on desktop and android cellular phones. The LAN based application can serve as a material relevant for educators in establishing the connections between mathematics, particularly Graph theory, and origami. Also, the LAN based SIM can serve as a platform in disseminating the results of the study as it contains the nine new propositions and five observations generated involving the graphs generated from modular origami, the different graphs generated from the crease patterns of the papers folded, and procedures to follow in making modular origami models involved in this study.

Sources of Data

To fulfil the objectives of this study, the researchers conducted extensive readings on relevant published materials like books and journals, and online materials which include e-journals and articles.

The objectives of the study were answered by the researchers through the results of the exploration and investigation on the various graphs determined by the crease patterns generated from each piece of paper folded in modular origami.

This study focused on the use of modular origami that utilizes a maximum of 20 papers in creating a model. In modular origami, all the folded square papers follow a single pattern.

In the presentation of the results of the investigation, the researchers used violet graphs, labelled as G , to represent the graphs generated directly from the crease patterns of the folded paper. Whereas, the green graphs G^* are the dual of the graphs G .

RESULTS AND DISCUSSION

Propositions and Observations on Graphs G and its Dual G^* Generated by Modular Origami

One of the objectives of the study is for the researchers to develop new propositions and observations involving graphs derived from the crease patterns of modular origami. Each proposition and observation was discussed and was provided with illustrations to establish clear understanding of the concepts involved.

The researchers used two colors in illustrating the graphs involved. Violet colored graphs pertain to the graphs G that are directly generated from the crease patterns of each square paper folded from each model of modular origami. This study focused on the use of modular origami that utilizes a maximum of 20 papers in creating a model.

There are various terms that were used in the discussion of the propositions and observations. Vertex refers to every point where

two or more lines meet. Lines refer to the edges or the creases generated after folding the paper. Degree of vertices refers to the number of lines or edges connected to every vertex.

The dual graph G^* was derived by drawing a vertex on any part of each of the faces of G . The edges of G^* were formed by connecting any two adjacent vertices drawn on each face of G . The edge joining any two adjacent vertices drawn on G should intersect with the edge of G that is found between these two adjacent vertices.

Definition 1. A graph G is planar if it can be drawn in the plane without its edges crossing. Such a drawing is called a plane drawing or a plane graph.

Proposition 1. Let G and G^* be the graph and its dual graph, respectively, be formed from crease patterns of modular origami. Then G and G^* are planar graphs.

Definition 2. A graph G is called connected if there is a path between any two vertices.

Proposition 2. Graphs derived from modular origami are connected graphs.

Definition 3. Simple graphs are graphs that are composed of edges that do not loop and have no multiple edges.

Proposition 3. The graph G and its dual G^* are simple graphs.

Definition 4. Undirected graphs' edges are all bidirectional such that its edge (a, b) is the same as edge (b, a) .

Proposition 4. Graphs derived from modular origami are undirected graphs.

Definition 5. Leaf of a vertex of degree one, where degree one, is the number of edges connected into a vertex.

Proposition 5. There exist no leaves in any graph obtained from modular origami.

Proposition 6. Suppose that G is a graph obtained from a crease pattern of a square paper done by folding. Then the order of G is at least four.

Definition 6. Hamiltonian Cycle is a cycle that passes through every vertex of G .

Definition 7. A graph $G = (V, E)$ is semi Hamiltonian if it possesses a path which uses each vertex of the graph exactly once.

Proposition 7. All graphs G derived from crease patterns are Hamiltonian Graphs or semi Hamiltonian Graphs.

Definition 8. Self-dual is a graph that is dual to itself.

The LAN based Supplementary Instructional Material

The LAN based supplementary instructional material has two components: the

Proposition 8. The graph G obtained from crease patterns and its dual graph G^* are isomorphic if and only if G and G^* are self-dual.

Proposition 9. Suppose that G is derived from modular origami and all faces of G are quadrangles then a bipartite graph exists in G .

Patterned Observation

Observation 1. The minimum degree of any vertex of a graph G derived from crease pattern is lesser than or equal to the minimum degree of any vertex of its dual graph G^* .

Observation 2. The total number of edges of any graph G derived from crease pattern is greater than or equal to the total number of edges of its dual graph G^* .

Observation 3. There exists a vertex of degree three in G and its dual graph G^*

Theorem (Euler). A connected graph is Eulerian if and only if every vertex has an even degree.

The next observation follows from the previous statement.

Observation 4. For all crease patterns and dual graphs, an Eulerian cycle is not possible.

Theorem (Euler's Polyhedral Formula). $f + v - e = 2$, where v is the number of polyhedron vertices, f is the number of faces and e is the number of polyhedron edges.

Observation 5. The sum of the total number of faces f and the total number of vertices v less the total number of edges e is greater than or equal to 2, $f + v - e \geq 2$.

graphs derived from modular origami and the 9 new propositions and 5 observations generated by the researchers were two of its main components. In other words, the results of this

research were integrated in the LAN based SIM to ensure the dissemination of the research based technology.

CONCLUSIONS

The following are the conclusions of the study based on the salient findings:

1. There are nine new propositions and five observations generated regarding the graphs formed from the crease patterns of the modular origami.
2. All graphs G derived from the crease patterns of the modular origami have their unique dual graphs G^* that are planar and Hamiltonian or semi Hamiltonian.
3. The LAN based SIM is a technology based instructional material that highlights the results of the study including nine new propositions and 5 observations generated, the graphs derived from modular origami, and the step by step procedures in making modular origami models.

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knowledge generated through the use of

RECOMMENDATIONS

Based from findings and conclusions, the following are recommended for the future researchers:

1. The generated propositions and observations may serve as baseline information in order to further understand the different graphs derived from modular origami. They can also serve as springboard for future researchers in coming up with other properties related to graphs derived from modular origami.
2. The graphs G derived from modular origami and their respective dual graphs G^* can be utilized as an enrichment topic in Graph Theory and other related fields.
3. The LAN based supplementary instructional material can be utilized as an instructional material in Graph Theory.
4. Future researchers may verify the results of the current study. They solve modular origami that utilize than 20 sheets of square papers. They may also dwell on investigating graphs derived from other types of origami.

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On Hamiltonian Cycles of Cayley Graphs of the Set of Least Non-Negative Residues Modulo $n \geq 3$ (Z_n)

Marjorie L. Aquino, Chandelle E. Nicdao, Joyce Anne C. Ofiana,
Jay Rose I. Villanueva, and Ralph Vincent E. Alambra

ABSTRACT

This paper analyzed and explored Cayley graphs particularly graphs generated by the set of least non-negative residues modulo $n \geq 3$ (Z_n) to introduce a new method in graph theory.

Seven propositions and two corollaries of Cayley graph of Z_n were presented and two algorithms on finding Hamiltonian cycles were also formulated. The concepts of Hamiltonian cycles were applied on cryptography, rerouting, puzzle and video games, knight tours, art works and designs and surface covering.

Keywords: *Cayley graphs, generating set, hamiltonian cycles, group, order*

INTRODUCTION

Situation Analysis

In the 21st Century, mathematics is the engine behind sciences. It provides the structure and models from which physicists, chemists, biologists, medics, engineers, economists, and social scientists build an understanding of the world which constructs the tools to improve human lives (Chung, 2010).

Graph theory studies the discrete structures known as graphs to model pair wise relations between objects from a certain collection. A graph is a collection of vertices or nodes and a collection of edges that connect pairs of vertices (Konstantinova, 2012).

Efficient algorithms exist for finding shortest paths and minimum spanning trees in graphs, matching in bipartite graphs, maximum increasing subsequences, maximum flows in networks, and so on because in each case their time requirement grows as a polynomial function (such as n , n^2 , n^3 or n^4) of the size n . All these problems could in principle be solved in exponential time by checking through all possible solutions, one by one. On the other hand, search problems wherein the fastest known algorithms are all exponential (2^n) are called NP-complete problems. One of which is the travelling salesman problem

(TSP). The travelling salesman problem (TSP) asks to find the shortest cycle that passes through every vertex once. Another search problem which reminiscent of TSP, and indeed no polynomial algorithm is known is the Hamilton cycle problem.

The Hamilton cycle problem asks to find a Hamiltonian cycle in a given graph. A Hamiltonian cycle is a cycle that passes through all the nodes exactly once.

In general, the problem of finding a Hamiltonian cycle is NP-complete, so the only known way to determine whether a given general graph has a Hamiltonian cycle is to undertake an exhaustive search (Weisstein, 2003).

A set G together with binary operation that assigns to each ordered pair (a, b) of the element of G is a group under this binary operation if the following three properties are satisfied: 1. Associativity 2. Existence of Identity 3. Existence of Inverses.

Consider $Z_6 = \{0,1,2,3,4,5\}$ under addition. It satisfies the following properties: 1. Associativity: Addition of modular arithmetic satisfies associative property.

Example:

$$\begin{aligned}(1 + 2) + 4 \text{ mod } 6 &= 1 + (2 + 4) \text{ mod } 6 \\ 3 + 4 \text{ mod } 6 &= 1 + 6 \text{ mod } 6 \\ 7 \text{ mod } 6 &= 7 \text{ mod } 6 \\ 1 \text{ mod } 6 &= 1 \text{ mod } 6\end{aligned}$$

2. Existence of Identity: there is an identity element e in Z_6 which is 0.

Example:

$$\begin{aligned}0 + 0 \text{ mod } 6 &= 0 \text{ mod } 6 \\ 1 + 0 \text{ mod } 6 &= 1 \text{ mod } 6 \\ 2 + 0 \text{ mod } 6 &= 2 \text{ mod } 6 \\ 3 + 0 \text{ mod } 6 &= 3 \text{ mod } 6 \\ 4 + 0 \text{ mod } 6 &= 4 \text{ mod } 6 \\ 5 + 0 \text{ mod } 6 &= 5 \text{ mod } 6\end{aligned}$$

3. Existence of Inverses: there is an inverse element a^{-1} for each element a in Z_6 .

Example:

$$\begin{aligned}0 + 0 \text{ mod } 6 &= 0 \text{ mod } 6 \\ 1 + 5 \text{ mod } 6 &= 6 \text{ mod } 6 = 0 \text{ mod } 6 \\ 2 + 4 \text{ mod } 6 &= 6 \text{ mod } 6 = 0 \text{ mod } 6 \\ 3 + 3 \text{ mod } 6 &= 6 \text{ mod } 6 = 0 \text{ mod } 6 \\ 4 + 2 \text{ mod } 6 &= 6 \text{ mod } 6 = 0 \text{ mod } 6\end{aligned}$$

$5 + 1 \text{ mod } 6 = 6 \text{ mod } 6 = 0 \text{ mod } 6$
Therefore $G = Z_6 = \{0,1,2,3,4,5\}$ is a group under addition.

A subset $H \subseteq G$ is a generating set of G if every element of G is obtainable as the product of elements of H . For the Cyclic group $G = Z_n$, every element of $Z_n = \{0,1,2, \dots, n - 1\}$ is obtainable as the sum of elements of subset $H \subseteq Z_n$ since the group is under binary operation of addition.

Example: The subset $H = \{1,5\}$ of $Z_6 = \{0,1,2,3,4,5\}$

1 and 5 of $H = \{1,5\}$ are the generator of itself.

For $H = \{1,5\}$ the sum of each element:

$$\begin{aligned}1 + 5 \text{ mod } 6 &= 6 \text{ mod } 6 = 0 \text{ mod } 6 \\ 1 + 1 \text{ mod } 6 &= 2 \text{ mod } 6 \\ 5 + 5 \text{ mod } 6 &= 10 \text{ mod } 6 = 4 \text{ mod } 6\end{aligned}$$

So $\{0,1,2,4,5\}$ is obtained.

And again the sum of the element 1 and 2:

$$\begin{aligned}1 + 2 \text{ mod } 6 &= 3 \text{ mod } 6 \\ Z_6 &= \{0,1,2,3,4,5\}\end{aligned}$$

Since $Z_6 = \{0,1,2,3,4,5\}$ was obtained by adding the elements of $H = \{1,5\}$, then $H = \{1,5\}$ is a generating set of Z_6 .

The elements of the generating set H of the group G are called generators of G . From the example above, 1 and 5 are the generators of Z_6 . The subset H of G is identity free if $e \in H$, so for $G = Z_6$ and $H = \{1,5\}$ the identity element $0 \notin H$ therefore $H = \{1,5\}$ is identity free. The subset H is symmetric if $h \in H$ implies $h^{-1} \in H$, from this the subset $H = \{1,5\}$ is symmetric since $1 + 5 \text{ mod } 6 = 6 \text{ mod } 6 = 0 \text{ mod } 6$.

Meanwhile, Cayley graph is a graph constructed out of a group G and its generating set H . In a Cayley graph denoted by $Cay(G, H) = (V, E)$ vertices correspond to the element of the group G and edges correspond to multiplication on the right by generators, $E = \{\{g, gh\} | g \in G, h \in H\}$, that is $V = G$ and $E = \{\{g, gh\} | g \in G, h \in H\}$.

Example: The Cayley graph

constructed out of $G = Z_6$ and its generating set $H = \{1,5\}$ is denoted by $Cay(Z_6, \{1,5\})$.

Since the vertices correspond to the element of the group then

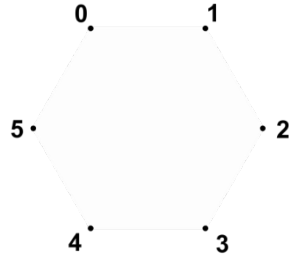


Fig. 1. Vertices of Z_6

Edges correspond to multiplication on the right by generators,

$E = \{\{g, gh\} \mid g \in G, h \in H\}$ but since Z_6 is under addition then simply write:

$$E = \{\{g, g + h\} \mid g \in G, h \in H\}$$

So if $G = Z_6 = \{0,1,2,3,4,5\}$ and $H = \{1,5\}$ then the edge set is:

- $\{0, 0 + 1 \text{ mod } 6\} = \{0,1\}$
- $\{0, 0 + 5 \text{ mod } 6\} = \{0,5\}$
- $\{1, 1 + 1 \text{ mod } 6\} = \{1,2\}$
- $\{1, 1 + 5 \text{ mod } 6\} = \{1,0\}$
- $\{2, 2 + 1 \text{ mod } 6\} = \{2,3\}$
- $\{2, 2 + 5 \text{ mod } 6\} = \{2,1\}$
- $\{3, 3 + 1 \text{ mod } 6\} = \{3,4\}$
- $\{3, 3 + 5 \text{ mod } 6\} = \{3,2\}$
- $\{4, 4 + 1 \text{ mod } 6\} = \{4,5\}$
- $\{4, 4 + 5 \text{ mod } 6\} = \{4,3\}$
- $\{5, 5 + 1 \text{ mod } 6\} = \{5,0\}$
- $\{5, 5 + 5 \text{ mod } 6\} = \{5,4\}$

Observe that every inverse of the edges exist since the Cayley graph is symmetric.

Constructing the Cayley graph, $Cay(Z_6, \{1,5\})$, figure 2 is obtained.

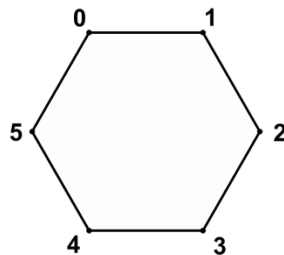


Fig. 2. $Cay(Z_6, \{1,5\})$

Observe that $Cay(Z_6, \{1,5\})$ above satisfies the three distinguishing properties of Cayley graphs:

- Regularity: Every vertex v contains the same number of edges. If we choose a generating set H of order k , each vertex will have in-degree and out-degree equal to k . In particular, If $\{1,5\}$ is chosen as generating set for Z_6 , A Cayley graph regular of degree 2 obtained.
- Connectedness: The graph is connected. Observe that in Figure 2, for every pair of vertices v_1 and v_2 there exist a walk beginning at v_1 and ending at v_2 .
- Homogeneity: For every pair of vertices x and y , there is a unique graph isomorphism maps x to y .

Cayley graphs arise naturally from computer science, from the study of word-hyperbolic groups and automatic groups, from change-ringing, from creating Escher-like repeating patterns in the hyperbolic plane, and from combinatorial designs. In connection with this, all graphs can be learned as an induced subgraph of a Cayley graph of any sufficiently large group (Curran & Gallian, 1996).

In the additive cyclic group Z_n (set of least non negative integers modulo n), a non-empty set of integers mod n is a generating set if its greatest common divisor (gcd) is 1 (Alspach, n.d.).

For instance, the set $\{3, 7\}$ generates Z_{10} , since $\text{gcd}(3, 7) = 1$ but $\{2, 8\}$ does not generate Z_{10} , since $\text{gcd}(2, 8) = 2$

In this research, Cayley Graph with Hamiltonian cycles was studied. This research aimed to provide algorithms that help the readers in locating the Hamiltonian cycles of graphs. Moreover, applications concerning the topic were presented.

Statement of Objectives

This study on Hamiltonian cycle of some graphs aimed to:

1. come up with properties of Cayley Graphs with Hamiltonian Cycle;
2. formulate algorithms on finding Hamiltonian cycle of some graphs; and
3. find possible application of Hamiltonian cycle in fields of Mathematics and in real life situation.

METHODOLOGY

Research Design

This study used a descriptive pure basic research design to come up with Hamiltonian cycles of Cayley graphs of the set of least non-negative residues modulo $n \geq 3 (Z_n)$. The study was developed through extensive research to introduce a new algorithm in graph theory. The researchers focused on analyzing and exploring Cayley graphs particularly graphs generated by the set of least non negative residues modulo $n \geq 3 (Z_n)$. To strengthen the results of this study, published papers, the internet and researchers' knowledge in graph theory were used. Furthermore, applications of Hamiltonian cycles were presented.

Sources of Data

The concept on Hamiltonian cycles of Cayley graphs of the set of least non-negative residues modulo $n \geq 3 (Z_n)$ is studied through pure basic research. Theorems and the conceptual definition of terms were purely searched from mathematics books, published papers related to the study and through the help of the internet. The determination and knowledge of the researchers including the concepts involved in the topic were used in introducing a new method in graph theory.

RESULTS AND FINDINGS

The researchers came up with six propositions and two corollaries of Cayley graph of Z_n . And these are the propositions:

- a) Cayley graph of Z_n is a connected Circulant graph.
- b) Every Cayley graph of Z_n is Hamiltonian.
- c) A Cayley graph of Z_n has perfect matching if n is even and near-perfect matching if n is odd.
- d) The Cayley Graph of Z_n is Hamiltonian decomposable. Furthermore there are $\frac{|H|}{2}$ Hamilton cycles if $|H|$ is even, and $\frac{|H|-1}{2}$ Hamiltonian cycles and a single perfect matching if $|H|$ is odd.
- e) There exist connected components of Circulant graph isomorphic to Cayley graph of Z_n .
- f) For the Cayley graph of Z_n , its circumference is equal to its number of vertices n .

Corollaries:

- a) A Cayley graph of Z_n is Eulerian if it is regular of even degree.
- b) For any Cayley Graph of Z_n , $e = \frac{|H|n}{2}$

The researchers also formulated two algorithms on finding the Hamiltonian cycles.

Algorithm 1. Finding Hamiltonian cycles of given graph

- Step 1. Label the vertices.
- Step 2. List pairs of vertices.
- Step 3. Select the initial vertex.
- Step 4. Look for pairs of the initial vertex.
- Step 5. Look for the pair the your first connecting vertex.
- Step 6. Look for pair of the vertex you have chosen in step 5.
- Step 7. Repeat step 6 until all the vertices have been chosen once.
- Step 8. Go back to the initial vertex.
- Step 9. Trace the Hamiltonian cycle of the graph according to the paired vertices.

Algorithm 2. Finding Hamiltonian decomposition of complete graph K_n where n is prime.

- Step 1. Label the vertices from 1 to n
- Step 2. Determine the number of distinct Hamiltonian cycles, which is given by $k = \frac{n-1}{2}$
- Step 3. Determine the edge set of every distinct Hamiltonian cycle r_i using the formula $(p, p + \frac{n-1}{2} \text{ mod } n)$.
- Step 4. Trace the distinct Hamiltonian cycles r_i .

The researchers found possible real-life application of Hamiltonian cycle in relation to the following:

- a) In cryptography
- b) In rerouting
- c) In puzzle and video games
- d) In knight tours
- e) In art works and designs
- f) In surface covering

CONCLUSIONS

After an extensive research on Hamiltonian cycle of Cayley graph of Z_n , these are the conclusions of the study:

1. The researchers came up with six propositions and two corollaries of Cayley graph of Z_n .
2. The researchers formulated a nine-

step algorithm on finding the Hamiltonian cycle of given graph graphs and a four-step algorithm on finding Hamiltonian decomposition of complete graph K_n where n is prime.

3. The researchers relates Hamiltonian cycle in cryptography, rerouting, puzzle games and video games, knight tours, art works and designs and surface covering.

RECOMMENDATIONS

Based on the findings and conclusion of this study the following are recommended for future researchers:

1. Research on structure and properties of other families of Cayley graph relevant to Hamiltonicity.
2. Develop a program that will

find distinct Hamiltonian Cycle of Cayley graph by putting into code the formulated algorithms and by entering generating set.

3. Look for possible applications of Cayley graph in fields of mathematics and in real life situation.

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On Harshad Number

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ABSTRACT

The purpose of this descriptive pure basic mathematics research is to generate properties of Harshad numbers from 1 to 5000. It also aimed to develop an equation that models the relationship between the frequencies of Harshad numbers given an interval of positive integers whose lower limit is 1. The analysis and exploration made involving the 895 Harshad numbers found from 1 to 5000 resulted in the discovery of 11 properties and 1 corollary. Further, the equation $y = 55 + 0.17x$ generated through the use of an interpolation process aided by the IBM SPSS approximates the total number (y) of Harshad numbers that can be determined from a range of positive integers from 1 to x .

Keywords: *Harshad numbers, interpolation, positive integers, Harshad number verifier*

INTRODUCTION

Situation Analysis

Mathematics is important in a field where researchers must explore and discover new ideas. Since the very beginning, mathematics is part of life. The ancient inhabitants use mathematics for constructing ships, houses, and other things and made the study passed from generations to generation that lead to different branches and related courses. Different generations investigated mathematics, pursued knowledge about the study, and contributed many discoveries in the different fields. Throughout the history, humans faced the need to measure and communicate time, quantity, and distance (Moursund & David, n.d.)

There are different branches of mathematics where teachers, mathematicians, and also researchers devote much of their time with in order to prove theorems, derive properties of a set of numbers and establish applications of

mathematical concepts to real life situations among others.

One of the branches of mathematics that is of most interest among the researchers is Number theory. Also known as higher arithmetic, Number Theory is a branch of mathematics concerned with the properties of integers, rational numbers, irrational numbers, and real numbers. Sometimes the discipline is considered to include the imaginary and complex numbers as well. Formally, numbers are represented in terms of set s ; there are various schemes for doing this. However, there are other ways to represent numbers -- for example, as angles, as points on a line, as points on a plane, or as points in space. It is the study of the set of positive whole numbers 1, 2, 3, 4, 5, 6, 7, . . . , which are often called the set of natural numbers (Silverman, 2011).

One interesting topic in Number Theory is the Harshad number. This topic

was discovered by an Indian mathematician Dattaraya Kaprekar who gave the name “harshad” which means joy giver in Sanskrit. Later Harshad numbers were investigated by another mathematician named Ivan Niven. Harshad number, also called a Niven number or a multidigital number, is any positive integer which is divisible by the sum of its digits. The first few Harshad numbers are 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 18, 20, 21, 24, ... (The OEIS Foundation, 2016).

In number theory, the word “divisible” simply means “division with no remainder”. Another way to express divisibility is to say that the divisor in the division process is also a factor of the dividend. Consider the number 126. To check if 126 is a Harshad number, first find the sum of the digits. Taking the sum of the digits leads to $1 + 2 + 6 = 9$. Then divide 126 by 9. Since 126 is exactly divisible by 9, that is $126 \div 9 = 14$, then 126 is a Harshad number. It can also be said that 9 is a factor of 126 because $126 = 9 \times 14$ (Kennedy, n.d.)

Harshad numbers are important part of mathematics as they enable mathematicians make numbers fun for learning. These numbers can also be used to generate another set of numbers.

Recent studies about this Harshad numbers are composed of consecutive Harshad numbers, multiple Harshad

Statement of the Problem

This study aimed to investigate some properties of Harshad numbers from 1 to 5000.

Specifically, this research answered the following questions:

numbers, square Harshad numbers, and prime Harshad numbers. The longest possible chain of consecutive Harshad numbers turned out to be 20. There is no string of 21 or more consecutive Harshad numbers yet found but there are infinitely many strings of consecutive Harshad numbers. Next is the square Harshad in which when a Harshad number is squared, the result is another Harshad number. The sequences of these are 1, 4, 9, 36, 81, 100, 144, 225, 324, 400, 441, 576, 900, 1296,...

Upon dividing the sum of the digits of a Harshad numbers you could obtain another Harshad number. This is called a multiple Harshad number. An example of this is 3,779,136. When 3,779,136 is divided by the sum of its digits which is 36, the quotient is 104, 976 which is also a Harshad number.

Last is the prime Harshad number which contains only the numbers 2, 3, 5, and 7. All of the results of the studies mentioned were utilized in this study particularly in the generation of properties on Harshad numbers (Smith, TR, n.d.).

Computer program using Visual Basic 2015 helps the users to easily determine the Harshad numbers and shows the solution using the definition of a Harshad number.

1. What properties can be derived on Harshad Numbers?
2. What equation that models the frequency of Harshad number can be developed given a range of positive integers n ?
3. What program can be developed in verifying Harshad number?

METHODOLOGY

Research Design

As there are only few existing properties of these numbers, the researchers determined Harshad numbers less than 5000. Then, these numbers were analyzed and were subjected to deep exploration in order to develop propositions that are true for all Harshad numbers found in the given range of positive integers. These propositions serve as a concrete contribution of this research to the body of knowledge in mathematics.

Further, the researchers also generated an equation through a process called interpolation with the aid of the IBM SPSS that approximates how many Harshad

numbers can be found between from 1 to 500, 1 to 1000, 1 to 1500, 1 to 2000, and so on.

Also, the researchers developed a computer program that verifies if a positive integer up to 17 digits is a Harshad number or not. The computer program has a “check” feature that shows the sum of the digits of the entered positive number and the quotient when this number was divided by the sum of its digits. This feature provides a verification process that establishes why the positive integer entered is a Harshad number or not a Harshad number.

Sources of Data

The researchers gathered information through web questing specifically through e-journals, online publications, and others. Other sources of information are published materials such as books, journals, and theses which assisted the researchers to collect and organize information related to the research study.

The determination of Harshad numbers was done through the use of Microsoft Excel where the researchers list down the numbers from 1 to 5000.

In determining the equation that approximates the frequency of Harshad numbers from a given range of positive

integers, the researchers used the IBM SPSS. They determined the frequency of Harshad numbers from 1 to 500, 1 to 1000, 1 to 1500, 1 to 2000, and so on up to 1 to 5000. The scatterplot was then drawn and the equation of the best fit line was also determined.

The researchers also came up with a program using Visual Basic 2015 that could easily determine Harshad number and check the answer by clicking the assigned button in the program. It helps the users to discover large values of Harshad numbers by entering a desired number with a maximum of seventeen-digits.

RESULTS AND DISCUSSION

1. Derived property:

Property 1. There are 895 Harshad numbers less than 5000.

Property 2. All two-digit Harshad numbers are divisible by 3 except 10, 20, 40, 50, 70, and 80.

Property 3. All 3-repdigits are Harshad numbers. Furthermore, the quotient of any 3-repdigit and the sum of their digits is always 37.

Property 4. The difference between any 2-digit Harshad number and the sum of its digits is also a Harshad number.

Property 5. Any positive integer n whose digit sum is 9 is a Harshad number.

Property 6. The product of any two odd consecutive Harshad numbers with the sum of the digits of the product equal to 9 is a Harshad number.

Property 7. When the sum of the cubes of the digits of a Harshad number is 9, then, the sum is a Harshad number.

2. Equation that Models the Frequency of Harshad Numbers from 1 to n where n is a Positive Integer

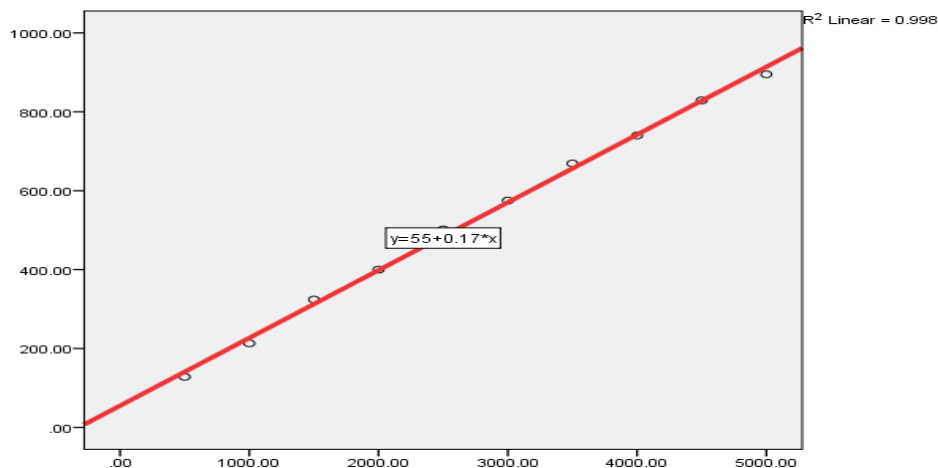


Figure 1. Scatterplot of the Frequency of Harshad Numbers

3. The developed program

The Harshad Number Verifier computer program was designed for verifying a number if it is divisible by the sum of its digits using Visual Basic 2015 application.

CONCLUSIONS

The following conclusions were made based on the findings of the study:

1. The seven new properties generated that involve the number of Harshad numbers less than 5,000, are divisibility rules for some Harshad numbers, d-repdigits that are Harshad numbers, the difference between any two Harshad numbers

and the sum of the difference to generate Harshad numbers, the product of any two odd consecutive Harshad numbers, and the sum of the cubes of the digits of a Harshad.

2. The equation $y = 55 + 0.17x$ determines the frequency (x) of given an interval from 1 to x .
3. The developed program verifies and illustrates whether a given positive integer up to 17 digits is a Harshad number or not.

RECOMMENDATIONS

Based on the conclusion, the study came up with the following recommendations:

1. Future researchers are encouraged to verify and to establish the formal proofs of the properties on Harshad numbers generated by the researchers. Similar studies involving Harshad numbers greater than or equal to 5,000 may be conducted. Researchers may also look into the relationship of Harshad numbers to other sets of numbers in Number Theory and other fields in mathematics.
2. The equation may be utilized to provide an initial idea on the frequency of Harshad numbers that can be identified from a given interval of positive integers from 1 to x without actually identifying the exact values of these Harshad numbers.
3. The developed computer program can be used as a computer-assisted supplementary instructional material in order to facilitate easier and faster process of identifying whether a number is a Harshad number or not.
4. Future studies on Harshad numbers are encouraged to verify the properties generated in this study. They may also establish the practical application of these numbers in various real-life situations or even to other fields or disciplines. It is also recommended that a formula will be established to generate the n^{th} Harshad number.

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On Leibniz Harmonic Triangle

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ABSTRACT

This basic research dealt mainly with the establishment of other properties of the Leibniz harmonic triangle, the application of its properties in mathematics-related concepts, the generation of mathematically designed artworks, and the publication of a website to serve as an e-learning program.

The researchers used manual operations to establish and to prove some properties, identities, and propositions on the Leibniz harmonic triangle.

In this research, four existing properties were shown and proven, 17 additional properties, three identities, and three propositions were established. Also, it was found out that the Leibniz harmonic triangle has varied applications in Egyptian fractions, in the Sierpinski triangle, and in generating mathematically designed artworks. Lastly, a website is created and published to serve as an e-learning program on the Leibniz harmonic triangle.

Keywords: *Leibniz harmonic triangle, applications, artworks, e-learning*

INTRODUCTION

Situation Analysis

The science of patterns and relationships is Mathematics. It is also a theoretical discipline which explores the possible relationships among abstractions without concern for whether those abstractions have counterparts in the real world. The abstractions can be anything from strings of numbers to geometric figures to sets of equations. In addressing, say, "Does the interval between prime numbers form a pattern?" As a theoretical question, mathematicians are interested only in finding a pattern or proving that there is none (Rutherford & Ahlgren, 1989).

Mathematicians, like other scientists, are particularly pleased when previously unrelated parts of mathematics are found to be derivable from one another, or from some more general theory. Part of the sense of beauty that many people have perceived in mathematics lies not in finding the greatest elaborateness or complexity but on the contrary, in finding the greatest economy and simplicity of representation and proof. As mathematics is progressing, more and more relationships have been found between parts of it that have been developed separately—for example, between the symbolic representations of harmonic analysis and the spatial

representations of harmonic triangle. (Rutherford & Ahlgren, 1989).

Mathematical analysis is a branch of mathematics that studies continuous change and includes the theories of differentiation, integration, measure, limits, infinite series, and analytic functions. These theories are usually studied in the context of real and complex numbers and functions. Analysis evolved from calculus, which involves the elementary concepts and techniques of analysis. (Mashood, 2015).

Harmonic analysis is nowadays one of the most important branches of mathematical analysis. (Cannings, 2013).

In harmonic analysis, the Leibniz triangle, also called the Leibniz harmonic triangle, is by far less known, although it relates to that of Pascal's triangle in a very simple way.

The Leibniz harmonic triangle is a triangular arrangement of fractions in which the outermost diagonals consist of the reciprocals of the row numbers and each inner cell is the absolute value of the difference of the cell above and the cell to the left. To put it algebraically, $L_{r,c} = \frac{1}{r}$, where r is the number of the row, starting from the column number $c = 1$, never more than r , and $L_{r,c} = |L_{r-1,c-1} - L_{r,c-1}|$ (Ayoub, 1987).

The first eight rows are:

$$\begin{array}{cccccccc}
 & & & & & & & 1 \\
 & & & & & & \frac{1}{2} & \frac{1}{2} \\
 & & & & & \frac{1}{3} & \frac{1}{6} & \frac{1}{3} \\
 & & & \frac{1}{4} & \frac{1}{12} & \frac{1}{12} & \frac{1}{4} & \frac{1}{4} \\
 & & \frac{1}{5} & \frac{1}{20} & \frac{1}{30} & \frac{1}{20} & \frac{1}{5} & \frac{1}{5} \\
 & \frac{1}{6} & \frac{1}{30} & \frac{1}{60} & \frac{1}{60} & \frac{1}{30} & \frac{1}{6} & \frac{1}{6} \\
 \frac{1}{7} & \frac{1}{42} & \frac{1}{105} & \frac{1}{140} & \frac{1}{105} & \frac{1}{42} & \frac{1}{7} & \frac{1}{7} \\
 \frac{1}{8} & \frac{1}{56} & \frac{1}{168} & \frac{1}{280} & \frac{1}{280} & \frac{1}{168} & \frac{1}{56} & \frac{1}{8} \\
 & \vdots & & \vdots & & \vdots & & \\
 & & & & & & &
 \end{array}$$

The numerators are all 1s.

Just as Pascal's triangle can be computed by using binomial coefficients, so can Leibniz's: $L_{r,c} = \frac{1}{r \binom{r-1}{c-1}}$. Furthermore, the entries of this triangle can be computed

from Pascal's triangle wherein the terms in each row are the initial term divided by the corresponding Pascal's triangle entries. In fact, each diagonal relates to corresponding Pascal's triangle diagonals: the first Leibniz diagonal consists of $1/(1 \times \text{natural numbers})$, the second of $1/(2 \times \text{triangular numbers})$, the third of $1/(3 \times \text{tetrahedral numbers})$ and so on (Ayoub, 1987).

A row of the Leibniz triangle starts with the reciprocal of the row number, or the row number plus one depending on whether one starts counting from 1 or 0. Every entry is the sum of the two numbers just below it. The entries can thus be computed sequentially left to right and top to bottom using subtraction instead of addition, e.g., in the fifth row, $\frac{1}{20} = \frac{1}{4} - \frac{1}{5}$, $\frac{1}{30} = \frac{1}{12} - \frac{1}{20}$, $\frac{1}{20} = \frac{1}{12} - \frac{1}{30}$, $\frac{1}{5} = \frac{1}{4} - \frac{1}{20}$ (Darling, 2004).

The study of properties, identities and propositions of a certain number triangle is important to build the ability to generalize and to study the limitations of generalization. It also helps us to learn that questioning math concepts and using them as an opportunity to build a higher conceptualization of the material is a good thing. These questions and abstractions from original ideas have led to discoveries of new ideas.

This study reveals deeper and broader understanding on the properties of Leibniz harmonic triangle. It will serve as a reference tool of future researchers who are planning to conduct studies on topics and researches related to this, despite the fact that this kind of topic is not that common in research studies. It may also be a source of information which is easy to understand because its structures tend to communicate with its simplest form.

This study is significant for it discovers a kind of number array related to other number triangles in the form of Leibniz harmonic triangle. The use of these properties may build concepts that will be applied and used in future researches.

Statement of Objectives

This study was conducted to contribute a body of knowledge that can be used for further mathematical analysis on Leibniz harmonic triangle, and to execute some applications of the properties studied for the benefit of mathematics instructors, students and other persons and researchers who aim to:

1. prove some existing and proposed properties on Leibniz harmonic triangle;
2. establish new properties and come up with new propositions and

identities on Leibniz harmonic triangle;

3. cite possible applications of Leibniz harmonic triangle in math-related concepts and in generating mathematically designed artworks; and
4. create e-learning website program about Leibniz harmonic triangle using HTML, CSS and PHP programming languages.

METHODOLOGY

Research Design

This study was developed through descriptive pure basic research and the interest of the researchers to attempt to introduce a new concept in the field of harmonic analysis including some concepts in algebra, number theory, and combinatorics. This research was conducted for the purpose of development of new properties, identities and propositions. Its results were intended to activate the desire of other researchers to explore more on this study and to transform basic knowledge that was known into a summarized yet reliable form wherein different properties turn-out.

In achieving the objectives of the study, some existing and established properties, identities, and propositions on Leibniz harmonic triangle were proven. In addition, figures, tables, and plates were presented to fully understand and clearly see the results.

The researchers indulged themselves in studying, analysing and discovering to obtain the result of their study. They used books, journals, magazines, articles, previous studies, internet explorations, and their knowledge in the fields of mathematics in order to obtain reliable, accurate and significant information on the said topic. They also made use of specialized computer programming languages called HTML, CSS, and PHP that can make an E-learning webpage.

Sources of Data

To study the basic concepts of Leibniz harmonic triangle, expository research was used. The researchers have undergone extensive studies and readings on its properties through the use of published and unpublished books, online books, and other resources.

Some of the properties as well as the conceptual definition of terms which served

as their bases were searched mainly from books, published papers, and the World Wide Web. The researchers used their knowledge in all the concepts involved in establishing new properties in this study to come-up with a new concept.

Furthermore, one of the sources of data which added to the knowledge and ideas of the researchers are the mathematics

teachers who specialize in mathematics fields that are related to this study. The researchers asked for the help of the experts

to assure the accurateness and reliability of the research.

RESULTS AND FINDINGS

1. Existing Properties of the Leibniz Harmonic Triangle Proven by the Researchers

The researchers have given proofs on the four (4) existing properties found without proof.

- a. The Leibniz harmonic triangle is symmetric.
- b. The two (2) element formulas of Leibniz harmonic triangle, $\frac{1}{r\binom{r-1}{c-1}}$ and $\frac{1}{c\binom{r}{c}}$, are equal where r is a row number and c is the column number.
- c. The sum of elements in any row of the Leibniz harmonic denominator triangle is equal to $r(2^{r-1})$ where r is a row number.
- d. Every row in the Leibniz harmonic triangle begins and ends with the reciprocal of the corresponding row number r .

2. Properties, Identities, and Propositions of Leibniz Harmonic Triangle Established by the Researchers

The researchers established 17 additional properties, three (3) additional identities, and three (3) additional propositions, which are the following:

A. Properties

- a. Each element in the second diagonal sequence, $\frac{1}{2}, \frac{1}{6}, \frac{1}{12}, \dots$, of the Leibniz harmonic triangle can be found by multiplying every two preceding elements in the first diagonal sequence.
- b. Each element in the third diagonal sequence, $\frac{1}{3}, \frac{1}{12}, \frac{1}{20}, \dots$ of the Leibniz harmonic triangle can be found by using the formula $\frac{1}{r(r-1)(r-2)}$ where the row number $r \geq 3$.
- c. Each element in the center of the Leibniz harmonic triangle can be found by using the formula $\frac{1}{(2n-1)\binom{2n-2}{n-1}}$ where n is a positive integer and $2n - 1$ is the row number r .
- d. Adding the elements in any even row of the Leibniz harmonic triangle with alternating signs will result to 0.

Properties 5, 6, 7, and 16 were anchored on Pascal's Triangle.

- e. The product of the six elements surrounding any element except for the first diagonal elements in the Leibniz harmonic triangle is a perfect square.
- f. The elements in any row of the Leibniz harmonic triangle can be obtained by using the formula $\frac{1}{r * (11^{r-1})}$ where r is the row number and the expression $r * (11^{r-1})$ is defined as "the product of r and each digit in the expansion of 11^{r-1} ".
- g. The product of the surrounding alternating elements of any element, except for the first diagonal elements, in the Leibniz harmonic triangle is equal to the product of the three remaining alternating elements at every other vertex of the magic hexagon.

- h. The elements in any even row number r of the Leibniz harmonic denominator triangle that are not equal to r are multiples of $r - 1$ except for $r = 2$.
- i. The elements in any even row number r of the Leibniz harmonic denominator triangle are all even numbers.
- j. The number of odd elements in any odd row number r of the Leibniz harmonic denominator triangle can be expressed as 2^n where n is a positive integer.
- k. The number of even elements in any odd row number r , except for row 1, of the Leibniz harmonic denominator triangle can be expressed as $2n - 1$ where n is a positive integer.
- l. In any row of the Leibniz harmonic denominator triangle, the sum of alternating elements in even position is equal to the sum of alternating elements in odd position.
- m. The sum of alternating elements in even and odd positions in any row of the Leibniz harmonic denominator triangle is equal to $r(2^{r-2})$ except for $r = 1$.
- n. Any diagonal of the Leibniz harmonic triangle can be found by using the combinatorial sequence $\frac{1}{d\binom{d-1}{d-1}}, \frac{1}{(d+1)\binom{d}{d-1}}, \frac{1}{(d+2)\binom{d+1}{d-1}}, \frac{1}{(d+3)\binom{d+2}{d-1}}, \frac{1}{(d+4)\binom{d+3}{d-1}}, \dots$ where d is the diagonal number.
- o. Any vertical of the Leibniz harmonic triangle can be found by using the combinatorial sequence $\frac{1}{v\binom{v-1}{v-1}}, \frac{1}{(v+2)\binom{v+1}{v}}, \frac{1}{(v+4)\binom{v+3}{v+1}}, \frac{1}{(v+6)\binom{v+5}{v+2}}, \dots$ where v is a vertical number.
- p. The infinite Catalan numbers can be found in the Leibniz harmonic denominator triangle by subtracting an element in vertical 3 from the corresponding element in vertical 1 and the result be divided by the corresponding row number r .
- q. The prime numbers can only be found on the two outer diagonals of the Leibniz harmonic denominator triangle (i.e. $d = 1$)

B. Identities

- a. The r^{th} term of the second diagonal in Leibniz harmonic triangle (i.e. the sequence $\frac{1}{2}, \frac{1}{6}, \frac{1}{12}, \dots$) is equal to $\frac{1}{r(r+1)}$ where r is the row number.
- b. $\frac{1}{(r-1)\binom{r}{0}} \cdot \frac{1}{r\binom{r+1}{0}} = \frac{1}{r\binom{r-1}{1}}$
- c. $\frac{1}{(r-1)\binom{r}{0}} \cdot \frac{1}{r\binom{r+1}{0}} = \frac{1}{\binom{r}{1}} - \frac{1}{\binom{r-1}{1}}$

C. Propositions

The following propositions were anchored from Pascal's triangle.

- a. The elements in any row of Leibniz harmonic triangle can be obtained by using the formula $\frac{1}{r * (1000\dots0001^{r-1})}$ where r is a row number and the expression, $r * (1000\dots0001^{r-1})$, is defined as "the product of row r and each digit in the expansion of $1000\dots0001^{r-1}$ ".

- b. The infinite Catalan numbers can be found in the Leibniz harmonic denominator triangle by subtracting an element in vertical 4 from the corresponding element in vertical 2 and the result be divided by the corresponding row number r .
- c. The infinite Catalan numbers can be found in the Leibniz harmonic denominator triangle by subtracting an element in vertical 5 from the corresponding element in vertical 1 and the result be divided by the corresponding row number r .

3. Applications of Leibniz Harmonic Triangle in Math-Related Concepts and Mathematically Designed Artworks

The Leibniz harmonic triangle has varied applications in:

- a. Egyptian Fractions
The Leibniz harmonic triangle can be used to analyze an Egyptian fraction obtained from the triangle.
- b. Sierpinski Triangle
The Sierpinski triangle can be constructed by coloring the even and odd numbers of the Leibniz harmonic denominator triangle.
- c. Construction of Mathematically Designed Artworks
The following designs were made by using *mod n* coloring on the Leibniz harmonic triangle:
 - i. Sierpinski Hexagon (Name taken from the Sierpinski Triangle)
 - ii. Sierpinski Star (Name taken from the Sierpinski Triangle)
 - iii. Colored Leibniz Harmonic Denominator Triangle Mod 3
 - iv. Veenna Hexagon (Name taken from the nickname of one of the researchers)
 - v. Maxpein Star (Name taken from an inspiration of one of the researchers)
 - vi. Colored Leibniz Harmonic Denominator Triangle Mod 4
 - vii. Glazean Hexagon (Name taken from the nickname of one of the researchers)
 - viii. Zydys Star (Name taken from an inspiration of one of the researchers)
 - ix. Colored Leibniz Harmonic Denominator Triangle Mod 5
 - x. Corrielle Hexagon (Name taken from one of the researchers)
 - xi. Dyaron Star (Name taken from one of the researcher's mother)
 - xii. Colored Leibniz Harmonic Denominator Triangle Mod 7
 - xiii. Orlean Hexagon (Name taken from the nickname of one of the researchers)
 - xiv. Padinean Star (Name taken from the surname of one of the researchers)

4. The E-Learning Website on Leibniz Harmonic Triangle

The researchers, with the help of a computer programmer, have developed a website using HTML, CSS, and PHP programming language, which serves as an E-learning on the topic Leibniz harmonic triangle. In the webpage, the properties, identities, propositions, definitions and applications of the Leibniz harmonic triangle with their corresponding proofs, figures and tables are included. Ten (10) calculators were created and published for a better understanding of the concepts in the study. These are the following:

- a. Leibniz Harmonic Triangle Calculator
- b. Leibniz Harmonic Triangle Element Calculator
- c. Sum of the Rows Calculator (Leibniz Harmonic Denominator Triangle)
- d. Symmetry Line Elements Calculator (Leibniz Harmonic Triangle)

- e. Magic Hexagon Calculator (Leibniz Harmonic Triangle)
- f. Square Rings Calculator (Leibniz Harmonic Triangle)
- g. Multiples of $\frac{1}{n}$ Calculator (Leibniz Harmonic Triangle)
- h. Odd Elements Calculator (Leibniz Harmonic Denominator Triangle)
- i. Even Elements Calculator (Leibniz Harmonic Denominator Triangle)
- j. Sum of Alternating Elements Calculator (Leibniz Harmonic Denominator Triangle)

CONCLUSIONS

After an extensive research on the Leibniz harmonic triangle, the researchers came up with the following conclusions:

1. Four (4) existing properties were shown and proven by the researchers.
2. Additional 17 properties, three (3) identities, and three (3) propositions were established by the researchers.
3. Leibniz harmonic triangle has varied applications in Egyptian fractions, in the Sierpinski triangle, and in generating mathematically designed artworks
4. A webpage is created and published to serve as an E-Learning website.

RECOMMENDATIONS

With the findings and conclusions derived from this study, the researchers arrived to the following recommendations:

1. The researchers encourage future researchers to discover more properties and patterns in the Leibniz harmonic triangle.
2. The researchers encourage future researchers to consider the cases wherein, the numerators of the elements in Leibniz harmonic triangle are replaced by imaginary numbers, positive or negative integers n where $n \neq 1, 0$.
3. The researchers encourage the future researchers to generate more mathematically designed artworks by evaluating the mod n of each element in the Leibniz harmonic denominator triangle where $n > 7$, and by using other colors which complement to each other.
4. The Leibniz harmonic triangle e-learning website developed by the researchers can serve as a guiding tool in exploring and discovering more concepts about the study.

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On Super-d Numbers
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ABSTRACT

A Super-d number n is any positive integer such that d is from 2 to 9, and contains a substring made of d digits in its decimal form. This research dealt with properties and observations that further describe the nature of these Super-d numbers. Deeper analysis on the Super-d number helped the researchers to discover new properties on Super-2 and Super-3 numbers. Additionally, they also found some new observation about palindromic numbers and the repdigits. A computer program using Visual Basic 2010 was created which can verify Super-d numbers and can generate Super-d numbers up to eight digits by using the program's calculator.

Keywords: *Palindromic numbers, properties, repdigit numbers, Super-d numbers, Visual Basic 2010 and computer program.*

INTRODUCTION

Situation Analysis

Mathematics is a branch of science that deals with the study of numbers. There are many fields of Mathematics such as Algebra, Trigonometry, Geometry, Calculus, Number Theory, Graph Theory, Statistics and Probability, and so on. Among these fields, Number Theory is considered by Gauss as the "Queen of Mathematics." It deals mainly about numbers, namely the set of integers. (Raji, 2013)

Number Theory is a huge and interesting field of Mathematics, which is concerned with special properties of the integers – for example, unique factorization, prime equations with integer coefficients and congruencies. Number Theory study prime numbers as well as the properties of objects made up of integers or defined as generalizations of the properties (Diffie & Hellman, 2013). This provided reasons for Number Theory to be an excellent area in learning to do proofs. (Aspiras, 2015)

One of the interesting topics in Number Theory is the Super- d Numbers. In representation, an integer n is a Super- d when n is any positive integers and d is from 2 to 9, which contains a substring made of d digits in its decimal. Hence, Super- d takes the form dn^d . In general, a Super- d number is a number n that

contains consecutive d in its decimal representation. The result will be a substring of d digits - for example, an integer $n = 261$ and $d = 3$ such that $3(261)^3 = 53338743$ which contain substring '333' expansion called a Super-3 number. The first seven Super-3 numbers are 261, 462, 471, 481, 558, 753, 1036... (Sloane, N. J. A, 2014).

Super- d number is a topic in Number Theory that is interrelated with other topics like the palindromic number, repdigits, and other digit-interrelated numbers. However, Super- d numbers are still reasonably unknown to most people since there are still quite a few studies being conducted about them (Sloane, N. J. A, 2014).

The importance of Super- d numbers is applicable to recreational topics in Number Theory. Also, by this generation Super- d is now applicable to the society. It is used in creating passwords in social media and generating numbers for company email passwords, Wi-Fi password and in cell phone security.

The researchers chose Super- d numbers as the topic of study because of their interest in formulating other properties and propositions. A computer program was also developed to verify if a number is Super- d or not and it has a calculator for Super- d number.

Statement of the Problem

This study focused on Super- d numbers. Specifically, it aims to answer the following questions:

1. What additional properties and observations can be derived from Super- d numbers?

2. What computer program can be developed that determines if a number is Super- d number or not?

METHODOLOGY

Research Design

This study was developed through expository research and the willingness of the researchers to introduce a new concept in Number Theory. Its results were intended to generate the desire of other researchers to explore more on this study. The explorations about the Super- d number are presented for further discussions and understanding of the discovered properties.

This study falls on pure basic research. As to definition, this study, in its purest form, was conducted for the purpose of developing new concepts and discovering properties on the topics discussed. Mathematical concepts, theorems, and properties served as the basis of the researchers in developing new properties and proposition brought about by the research study. The scope of the study focused more on Super-2 and Super-3.

The researchers also developed a specialized computer program using Visual Basic 2010 which could determine whether a number is Super- d or not, and generate Super- d numbers under 10^7 .

Sources of Data

This study worked on pure basic research design since its focus is on Super- d numbers. The study is a full blown research that utilized efficient exploration on Super- d numbers. The researchers conducted a detailed study through library works and internet

exploration. Results of the study were based on reliable sources such as books in mathematics, internet and huge source on the World Wide Web supported by examples and illustrations.

The researchers created and analyzed the properties of Super- d numbers mainly from books, theses, and the World Wide Web which intensified from relevant studies to the topic.

The researchers conducted extensive studies and readings from published journals and other resources. They browsed the internet for latest publications and discoveries to get updates on the new trends. Supplementing the resources with additional wisdom and knowledge that the researchers know, teachers and friends were also considered sources of data because they shared their knowledge and expertise that contributed a lot for the improvement and reliability of this study.

RESULTS AND DISCUSSION

Additional Properties in Super- d Numbers

Property 1. All positive integers ending with 19 are Super-2 numbers.

Proof:

Let a_{m-1} be any arbitrary number of multiple base 10 where $m \geq 2$.
By definition of Super-2,

$$\begin{aligned} 2n^2 &= 2 \left(\sum_{m=2}^k a_{m-1} 10^m + 19 \right)^2 \\ &= 2 \left[\left(\sum_{m=2}^k a_{m-1} 10^m \right)^2 + 38 \left(\sum_{m=2}^k a_{m-1} 10^m \right) + 361 \right] \\ &= 2 \left(\sum_{m=2}^k a_{m-1} 10^m \right)^2 + 76 \left(\sum_{m=2}^k a_{m-1} 10^m \right) + 722 \end{aligned}$$

The first two terms of the expansion will always be a multiple of 100. Hence, if 722 is added to the first two terms the result will always have a substring of two digits 2. Therefore, all positive integers ending with 19 are Super-2 numbers. ■

Example 1. Let $n = 2319$.

$$\begin{aligned} \text{Then,} \quad 2n^2 &= 2(2,319)^2 \\ &= 2(5,377,761) \\ &= 10,755,522 \end{aligned}$$

The result contains a substring consisting of two digits of 2. Therefore, 2,319 is a Super-2 number.

Property 2. All positive integers ending with 31 are Super-2 numbers.

Proof:

Let b_{m-1} be any arbitrary number of multiple 10 where $m \geq 2$ in the form
By definition of Super-2,

$$\begin{aligned} 2n^2 &= 2 \left(\sum_{m=2}^k b_{m-1} 10^m + 31 \right)^2 \\ &= 2 \left[\left(\sum_{m=2}^k b_{m-1} 10^m \right)^2 + 62 \left(\sum_{m=2}^k b_{m-1} 10^m \right) + 961 \right] \\ &= 2 \left(\sum_{m=2}^k b_{m-1} 10^m \right)^2 + 124 \left(\sum_{m=2}^k b_{m-1} 10^m \right) + 1922 \end{aligned}$$

The first two terms of the expansion will always be a multiple of 100. Hence, if 1922 is added to the first two terms the result will always have a substring of two digits 2. Therefore, all positive integers ending with 31 are Super-2 numbers. ■

Example 2. Let $n = 4,231$.

$$\begin{aligned} \text{Then,} \quad 2n^2 &= 2(4231)^2 \\ &= 2(17,901,361) \\ &= 35,802,722 \end{aligned}$$

The result contains a substring consisting of two digits of 2. Therefore, 4,231 is a Super-2 number.

Property 3. All positive integers ending with 69 are Super-2 numbers.

Proof:

Let c_{m-1} be any arbitrary number multiple of base 10 where $m \geq 2$.
By definition of Super-2

$$\begin{aligned} 2n^2 &= 2 \left(\sum_{m=2}^k c_{m-1} 10^m + 69 \right)^2 \\ &= 2 \left[\left(\sum_{m=2}^k c_{m-1} 10^m \right)^2 + 138 \left(\sum_{m=2}^k c_{m-1} 10^m \right) + 4761 \right] \\ &= 2 \left(\sum_{m=2}^k c_{m-1} 10^m \right)^2 + 276 \left(\sum_{m=2}^k c_{m-1} 10^m \right) + 9522 \end{aligned}$$

The first two terms of the expansion will always be a multiple of 100. Hence, if the 9522 is added to the first two terms the result will always have a substring of two digits 2. Therefore, all positive integers ending with 69 are Super-2 numbers. ■

Example 3. Let $n = 8,669$.

$$\begin{aligned} \text{Then,} \quad 2n^2 &= 2(8,669)^2 \\ &= 2(75,151,561) \\ &= 150,303,122 \end{aligned}$$

The result contains a substring consisting of two digits of 2. Therefore 8,669 is a Super-2 number.

Property 4. All positive integers ending with 81 are Super-2 numbers.

Proof:

Let d_{m-1} be any arbitrary number multiple of base 10 where $m \geq 2$ and all positive integers ending with 81.

By definition of Super-2,

$$\begin{aligned} 2n^2 &= 2 \left(\sum_{m=2}^k d_{m-1} 10^m + 81 \right)^2 \\ &= 2 \left[\left(\sum_{m=2}^k d_{m-1} 10^m \right)^2 + 162 \left(\sum_{m=2}^k d_{m-1} 10^m \right) + 6561 \right] \\ &= 2 \left(\sum_{m=2}^k d_{m-1} 10^m \right)^2 + 324 \left(\sum_{m=2}^k d_{m-1} 10^m \right) + 13,122 \end{aligned}$$

The first two terms of the expansion will always be a multiple of 100. Hence, if 13,122 is added to the first two terms the result will always have a substring of two digits 2. Therefore, all positive integers ending with 81 are Super-2 numbers. ■

Example 4. Let $n = 1281$.

$$\begin{aligned} \text{Then,} \quad 2n^2 &= 2(1,281)^2 \\ &= 2(1,640,961) \\ &= 3,281,922 \end{aligned}$$

The result contains a substring consisting of two digits of 2. Therefore, 1,281 is a Super-2 number.

Property 5. The sum of three consecutive Super-2 numbers ending with 19, 31, 69, and 81 is also a Super-2 number.

Proof:

Four cases will be considered. Let a_{m-1} , b_{m-1} , c_{m-1} , and d_{m-1} be any positive integer. Then, let

$$\begin{aligned} & \sum_{m=2}^k a_{m-1} 10^m + 19; \\ & \sum_{m=2}^k b_{m-1} 10^m + 31; \\ & \sum_{m=2}^k c_{m-1} 10^m + 69; \text{ and} \\ & \sum_{m=2}^k d_{m-1} 10^m + 81; \text{ where } k \geq 2, \end{aligned}$$

be the integers that ends with 19, 31, 69 and 81 respectively.

Case 1: If a number is the sum of Super-2 numbers ending with 19, 31, and 69, then

$$\begin{aligned} n &= \sum_{m=2}^k a_{m-1} 10^m + 19 + \sum_{m=2}^k b_{m-1} 10^m + 31 + \sum_{m=2}^k c_{m-1} 10^m + 69 \\ &= \sum_{m=2}^k (a_{m-1} + b_{m-1} + c_{m-1}) 10^m + 119 \end{aligned}$$

The first term will always be a multiple of 100. Hence, if 119 is added, then n will always end with 19. Therefore, by property 1, the sum is also a Super-2 number.

Case 2: If the number is the sum of Super-2 numbers ending with 31, 69 and 81, then

$$\begin{aligned} n &= \sum_{m=2}^k b_{m-1} 10^m + 31 + \sum_{m=2}^k c_{m-1} 10^m + 69 + \sum_{m=2}^k d_{m-1} 10^m + 81 \\ &= \sum_{m=2}^k (b_{m-1} + c_{m-1} + d_{m-1}) 10^m + 181 \end{aligned}$$

The first term will always be a multiple of 100. Hence, if 181 is added, then n will always end with 81. Therefore, by property 4, the sum is also a Super-2.

Case 3: If the number is the sum of Super-2 numbers ending with 69, 81 and 19, then

$$\begin{aligned} n &= \sum_{m=2}^k c_{m-1} 10^m + 69 + \sum_{m=2}^k d_{m-1} 10^m + 81 + \sum_{m=2}^k a_{m-1} 10^m + 19 \\ &= \sum_{m=2}^k (c_{m-1} + d_{m-1} + a_{m-1}) 10^m + 169 \end{aligned}$$

The first term will always be a multiple of 100. Hence, if 169 is added, then n will always end with 69. Therefore, by property 3, the sum is also a Super-2.

Case 4: If the number is the sum of Super-2 numbers ending with 81, 19 and 31, then

$$\begin{aligned}
n &= \sum_{m=2}^k d_{m-1} 10^m + 81 + \sum_{m=2}^k a_{m-1} 10^m + 19 + \sum_{m=2}^k b_{m-1} 10^m + 31 \\
&= \sum_{m=2}^k (d_{m-1} + a_{m-1} + b_{m-1}) 10^m + 131
\end{aligned}$$

The first term will always be a multiple of 100. Hence, if 131 is added, then n will always end with 31. Therefore, by property 2, the sum is also a Super-2.

By exhausting all cases, the property has been proven. ■

Example 5. Let 469, 481, and 519 be the three consecutive Super-2 numbers that ends with 19, 31, 69, and 81.

The sum is,

$$n = 469 + 481 + 519 = 1,469$$

Let $n = 1,469$.

Then,

$$\begin{aligned}
2n^2 &= 2(1469)^2 \\
&= 4,315,922
\end{aligned}$$

Since, the result has a substring of two digits 2; therefore, the sum must also be a Super-2 number.

Property 6. The sum of five consecutive Super-2 numbers ending with 19, 31, 69 and 81 is also a Super-2 numbers.

Example 6. Let 469, 481, 519, 531, and 569 be the five consecutive Super-2 numbers that ends with 19, 31, 69, and 81.

The sum is,

$$n = 469 + 481 + 519 + 531 + 569 = 2,569$$

Let $n = 2,569$.

Then,

$$\begin{aligned}
2n^2 &= 2(2569)^2 \\
&= 13,199,522
\end{aligned}$$

Since, the result has a substring of two digits 2; therefore, the sum must also be a Super-2 number.

A similar proof with property 5 and property 6 is shown below for properties 7, 8 and 9.

Property 7. The sum of seven consecutive Super-2 numbers ending with 19, 31, 69 and 81 is also a Super-2 numbers.

Example 7. Let 469,481, 519, 531,569, 581,and 619 be the seven consecutive Super-2 numbers that end with 19, 31, 69, and 81.

The sum is,

$$n = 469 + 481 + 519 + 531 + 569 + 581 + 619 = 3,769$$

Let $n = 3,769$.

Then,

$$\begin{aligned}
2n^2 &= 2(3769)^2 \\
&= 28,410,722
\end{aligned}$$

Since, the result has a substring of two digits 2; therefore the sum must also be a Super-2 number.

Property 8. The sum of nine consecutive Super-2 numbers ending with 19, 31, 69 and 81 is also a Super-2 numbers.

Example 8. Let 469,481, 519,531,569,581,619,631 and 669 be the nine consecutive Super-2 numbers that ends with 19, 31, 69, and 81.

The sum is,

$$n = 469 + 481 + 519 + 531 + 569 + 581 + 619 + 631 + 669 = 5,069$$

Let $n = 5,069$

Then,
$$2n^2 = 2(5069)^2 = 51,389,522$$

Since, the result has a substring of two digits 2; therefore, the sum must also be a Super-2 number.

Property 9. The sum of 11 Consecutive Super-2 numbers ending with 19, 31, 69 and 81 are also a Super-2 numbers.

Example 9. Let 469,481, 519,531,569,581,619,631,669,681 and 719 be the nine consecutive Super-2 numbers that ends with 19, 31, 69, and 81.

The sum is,

$$n = 469 + 481 + 519 + 531 + 569 + 581 + 619 + 631 + 669 + 681 + 719$$

$$n = 6,469$$

Let $n = 6,469$.

Then,
$$2n^2 = 2(6,469)^2 = 83,695,922$$

Since, the result has a substring of two digits 2; therefore, the sum must also be a Super-2 number.

Observation 1. As observed from the properties above, if the added number of odd consecutive Super-2 numbers ending with 19, 31, 69, and 81 increases, the sum always end with the numbers 19,31,69, and 81 which was shown in property 1 to 4 are also Super-2 numbers.

The following conjecture is due to A. Anderson:

Conjecture (Anderson). All numbers ending in 471, 4710, 47100 are Super-3 numbers.

Property 10. All positive integers ending with 471 are Super-3 numbers.

Proof:

Let e_{m-2} be any arbitrary number multiple of base 10 where $m \geq 3$ and all positive integers ending with 471 in the form

By definition of Super-3,

$$n = \sum_{m=3}^k e_{m-2} 10^m + 471$$

By substitution,

$$3n^3 = 3 \left(\sum_{m=3}^k e_{m-2} 10^m + 471 \right)^3$$

$$\begin{aligned}
&= 3 \left[\left(\sum_{m=3}^k e_{m-2} 10^m \right)^3 + 1,413 \left(\sum_{m=3}^k e_{m-2} 10^m \right)^2 + 665,523 \left(\sum_{m=3}^k e_{m-2} 10^m \right) \right. \\
&\quad \left. + 104,487,111 \right] \\
&= 3 \left(\sum_{m=3}^k e_{m-2} 10^m \right)^3 + 4,239 \left(\sum_{m=3}^k e_{m-2} 10^m \right)^2 + 1,996,569 \left(\sum_{m=3}^k e_{m-2} 10^m \right) \\
&\quad + 313,461,333
\end{aligned}$$

The first three terms of the expansion will always be a multiple of 1000. Hence, if 313,461,333 is added to the first three terms the result will always have a substring made of three digits 3. Therefore, all positive integers ending with 471 are Super-3 numbers. ■

Example 10. Let $n = 23,471$

$$\begin{aligned}
\text{Then, } 3n^3 &= 3(23,471)^3 \\
&= 3(12,929,888,516,111) \\
&= 38,789,665,548,333
\end{aligned}$$

The result contains a substring consisting of three digits 3. Therefore 23,471 is a Super-3 number.

Definition 2. *Repdigits* are the representation in base B of the number $x \left(\frac{B^y-1}{B-1} \right)$ where $0 < x < B$, is the repeated digit and y is the number of repetitions.

For example, 888 in base 10 is

$$x \left(\frac{B^y-1}{B-1} \right) = 8 \left(\frac{10^3-1}{10-1} \right)$$

Observation 2. All Repdigits in the form

$$n = 3 \left(\frac{10^y - 1}{10 - 1} \right), \text{ where } y > 2$$

are Super-2 numbers.

Proof.

As observed in the table in APPENDIX H, as the number of y repetitions of the digit 3 in n increases, the repetition of the digits 2 and 7 also increases. The result is always in the form.

$$\begin{aligned}
2n^2 &= 2 \left[3 \left(\frac{10^y-1}{10-1} \right) \right]^2 \\
&= 2 \left[\left(\frac{10^{y-1}-1}{10-1} \right) \right] 10^{y+1} + 10^y + 7 \left(\frac{10^{y-1}-1}{10-1} \right) 10^{y-2} + 8, \text{ where } y > 2
\end{aligned}$$

If the last three terms are added to the first term, the result will always have a substring made of two digits 2. Therefore, the Repdigits is a Super-2 number. ■

More Observations

1. Some palindromic numbers are Super- d numbers.

As defined, Palindromic number is a number that remains the same when its digits are reversed.

For example, let $n = 454$ be a palindromic number.

Applying the formulate for Super-2,

$$\begin{aligned}
2n^2 &= 2(454)^2 \\
&= 412232
\end{aligned}$$

Hence, $n = 454$ is a Super-2 number.

2. All positive integers beginning with 105 and 106 are also Super-2 numbers.

Example, let $n = 1051$.

By definition of Super-2,

$$(1) \quad 2n^2 = 2(1051)^2 \\ = 2209202$$

Let $n = 10632$

By definition of Super-2,

$$(2) \quad 2n^2 = 2(10632)^2 \\ = 226078848$$

3. All positive integers beginning with 333 are Super-2 numbers.

Example, let $n = 33367$

By definition of Super-2,

$$2n^2 = 2(33367)^2 \\ = 2226713378$$

Super- d Numbers Calculator and Verifier

Using all the collected data on how to list and determine Super- d numbers, the researchers, with the aid of a computer programmer, developed a computer program on Super- d . This program uses the computer software Visual Basic 2010. The program, On Super- d can generate Super-2 to Super-9 numbers up to 10^7 . The program uses the same process as the manual computation in generating Super- d numbers. The other program will verify whether a number is a Super- d number or not.

CONCLUSIONS

After some observations on Super- d numbers, these are the conclusions of the study:

1. As observed in the properties 1 through 5, larger Super- d numbers can be generated using the existing smaller Super- d numbers.
2. The program created by the researchers could compute Super- d numbers up to 10^7 .

RECOMMENDATIONS

After understanding the extensive study of Super- d numbers, the researchers have come up with the following recommendations:

1. Future researchers may continue to find additional properties and propositions like the following:

- a) All positive integers beginning with 333 are Super-2 numbers;
 - b) All positive integers beginning with 105 and 106 followed by integers are Super-2;
 - c) Continue formulating properties and theorems for Super-4 up to Super-9.
2. Give more applications in other fields such in recreational in mathematics.
 3. Administrators, instructors, students and other staff of the university may use the program that the researchers developed for them to introduce Super- d numbers in Number Theory.

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On Weird Numbers

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ABSTRACT

A weird number n is a positive integer for which the sum of all proper divisors of n is greater than the number n itself, and there is no subset of proper divisors that will sum up to n . Simply, weird numbers are abundant numbers but not pseudoperfect. This research mainly dealt with the formulation of algorithm that can generate all known weird numbers. It also focused on the construction of potential properties and determination of applications to other fields of mathematics and in real-life situations. In addition, the researchers developed a computer program using Python programming language that served three functions: (1) to verify whether a specified number is a weird number or not, given a certain range; (2) enumerate weird numbers given an interval; and (3) list distinct weird numbers when integers are divided by numbers 2 to 11.

Keywords: *abundant numbers, pseudoperfect numbers, Python programming language, weird number applications, weird numbers*

INTRODUCTION

Situational Analysis

“Mathematics is the key and the door to the Sciences.”

-Galileo Galilei

Mathematics is inevitable. It is an indispensable field of study to mankind. It is the science that deals with logic, shape, quantity and arrangement. It may be described as the fundamental science that uses numbers and symbols which are arranged using systematic mathematical rules. It may also be defined as “the study of relationships among quantities, magnitudes, and properties that may be deduced” (Microsoft Encarta Encyclopedia).

Number Theory, is a field of Mathematics considered by Carl Friedrich Gauss as the “Queen of Mathematics”. It is also termed as higher arithmetic consisting of the study of the properties of natural

numbers or counting numbers. It is a limitless and such an exciting branch of mathematics that desires to explore new and fascinating numbers. Distinct properties and special patterns can be studied from time to time. Mathematicians, especially the number theorists, proved the existence of number patterns that are fun to work on. Some of which are abundant numbers, cyclic numbers, powerful numbers and many others. Aside from these, a lot more numbers can be discovered and studied, one of which is the set of numbers known as weird numbers.

A natural number n is called abundant if the sum of all its proper divisors is greater than the number n itself. Number 12, for example, is said to be the smallest abundant number. The proper divisors of 12 are 1, 2, 3, 4 and 6; the sum of

all its proper divisors is 16 which is greater than 12. On the other hand, a natural number n is called pseudoperfect (or semiperfect) if there exists a subset of the proper divisors of n that would sum up to itself. For example, 18 is a pseudoperfect number because a subset of the proper divisors e.g. $\{3, 6, 9\}$ sum up to the number 18. From these two definitions, the definition of weird numbers can be drawn. A natural number n is said to be a weird number if the sum of all the proper divisors of n is greater than the number n , and at the same time, no subset of the proper divisors would sum up to the number n itself. Thus, a number n is said to be weird if it is abundant without being pseudoperfect. To see this, let A and B , be the sets of abundant numbers and pseudoperfect numbers, respectively. The difference between A and B , denoted by $A - B = \{x/x \in A \text{ and } x \notin B\}$ is the set of all elements in B that are not in A . This set is the set of weird numbers as shown in Figure 1. The term “weird” by the way, has been introduced by Benskoski in 1972.

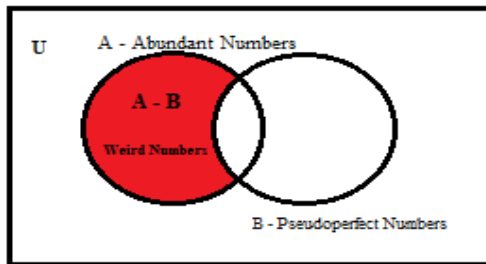


Fig. 1. Venn diagram for the set of Weird Numbers, $A - B$

The smallest known weird number is 70. As one can see, the set of proper divisors of 70 is $\{1,2,5,7,10,14,35\}$ and the sum of all these divisors is 74 which is greater than 70. Moreover, there is no subset of the proper divisors that would add up to 70. The first few weird numbers indexed as sequence A006037 in the On-line Encyclopedia of Integer Sequences (OEIS) database are 70, 836, 4030, 5830, 7192, 7912, 9272, 10430, 10570, 10792, 10990,

11410, 11690, 12110, 12530, 12670, 13370, 13510, 13790, 13930, 14770, ... etc.

Sidney Kravitz, in 1976, obtained the 53-digit primitive weird number $n = 2.55 \times 10^{57}$ using the formula $n = 2^{k-1} QR$, where k is a positive integer, Q is a prime and $R = \frac{2^k Q - (Q+1)}{(Q+1) - 2^k}$ is a prime (Weisstein, 2005). Here, Kravitz used $k = 57$, $Q = 153722867280912929$ and $R = 230543009213693951$ to obtain the value of $n = 2.55 \times 10^{57}$ (Iannucci, 2015). As an update, in 2013, mathematics students at Central Washington University have broken Kravitz' record by discovering the largest primitive weird number which is 1, 304, 478, 802, 221, 037, 336, 898, 806, 955, 880, 590, 950, 108, 213, 611, 184, 211, 428, 152, 436, 309, 358, 286, 058, 099, 789, 749, 839, 735, 498, 620, 012, 494, 920, 476, 023, 972, 998, 095, 015, 247, 872 comprising of 127 digits (KIMA, 2013). Kravitz' formula has been their basis in discovering this largest primitive weird number. Meanwhile, one of the open problems raised by Paul Erdos and Stanley Benkoski in the '70s is the existence of odd weird numbers, whereas, the former even offered \$10 for the existence of the first odd weird number and \$25 for a proof that none exists. Recently, there have been no claims for the existence of odd weird numbers less than 1.8×10^{19} (Feng, 2013).

In line with the above-mentioned facts, the researchers focused on this topic mainly because it is interesting. Considering the fact that from 1 up to 10,000 integers, only 7 weird numbers are named as seen in the OEIS. Kravitz' formula cannot therefore generate all known weird numbers. To address this, the researchers established an algorithm as an alternative way to generate weird numbers in general. Moreover, by analyzing the definition and existing properties of weird numbers, new potential properties were formulated, which contributes to the development of new knowledge about this kind of numbers, and

the improvement in learning mathematics as well. In addition, a computer program was created that can (a) verify whether a specified number is a weird number or not,

given a certain range; (b) enumerate weird numbers given an interval; and (c) list distinct weird numbers when integers are divided by numbers 2 to 11.

Statement of Objectives

This research specifically aims to:

1. formulate an algorithm for finding weird numbers;
2. find new potential properties of weird numbers;
3. determine applications of weird numbers to other fields of Mathematics and in real life situations; and

4. develop a computer program using Python programming language that serves the following functions:
 - a. verify a specified number if it is a weird number or not, given a certain range;
 - b. enumerate weird numbers given an interval; and
 - c. list distinct weird numbers when integers are divided by numbers 2 to 11.

METHODOLOGY

Research Design

This study on weird numbers is considered as a pure basic research based on descriptive design. Related studies about weird numbers were analyzed, and intensive library hopping and internet searching were done in order to provide valuable answers to their stated objectives.

Sources of Data

The vast information about weird numbers from the World Wide Web is the foremost source of the researchers. Specifically, the Online Encyclopedia for Integer Sequences (OEIS) provided the researchers a list of weird numbers. Online

journals like those of Pajunen, Ianucci, Melfi and Benkoski, were studied to get some more ideas in formulating the algorithm to generate weird numbers and to derive new properties about the numbers.

As to the computer program being developed, the researchers studied some tutorials from YouTube about Python programming language and other online sources. Friends and computer programmers who have knowledge about the language were also consulted to ensure a better output of the developed computer program. Finally, secondary sources like books in Number Theory and related fields were also used as sources of information for this study.

RESULTS AND FINDINGS

1) An Algorithm for Finding Weird Numbers

Since the researchers observed that the formula presented by Sidney Kravitz can only generate some of known weird numbers, a new algorithm is then created to determine whether the given number is weird or not. It can also be used to find the set of weird numbers from a given range. This algorithm was also used to create a computer program using the Python programming language.

2) Derived Properties of Weird Number

Property 1. If n is primitive weird number, then n^2 is not weird number.

Property 2. If n is a weird number but not primitive, then n^2 is not weird number.

Property 3. Weird numbers are not powers of 2.

Property 4. A weird number is a polite number.

Property 5. Not all polite numbers are weird numbers.

Property 6. A weird number can be drawn using a series of dots that forms of a trapezoid.

Property 7. Weird numbers from 1 to 500000 are not multiples of 3.

Property 8. Weird numbers from 1 to 500000 have remainders 2 and 4 modulo 6.

Property 9. The abundancy index of weird numbers, $I(n)$ is $2.00 < I(n) < 2.08$.

3.) Applications of Weird Numbers

Weird numbers have real life applications that can contribute in the society. Weird numbers can be used in (1) personal passwords, (2) concept of game, (3) cryptography, (4) telecommunications and (5) modular designs.

4.) The Created Main Computer Program

The created computer program used the computer software PyCharm Community Edition 2016.3 with Python as the programming language. Basically, the developed program served three main functions: (a) to verify whether a specified number is a weird number or not, given a certain range; (b) enumerate weird numbers given an interval; and (c) list distinct weird numbers when integers are divided by numbers 2 to 11.

CONCLUSIONS

1. The formulated algorithm for finding weird numbers plays an important role in this study for it can generate all known weird numbers.
2. There are nine potential properties of weird numbers established by the researchers provided with proofs and examples.
3. There are five applications of weird numbers that were determined. These are (1) as personal passwords, (2) as concept of game, (3) in cryptography,
- (4) in telecommunications and (5) in modular designs.
4. The formulated algorithm is also an essential part in the development of computer program which creates three important functions 1) validates a certain number whether it is weird or not 2) generates a list of weird numbers from a certain interval, and 3) generates a list of distinct weird numbers when they are divided from 2 to 11.

RECOMMENDATIONS

1. Future researchers may improve the formulated algorithm presented in this research. A new algorithm may be created to generate weird numbers.
2. Weird number patterns seemed to be rare because of a large gap between two weird numbers, so the researchers recommend to find more potential properties about weird numbers including the patterns formed by the gaps, density and other properties.
3. Future researchers may find applications of weird numbers in other fields of Mathematics and they may improve the developed Weird Game using other programming languages.
4. The developed program can generate a list of weird numbers from a larger interval; however, when it runs, the process become slow so it will take an hour or more to come up with the result. Future researchers may improve it using highly upgraded computer software. Subsequently, the process will become faster.
5. Future researchers may conduct a study about primitive weird numbers.
6. Future researchers may perform study on the following topics related to weird numbers:
 - a) Polite Numbers,
 - b) Trapezoidal Numbers,
 - c) Abundant Numbers, and
 - d) Pseudoperfect Numbers

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Properties of Graphs Generated by Prime Knots

Alison D. Paling, Elmer R. Rosimo, and Prievelyn N. Serrana and Ronald L. Aquino

ABSTRACT

This research dealt with the different concepts in graph theory and on prime knots. It developed properties, a proposition and an algorithm based on observations on the existing concepts on knot theory and graph theory. The researchers deeply analyzed the topic to come up with a method that creates a graph from prime knot and vice-versa. Through this, the researchers observed different properties and a proposition that future researchers can use in creating higher crossing numbers of prime knot through the faces, vertices and edges of the given graph. The study provides future researchers with additional tools and knowledge required in conducting further research in graph theory and knot theory.

Keywords: *Prime knots, graphs, regular projection, and graph $P_{H,i}$*

INTRODUCTION

Situation Analysis

Mathematics is everywhere, but sometimes it is not seen by the naked eyes because it remains as an idea in a person's mind. It has a very big contribution to people's daily lives in the fields of: mobile devices, architecture (ancient or modern), art, money, engineering and even in sports.

From the beginning of recorded history, mathematics has a very big part because it became the forefront of every civilized society. It was in use in even the most primitive of cultures. The needs of math arose based on the wants of society. The more complicated the society is, the more complicated the mathematics needs (Hom, 2013).

As such, graph theory is the study of points and lines. In relation to this, it involves vertices, the ways in which sets of points can be connected by edges in the form of lines or curves, called graphs. Graphs are also classified according to their qualities or properties; the number of edges allows connection of two vertices. Rules can be stated as theorems in various sets of rules resulting in specific

properties that can be stated as theorems (Rouse, 2005).

Topology is the mathematical study of the properties that are preserved through deformations, twisting and stretching of objects but tearing is not allowed, Weisstein (as cited in Wolfram Math World, 2016). When topology emerged as a part of Geometry, it dealt with metric properties of shapes, angles and distances (Bogomolny, 2016).

Everyone knows how to create a knot. People do this all the time, but sometimes they do it unknowingly. Perhaps some of them say that knot is just for tying a shoe lace, for laundry and many more, but most of them do not know that if they glue the ends together, they will form a subject in the field of mathematics, so called knot theory. It deals with defining the different kinds of knots that consist of different shapes and forms which can be defined as graphs to be used on some topics on Graph theory (Bogomolny, 2016).

A knot is called prime if, in any decomposition of the knot as a connected sum,

one of the factors is unknotted, Weisstein (as cited in Wolfram Math World, 2016). A knot which is not a prime is a composite knot (Schubert, 1949). Combinations of two prime knots to create two different composite knots are possible, but it depends on the orientation of the two prime knots. This shows that every knot can be decomposed (up to the order in which the decomposition is performed as a knot sum of prime knots), Weisstein (as cited in Wolfram Math World, 2016).

Knot theory is an appealing subject because the objects studied are familiar in every physical space. Although the subject matter of knot theory is familiar to everyone and its problems are easily stated, arising not only in many branches of mathematics but also in such diverse fields as biology and chemistry it is often unclear how to apply mathematical techniques even to the most basic problems (De Santi, 2002).

Knot theory in terms of biology deals within very big contribution in the DNA of a

Objectives of the Study

This study, with regards to the properties and theorems usually seen in Graph theory and Knot theory, had the following objectives:

METHODOLOGY

Research design

This study is a pure basic research under the descriptive research design, with extreme focus on properties of graph generated by prime knots that will create information on how different topics in graph theory will relate on the graphs generated by prime knots. It aimed to show properties of graph using the different properties and theorem on knot theory. This study used different theorems to prove some different properties of the graphs generated. New application to real life situation and in other fields of sciences just like in biology,

person. In the DNA packing and unpacking, and enzymatic reaction converts DNA strands to knots, link strands, or a more orderly form. Knot theory is able to help the scientists to find out the mechanisms by which these enzymes work (M.Beals, L.Gross, S.Harrell, 1999).

Knot theory gives a big impact in chemistry because the atoms of a chemical move in way that it forms a knot. Knot theory can help chemists to determine different kinds of elements (Lim, N. C.H. & Jackson, S.E.(2015)). Knots are also associated to music. In the Chinese traditional music, the Jasmine

Flower uses different melodies, various keys, time signature, instrument and emotions. Using different tools for sounds it can arrange in the shape of prime knots for example is the Jasmine Flower (MoLiHua) (Chou, S. (n.d))

Hence, this study give clarification on some property of knots by analyzing its generated graph to get properties, using some property and basic concepts of Graph theory by applying its theorems.

1. To come up with the properties from the generated graphs.
2. To create a method on how to form graphs from knots and vice versa
3. To present new application in real life situation and other fields

chemistry and music were also outputs in the research based on the concepts and theories presented.

Sources of Data

The data used in this study were gathered from textbooks, journals, magazines, the internet, Microsoft Office Word application, and unpublished materials whose results are on; prime knots, knot theory and general graph theory. Teachers with the vast knowledge about this field of study and graphs generated from prime knots were also consulted to verify and discuss the results produced in this research.

RESULTS AND FINDINGS

With analysis and study of different topics on graph theory and knot theory, the following were obtained:

1. Properties and Observed Patterns on the Graph Generated

The next section shows the following properties and observed patterns on the graphs generated and produced in this study.

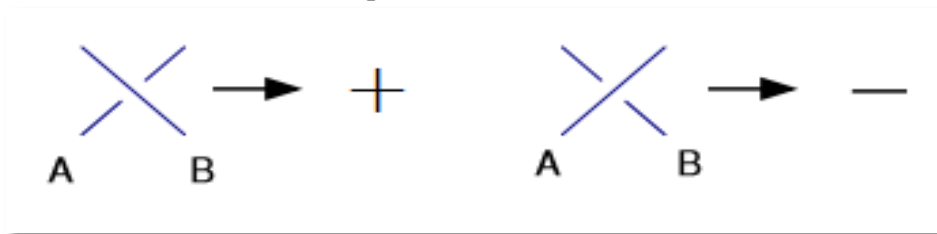
These are the properties that were observed in this research:

1. Graphs created from the regular projection of prime knots are planar graphs.
2. Graphs generated from prime knots are closed and bounded.
3. All graphs generated from prime knots with odd number crossings and subscript 1 are cycle graphs.
4. Every vertex of generated graph from prime knots except unknot (0_1) has a degree of at least 2.
5. Some graphs generated by prime knots are either Eulerian or Semi-Eulerian.
6. Graphs generated by prime knots are Hamiltonian or semi-Hamiltonian graphs.
7. The vertices of the graphs generated by prime knots are k-colorable.

These are the observed patterns on the graphs generated in this research:

1. Graphs generated from prime knots have a pattern where $v - e + f = 2$, where $n \geq 3$.

2. Method on How to Form Graphs from Knots and Vice versa



This figure will help the readers to label the signs of the prime knots.

These are the different methods on how to form graphs from prime knots

Methods using only one sign for the crossing points for the Alternating Prime Knots

1. Labelling of corresponding signs on the crossing points of a prime knot.

2. Using the Jordan Curve Theorem, the plane is divided into several regions that can be colorable into white for the unbounded and blue for the bounded regions. These can be used in the next step in plotting the vertex of the graph.
3. Vertices are the bounded regions. In plotting the vertices,

it must be beyond the shaded area or the bounded regions of the knot.

4. Connect the vertex that must pass across the crossing point off the knot projection. The white faces remain unbounded.

Methods for the non-Alternating Prime Knots

1. Label signs in all crossing points of the knots.
2. Look for the bounded regions of the knots using Jordan Curve Theorem, and then plot the vertices in the center of the bounded regions.
3. Connect the vertices. The edge that connects the vertices must

5. After accomplishing the steps, graph $P_{H,i}$ is then generated with a sign.

pass the crossing points of the knot.

4. In the graph generated, the signed label in the knots must go with the generated graphs. The label can be used in converting the graph into a prime knot.

These are the methods in generating prime knots from graphs

1. Identify the graph that is to be restored.
2. Plot cross signs in every edge since there is a crossing sign in the graph. Use the given symbol for the crossing type.
3. Connect the ending of the crossings around the vertex of the graph.

4. Upon following the steps, the regular projection of the prime knot will be generated
5. Create the prime knot based on its regular projection and by following the rules on signs regarding each other.

3. Application in Real Life Situation

The graphs generated may create possible graphs from prime knots with higher number of crossings. Using the method on generating graphs from prime knots and vice

versa, the properties of the graphs can be used to draw a graph that can generate a higher number of crossing counts. Also, prime knots have the property to generate planar graphs. In order to generate a planar graph, the knots to be drawn must be closed.

CONCLUSIONS

After a study on graphs generated by prime knots the researchers have concluded that:

1. The graphs generated have different properties and observed patterns that can help researchers to classify the graphs generated from prime knots if it is Hamiltonian or Semi-Hamiltonian and if it is Eulerian, Semi-Eulerian or neither Eulerian.

2. Researchers have formulated methods on how to form graphs from prime knots and vice versa. The methods that the researchers created are utilized from Tait's former method.
3. Prime knots have different applications in different fields of science but it is greatly applied in the field of Mathematics.

RECOMMENDATIONS

Based on the study on the graphs generated from the projection of prime knots, the following are recommended;

1. Future researchers may use the gathered data for their study in higher prime knots.
2. Programmers may use the method in this study in creating an algorithm in generating graphs from prime knots.

3. Students may explore the world of composite knots.

4. Researchers may create a method to generate graphs from composite knots.

5. Future researchers can create a tool in making prime knots of their own.

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Solving Circular Sudoku Puzzles Using Graph Coloring

Nancy G. Bautista, Bryan Jay D. Cabalbag, Emmanuel C. De Guzman
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ABSTRACT

This research dealt mainly with solving Circular Sudoku puzzles by using properties of graph coloring. These properties were discussed thoroughly through proofs, illustrations and examples. A complete discussion of the steps in solving Circular Sudoku puzzles through graph coloring was also presented. Descriptive research, specifically pure math research was employed to come up with the properties of graph coloring and the strategy in solving Circular Sudoku puzzles by using these properties.

The similarities of graph coloring and Circular Sudoku are evident. In graph coloring, no two adjacent vertices share the same color while in Circular Sudoku puzzles, no cells in the same concentric circles (C) or spokes (S) have the same number. Also, the researchers developed a computer program using Visual Basic 6.0, which can solve the Circular Sudoku puzzles using graph coloring.

Keywords: *Chromatic number, circular sudoku puzzle, concentric circles, graph coloring, spokes*

INTRODUCTION

Situation Analysis

Mathematics is the science that deals with the logic of shape, quantity and arrangement. It is a building block for everything in daily lives, including mobile devices, architecture, art, money, engineering, event spots, etc. (Hom, 2013). Today, every person needs at least a familiarity with the knowledge of mathematics, particularly in logical thinking and problem-solving skills.

Graph theory is among the areas in mathematics that catches the interests of the researchers. It is a branch of mathematics concerned with the networks of points connected by lines. The subject Graph Theory had its beginnings in recreational mathematics problems, but it has grown into a significant area of mathematical research with applications in chemistry, operations research, social sciences, and computer science (Carlson, 2016). As highlighted by Singleton (2007), "Graph theory can help one understand games, hierarchies, networks, family trees, food webs, flow charts, algorithms, trains of

thought, just about anything you can think of".

Graph coloring is one of the best known, popular and extensively researched subjects in the field of graph theory. (Formanowicz & Tanas, 2012). In its simplest form, it is a way of coloring the vertices of a graph known as the vertex coloring, such that no two adjacent vertices share the same color. Chromatic number of a graph is the minimum number of different colors required for a proper vertex coloring (Gross & Yellen, 2006).

Sudoku puzzle is defined as a logic-based, number placement puzzle (Murphy, 2011). To solve the puzzle, one needs to exert effort, concentration and patience just like one's life battles. Sudoku is good and beneficial for all ages. It improves the memory, stimulates the mind, teaches how to think quickly and efficiently, and increases the concentration of the player for higher IQs (Marina, 2013).

Meanwhile, Circular Sudoku puzzle as the name implies, is a Sudoku based puzzle, but one that is played on a circular grid rather than the orthodox square shaped

grid. There are two regions, the spokes (S) and the concentric circles (C). Usually the aim of Circular Sudoku is to place the numbers 1 to n into each of the concentric circle in the puzzle, and also in each of the spokes that the puzzles are split into. Then, the puzzles have a rule of non-adjacency in them, saying that a number may not have consecutive values to the cells around it (Media, 2017).

With a standard Circular Sudoku, the rules that apply to solve the puzzle are exactly the same as with ordinary Sudoku. However, it is trickier to apply the rules when looking along straight lines as with an orthodox Sudoku Puzzle grid. Thus, the researchers became interested in studying graph coloring in solving Circular Sudoku

Statement of the Problem

The main objective of this study is to solve Circular Sudoku puzzles by using graph coloring. Specifically, the researchers aimed to answer the following problems:

1. What properties of graph coloring can be applied in solving Circular Sudoku puzzles?

METHODOLOGY

Research Design

The study utilized a descriptive research method, specifically pure research design in order to analyse and explore solving Sudoku puzzles by using the graph coloring. Results were utilized to develop a computer application that would solve the Circular Sudoku puzzles involving the graph coloring.

The different observable properties and algorithms regarding that of graph coloring were used and implemented in producing new techniques on how to solve Circular Sudoku puzzles. To reinforce the results of this study, the researchers used mathematics books, published papers, internet sources, and especially their knowledge in the field of graph theory.

puzzles and not the usual square-shaped Sudoku, because the normal Sudoku is very common. The above concepts provided motivation for the researchers to conduct this study.

This research aimed to level up the interest of those who play Sudoku puzzles and to encourage other people to play Circular Sudoku by applying the concepts of graph coloring. The researchers' intention is to come up with an alternative way of solving Sudoku puzzles which is through using graph coloring. The knowledge of the researchers, including the concepts of graph coloring was used in coming up with the new techniques in solving Circular Sudoku puzzles.

2. What strategy can be devised in solving Circular Sudoku puzzles by using graph coloring?
3. What computer program can be developed to solve Circular Sudoku puzzles by applying graph coloring?

Furthermore, a computer program was created to solve Circular Sudoku puzzle in a more convenient manner. This computer program was created using Visual Basic 6.0.

Sources of Data

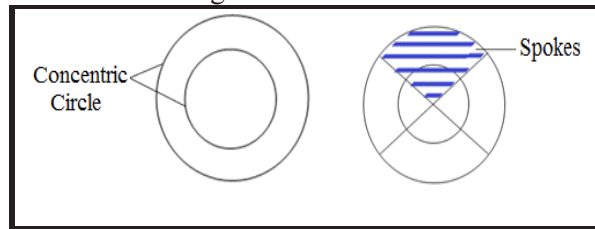
The concepts on the analysis of Circular Sudoku puzzles using graph coloring and the development of the computer program that generate them were studied through pure research. Algorithms and conceptual definitions of terms were purely searched from mathematics books, published papers related to the study, and through the help of the internet. The researchers conducted a detailed study, created observable properties through analysis of Circular Sudoku using graph coloring and internet exploration.

The fortitude and knowledge of the researchers including their concepts of graph coloring were used in coming up with the new techniques in solving Circular Sudoku

puzzles and a functional computer program that solve the Circular Sudoku puzzles using the graph coloring.

RESULTS AND DISCUSSION

This study focused on how to solve the Circular Sudoku puzzle using the concepts of graph coloring. The two regions of the Circular Sudoku puzzle are the spokes and the concentric circles. The spokes is a part of the Circular Sudoku puzzle which divides the puzzle starting from the center to the outermost circle. The concentric circle is a part of a Circular Sudoku puzzle which divides the puzzle into Circular regions.



Regions of Circular Sudoku puzzle

To construct a Circular Sudoku puzzle, the following steps are followed:

Step 1. Draw concentric circles with a minimum number of 2, as $C_i = (2, 3, 4, \dots, i)$.

Step 2. Draw the spokes (S) according to the number of concentric circles (C) in step 1.

Step 3. Place the numbers 1 to n into each of the cell of each concentric circles (C) in the puzzle, and also in each of the spokes (S) of the puzzle by taking note that no cells in the same spokes and concentric circle have the same number.

Properties of Graph Coloring applied in Solving Circular Sudoku puzzle

Property 1. The total number of vertices of the graph generated from circular Sudoku is $S \times C$ or $2C^2$ or $\frac{1}{2}S^2$.

Proof:

A Circular Sudoku puzzle contains $S \times C$ number of cells. Since every cell corresponds to a vertex of the graph, then the number of cells in Circular Sudoku is also the number of vertices corresponding in a graph.

Since the total number of vertices generated from Circular Sudoku is $S \times C$, then the number of spokes is always twice the number of concentric circle ($S = 2C$). Substitute the value of $S = 2C$ in $S \times C$. The total number of vertices is also the same as $2C \times C = 2C^2$.

In the same manner, if the number of concentric circles is half the number of spokes ($C = \frac{1}{2}S$) then the total number of vertices is also the same as $\frac{1}{2}S^2$. ■

Example 1. Use the formula $v = S \times C$ to get the total number of vertices in a graph, given the values of S and C .

S	C		$v = S \times C$
4	2	→	$4 \times 2 = 8$ vertices
8	4	→	$8 \times 4 = 32$ vertices

Example 2. Use the formula $v = 2C^2$ to get the same total number of vertices in a graph, given the values of C .

$$\begin{array}{lcl} S & C & \\ 4 & 2 & \rightarrow 2C^2 = 2(2)^2 = 8 \text{ vertices} \\ 8 & 4 & \rightarrow 2C^2 = 2(4)^2 = 32 \text{ vertices} \end{array}$$

Example 3. Use the formula of $v = \frac{1}{2}S^2$ to get the same total number of vertices in a graph, given the values of S .

$$\begin{array}{lcl} S & C & \\ 4 & 2 & \rightarrow \frac{1}{2}S^2 = \frac{1}{2}(4)^2 = 8 \text{ vertices} \\ 8 & 4 & \rightarrow \frac{1}{2}S^2 = \frac{1}{2}(8)^2 = 32 \text{ vertices} \end{array}$$

Property 2. The degree of a vertex, $deg(v)$ of graph generated from Circular Sudoku puzzle is $2C + S - 3$ or $4C - 3$ or $2S - 3$.

Proof:

First, observe that for every given vertex, there are 5 edges connected to it which corresponds to the cells that belong to the same concentric circle or to the same vertical spokes.

Second, the spokes (S) consist of two empty vertices which correspond to two disconnected vertices will be denoted as $S - 2$. Every concentric circles (C) consists of one given vertex, denoted as $C - 1$.

The degree of a vertex v_i will now be equal to the difference between the total number of vertices and to the number of cells which are not connected to the given vertex v_i . Since the vertex v_i is not connected to itself and to the vertices presented above, which are $S - 2$ and $C - 1$,

Then,

$$deg(v_i) = n - [1 + (S - 2)(C - 1)]$$

Substituting $n = S \times C$,

$$= (S \times C) - [1 + (S - 2)(C - 1)]$$

Simplify,

$$\begin{aligned} &= SC - (1 + SC - 2C - S + 2) \\ &= SC - 1 - SC + 2C + S - 2 \end{aligned}$$

Finally,

$$deg(v_i) = 2C + S - 3$$

From Property 1, $S = 2C$ and $C = \frac{1}{2}S$. Substitute these formulas to the derived formula $2C + S - 3$.

Given $S = 2C$, substitute the value of S in the derived formula of $2C + S - 3$. Performing the operation and simplifying the expression will yield to another equation, that is $4C - 3$.

$$\begin{aligned} deg(v_i) &= 2C + S - 3 \\ &= 2C + 2C - 3 \\ deg(v_i) &= 4C - 3 \end{aligned}$$

Given the $C = \frac{1}{2}S$, substitute the value of C in the derived formula of $2C + S - 3$

3. Performing the operation and simplifying the expression will yield to another equation, that is $2S - 3$.

$$deg(v_i) = 2C + S - 3$$

$$= 2\left(\frac{1}{2}S\right) + S - 3$$

$$deg(v_i) = 2S - 3$$

Hence, the following equations $2C + S - 3$ or $4C - 3$ or $2S - 3$ gave the formula to solve the degree of a vertex in the graph generated from Circular Sudoku puzzle. ■

Example 4. Use the first derived formula $deg(v_i) = 2C + S - 3$ to get the degree of a vertex, given the following number of concentric circles (C) and number of spokes (S).

$$S = 4, C = 2 \rightarrow deg(v_i) = 2C + S - 3 = 2(2) + (4) - 3 = 5$$

$$S = 8, C = 4 \rightarrow deg(v_i) = 2C + S - 3 = 2(4) + (8) - 3 = 13$$

Example 5. Use the formula $deg(v_i) = 4C - 3$ to find the degree of a vertex given the following number of concentric circles (C).

$$S = 4, C = 2 \rightarrow deg(v_i) = 4C - 3 = 4(2) - 3 = 5$$

$$S = 8, C = 4 \rightarrow deg(v_i) = 4C - 3 = 4(4) - 3 = 13$$

Example 6. Use the formula $deg(v_i) = 2S - 3$ to find the degree of a vertex given the following number of spokes (S).

$$S = 4, C = 2 \rightarrow deg(v_i) = 2S - 3 = 2(4) = 5$$

$$S = 8, C = 4 \rightarrow deg(v_i) = 2S - 3 = 2(8) = 13$$

Property 3. The graph generated from Circular Sudoku is a regular graph.

Proof:

Property 2 states that, every vertex in a graph involving Circular Sudoku puzzle has an equal degree n , i.e $deg(v) = n$. According to Definition 1, if every vertex have the same degree it is a regular graph. Then all graphs generated from the Circular Sudoku are regular graphs. ■

Example 7.

The graph generated from 4×2 Circular Sudoku puzzle has 8 vertices. Each vertex has a degree of 5.

The graph generated from 8×4 Circular Sudoku puzzle has 32 vertices, each of which has degree 13.

Theorem 1. (Degree Theorem) If G is a graph with m , where m is the number of edges

Then

$$\sum_{i=1}^n deg(v_i) = 2m$$

(Chartrand & Zhang, 2009)

Property 4. The total number of edges of a graph generated from a Circular Sudoku puzzle is equal to half the product of the number of vertices and its degree. In symbol

$$m = \frac{(deg v_i)(n)}{2}, \text{ where } m \text{ is the total number of edges.}$$

Proof:

From the Degree theorem, the total number of edges is half the sum of the degree of every vertex (i.e. $m = \frac{\sum_{i=1}^n deg(v_i)}{2}$). Since all of the graphs generated from

Circular Sudoku puzzles are regular graphs, from Property 3 $m = \frac{(deg v_i)(n)}{2}$. Using

Property 1 and Property 2, the total number of edges (m) is also the same as

$$m = \frac{(deg v_i)(n)}{2} = \frac{(2C+S-3)(S \times C)}{2}$$

$$m = \frac{(deg v_i)(n)}{2} = \frac{(4C-3)(2C^2)}{2}$$

$$m = \frac{(deg v_i)(n)}{2} = \frac{(2S-3)(\frac{1}{2}S^2)}{2}$$

Example 8. Use the formula $m = \frac{(2C+S-3)(S \times C)}{2}$ given the values of S and C , to find the total number of edges.

$$S = 4, C = 2 \rightarrow m = \frac{(2C+S-3)(S \times C)}{2} = \frac{(2(2)+(4)-3)}{2} = \frac{(5)(8)}{2} = 20$$

$$S = 8, C = 4 \rightarrow m = \frac{(2C+S-3)(S \times C)}{2} = \frac{(2(4)+(8)-3)}{2} = \frac{(13)(32)}{2} = 208$$

Example 9. Use the formula $m = \frac{(4C-3)(2C^2)}{2}$ given the value of C , to find the total number of edges.

$$S = 4, C = 2 \rightarrow m = \frac{(4c-3)(2C^2)}{2} = \frac{(4(2)-3)(2(2)^2)}{2} = \frac{(5)(8)}{2} = 20$$

$$S = 4, C = 2 \rightarrow m = \frac{(4c-3)(2C^2)}{2} = \frac{(4(4)-3)(2(4)^2)}{2} = \frac{(13)(32)}{2} = 208$$

Example 10. Use the formula $m = \frac{(2S-3)(\frac{1}{2}S^2)}{2}$ given the value of S , to find the total number of edges.

$$S = 4, C = 2 \rightarrow m = \frac{(2S-3)(\frac{1}{2}S^2)}{2} = \frac{(2(4)-3)(\frac{1}{2}(4)^2)}{2} = \frac{(5)(8)}{2} = 20$$

$$S = 4, C = 2 \rightarrow m = \frac{(2S-3)(\frac{1}{2}S^2)}{2} = \frac{(2(8)-3)(\frac{1}{2}(8)^2)}{2} = \frac{(13)(32)}{2} = 208$$

Property 5. The Chromatic number of the graph derived from a Circular Sudoku puzzle is $\chi(G) = S$.

Proof:

From step 3 in constructing Circular Sudoku puzzles, no two cells on the same concentric circles (C) should share the same number, then the chromatic number $\chi(G)$ in the graph coloring problem is always equal to the number of spokes (S) in the circular Sudoku puzzles.

Example 11. Use the formula $\chi(G) = S$ given the value of S , to find the chromatic number.

$$S = 4, C = 2 \rightarrow \chi(G) = 4$$

$$S = 8, C = 24 \rightarrow \chi(G) = 8$$

A Strategy in Solving Circular Sudoku Puzzles using Graph Coloring

The properties which were previously discussed were used in developing the steps in solving a Circular Sudoku puzzle using Graph Coloring. The steps are as follows:

1. Assign numbers to the cells of the Circular Sudoku. The number will range from v_1 to v_n ($n = S \times C$).
2. Construct a graph by using the numbers assigned to the cells as the vertices.
3. Connect each vertex to the vertices whose numbers are assigned to the same ring or the same diagonal spoke as the given vertex.
4. Determine the number of colors (Chromatic Number, $\chi(G)$) of the graph, that is equal to the number of spokes. Assign a corresponding color to each of the chromatic numbers.
5. Based from the given vertex numbers in the Circular Sudoku problem, fill its corresponding vertex with the colors assigned to the given number.

6. In the graph, assign colors to the uncoloured vertices such that no two adjacent vertices share the same color.
7. Based from the assigned colors to the numbers in step 4, fill each cell in the Circular Sudoku problem with its corresponding vertex number.

Computer Program to Solve Circular Sudoku Puzzles by Applying Graph Coloring

A computer program was created using the Visual Basic 6.0 to solve Circular Sudoku puzzles using graph coloring. The program can only solve 4×2 and 8×4 Circular Sudoku puzzle. The parts of the program and how the program works will be discussed herein.

Step 1. Open the application/ program.

Step 2. Choose either a 4×2 or 8×4 Circular Sudoku, then click “RANDOM” for the program to give random numbers.

Step 3. After choosing random numbers, click “VIEW GRAPH”.

Step 4. After clicking the “VIEW GRAPH”, the program will show the corresponding graph of the given Circular Sudoku puzzle.

Step 5. Choose a vertex by pointing the arrows on the graph of the Circular Sudoku and the colors will appear, then choose one color.

Step 6. Do step 5 repeatedly until all the vertices will be filled with color. As a result, the given Circular Sudoku will also be completed.

CONCLUSIONS

In this study, the researchers discovered different properties of graph coloring related to Circular Sudoku puzzles. Based on the findings, the following are the conclusions:

Here are the conclusions from the study conducted:

1. Solving Circular Sudoku using the graph coloring utilizes the vertices, degree of a vertex, regular graph, total number of edges and chromatic number of the graph. These properties depend on the spokes (S) and concentric circle (C) of the Circular Sudoku puzzle.
2. By considering different properties, the new strategy in solving Circular Sudoku puzzle using graph coloring is evident. In graph coloring, no two adjacent vertices share the same color while in Circular Sudoku puzzle, no cells in the same concentric circle (C) or spoke (S) have the same number. Furthermore, the number of cells in the Circular Sudoku puzzle is similar with the number of vertices in its graph.
3. A specialized computer program is generated to solve Circular Sudoku puzzles using graph coloring. The said program was developed using Visual Basic 6.0 Version.

RECOMMENDATIONS

With the findings and conclusions derived from this study, the researchers arrived to the following recommendations:

1. Future researchers are encouraged to discover more properties of graph coloring to solve the Circular Sudoku puzzles.
2. Discovery of additional techniques to solve the Circular Sudoku puzzles using graph coloring is recommended.
3. Further researches in applying the concepts of graph coloring in solving other types of Sudoku puzzles such as the following may be conducted:
 - a. Calcludoku
 - b. HyperSudoku
 - c. Irregular Sudoku

d. Killer Sudoku
e. Outside Sudoku

f. SamuraiSudo

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BS BIOLOGY

Anthelmintic Activity of *Euphorbia hirta* (Tawa-tawa) on Endoparasites

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ABSTRACT

Anthelmintic resistance is now a worldwide phenomenon leading to the search for alternative anthelmintics. This study was conducted to isolate and identify the parasites present in the puppies and to test the anthelmintic potency of Euphorbia hirta (Tawa-tawa) extract as to the number of eggs present. The study used fifteen (15) puppies with age ranging from 96 to 106 days old. The samples were distributed randomly to five (5) treatments. Each treatment had three (3) replications. Each sample had undergone fecalysis. Ancylostoma caninum was isolated. The samples were then subjected to the following treatments: T0 – Negative Control (untreated); T1 – Positive Control (Combantrin®); T2 – 25 percent E. hirta expressed juice; T3 – 50 percent E. hirta expressed juice; and T4 – 75 percent E. hirta expressed juice. A series of fecalysis were continued at days 1, 3, 5 and 7, after the treatment application. Results showed that E. hirta expressed juice above 50 percent concentration can effectively eliminate A. caninum at Day 7. Although 25 percent can reduce the number of egg, it is not sufficient to eliminate A. caninum eggs.

Keywords: *Euphorbia hirta, Anthelmintic, Endoparasites, Ancylostoma caninum*

INTRODUCTION

Endoparasites are parasitic organisms that inhabit the internal organs of their animal or plant host. Endoparasites include intracellular parasites, which inhabit specific cells in their host. They belong to the group of endotrophic organisms. Many have complex life cycles, which include changes of hosts i.e. helminths, protest, and microorganisms. Helminths are a diverse group of parasitic worms encompassing nematodes, cestodes and trematodes, and constitute a major health problem for humans and animals in many parts of the world (Kaplam, R.M. 2004; Hotez, P.J. et al. 2008).

The endoparasites commonly found in dogs are roundworms (*Toxocara canis*), hookworms (*Ancylostoma caninum*), whipworms (*Trichuris vulpis*), and tapeworms (*Dipylidium caninum*).

Anthelmintics are drugs that are used to treat infections with parasitic worms. They include both flat worms, e.g., flukes and tapeworms and round worms, i.e., nematodes. They are of huge importance for human tropical medicine and for veterinary medicine. The World Health Organization estimates that a staggering two billion people harbour parasitic worm infections. Parasitic worms also infect

livestock and crops, affecting food production with a resultant economic impact. Also of importance is the infection of domestic pets which enabled animal health companies to undertake drug discovery programmes and to consider the companion animal market.

The control of gastrointestinal parasites in animals has long been relying on the repeated prophylactic use of broad spectrum anthelmintic (AH). However, the intensive use of drugs in the livestock industry has led to widespread resistance to all current anthelmintics (Wolstenholme, A.J. et al., 2004).

The phenomenon of AH resistance is worldwide and has been described both in temperate and tropical areas (Jackson and Coop, 2000) which has decreased motivation for anthelmintic drug discovery programmes (Geary et al., 1999). Anthelmintic resistance is a threat to agricultural incomes, and has been reported from all the four corners of the world, to all available drugs, in all classes of helminths (Lalchhandama, 2010). This prompted concern, as anthelmintic resistance has been widely reported in livestock and it may also only be a matter of time before this phenomenon also occurs widely in parasites of humans (Osei-

Atweneboana et al., 2011; Churcher et al., 2009; Osei-Atweneboana et al., 2007).

The use of traditional medicinal plants in relieving symptoms of disease and curing various infections has been observed as the practice way back many centuries. In recent years, considerable interest has developed in Asian countries in the collection and extended use of the indigenous and introduced plants for medicinal purposes. Knowledge of medicinal plants has been the key for the survival of the ethnic groups who live in the interior parts of the society. Peoples who live far from towns and in forests still rely on traditional cures handed down to them through the generations. Plants are used in one form or another to cure a variety of ills, for example, toothache, stomachache and cough (Hadjula, M. 2006). However, these plants are rarely used as anthelmintic. In tropical countries, a promising approach is represented by the scientific evaluation of plants which are traditionally used against digestive troubles and or helminths. Several recent reviews have focused on ethno veterinary medicine from several continents (Hammond et al, 1997; Alawa et al, 2003).

Tawa-tawa, the local name of *Euphorbia hirta* in Philippines, is used for urinary complaints, and is useful in diseases arising from corrupt blood and bile. Tawa-tawa is known as a diuretic, and is considered anti-asthmatic. *Euphorbia hirta* is a hairy herb that can be found growing in open grassland, roadsides and pathways all throughout the Philippines.

This present study verified the anthelmintic effect of Tawa-tawa (*Euphorbia hirta*) leaves expressed juice in puppies (*Canis lupus familiaris*) naturally infected with gastro-intestinal parasites. The study confirmed the result of Adedapo, et al., (2005) regarding the anthelmintic effect of *Euphorbia hirta* in their study entitled "Anthelmintic efficacy of the aqueous crude extract of *Euphorbia hirta* Linn in Nigerian dogs". The study is similar with the study of Adedapo, et al., (2005) by using *Euphorbia hirta* Linn as the source of the extract; however, the present study used *Pyrantel emboate* (Combantrin) as the control, while the former used Mebendazole. The present study administered the treatment orally only,

while the former administered the treatments orally and intramuscularly.

Results of this study may be helpful to people specially the pet-lovers. If proven effective, it may reduce the expenses for medicines used for deworming dogs.

Statement of Objectives

This study aimed to determine the anthelmintic activity of *E. hirta* leaf expressed juice against endoparasites in puppies.

Specifically, the study aimed to:

1. Isolate and identify endoparasites present in the test animals before and after treatment through fecalysis.
2. Validate and quantify the anthelmintic potency of *E. hirta* leaf expressed juice at various concentrations as to number of eggs.

METHODOLOGY

This study employed the common laboratory procedure in sampling. A total of 15 experimental animals (puppies) with ages ranging from 96-106 days were used in the study. Each treatment was replicated three times and the treatments were as follows:

- T0- untreated (Negative Control)
- T1- *Pyrantel emboate*, Combantrin (Positive Control)
- T2- 2.5ml *E. hirta* leaf expressed juice + 7.5ml distilled water (25%)
- T3- 5ml *E. hirta* leaf expressed juice + 5ml distilled water (50%)
- T4- 7.5ml *E. hirta* leaf expressed juice + 2.5ml distilled water (75%)

Materials and Procedures

Materials

The study made use of the following materials:

1. Experimental Plants. *Euphorbia hirta* (Tawa-tawa) were used as plant source for the expressed juice. The plants were collected from Brgy. Sevilla Norte, City of San Fernando, La Union.
2. Chemical Materials. The chemicals used in this study were *Pyrantel emboate*

commonly known as Combantrin. The floatation fluid used for the fecalysis was provided by the Regional Animal Disease Diagnostic Laboratory in Brgy. Tebag, Sta. Barbara, Pangasinan.

3. Laboratory Apparatuses. Apparatuses such as syringes and weighing scales were provided by the researchers while the microscope, McMaster counting chamber, Pasteur pipette, stirrer, cheese cloth strainer and graduated cylinders used were provided by the Regional Animal Disease Diagnostic Laboratory in Brgy. Tebag, Sta. Barbara, Pangasinan.

4. Test Organism. The test organisms used in the study were 15 *Canis lupus familiaris* (puppies) naturally infected with gastrointestinal parasites.

Procedures

Selection of Test Animals

Fifteen (15) puppies with weights ranging from 1 kilogram to 2.5 kilograms and ages ranging from 96 to 106 days old were selected after they were positively identified to be infested with parasites in their feces using the floatation method of fecalysis.

The puppies were assigned into five (5) groups, groups A, B, C, D, and E and they were safely leashed in a way that they do not overlap and reach other puppies. The puppies were fed with a diet of seven (7) parts rice and three (3) parts fish flakes mixed together. One cup (250ml) of the mixture was fed to each puppy, during 7 am, 12 pm, and 7 pm daily during the entire duration of the study.

Preparation of the Treatments

Fresh Tawa-tawa leaves (1 kg) were collected and thoroughly washed with distilled water. Then the leaves were drained, blended, and filtered with cheese cloth to gather a 50-ml juice.

The extracted juice was measured and diluted with distilled water to make the desired Treatment Concentrations (TC) which are as follows: 25 2.5 ml of *E. hirta* + 7.5 ml of distilled water (25%); 5 ml of *E. hirta* + 5 ml of distilled water (50%); and 7.5ml of *E. hirta* + 2.5 ml of distilled water (75%).

Application of Treatments

Group A was left untreated and labelled as a Negative Control, while group B was treated orally with the commercial anthelmintic Combantrin (*Pyrantel emboate*) and labelled as the Positive Control. Groups C, D and E were treated orally with *E. hirta* leaf expressed juice at 25 percent, 50 percent and 75 percent concentrations, respectively at a dose of 1.0 ml per 5-kilogram bodyweight basing on the suggested dosage of Combantrin. The treatments were administered to the puppies once at 4pm of Day 0.

Collection of Feces and Isolation of Endoparasites

The first fecalysis was done in the morning before the application of treatments (Day 0). This was done to identify the endoparasites and the number of eggs of the endoparasites present in each test organism.

The feces samples were scooped in the area of each test puppies and were put in fecal containers labelled as to the treatment administered to the test animals. The containers were then placed in a cooling box filled with ice to retain the freshness of the sample, Then they were transported to the Regional Animal Disease Diagnostic Laboratory in Brgy. Tebag, Sta. Barbara, Pangasinan for the fecalysis.

A day after application of the different treatments, fecalysis was again done for counting of endoparasites. The process was repeated on the third, fifth and the seventh day after the application of the different treatments.

McMaster Floatation Technique of Fecalysis

The researchers used the McMaster Floatation Technique of fecalysis which is a procedure for concentrating helminth eggs for more reliable result when eggs are difficult to find in direct examination. The technique depended on floatation of helminth eggs of the surface of a liquid of sufficiently high specific gravity. A floatation fluid was used to separate eggs from fecal material in a counting chamber (McMaster) with two compartments. The sample was then observed under the microscope and eggs found in the two compartments were

counted and then multiplied to a hundred (100) to determine the Eggs per Gram.

RESULTS AND DISCUSSIONS

Isolation and Identification of the Parasites

Laboratory results using the floatation method showed that ova isolated and identified were *Ancylostoma caninum* or more commonly called “hookworm”. The ova of *A. caninum*, when observed under the microscope are oval-shaped and the internal structure was somewhat clear. Under higher magnification some worms were present inside the egg. (Figure 1)

Hookworms are commonly found in dogs. These parasites are small reddish-brown worms which live in the small intestine of the dogs. The worms hang onto the intestinal wall by using sharp teeth. An adult hookworm actually sucks blood from the dog’s intestine. Puppies with heavy infection of hookworms can

lose a large quantity of blood becoming anemic resulting in lethargy and possible death.

Hookworm eggs are laid by the adult female and passed in the dog’s feces. The eggs hatch in the environment and develop into infective larvae. Dogs can acquire a hookworm infection in four ways: ingesting an infective larval form; nursing from an infected mother; penetration of the skin by an infective larval form; lastly, during embryonic development (unborn puppies infected from their mother while in the womb). Once the larvae are inside the dog, they make their way to the intestine where they stay and mature into adults and start the life cycle again (Traversa, 2012).

Anthelmintic Activity of *E. hirta* (Tawa-tawa)

Table 1 shows the effect of *E. hirta* expressed juice under different concentrations to the puppies’ parasites measured in terms of mean number of eggs per gram (EPG).

Table 1. Mean Number of Eggs Per Gram (EPG) of the Endoparasites Observed

Treatments	Day 0 (Baseline EPG)	Day 1	Day 3	Day 5	Day 7
T0- Untreated (Negative Control)	1033.33	1033.33b	966.67d	1066.67b	1066.67b
T1- Combantrin (Positive Control)	1066.67	466.67a	33.33a	0.00a	0.00a
T2- 25% <i>E. hirta</i> expressed juice	1000.00	933.33b	600.00c	200.00a	100.00a
T3- 50% <i>E. hirta</i> expressed juice	900.00	533.33a	300.00b	66.67a	0.00a
T4- 75% <i>E. hirta</i> expressed juice	933.33	433.33a	100.00a	66.67a	0.00a

As gleaned on the table, the number of eggs counted from the different groups of dogs at the start of the study (Day 0) is comparable. The highest of which is from the group of dogs treated with the positive control.

On the first day after the application of the treatments, the lowest number of eggs is from the 75 percent concentration of *E. hirta*. This is followed by the positive control, Combantrin, a commercial and well established brand of anthelmintic drug. Among the treatments the highest number of eggs was

obtained from the dogs treated with 25% *E. hirta*.

The analysis of variance on the number of eggs at day one (1) resulted in a highly significant difference. Dogs dewormed with 75 percent *E. hirta*, and 50 percent *E. hirta* were found to be comparable with each other. Both concentrations were insignificantly different with the positive control. This implies that 50 percent and 75 percent *E. hirta* expressed juice were as effective as the positive control, Combantrin. This suggests that *E. hirta* is a candidate anthelmintic.

On the third day after the treatment application, it was observed that the number of eggs decreased in all treatments including that of the untreated dogs. The least number of eggs was obtained from the dogs dewormed by the positive control. This was followed by treatment four (T4) with 100 EPG and treatment 3 (T3) with 300 EPG.

The analysis of variance result for the number of eggs was declared to be highly significant; T4 showed comparable number of eggs as that of T1, Combantrin, while T3 and T2 are significantly different from each other. Moreover, both registered significantly higher number of eggs compared to Combantrin, which is a known anthelmintic drug.

Result implies that a higher dose (75%) of *E. hirta* is effective as anthelmintic drug since it was able to significantly reduce the number of eggs in dogs as compared to those treated with the positive control. A similar anthelmintic property is observed in highest dose of *E. hirta* and Combantrin. Result is contrary to the result of the study of Adedapo et al., 2005 which showed that the effect of the proprietary anthelmintic is more pronounced on the worm than those of the extracts of *E. hirta*.

A significantly lower number of eggs were obtained from 50 percent concentration of *E. hirta* compared to those treated with 25 percent *E. hirta*. Result suggests that higher dosage of *E. hirta* is more effective anthelmintic than lower dosage of *E. hirta*.

Five (5) days after the application of treatment, it was observed that even the least concentration of *E. hirta* (25%) reduced the number of eggs from 600 EPG to 200 EPG, a value that is insignificant with that of the higher doses of *E. hirta* and that of the positive control. This suggests that this concentration is still effective to eliminate eggs from dogs. However, it requires more time in decreasing the eggs.

The 50 percent *E. hirta* juice reduced the number of eggs from 300 EPG to 66.67

EPG, a similar result was generated by the 75 percent *E. hirta* juice concentration which reduced the number of eggs from 100 EPG to 66.67 EPG. This reflects that both concentrations are still effective to remove the eggs from dog intestines, the number of eggs on day five (5) was insignificant compared to all other treatments of *E. hirta* and Combantrin. The number of eggs of dogs treated with different concentrations of *E. hirta* and the positive control was significantly reduced as compared to the untreated dogs.

This suggests that different *E. hirta* concentrations are as effective as the known anthelmintic (Combantrin) to reduce the number of endoparasite eggs as compared to a known anthelmintic drug, although the positive control totally eliminated the endoparasite in dogs.

On the 7th day after treatment application, high doses (50% and 75%) of *E. hirta* were observed to have totally eliminated the endoparasites in dogs, a result similar to the positive control. Result reveals an anthelmintic property of *E. hirta* expressed juice. Concentrations of at least 50 percent of *E. hirta* juice are highly sufficient to eliminate *A. caninum* via oral route. Direct contact between the extract and the parasite ensures immediate and efficient action.

As revealed by Figure 2, *E. hirta* concentrations reduce the number of endoparasite eggs similar to the positive control. *E. hirta* is therefore found to have anthelmintic property.

As observed throughout the study, the puppies treated with Combantrin became more energetic and alert. They were observed to have increased appetite after the application of the treatment. This is true with the puppies treated with 50 percent and 75 percent concentration of *E. hirta*. Puppies treated with 25 percent *E. hirta* also show these observations, however, in a lower magnitude. The puppies from this dosage were observed to have stout bellies.

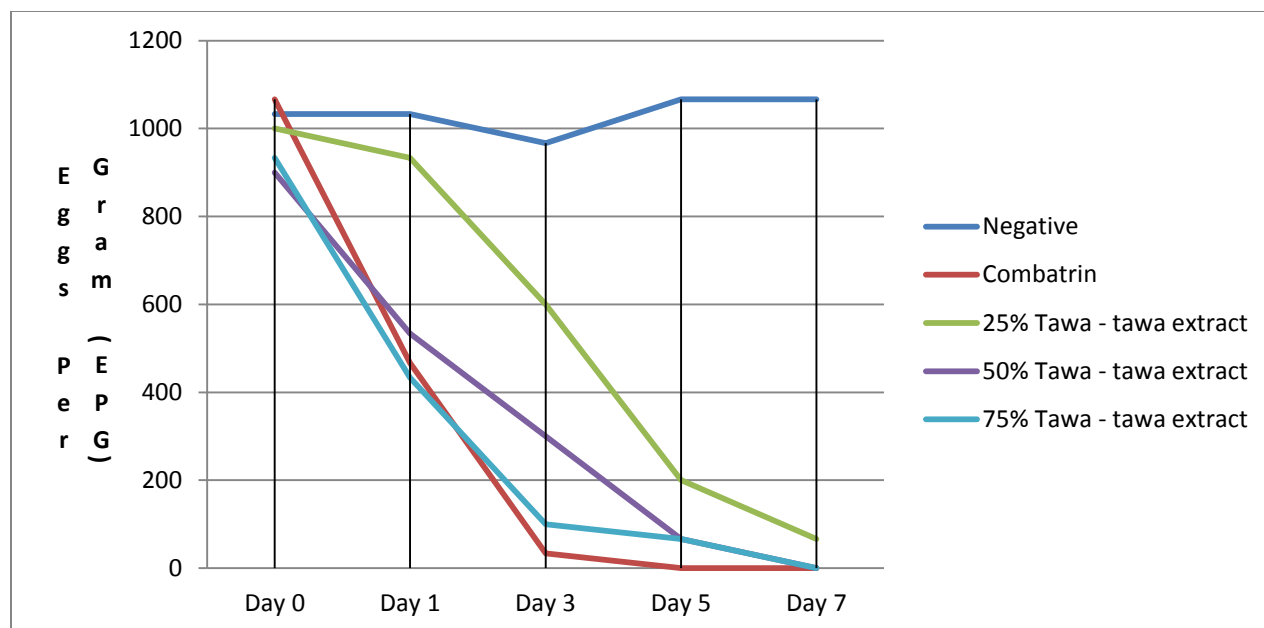


Figure 2. Graphic Presentation of Table 1.

Results support the findings of Adedapo, et al. in 2005 when they found that the *E. hirta* extracts administered orally significantly reduced the worm burden of the dogs. This observation may be due to the fact that helminths were found in the gastrointestinal tract. Thus, having a direct contact with the worms may require increased concentration for better effect.

The anthelmintic effect may be attributed to the phenol compound in the plant extract (RICE, 1965 as cited in Adedapo, et al., 2005). According to Behnke, et al., 1990, substituted phenols are established anthelmintics which act by uncoupling the mitochondria reaction involved in electron transport-associated event from ATP generation, which is lethal to blood sucking helminths.

CONCLUSIONS

Within the limits of the study the following conclusions were drawn:

1. *E. hirta* expressed juice can reduce the number of endoparasit eggs similar to Combantrin which is a well-established anthelmintics

2. *E. hirta*'s anthelmintic potency is directly proportional with its concentration.

RECOMMENDATIONS

Based from the finding and conclusions of the study, the following are recommended:

1. Additional researches should be done to be determining the effect of *E. hirta* on adult dogs.
2. Researches on the possibility of drug resistance to develop in parasites should also be evaluated.

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Antifungal Activity of *Tabernaemontana pandacqui* (Kampupot) and *Chromolaena odorata* (SIAM) Ointment Against *Trichophyton mentagrophytes*

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ABSTRACT

Dermatomycosis is one of the leading skin problems in the world. Finding some alternative medicine was one of the solutions to prevent the resistance of the microorganisms to a commercial antifungal drug.

*This study aimed to test the antifungal activity of *Tabernaemontana pandacqui* and *Chromolaena odorata* expressed juice ointment against *Trichophyton mentagrophytes*. The extraction method was through conventional leaf juice extraction. By using Agar Well Diffusion Method, a strain of *Trichophyton mentagrophytes* was sub-cultured and used in the study to test the antifungal activity of the two plants.*

Kampupot expressed juice ointment was comparable to the effect of the commercial antifungal ointment, Ketoconazole. Siam expressed juice ointment had a weak effect to the growth of the fungus and was significantly different to Kampupot expressed juice ointment and Ketoconazole.

Among the two leaf juice extracts, Kampupot expressed juice ointment showed a high significant effect as an antifungal activity than Siam expressed juice ointment.

Keywords: *Trichophyton mentagrophytes, Tabernaemontana pandacqui, Chromolaena odorata.*

INTRODUCTION

In the past several years, fungal infection was one of the major problems in the world and the increasing number of incidents and prolonged treatment of the disease have caused the resistance of the microorganisms to several antifungal drugs (Jayaprakash, et al., 2012). One of the alternative solutions of this problem is to find another treatment to the fungi that became resistant to many antifungal drugs (Hizon, 2016).

Dermatophytes are the fungi that are responsible for fungal infection to the skin, nails and hair. Skin fungal infection is one of the major leading problems of people right now. Dermatophytosis of scalp, glabrous skin and nails is caused by closely related fungi known as dermatophytes (Ellis, 2016). There are varieties of clinical manifestation that lead to this infection such as tinea pedis, tinea corporis, tinea cruris, tinea capitis, tinea unguium and majocchi's granuloma (Goldstein, et al., 2016). *Microsporium*, *Epidermophyton* and *Trichophyton* are the genera that belong to this group of fungi (Aktas, et al., 2014).

The fungus *Trichophyton mentagrophytes* can cause fungal infection in the feet that is called Tineapedis or athlete's foot.

Trichophyton mentagrophytes is a zoophilic fungus with a worldwide distribution and wide range of animal host like rabbit, rat and humans. This is more common in adults than in children and it may affect one or both feet (Ellis, 2016). It is most commonly obtained in moist and warm environments such as bath tub, shower and even in swimming pools. Most often, it may be taken anywhere if someone who has athlete's foot has walked on the area barefooted. It can easily be transferred to one's shoes and slippers (Jusdad, et al., 2012). The disease, although not life-threatening, can markedly affect quality of life and well-being (Jo Siu, et al., 2016).

Tabernaemontana pandacqui locally known as Kampupot or Pandacquiputi in Tagalog, Banana bush in English and Kuribetbet in Ilokano is from the family Apocynaceae. It is an evergreen shrub growing from one to four meters tall. Its habitat is in thickest at low elevations in the Philippines. The sap from the ripe fruit is applied to the skin affected by ringworm. The leaves are used as a bleaching agent (Fern, et al., 2016). The other species, the *Tabernaemontana heyneana* was studied already as antifungal and antibacterial (Sathishkumar, et al., 2012); however, the species *Tabernaemo-*

ntan apandacaqui leaf juice was tested, too, by the researchers if it has an antifungal property against *Trichophyton mentagrophytes*.

According to Bassey, et al., 2012, *Chromolaena odorata* or Siam weed in English and Hagonoy in Tagalog is from the family Asteraceae. One member from this family is the sunflower and a shrub of about four meters tall. Other names for Siam weed are Devil weed, French weed, Communist weed and Cohoy. This plant is a soil improver and indicator of a good and fertile soil. In other countries, like Vietnam and Nigeria, the fresh leaves and decoctions of *C. odorata* are used to stop bleeding and for the treatment of leech bite, burn wounds, soft tissue wounds, and skin infection. According to Ngono, et al., 2005, Siam leaf extract has the potential antifungal activity.

This research tested the antifungal property of *C. odorata* against *Trichophyton mentagrophytes*.

Statement of Objectives

This study tested the Antifungal Activity of *Tabernaemontana pandacaqui* (kampungot) and *Chromolaena odorata* (Siam weed) ointments against *Trichophyton mentagrophytes*, Specifically it aimed to:

1. determine the zone of inhibition after applying the treatments/ointments after:
 - 1.1. two days
 - 1.2. four days
 - 1.3. six days;
2. find out the significant difference of the antifungal activity of the different treatments against *Trichophyton mentagrophytes*; and.
3. test the efficacy of the treatments/ointments against *Trichophyton mentagrophytes* from day two to day six.

METHODOLOGY

Materials and Procedures

Materials. The following materials were used in the study: a.) plant materials: Kampungot and Siam leaves; b.) laboratory supplies: beaker, erlenmeyer flask, cork borer, mortar and pestle, Petri dishes, stirring rod, hockey stick, Pasteur

pipette, aluminum foil, microscope, inoculating loop, weighing scale, spatula; c.) test organism: *Trichophyton mentagrophytes*; and d.) other supplies: 5 percent ethanol, petroleum gel, mineral oil, tissue, distilled water, cotton, test tubes, marker, paper and plastic tapes, ballpens, Ketoconazole, Potato Dextrose Agar (PDA), record book and ruler.

Procedures

Collection, Identification and Preparation of Plant Materials. Mature fresh leaves of *Tabernaemontana pandacaqui* (Kampungot) and *Chromolaena odorata* (Siam) were collected from the town of San Fabian, Pangasinan. Meanwhile, sample leaves and young plant were brought to the National Museum for the proper identification and authentication of the sample plant used. The collected plant leaves were washed and dried for 5 minutes to remove the excess water. After that, the fresh leaves were cut into small pieces and were placed in a container for the extraction method.

Extraction Method

Conventional Leaf Juice Extraction. Fresh leaves were cut into the small pieces of Kampungot and Siam leaves were placed in a mortar and grinder by the use of a pestle. To obtain the expressed juice extracts, the ground leaves were squeezed using cheese cloth. The obtained juice was placed in a test tube and kept inside the refrigerator (freezer) at - 4°C for future use.

Preparation of Ointments/Treatments. The expressed juice extracted from Kampungot and Siam leaves were used in the preparation of ointments. The petroleum gel was purchased from The Generics Pharmacy (TGP) in Agoo, La Union. The Mineral oil was purchased from Puljed Trading at 1336 Rizal Ave. Sta Cruz, Manila.

The Negative control ointment (T_0) was prepared by mixing 7.5 percent (3.75g) of 5 percent ethyl alcohol, 3 percent (1.5g) of mineral oil and 89.5 percent (44.75g) of petroleum gel.

For Ketoconazole ointment (T_1), a commercial Ketoconazole was bought from TGP

located at Agoo, La Union and was utilized as positive control.

For Kampupot expressed juice ointment (T_2), 9 percent (4.5g) of Kampupot express juice, 7.5 percent (3.75g) of 5 percent ethyl alcohol, 3 percent (1.5g) of mineral oil and 80.5 percent (40.25g) of petroleum gel were mixed.

The Siam expressed juice ointment (T_3) was similarly prepared following the preparation of the Kampupot expressed juice ointment (T_2).

Microbiological Testing. The following procedures were undertaken for microbiological testing: a.) purchase of microorganism, b.) culture medium, c.) preparation of inoculums, d.) agar well diffusion method, e.) measurement of the zone of inhibition, and f.) decontamination procedure and disposal. The fungus was cultured at BFAR-NIFTDC Dagupan City, Pangasinan.

Purchase of microorganism. *Trichophyton mentagrophytes* was obtained from the College of Public Health, University of the Philippines, Manila, Philippines. Proper packaging was observed in transporting the microorganism from Manila to Pangasinan.

Culture Medium. Potato Dextrose Agar (PDA) was the medium used in the fungus. The medium was prepared by dissolving 18.72 g of PDA in 480 ml of distilled water. It was heated with frequent agitation and was boiled for one minute to completely dissolve the medium. After that, it was placed in autoclave at 121° C for 15 minutes. Then, it was cooled for about 45°C and it was poured in the Petri dish and was allowed to solidify (Aryal, 2015).

Preparation of Inoculum. The strain of *T. mentagrophytes* obtained from the CPH, UP, Manila, Philippines was subcultured for seven days at room temperature on the prepared Potato Dextrose Agar (PDA). After seven days, a three-ml normal saline was poured in the sterile test tube. Then, the colony was gently scraped with the tip of an inoculating loop and was placed in the test tube with normal saline. Some heavy particles were present in the suspension and it was allowed to settle for 15 minutes at room temperature. The suspension was then mixed until it matched the opacity of 0.5 McFarland's Standard which was equivalent to a cell

concentration of 1.5×10^8 that was used in BFAR-NIFTDC (Oladejo, et al., 2013).

Agar Well Diffusion Method. Using sterile Pasteur pipette, two drops of prepared concentration of standardized *T. mentagrophytes* inoculum were dropped into the surface of every PDA plate and were spread by using hockey stick. A six-mm. cork borer was used to bore holes into the agar. After that, a 0.1 g of the prepared ointments was weighed and was placed into the holes by using a sterile microspatula. The plates were incubated at room temperature for six days (Oladejo, et al., 2013).

Measurement of the Zone of Inhibition. The zone inhibition or the clear zone diameter which appeared around the agar well was measured using ruler (mm) (Muhsin, et. al., 2009). There were nine replicates per treatments. Mean was obtained using the formula below:

$$\text{Mean} = \frac{\text{Total Zone of Inhibitions}}{\text{Number of Replicates}}$$

Decontamination Procedure and Disposal. According to Ward's Science (2013), the procedure followed three ways of decontaminations: (1) 20 percent bleach solution was poured in the organism for 10 minutes; (2) 70 percent isopropyl alcohol or Lysol was placed in the organisms for 24 hours until the culture was submerged in the solution in order for the organism not be released into the environment; and (3) The organism was placed in the autoclave at 121°C for 15 minutes.

RESULTS AND DISCUSSION

Zone of Inhibitions after Applying the Treatments in Day two, four and six and the Significant Differences of the Treatments

Table 1 reveals that in day two, the zone of inhibitions were clearly seen in every plate of the ointments Keo, Kejo and Sejo. It indicates that the ointments really affected the growth of the fungus. In day two, the highest mean zone of inhibition recorded was exhibited by Kejo and the lowest was Sejo. Kejo and Keo (positive control) were not significantly different from each other. This means, these two ointments had the same effect against the fungus. On the other

hand, Sejo was significantly lower ($p < 0.05$) than the effect of the positive control, Ketoconazole and Kejo in terms of mean zone of inhibitions.

On the fourth day, as also shown in Table 1, the highest mean zone inhibition was seen in Keo and the lowest was Sejo. Kejo had decreased its mean zone of inhibitions and it was significantly different from Keo. Meaning, the inhibitory effect of Keo was significantly higher ($p < 0.05$) than the effect of Kejo against *T. mentagrophytes*. Sejo again was significantly different from Keo and Kejo in terms of the mean zone of inhibitions.

On the sixth day of incubation, the highest mean zone of inhibition was exhibited

by Kejo and the lowest was Sejo. Kejo and Keo were significantly different from each other. This means that in terms of mean zone of inhibitions, Kejo had significantly higher mean zone of inhibitions than Keo. Sejo was significantly lower ($p < 0.05$) than the effect of Kejo and Keo against *T. mentagrophytes*

Negative control ointment (Neo) had no effect on the fungus from days 2 to 6. This means that without any expressed juice extracts, it did not affect the growth of the microorganism.

Table 1. Mean Zone of Inhibition of the Four Treatments against *T. mentagrophytes* at Day Two, Four and Six

Treatments	Day 2	Day 4	Day 6
Negative control (Neo)	00.00c	00.00d	00.00c
Ketoconazole ointment (Keo)	18.22a	18.00a	08.00b
Kampupot expressed juice ointment (Kejo)	20.67a	13.33b	10.11a
Siam expressed juice ointment (Sejo)	05.78b	02.33c	01.00c

* Means followed by the same letter are not significantly different from each other at 0.05 level of significance

Finally, comparing the two leaf juice extracts, Siam leaf expressed juice showed a significantly lower inhibitory effect than the positive control which was Ketoconazole (Keo) against *Trichophyton mentagrophytes*. Kampupot leaf expressed juice prevented the growth of the fungus *T. mentagrophytes* and was significantly higher than the effect of Siam leaf expressed juice. Also, the effect of Kampupot leaf expressed juice has comparable effect to the commercial antifungal drug, Ketoconazole at day 2, however, better after day 6.

As revealed in the results, Kampupot expressed juice ointment is comparable to the effect of the commercial antifungal drug, Ketoconazole. This means that *Trichophyton mentagrophytes* was sensitive to both Kejo and

Keo. And among the two leaf expressed juices, Sejo showed significantly lower effect than that of Kejo on the antifungal activity against the *T. mentagrophytes*.

The previous results showed that *Chromolaena odorata* have a variety of bioactive compounds which play an important role in antifungal activity against dermatophytes. Results of the study of Ngono, et al. (2005) showed that Siam leaf extracts have the potential antifungal activity against *T. mentagrophytes*. The Phytochemical research on the study of Ngono, et al. (2005) revealed that flavonoids and phenol were present in the extract. These phytochemical compounds were known to have antifungal activity. One of the reasons why Sejo did not totally inhibit the growth of the fungus

as compared to the inhibitory effect of Kejo and Keo was the fungicidal activity of the expressed juice which contains low amount of flavonoids and phenol which were not enough to inhibit the growth of the fungus.

On the other hand, Kejo showed high significant effect than Sejo and Keo. This is similar to the result in the study of the other species of *Tabernaemontana*. The phytochemical analysis of *Tabernaemontana heyneana* shows that it has flavonoids (Sathishkumar, et al., 2012). This phytochemical compound is one of the indications that this plant has an antifungal activity. *Tabernaemontana pandacaqui* (kampupot)

expressed juice may also have flavonoids that can inhibit the growth of the fungus because Kejo had better antifungal activity than Ketoconazole (positive control) at day six.

Efficacy of the Different Ointments/Treatments

Figure 1 shows the graph of the mean zone inhibitions (mm) of the different ointments against *Trichophyton mentagrophytes* at day two and day four. Kejo had a highest effect on the fungus compared to Keo and Sejo at day two. At day four, Keo had the highest inhibitory effect than Kejo and Sejo.

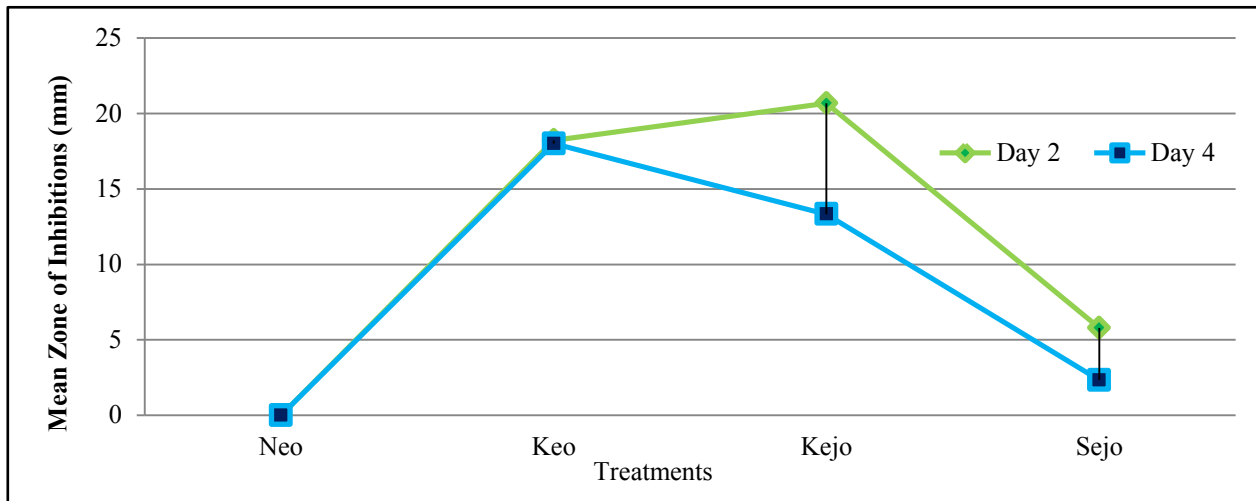


Fig. 1. Efficacy of the Four Ointments against *Trichophyton mentagrophytes* in Day Two and Day Four

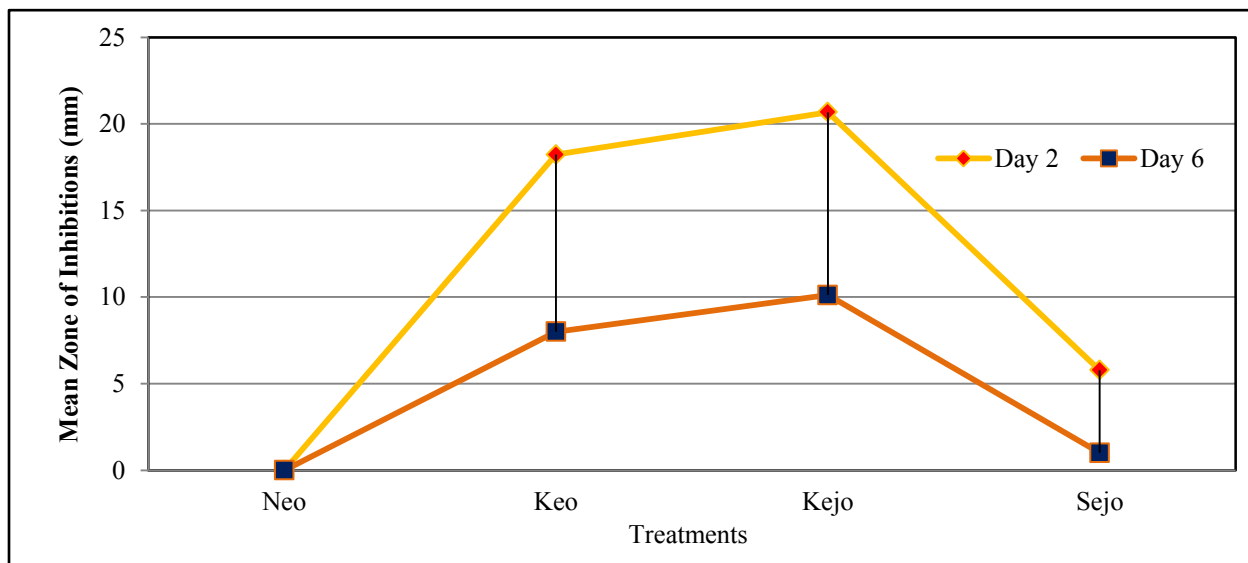


Fig. 2. Efficacy of the Four Ointments against *Trichophyton mentagrophytes* at Day Two and Day Six

Figure 2 shows the graph of the mean zone inhibitions of the different ointments against *Trichophyton mentagrophytes* at day two and day six. At day two, it shows that Keo had a significantly lower inhibitory effect than Kejo which had the highest effect against *Trichophyton mentagrophytes*. Also, Sejo has significantly lower antifungal effect than Keo and Kejo against *T. mentagrophytes*. Same trend was followed at day six; however, the inhibitory effect was decreased

In general, among the two leaf express juice, Kampupot leaf expressed juice has the potential to inhibit the growth of *Trichophyton mentagrophytes*. Result revealed that Kampupot has significant effect as an antifungal against *T. mentagrophytes* in terms of the mean zone of inhibitions. On the other hand, Siam leaf expressed juice ointment has significant lower antifungal effect against *T. mentagrophytes*. Moreover, Kejo has comparable antifungal activity as the commercial antifungal drug, Ketoconazole at day 2 and better at day 6. Therefore, Kampupot expressed juice ointment has the potential as antifungal against *Trichophyton mentagrophytes*.

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CONCLUSIONS

Based on the findings, the following conclusions were derived:

1. Highest mean zone of inhibitions of 20.67 mm was observed from Kampupot expressed juice ointment comparable to 18.22 mm Ketoconazole.
2. The Kampupot expressed juice ointment has significantly high effect as an antifungal activity against *Trichophyton mentagrophytes* comparable to the commercial antifungal ointment, Ketoconazole. Siam expressed juice ointment shows antifungal activity, too, but lower than Kampupot expressed juice ointment and the commercial antifungal drug, Ketoconazole.
3. Kampupot expressed juice ointment and Ketoconazole ointment show antifungal effect but decreases until day six against *Trichophyton mentagrophytes*. Siam expressed juice ointment shows lower antifungal effect until day six compared to Kampupot expressed juice ointment and Ketoconazole.

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**Antiangiogenic and Antiteratogenic Potential of *Ocimum sanctum* L.
(Holy Basil) Leaf Extract Using Chorioallantoic Membrane
and Embryos of *Anas platyrhynchos* (DUCK)**

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ABSTRACT

Ocimum sanctum L. leaf ethanol extract at 10 µg/ml, 20 µg/ml, 30 µg/ml and 40 µg/ml concentrations were tested for their antiangiogenicity and antiteratogenicity on the chorioallantoic membrane and embryos of ducks in terms of the branching frequency, branching point density and percent embryos with dysmorphogenesis. The presence of vascular damage and morphological malformations were also noted in the ducks' CAM and embryos. Results showed that *O. sanctum* ethanol extract ranging from 20 µg/ml to 40 µg/ml significantly lowered the branching frequency and branching point density of blood vessels in the ducks' CAM compared to the negative control and the untreated eggs. Vascular damage was also evident at these concentrations signifying the extracts' antiangiogenic potential. Meanwhile, the ducks' embryos treated with the highest dose of 40 µg/ml significantly counteracted the teratogenic effect of a known teratogen, carrageenan, suggesting that *O. sanctum* can be a good candidate antiteratogenic agent.

Keywords: angiogenic, antiangiogenic, antiteratogenic, dysmorphogenesis, *Ocimum sanctum* L.

INTRODUCTION

One of the major problems faced by the Philippines today is treating cancer. Cancer is a life severe human disease which causes increasing mortality every year in the world (Gong et al., 2013). Angiogenesis is the formation of new blood vessels for the transportation of nutrients. In most cases, this is a normal, healthy process. It is vital to the development and progression of solid tumors (Bhadwaj et al., 2010). There exist a number of angiogenesis and therefore may lead to serious tumor growth.

Antiangiogenesis is a form of targeted therapy that uses drugs or other substances to stop tumors from making new blood vessels. Teratogenesis pertains to the study of developmental abnormalities. It includes all manifestations of abnormal development that are caused by environmental insult.

Teratogens are drugs that may cause birth defects. Antiteratogenesis, is a form of targeted therapy which involves the ability to inhibit the occurrence of developmental malformations.

The duck chorioallantoic membrane (CAM) assay is commonly used to study anti-angiogenesis. Duck embryo assay, is used to study the antiteratogenic activity of plant extracts. The presence of these extracellular matrix proteins simulates the cancer cell environment (Lokman et al., 2012). CAM is formed by the fusion of extraembryonic membrane known as chorion and allantois.

Ocimum sanctum L. is a plant that belongs to the family Lamiaceae which is native to the Tropical Asian country and Indian subcontinent and though it is relatively new to western

medicine systems, it is grown by over 3000 years. It is distributed throughout the Philippines (Sheng lu o le, 2014).

The leaves contain a variety of phytoconstituents including saponins, flavonoids, triterpenoids and tannins and other biologically active compounds with the properties varying between and among different varieties (Pattanayak et al., 2010).

Statement of Objectives:

The study aimed to:

1. identify and verify the phytochemicals present in the *O. sanctum* L. extract; and
2. examine the effects of the different concentrations of holy basil extract (HBE) on the proliferation of the blood vessels of ducks' CAM in terms of:
 - 2.1 branching frequency
 - 2.2 branching point density

METHODOLOGY

Materials and Procedures

Materials. 100 percent Ethanol was obtained from SPEED Scientific and Laboratory Supply, Dagupan City, Pangasinan. Carrageenan (Positive Control) was purchased at Fame Lab, Pasig City. Normal Saline Solution/NSS (Solvent Control) was purchased at SPEED Scientific and Laboratory Supply, Dagupan City Pangasinan. Distilled water was purchased at SPEED Scientific and Laboratory Supply, Dagupan City Pangasinan.

Plant material. *Ocimum sanctum* L. (Holy Basil) was collected at #162 Brgy. Cayanga, San Fabian, Pangasinan.

Test Organism. Sixty three (63) pieces of three - day old duck eggs were obtained from a poultry store at San Fernando City, La Union.

Procedures

Bulk Extraction. The homogenized leaves of *Ocimum sanctum* L. were soaked in ethanol for 72 hours with occasional stirring. After 72 hours, the extract was filtered using a cotton-plugged funnel. The filtrate were concentrated in vacuum at 45°C using a rotary evaporator at speed of 50 rpm. The procedure yielded a scrupy liquid called Ethanol extract.

Phytochemical Screening. Fifty (50) grams of Holy Basil was submitted to the Science Laboratory, Saint Louis University, Baguio City for qualitative testing of plant secondary metabolites like alkaloids, flavonoids, saponins, tannins, and phenolic compounds.

Preparation of Different Treatments. The different treatments were formulated by preparing a stock solution at concentration of 10 mg holy basil extract dissolved in 10 ml Normal Saline Solution (NSS). All the mixtures were formulated to a final volume of 15 ml. Then, 0.2 ml from each treatment was administered to the duck eggs.

For the positive control, 0.2 ml of 0.1 percent Carrageenan in NSS was prepared by dissolving 0.05 mg Carrageenan in 500 ml NSS which served as the stock solution.

Duck Eggs Collection. Sixty three pieces of three-day old duck eggs were purchased from a poultry store at San Fernando City, La Union. Another 20

extra eggs were reserved in case there were eggs which were not fertilized. The eggs were then brought to Abarabar's residence at Brgy. Cayanga for the succeeding assays.

Bioassay. Three - day old eggs were wiped with clean cloth and were placed in an incubator at a constant humidity (60%) and temperature (37°C). The test was divided into eight treatments. After two days of acclimation in an incubator, the eggs were scratched and eventually punctured using syringe. By using the modified windowing technique, the different concentrations of the test samples were injected into the holes or windows at the blunt end of the shell in the air sac region (Seravillo and Herrera, 2004).

Gross Morphological Analysis. After two (2) weeks of incubation, the eggs were removed from the incubator and open for gross morphological analysis. Antiangiogenic potential was determined by comparing the degree of extraembryonic blood vessel proliferation in the different treatment groups against the untreated samples, negative and positive control groups in terms of branching frequency and branching point density (Raga et al., 2013). Antiteratogenicity was assessed by examining for the presence or absence dysmorphogenesis which is described as morphological malformations (MM) in external body structure of embryos in the different treatment groups in comparison to the untreated, negative and positive control groups.

RESULTS AND DISCUSSION

Phytochemical Analysis

The qualitative phytochemical analysis of the dried leaves of *Ocimum sanctum* L. showed the presence of secondary metabolites such as flavonoids, alkaloids, saponins, triterpenoids, tannins and primary metabolites such as proteins, carbohydrates, fats and reducing sugars. The phytochemicals present in HBE were reported to exhibit the following biological activities such as antioxidant (Kath & Gupta, 2010), antilipidemic (Lahon & Dahos, 2011) and antibacterial (Joshi et al., 2010). In a study that was conducted by Gamallo et al. (2016), *Ocimum basilica* which was found to have saponins, alkaloids, flavonoids, triterpenoids and tannins decreased the growth of blood vessels and diminished the teratogenic effect of an introduced teratogen, retinoic acid (RA).

Evaluation of Antiangiogenicity of *Ocimum sanctum* L. Using CAM Assay

CAM Assay provides valuable information on the antiangiogenicity of the various extracts in several experiments. In this study, antiangiogenicity was evaluated in terms of branching frequency and branching point density such that the lower the branching frequency and branching point density, the higher is the antiangiogenic potential of the extract.

Table 1 presents the mean branching frequency of the blood vessels in ducks' chorioallantoic membrane after the introduction of various treatments.

Table 1. Mean Branching Frequency of the Blood Vessels in the Ducks CAM after the Introduction of Various Treatments

Treatments	Mean
T ₁ – Untreated Eggs	86.67a
T ₂ - dH ₂ O	92.11a
T ₃ - Normal Saline Solution (NSS)	88.22a
T ₄ - 0.1 % of Carrageenan	67.87ab
T ₅ - 10 µg/ml Holy Basil Extract (HBE) + 1 µg/ml of Carrageenan	83.66a
T ₆ - 20 µg/ml Holy Basil Extract (HBE) + 1 µg/ml of Carrageenan	46.44b
T ₇ –30 µg/ml Holy Basil Extract (HBE) + 1 µg/ml of Carrageenan	45.78b
T ₈ - 40 µg/ml Holy Basil Extract (HBE) + 1 µg/ml of Carrageenan	39.00b

❖ Means followed by the same letter are not significantly Different from each other at 0.05 level

c.v. = 26.00%

Univariate Analysis of Variance (ANOVA) showed that a statistically significant difference was evident at 0.05 level of significance on the mean branching frequency of blood vessels. Duncan's Test further revealed that T₈ which used the highest dose of 40 µg/ml Holy Basil extract varied significantly from T₅ which received 10 µg/ml HBE. On the other hand, T₈ was not significantly different from T₆-20 µg/ml HBE and T₇-30 µg/ml HBE. However T₆, T₇, T₈ did not vary significantly from each other. Moreover T₆, T₇, T₈ were statistically different from T₁, untreated, T₂, dH₂O and T₃, NSS, the negative control groups but did not vary significantly from T₄, positive control.

This result implies that the mean branching frequency of blood vessels in the duck CAM treated with 20 µg/ml, 30 µg/ml, and 40 µg/ml HBE were significantly lower than the untreated

and the negative control groups but were comparable to carrageenan, the positive control. This suggests that doses of HBE ranging from 20 µg/ml to 40 µg/ml were able to prevent the proliferation of the blood vessels comparable to carrageenan, a known antiangiogenic agent. Supporting this finding were studies of Herrera and Amor (2011) and Tantiado et al. (2012) which showed that the methanol extract and hexane fraction of *Ardisia pyramidalis* resulted to a reduction in blood vessel count on the ducks' chorioallantoic membrane. This is similar also of the findings of Tantiado et al. (2012) which revealed that the *Tinospora rumphii* (makabuhay) stem extract inhibited the growth of new blood vessels suggesting its antiangiogenic potential. Tantiado et al. (2012) further stated that the greater the dosage, the lesser the branch points observed.

Table 2 presents the mean branching point density of the blood vessels in ducks' CAM after the introduction of various treatments. It is shown in the table that T₅ registered the highest mean branching point density among the treatments with HBE. The

lowest mean branching point density of blood vessels was registered by T₈. Overall, T₈-40 µg/ml showed the lowest mean branching point density of blood vessels in the ducks' chorioallantoic membrane.

Table 2. Mean Branching Point Density in Ducks' CAM after the Introduction of Various Treatments.

Treatments	Mean
T ₁ – Untreated Eggs	75.27a
T ₂ - dH ₂ O	80.00a
T ₃ - Normal Saline Solution (NSS)	76.62a
T ₄ - 0.1 % of Carrageenan	58.96ab
T ₅ - 10 µg/ml Holy Basil Extract (HBE) + 1 µg/ml of Carrageenan	72.66a
T ₆ - 20 µg/ml Holy Basil Extract (HBE) + 1 µg/ml of Carrageenan	41.30b
T ₇ -30 µg/ml Holy Basil Extract (HBE) + 1 µg/ml of Carrageenan	39.76b
T ₈ - 40 µg/ml Holy Basil Extract (HBE) + 1 µg/ml of Carrageenan	33.87b

❖ Means followed by the same letter are not significantly different from each other at 0.05 level

c.v. = 25.49%

Univariate Analysis of Variance (ANOVA) declared that a statistical significance was evident at 0.05 level of significance on the mean branching point density of blood vessels (see appendix). Duncan's test further showed that T₈ which used the highest dose of 40 µg/ml varied significantly from T₅ which used the lowest dose of 10 µg/ml HBE. On the other hand, T₈ was not significantly different from T₆- 20 µg/ml HBE and T₇-30 µg/ml Holy Basil Extract.

Moreover T₆, T₇, and T₈ varied significantly from T₁-untreated, T₂-distilled water and T₃- NSS. Furthermore, all treatments at 20, 30, 40 µg/ml concentrations of Holy Basil extract did not vary significantly from T₄- Carrageenan, which is the positive control. This indicates that concentrations ranging from 20 µg/ml to 40 µg/ml of Holy Basil (HBE) showed remarkable decrease in the branching point density compared to the positive control which used Carrageenan.

Apparently, doses ranging from 20 µg/ml to 40 µg/ml Holy Basil Extract

was able to inhibit the proliferation of blood vessels; hence, responsible for the decrease in the mean branching point of blood vessels.

According to Gamaallo et al. (2016), *Ocimum basilica* ethanol extract demonstrated antiangiogenic property exemplified by its ability to reduce the number of branching points in the blood

vessels of duck's CAM. The antiangiogenic potential demonstrated

by the various concentrations of Holy Basil extract (HBE) may be attributed to the presence of secondary metabolites which were similarly detected in *Ocimum basilica* such as flavonoids, alkaloids, saponins, tannins, and triterpenoids.

Evaluation of the Antiteratogenicity of *O. sanctum* L. Using Duck Embryo Assay

Table 3. Mean Percent (%) of Embryos with Dysmorphogenesis after the Introduction of Various Treatments

Treatments	Mean
T ₁ – Untreated Eggs	0.00c
T ₂ - dH ₂ O	55.67ab
T ₃ - Normal Saline Solution (NSS)	78.00a
T ₄ - 0.1 % of Carrageenan	89.00a
T ₅ - 10 µg/ml Holy Basil Extract (HBE) + 1 µg/ml of Carrageenan	100.00a
T ₆ - 20 µg/ml Holy Basil Extract (HBE) + 1 µg/ml of Carrageenan	100.00a
T ₇ – 30 µg/ml Holy Basil Extract (HBE) + 1 µg/ml of Carrageenan	55.67ab
T ₈ - 40 µg/ml Holy Basil Extract (HBE) + 1 µg/ml of Carrageenan	22.22bc

❖ Means followed by the same letter are not significantly different from each other at 0.05 level.

C.V. = 40.66%

Univariate Analysis of Variance (ANOVA) revealed that there was a significant difference on the mean percent embryos with dysmorphogenesis at 0.05 level of significance. Furthermore, it was declared by Duncan's test that T₅, T₆ and T₇ varied significantly from T₁, the untreated eggs but not significantly different from each other. Moreover, T₅,

T₆ and T₇ were comparable to T₂, T₃ and T₄, the positive control. On the other hand, T₈, the highest dose of 40 µg/ml was statistically different from T₅ and T₆, the treatments containing HBE ranging from 10 µg/ml – 20 µg/ml. T₈ was also significantly different from T₃- NSS and T₄- Carrageenan, the positive control, but not significantly different from T₇. This

implies that the higher doses ranging from 30 µg/ml to 40 µg/ml HBE counteracted the effect of Carrageenan, which is a known teratogen. A low dose of 10 µg/ml - 20 µg/ml HBE, however was unable to suppress the effect of the teratogen. In a study performed by David et al. (2014), it was shown that *Moringa oleifera* ethanol extracts exhibited antiteratogenic activity by inhibiting the effects of Retinoic acid

Morphological Examination of Duck Embryos Exposed To the Different Treatments

Normal Duck Embryos from Untreated Samples at 14th Day. T₁ which consisted of duck embryo eggs that did not receive any treatment exhibited normal development (Fig. 4). The embryos showed normal development of feathers and well-developed wings and limbs. The head was somewhat elongated at the snout. The body was slender compared to the underdeveloped body of the Carrageenan-treated ducks.

Early Death and Morphological Abnormalities from Carrageenan-treated Eggs

After fourteen days of incubation, the Carrageenan-treated duck embryos manifested several degrees of morphological malformations. It was clearly observed that they manifested the following malformations particularly growth retardation, underdeveloped wings, underdeveloped limbs, and pale coloration. There was also early death in the duck embryos.

As a known teratogen reported in several studies, carrageenan as a positive control resulted to the presence of

(RA), the positive control. The embryo treated with *M. oleifera* ethanol extract at doses ranging from 20 µg/ml to 40 µg/ml + 1 µg/ml of RA exhibited normal beak, head and limbs. Normal development of the embryos was evident resembling their untreated counterparts. Almost similar results were observed in the present investigation involving HBE at the highest dose.

various developmental malformations (Kolosan et al., 2010). In all the results gathered, T₄ (Carrageenan), undeniably a teratogen resulted in embryos with abnormal development including underdeveloped wings and limbs. Growth retardation was also evident. All embryos were also pale-colored, indicating poor vascularization. These morphological malformations were also observed in Carrageenan-treated embryos conducted by Kolosan et al. (2010).

Embryos Treated with the Different Concentrations of *O. sanctum* L. Leaf Extract

The embryos from 10 µg/ml (T₅) and 20 µg/ml (T₆) *Ocimum sanctum* L. ethanol extract after 14 days of incubation evidently showed abnormal morphology. The embryos appeared with defects and showed abnormal condition. Growth retardation was apparent. The wings and limbs were short. The beak or snout was somewhat round next to the eye. Poor vascularization was obvious. The body was undeveloped and the translucent pinkish skin of the embryos was not seen indicating that they are not in normal and healthy condition. It was observed that even in embryos treated with dH₂O and NSS, some abnormalities were

observed. The presence of abnormalities exemplified by the control groups was also seen in the study of Rovasio and Monis (1980). In their study, embryos that received dH₂O and saline solution exhibited hip dislocation, gastroschisis and anophthalmia.

Most embryos in T₇ and T₈ showed normal external morphology in terms of growth, development of the wings and limbs, and normal vascularization similar to the untreated embryos, although in T₇, some of the embryos were affected by some morphological malformations such as irregularity in beak shape. Pale coloration of some embryos was also evident.

CONCLUSIONS

1. Phytochemical screening of *O. sanctum* L. revealed the presence of secondary metabolites such as saponins, alkaloids, flavonoids, triterpenoids and tannins. The screening also showed the presence of proteins, carbohydrates and reducing sugars. It is believed that these active components detected are responsible for the antiangiogenicity and antiteratogenicity of the *O. sanctum* L. leaf extract in ducks' CAM and embryos.

2. The different concentrations of Holy Basil Extract (HBE) affected the proliferation of blood vessels in ducks' CAM with the following results:

2.1. The branching frequency showed that increasing concentrations of the *O. sanctum* L. leaf extract reduced the number of branching points in the ducks' chorioallantoic membrane.

2.2. The branching point density of blood vessels in ducks' CAM treated with different concentration of HBE ranging from 20 µg/ml to 40 µg/ml was likewise reduced.

3. Vascular damage due to blood occlusions led to the formation of ghost vessels and petechial hemorrhage which are indicators of the antiangiogenicity of the extract.

4. The highest percent embryos with dysmorphogenesis was apparent at concentrations ranging from 10 µg/ml to 20 µg/ml HBE; whereas, the lowest percent dysmorphogenesis were observed at concentrations ranging from 30 µg/ml to 40 µg/ml HBE with the highest dose of 40 µg/ml registering the lowest percent dysmorphogenesis.

5. Growth retardation, underdeveloped wings and limbs and pale coloration were among the morphological abnormalities observed in the duck embryos treated with the low doses of *O. sanctum* L. extract and those treated with Carrageenan.

RECOMMENDATIONS

1. Concentrations ranging from 20 µg/ml to 40 µg/ml HBE are highly recommended doses because they registered lower branching frequency and branch point density which are indicative of the extract's antiangiogenic potential. Moreover, a concentration of 40 µg/ml registered the lowest percent embryos with dysmorphogenesis suggesting that it has the ability to counteract the teratogenic effects of carrageenan, a known teratogen.

2. The leaves of *O. sanctum* L. was the only part of the plant used in the study; hence, the researchers

- recommended to consider the antiangiogenic and antitumorogenic properties of parts other than the leaves.
3. Further studies using other organism may also be done to have better evaluation of the potential of the plant as a standard procedure in screening for possible drugs for human consumption. If proven effective with other types of organisms, clinical trials involving human subjects may follow.
 4. A laboratory egg incubator with complete settings must be used to ensure that moisture and temperature are properly distributed and regulated.

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Antifungal Activity of Different Plant Extracts against *Aspergillus niger* Isolated from Onion Bulbs Infected with Black Mold Rot

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ABSTRACT

This study was conducted to test the antifungal activity of weeds commonly found in the locality namely, Lantana camara L. (lantana), Cyathium cinereum L. (little ironweed) and Chromolaena odorata L. (siam weed). Basically, this study aimed to discover cheap and biodegradable sources of fungicides which can be as effective as the chemical ones. In this study, leaf methanolic extracts were tested against Aspergillus niger. This pathogen was isolated from onion bulbs (var. red pinoy) infected with black mold rot.

Results showed that all the plant extracts were effective against A. niger comparable to fungicides, Nordox and Mancozeb. The inhibitory effect of the extracts lies on their ability to destroy hyphal walls and possibly to cross the lipid layer of the cell membrane. Results suggest that these plant extracts are potential sources of natural fungicides.

Keywords: *Aspergillus niger, black mold rot, onion, plant extracts, natural fungicide*

INTRODUCTION

Onion (*Allium cepa* L.) is one of the top five vegetable crops grown in the Philippines with high production value (DA-Bureau of Agricultural Research, 2014). However, the production of onion significantly decreased due to incidence of pests and diseases, excessive use of pesticides and postharvest losses.

Among other fungal diseases, black mold rot is the most destructive disease caused by *Aspergillus niger*. This infection causes onion to decay when stored and when in the field but black mold is primarily a postharvest disorder, which causes extensive losses and accounts the major problems in agricultural industry (Arowora & Adentunji, 2014).

Lantana camara L. (lantana) is an important medicinal plant that belongs to the family Verbenaceae. This plant is reported for various medicinal uses with high antimicrobial properties (Sanjeeb et al., 2012; Bazie et al., 2014).

Another plant which was utilized in this study is *Cyathium cinereum* L. (little ironweed). This weed is a common Asteraceae grown in the wild together with other weeds and grasses. Previous study of Toyang & Verpoorte (2013) confirmed some of the medicinal properties of this plant, which include the

analgesic, antipyretic, anti-inflammatory, antibacterial and antifungal effects.

Similarly, a study conducted by Okey (2015) revealed that *Chromolaena odorata* aqueous leaf methanol extracts are effective in inhibiting the growth of seven phytopathogenic fungi associated with cassava tuber rot. *C. odorata* leaf extract showed increasing inhibitory effects on mycelial growth, sporulation and spore germination as the concentration of the extracts increase.

Statement of Objectives

The objective of this study is to investigate the effects of different plant extracts against *Aspergillus niger* isolated from onions exhibiting the symptoms of black mold rot and their mode of action in inhibiting the mycelial growth of the pathogen.

MATERIALS AND METHODS

Collection of Disease Plant Tissue

Onion bulbs infected with black mold rot were collected from Manabong Parte, Bayambang, Pangasinan. The infected onions were critically diagnosed based on physical examination and symptoms.

Isolation of Fungal Pathogen

Isolation of fungal pathogen was done by tissue isolation method. To isolate the fungal pathogen, affected portions of the onion bulbs were washed thoroughly with tap water to remove adherent particles. Washed onion bulbs were dried on sterilized paper towel. Small sections about 5 mm square were cut from the margin of the bulbs' external lesions so that they contain both diseased and healthy-looking tissue. These sections were surface sterilized with 10 percent sodium hypochlorite solution (Clorox) for one minute. The disinfected tissues were blotted dry on sterile paper towel to remove Clorox excess (Agrios, 2005).

Three to four sections of rotted lesions were plated aseptically on 90 mm Petri plates containing PDA medium. The Petri plates were incubated at room temperature ($28 \pm 3^\circ\text{C}$) in an incubation cabinet. As soon as fungal growth became visible, an isolated fungal colony free from contamination was re-isolated and maintained on PDA medium to obtain a pure culture of the fungi using single spore isolation method. The pure culture of the pathogen was subjected to antifungal assay through the poison food technique and pathogenicity test.

Pathogenicity Test

The protocol of Riaz et al. (2010) was generally followed in this study with slight modification. Instead of using chickpea seeds, corn seeds were used as bait for the colonization of the pathogen.

For the preparation of fungal inoculum, 500 g boiled corn seeds were autoclaved at 121°C for 30 minutes in transparent plastic bags. After cooling at room temperature, 500 g sterilized, boiled, corn seeds, were inoculated with 0.3 g, 14 day-old pure culture of isolated fungus and incubated for 14 days at room temperature until the fungi grew. Ten (10) grams of the infected corn seeds were placed in plastic cups (diameter of 93 mm and a height of 117 mm) then 350 g sterilized sandy loam soil was added. The inoculated soil in the cups was incubated for seven (7) days at room temperature, frequently stirred and watered so that the fungi could colonize the soil. The inoculated soil was planted with surface-sterilized, 3 cm-diameter (red pinoy variety)

onion bulbs. Following the Koch's postulates (Agrios, 1997), onion was used as the host plant in this experiment to verify the identity and the virulence of the isolate. The occurrence of black mold rot in onions was observed for a period of ten weeks.

***In vitro* Antifungal Assay**

Collection and Preparation of Methanolic Crude Extracts

L. camara, *C. cinereum* and *C. odorata* were collected from the vicinity of Don Mariano Marcos Memorial State University, South La Union Campus, Agoo, La Union in November 2016. Voucher specimens were preserved and submitted to Mr. Danilo N. Tandang of the Botany Division, National Museum Manila, for identification and authentication. Air-dried leaves of the plants were homogenized by a blender. Plant samples weighing 250 g of each plant type were extracted separately using 95 percent methanol. The solutions were kept for 48 hours to extract the active principles of the plants. The resulting supernatant was concentrated *in vacuo* at 45°C using a rotary evaporator to obtain the methanolic crude extracts.

Preparation of Treatments

Poison food technique was employed to test the antifungal activity of the plant extracts. PDA was used as culture medium. Varying amounts of plants extract were added to PDA to get final concentrations of two percent, six percent, and 10 percent. For the positive control, three percent Nordox was used while three percent Mancozeb was used for the farmer's practice. The negative control was applied with distilled water.

Inoculation of Fungi

The media amended with plant extracts and fungicides were inoculated with five (5) mm mycelial discs. Each mycelial disc was taken from the advancing edges of five-day-old pure cultures of *A. niger* using a sterilized corked borer. This was placed at the center of each amended agar plates. All the plates were incubated at room temperature ($28 \pm 3^\circ\text{C}$) in an incubation cabinet for five (5) days. Three replications were employed for each treatment.

Determination of Colony Diameter

Using a foot ruler, the diameter of the fungal colony growing on the plates containing the different plant extracts and the controls were recorded after five (5) days of incubation. Colony diameter was recorded by measuring the two opposite ends of the colony growth. In case irregular mycelial growth was observed on the plates, the widest diameter occupied by the fungus was measured (Das et al., 2010).

Percent Inhibition

The mycelial growth was evaluated by comparing the colony diameter of poison plate (with plant extract and fungicide) and non-poison plate (with distilled water) and calculated using the formula mentioned by Das et al. (2010) which is,

$$\% \text{ inhibition} = [C - T / C] \times 100$$

Where:

C = diameter (mm) of negative control colony

T = diameter (mm) of treated colony

Staining and Microscopic Examination of *A. niger*

Using 10 percent crystal violet, a sample mycelium taken from the advancing edges of a five-day-old fungal culture was stained and examined under the microscope. This was obtained from the previous assay. With a mounting needle, a drop of stain was dropped on a slide containing a small portion of the fungal mycelium. Only the treatments containing two percent plant extract, negative control, positive control and farmer's practice were examined because no or very minimal mycelial growth was seen in the set-ups treated with six percent and 10 percent plant extracts. These slides containing mycelia were examined per replicate.

Data Analysis

The data gathered on the previous experiment were tabulated and analyzed by using One-Way Analysis of Variance (ANOVA) using SPSS software version 21. Data that showed statistical differences were subjected to Tukey Test at $p < .05$.

RESULTS AND DISCUSSION

Identification of Fungal Isolate

As identified and verified by the experts of the Department of Agriculture (DA), the fungal isolate belongs to the black Aspergilli (*Aspergillus* section Nigri). The cultural and morphological characteristic of the fungal isolate is identical to the characteristic of *Aspergillus niger*.

Pathogenicity of the Isolate

Initial examination of the infected bulbs showed the following symptoms; (1) black discoloration of the tissues; (2) black spot or mycelia seen at the neck and outer papery scales; and (3) water-soaked appearance and shrivelling over time.

Following the steps in Koch's postulates in the pathogenicity assay, results showed that the plants inoculated with *A. niger* manifested symptoms typical and similar to the bulb infected with black mold rot. In contrast, the plants grown in the un-inoculated cups did not show any symptoms of the disease.

It was also observed that some of the inoculated plants did not show symptoms while still in the cups but later infection was seen at storage. Re-isolation of the fungi from the infected bulbs confirmed that it was indeed *A. niger*.

These observations coincide with the study of Sharma (2012), that *A. niger* (black mold) can infect onion bulbs both in the field and when stored.

Table 1. Antifungal Activity of the Different Leaf Methanol Extracts against *A. niger* Measured in Terms of Colony Diameter (CD) and Percent Inhibition (PI)

Treatments	<i>L. camara</i>		<i>C. cinereum</i>		<i>C. odorata</i>	
	CD (mm)	PI (%)	CD (mm)	PI (%)	CD (mm)	PI (%)
Distilled water (Negative Control)	74.67a	-	71.33a	-	72.33a	-
3% Nordox (Positive Control)	5.67d	92.56a	5.33b	92.66a	8.00e	88.95a
3% Mancozeb (Farmer's Practice)	15.00c	79.79b	14.67c	80.89ab	13.67d	81.13b
2% plant extract	35.67b	52.06c	35.67d	49.91c	50.67b	26.80d
6% plant extract	11.00cd	85.23ab	18.00c	74.73b	24.67c	66.34c
10% plant extract	0.00d	100a	2.33b	96.85a	7.33e	89.85a
c.v.	12.67	5.44	11.60	5.57	7.16	2.48

*Means are compared along columns; means followed by the same letter are not significantly different at

Antifungal Activity of the Different Plant Extracts

Table 1 shows the effect of the different plant extracts to the growth of *A. niger* measured in terms of colony diameter (CD) and percent inhibition (PI).

Effect of *L. camara* Leaf Methanol Extracts

Results revealed that the highest concentration (10%) significantly stopped the growth of the fungi, even more effective than Mancozeb which is commonly used by the farmers. At six percent concentration, the extract had a comparable effect with Nordox and Mancozeb together with the 10 percent concentration.

As to percent inhibition, result shows that 10 percent concentration of the extract completely inhibited the growth of *A. niger*. Its effect is comparable to Nordox and the six percent concentration of the extract.

Moreover, six percent concentration of the extract is comparable to Mancozeb. The lowest concentration of the extract (2%) had the least effect among the treatments inhibiting the growth of the fungi by only 52.06 percent. Result implies that *L. camara* crude extract at a concentration as low as 10 percent can inhibit the growth and multiplication of *A. niger* even better or comparable to chemical fungicides.

Effect of *C. cinereum* Leaf Methanol Extracts

As shown in Table 1, the highest concentration of the extract (10%) significantly inhibited the growth of *A. niger* effecting the lowest CD of 2.33 mm which is comparable to Nordox. At percent concentration, *C. cinereum* extract had a similar effect with Mancozeb in inhibiting the growth of the fungi. The treatment with the least concentration which is two percent *C. cinereum* leaf methanol extracts demonstrated a low inhibitory action against *A. niger* effecting the largest mean diameter of 35.67 mm next to the negative control which is 71.33 mm.

In terms of PI, results further revealed that 10 percent concentration of the extract has a similar effect with Nordox and Mancozeb showing a 96.85 percent inhibition. Intermediate effect was observed in the six percent concentration of the plant extract which showed an inhibition of 74.73 percent comparable to Mancozeb.

In contrast, the lowest concentration of the extract which is two percent has the least effect among the other treatments inhibiting the growth by only 49.91 percent. This indicates that the effect of the extract is dose-dependent.

Phytochemical analysis of ethanol and aqueous extracts of *C. cinereum* showed the presence of alkaloids, phenols, tannins, saponins, steroids, glycosides, and flavonoids (Varsha et al., 2015). These phytochemicals and secondary

metabolites have been documented to exhibit antimicrobial activities (Trentin et al., 2013 & Manner et al., 2013) which could be the reason why *C. cinereum* extracts as tested in this study are effective against *A. niger*.

Effect of *C. odorata* Leaf Methanol Extracts

Similar to the effect of the previous extracts, the highest concentration (10%) of *C. odorata* leaf methanol extract was effective in reducing the growth of the fungi comparable to Nordox. In contrast, lower concentrations of two percent and six percent plant extracts together with Mancozeb shows different degrees of growth inhibition. A concentration of six percent of the extract resulted in a colony diameter of 24.67 mm more effective than two percent of the extract which resulted in a colony diameter of 50.67 mm.

Furthermore, 10 percent concentration of the extract was effective in suppressing the growth of *A. niger* by 89.85 percent comparable to Nordox, while concentrations of two and six percent were found to be slightly effective against fungal growth resulting in 26.80 percent and 66.34 percent inhibition, respectively.

The slight differences in the antifungal activities of the different plant extracts against *A. niger* may be due to variations in their phytochemical components.

Mode of Action of the Different Plant Extracts

Intact hyphal wall and clear cytoplasm were seen in the untreated set-up or negative control. The conidial head of the fungus was large and radiating with well-defined vesicles. In contrast, the hyphal wall of the pathogen subjected to the three percent Nordox (positive control) became flaccid and the cytoplasm seemed to leak out of the hyphal wall. Moreover, there seemed to be a clear decrease in the cytoplasmic content of the hyphae in this treatment which might be a result of the destruction of the hyphal wall.

For the fungi applied with three percent Mancozeb (farmer's practice), the hyphal cytoplasm showed empty spaces with granulation.

Same effect was seen with two percent concentration of *L. camara*. It was noted that the cytoplasm retracted from the hyphae and a large portion of the hyphae lacked cytoplasm. Manifestations of conidial head destruction were also evident like irregularity in shape and clear absence of conidia.

Similar results were seen to those subjected in two percent concentration of *C. cinereum* and two percent concentration of *C. odorata*. Morphological anomaly like clear separation of cytoplasm from the hyphal cell wall was also evident.

These observations are in agreement with the results by Sharma & Tripathi (2008) who observed that application of essential oil of *Citrus sinensis* to *A. niger* resulted in the loss of cytoplasm and retraction of hyphae. Other studies also revealed that aqueous extract of *Dumortiera hirsute* showed variable effects on hyphal structures of *A. niger* (Alam et al., 2011). These observations indicate that the mode of action of the different plant extracts tested in this study might be a result of the attack of the active components of the extracts on the cell wall leading to the leakage of the cell as manifested by the retraction of cytoplasm in the hyphae and eventually death of the mycelium.

CONCLUSIONS

From the results, the pathogen causing black mold rot infection in onion is a fungus known as *Aspergillus niger*. Plant extracts of *L. camara*, *C. cinereum* and *C. odorata* are potential sources of natural fungicides which can have comparable effect to the high doses of commercial ones. The recommended rate of Nordox and Mancozeb commonly used by farmers is no longer effective in inhibiting the growth of the fungal pathogen but requires a greater dosage. The inhibitory effect of the plant extracts tested in this study lies on their ability to destroy the hyphal walls and to cross the lipid layer.

RECOMMENDATIONS

Based from the findings and conclusions of the study, field trials should be conducted

where all the tested extracts will be sprayed to the onion bulbs infected with black mold rot. Evaluate the effect of the leaves of the test plants if they can prolong the shelf life of onions when used as shield in the storage areas. DNA analysis and gene sequencing can also be done to ascertain further the identity of the fungus. Isolation of the active components of *L. camara*, *C. cinereum* and *C. odorata* can be conducted.

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Antihypokalemic and Antihypomagnesemic Potential of *Moringa Oleifera* Lam. (Malunggay) Leaf Extract in Mice

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ABSTRACT

Potassium and magnesium are the body's intracellular ions which are crucial in cell membrane potential and muscular contraction. The normal range of potassium is 3.5-5 mEq/L and magnesium is 1.7-2.1 mg/dl. Below these normal levels, hypokalemia and hypomagnesemia result. Despite the commercially available drugs, search for potential antihypokalemic and antihypomagnesemic agent is underway.

Different concentrations of Moringa oleifera leaf extract were administered to the hypokalemic and hypomagnesemic mice to assess their antihypokalemic and antihypomagnesemic potential in terms of SK^+ and SMg^+ levels after five and eight days of treatment administration, including their percent increase.

Findings showed that after five days and eight days of treatment administration, 20, 40, 60 ml M. oleifera/kg bw of mouse significantly increased the SK^+ and SMg^+ levels in mice. Correlation showed a weak relationship between serum potassium and magnesium levels. Nevertheless, M. oleifera leaf extract can be a good candidate agent against hypokalemia and hypomagnesemia.

Keywords: *Moringa oleifera, hypokalemia, hypomagnesemia, Serum Potassium level, Serum Magnesium level*

INTRODUCTION

Nowadays, life threatening conditions such as paralysis of the lung muscles and abnormal heartbeat known as arrhythmia that can lead to cardiac arrest are the sudden causes of death among people (Kjeldsen, 2010). According to the Philippine Heart Association, heart diseases are the common cause of death among adults in the country. These diseases are some serious manifestations of the insufficient amount of electrolytes such as potassium and magnesium in the body.

One of the major ions in the body is potassium. The maintenance of cell membrane potential which is important in sustaining life is one of the vital roles of K^+ . It is crucial in heart function, kidney function, nerve impulse transmission, transfer of nutrients to cells. It plays a key role in skeletal and smooth muscle

contraction (Pohl et al., 2012). 3.5-5 mEq/L is the reference range for serum potassium level in humans. A condition below the normal level of potassium in the blood is known as hypokalemia (Garth et al., 2015). Many of the symptoms of hypokalemia are manifested in electrically excitable tissues. Potassium deficit can be caused either by low potassium intake or excessive potassium losses through the gastrointestinal and urinary tracts (Manu et al., 2015).

The second-most abundant intracellular which is associated with potassium is magnesium (Fulop, 2016). It acts as a cofactor in reactions which require adenosine triphosphate essential for the activity of the sodium-potassium ATPase pump (Manu et al., 2015). It plays a fundamental role in several functions of the cell. Systemically, magnesium lowers blood

pressure and alters peripheral vascular resistance (Fulop, 2016).

Normal magnesium concentration is 1.4-1.7 mEq/l. Hypomagnesemia is a condition with a magnesium level below this range. This abnormality occurs primarily as a result of insufficient dietary magnesium intake or of increased gastrointestinal and renal losses of magnesium (Manu et al., 2015). Severe magnesium deficiency results in varied manifestations ranging from ECG changes, neuromuscular abnormalities and defects in hormonal homeostasis and electrolyte (Aggarwal et al., 2013). Deficiency of magnesium in the body is frequently associated with hypokalemia. Hypomagnesemia impairs Na-K-ATPase, which would decrease cellular uptake of potassium which could lead to hypokalemia. Clinically, combined potassium and magnesium deficiency is most frequently observed in individuals receiving loop or thiazide diuretic therapy (Huang et al., 2007).

These rarely heard conditions can be critical in the clinical medicine, hence, necessitates various treatments. Such known medicines that can be obtained over the counter are oral potassium chloride for hypokalemia whereas, magnesium chloride for hypomagnesemia. Severe hypokalemia with hypomagnesemia needs an intravenous injection (Aggarwal et al., 2013).

Meanwhile, there have not been a very thorough research on any alternative herbal medicine that can treat hypokalemia associated with hypomagnesemia, the researchers were motivated to seek for a plant which is a great source of the minerals, potassium and magnesium. Good source of these minerals are the green leafy vegetables which include *Moringa oleifera* commonly known as malunggay.

Moringa oleifera is a tree, widely found in tropical and sub-tropical belts. It is regarded as a multipurpose plant (Planco, 2009). *Moringa* is a very impressive and amazing plant due to its tested, trusted and potential benefits from nutritional as well

therapeutical point of view. *Moringa* is sometimes called as "Mother's Best Friend" and "Miracle Tree". In fact, *M. oleifera* is the most nutrient rich plant yet discovered (Mahmood et al., 2010). It contains the essential amino acids in good proportion (Bennett et al., 2003). It has various phytoconstituents. Phytochemical analyses have shown that its leaves are particularly rich in minerals such as potassium and vitamins (Bennett et al., 2003). This plant has the potential to combat micronutrient deficiencies (Nambiar, 2006). It contains a range of fairly unique phytochemicals containing the simple sugar, rhamnose, and it is rich in a fairly unique group of compounds called glucosinolates and isothiocyanates. Research suggests that the extracts of *Moringa oleifera* both mature and tender leaves have potent antioxidant activity against free radicals (Mahmood et al., 2010). It is widely consumed for self-medication by patients affected by HIV/AIDS, diabetes and hypertension (Dieye et al., 2008).

What pushed the researchers to conduct this study is that, *M. oleifera* is richer in potassium than banana and it contains magnesium at 45 mg per 100 g adequate to treat hypokalemia and at the same time, hypomagnesemia.

Statement of Objectives

This study was conducted to evaluate the antihypokalemic and antihypomagnesemic potential of *Moringa oleifera* (Malunggay) leaf extract on furosemide- induced hypokalemic and hypomagnesemic mice.

Specifically, it sought to:

1. assess the K⁺ and Mg⁺ levels of mice treated with various concentrations of *M. oleifera* leaf extracts:
 - 1.1 before the experiment
 - 1.2 two hours after the introduction of furosemide (Lasix)

- 1.3 after five (5) days of treatment administration and;
- 1.4 after eight (8) days of treatment administration
2. determine the per cent increase in serum potassium and magnesium levels after *M.*
3. determine if there is a relationship between serum potassium and magnesium after the treatment

Research Design

The study followed the experimental method of research. The study used six treatments.

T₁- 20 mg Furosemide (Lasix)

T₂- 0.25 ml distilled water

T₃- 20 mg Potassium chloride (positive control)/20 mg Magnesium chloride (positive control)

T₄- 20 ml *M. oleifera* leaf extract

T₅- 40 ml *M. oleifera* leaf extract

T₆- 60 ml *M. oleifera* leaf extract

MATERIALS AND PROCEDURES

Materials

Chemicals and Reagents

Furosemide (Lasix) was purchased at Mercury Drug Store, Agoo, La Union Branch. Potassium chloride, Magnesium chloride, and Potassium and Magnesium reagents were obtained from Fame Analytical Reagents and Laboratory at Pasig City.

Plant Material. *Moringa oleifera* leaves were collected at Namonitan, Sto. Tomas, La Union.

Test Animal. Sixty- three (63) male albino mice with weights ranging from 30-40 g were purchased at My Petville, San Fernando City, La Union. A permit for the animal procedure was sought from the Department of Agriculture, Bureau of Animal Industry.

Collection and Preparation of Plant Material. *M. oleifera* fresh leaves (1 kg) were collected at Namonitan, Sto. Tomas, Agoo, La Union. The plant was

oleifera leaf extract treatment on furosemide-induced hypokalemic and hypomagnesemic mice; and

Procedures

authenticated at the Botany Division National Museum in Metro Manila. The leaves of *M. oleifera* were washed thoroughly using running water and air dried for three days.

Water extraction. 0.5 gram malunggay powder was diluted with distilled water at 1:100 ratio (w/v) and shaken for 20 minutes. The solution was filtered using filter paper. The filtrate was stored in a covered glass bottle provided with care.

Preparation of Treatments. Extract from *M. oleifera* leaves was placed in Eppendorf tubes. Treatments were prepared by dispensing 20 ml, 40 ml and 60 ml for T₄, T₅ and T₆, respectively. T₁ and T₃ were dissolved in 0.25 ml distilled water.

Biological Screening for Antihypokalemic and Antihypomagnesemic Potential of *M. oleifera*

Furosemide-Induced Hypokalemic and Hypomagnesemic Mice. Before the administration of furosemide and treatments, the mice were acclimated to laboratory conditions for seven days. The mice were properly cared and fed with BMEG Integra 3 and supplied with water in *ad libitum*. Mice were weighed to ensure that they have maintained their weights within the range of 30-40 g.

20 mg of furosemide per kg body weight of mouse was introduced via oral gavage after seven days of acclimation.

Blood Sample Collection

Lateral saphenous vein was used for sampling while taking aseptic precautions. The back of the hind leg was shaved with blade until saphenous vein was visible. The animal was restrained with the use of aseptic syringe. The vein was punctured using a twenty-five (25) gauge needle and the capillary tube was filled to within 1-2 cm of blood. The punctured site was compressed to stop the bleeding (Parasuraman et al., 2010).

One end of the tube was pressed-filled with sealing clay and candle. It was then placed vertically in the wooden rack and stored at room temperature. The collected blood was allowed to clot for approximately one (1) hour until ready to be centrifuged at 6000 rpm for five (5) minutes. By using spectrophotometer, the sera collected were stored in refrigerator until the succeeding analysis

Treatment Administration

A study conducted by Berne et al. (2005) used furosemide in order to observe its effect on urinary essential nutrient loss in rats. Results showed that furosemide caused great urinary losses in all the measured nutrients and electrolytes including potassium and magnesium. This indicated that furosemide (Lasix) successfully decreased the SK^+ and SMg^+ levels in mice.

Oral administration of the different treatments was done for eight days via gavage method. The mice were deprived of food one hour before the administration to make sure they take in the different treatments. The volume of the treatment administered to each mouse was based on their body weights measured immediately prior to introduction of each dose. Treatments were given single dose daily. After administration of the treatments, feeding was resumed *ad libitum*.

RESULTS AND DISCUSSION

Effects of Furosemide (Lasix) on Serum Potassium and Serum Magnesium of Mice

The introduction of furosemide resulted to sudden decrease in the serum potassium levels and serum magnesium levels in mice. The SK^+ level in furosemide-induced mice decreased by 0.65 to 1.24 compared to the baseline potassium levels. Whereas, the SMg^+ level in furosemide-induced mice decreased by 0.1 to 0.54 compared to the baseline SMg^+ levels.

Effects of the Different Treatments After Five and Eight Days SK^+ Levels

To assess their effects on the serum potassium and serum magnesium levels of the mice, different treatments were administered to the furosemide-pretreated mice which consisted of potassium chloride and magnesium chloride which served as the positive control, distilled water and the different concentrations of *Moringa oleifera*

Table 1. Mean SK⁺ Levels (mmol/L) after Five and Eight Days Administration of Treatments in Furosemide-Induced

Mic

Treatments	Mean after 5 days	Mean after 8 Days
T ₁	3.11	3.11b
T ₂	3.40	3.59ab
T ₃	3.92	4.19ab
T ₄	3.30	4.57a
T ₅	3.59	4.48a
T ₆	3.20	4.65a
	c.v. = 21.05 %	c.v. = 26.16

Table 1 shows the mean serum potassium level after five and eight days introduction of the different treatments in hypokalemic and hypomagnesemic mice.

After five days, all treatments were observed to have SK⁺ levels similar to each other. Meanwhile, among treatments orally administered with *M. oleifera* extract, T₅ which received 40 ml of *M. oleifera* leaf extract has the highest SK⁺ level. After eight days, SK⁺ level of the mice in T₄, T₅ and T₆ were comparable to T₃, potassium chloride. This means that the treatments containing

various concentrations of *M. oleifera* extract were as efficacious as that of T₃, the positive control.

Effects of the Different Treatments After Five and Eight days on SMg⁺ Levels

Table 2 shows the mean serum magnesium levels after five and eight days introduction of the different treatments in hypokalemic and hypomagnesemic mice. After five days, T₃ which received magnesium chloride expectedly increased the SMg⁺ level. Mice in T₆ which were given 60 ml of *M. oleifera* had the highest SMg⁺ levels among the treatments.

Table 2. Mean SMg⁺ Levels (mmol/L) after Five and Eight Days Administration of Treatments in Furosemide- Induced Mice

Treatment	Mean After 5 Days	Mean After 8 Days
T ₁	.71b	0.71b
T ₂	1.12ab	1.47ab
T ₃	1.35ab	1.27ab
T ₄	1.33ab	1.17ab
T ₅	1.45a	1.51a
T ₆	1.60a	1.43ab
*Means with same letter are not significantly different	c.v. = 42.31 %	c.v. = 47.85%

Percent Increase in SK⁺ Levels of the Hypokalemic and Hypomagnesemic Mice

It is even higher than magnesium chloride. After eight days, 40 ml of *M. oleifera* has the highest SMg⁺ levels among the treat

Table 3 depicts the percent increase of serum potassium after five and eight days administration of treatments. It is depicted that after five days, 40 ml of *M. oleifera* leaf

extract has the highest percent increase among the treatments with 22.72 percent. while T₄, 20 ml of *M. oleifera* leaf extract has the lowest percentage with 10.90 percent. Meanwhile, after eight days, it

shows that T₆, 60 ml of *M. oleifera* leaf extract has the highest percent increase among the treatments while T₂, 0.25 ml distilled water has the lowest percentage with 16.73 percent.

Table 3. Percent Increase of SK⁺ after Five and Eight Days Treatment

Treatments	% Increase After 5 Days	% Increase After 8 days
T ₁	0b	0d
T ₂	11.52ab	16.73cd
T ₃	21.68a	29.20bcd
T ₄	10.90ab	57.42ab
T ₅	22.72a	53.56abc
T ₆	18.46ab	75.44a
* Means with same letter are not significantly different		
	c.v. = 1.14 %	c.v. = 0.97 %

Percent Increase in SMg⁺ Levels of the Hypokalemic and Hypomagnesemic Mice

Table 4 depicts the percent increase of serum magnesium after five and eight days introduction of treatments. After five days, T₃ which received 20 mg of magnesium chloride, a positive control,

registered the highest percent increase among the treatments with 67.72 percent while T₅, 40 ml of *M. oleifera* has the lowest percentage with 35.05 percent. After eight days administration of treatments, it shows that T₂, 0.25 ml distilled water has the highest percent increase among the treatments while T₅, 40 ml *M. oleifera* has the lowest percentage with 34.58 percent.

Table 4. Percent Increase SMg⁺ After Five and Eight Days Treatment

Treatments	% Increase After 5 Days	% Increase After 8 Days
T ₁	0	0
T ₂	39.64	88.27
T ₃	67.72	57.25
T ₄	66.13	39.44
T ₅	35.05	34.58
T ₆	66.65	42.42
c.v. = 1.32 %		
c.v. = 1.49 %		

Relationship Between Serum Potassium and Serum Magnesium Levels in Mice

Table 5 presents the relationship between serum potassium and serum

magnesium levels of the mice after five days and after eight days of treatment

administration. After five days administration of treatments, there was no significant difference between serum potassium and serum magnesium levels. Pearson's correlation coefficient (2 tailed) was -0.114 which indicates that serum potassium and serum magnesium has a very weak negative correlation. This means that the relationship between potassium and magnesium is that, when SK^+ increases, SMg^+ decreases, and vice versa. After eight days administration of treatments, there was no significant difference between serum potassium and serum magnesium levels. Pearson's correlation coefficient (2 tailed) was 0.032 which indicates that serum potassium and serum magnesium has a very weak positive correlation.

Hypokalemia has been found to be frequently associated with hypomagnesemia. A study by Djagbletey (2016) in emergency surgical patients showed that there was a significant but weak positive correlation between serum potassium and serum magnesium levels. Some studies like the present study have, however, found no correlation between serum magnesium levels and serum potassium levels. As studied by Whang et al. (nd), this phenomenon is known as “refractory potassium repletion” which is the inability to correct hypokalemia in the presence of unrecognized and continuing magnesium deficiency.

Table 5. Relationship Between SK^+ and SMg^+ after the Administration of Treatments

Variables	r value	Sig	Remarks
After 5 days	-0.114	0.375	Very weak negative correlation
After 8 days	0.032	0.806	Very weak positive correlation

- significant at 0.05 level

CONCLUSIONS

Within the limits of the study the following conclusions were drawn:

1. Furosemide (Lasix) successfully lower the serum potassium and serum magnesium levels in mice.
2. Concentrations of *Moringa oleifera* ranging from 20 to 60 ml are all effective in treating both hypokalemia and hypomagnesemia in five days and eight days of treatment administration.

3. In terms of percent increase, 20 to 60 ml concentrations of *M. oleifera* leaf extract are as efficacious as that of the potassium chloride and magnesium chloride in increasing serum potassium and serum magnesium levels in five days and eight days of treatment administration.

4. There is a very weak relationship between serum potassium and serum magnesium levels in the study.

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Antimicrobial Property of *Sesbania grandiflora* (Katuray) Leaf Extract against *Escherichia coli* and *Rhizopus* spp.

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ABSTRACT

Research is unending for the medical practitioners and scientists in order for them to discover biological properties of plants. The present study showed the potential of crude *Sesbania grandiflora* leaf extract (SGELE) as antimicrobial. Specifically, result revealed that there is no antibacterial property of SGELE at 50 µg/ml, 100 µg/ml, 150 µg/ml, 200 µg/ml, and 250 µg/ml against *E. coli*. However, by using Kirby-Bauer Assay, a weak antifungal property was observed against *Rhizopus* spp. Furthermore, identification of MIC revealed a significant ($p < 0.05$) antifungal property (MIC < 50 µg/ml) of SGELE when compared to Clotrimazole against *Rhizopus* spp. This result supports the importance of *Sesbania grandiflora* as potential source of antifungal agent.

Keywords: antimicrobial, pathogenic

INTRODUCTION

For medical practitioners and scientists, research is unending in order for them to discover hidden healing abilities of plants. Nowadays, there is an improvement in the quality of life because medical professionals continue to widen the knowledge in the field of medicine by exploring natural products from plants. Plants and their products have been used by humans for treating numerous diseases. The World Health Organization (WHO) estimates that about three quarters of the population relies on plant based preparation used in their traditional medicinal system, and as the basic need for human primary health care (Padmalochana et al., 2014). Among the plants with reported several folkloric medical uses is *Sesbania grandiflora* which is yet to be fully explored for its complete utilization in the modern health care settings (Gomanse et al., 2012).

In medical field, all parts of *S. grandiflora* are utilized to treat diseases which can be linked to the secondary metabolites present. Lakshmi et al. (2010) showed that the leaf extract is a good anticonvulsant and anxiolytic due its triterpene component. In a reported phytochemical analysis, both the methanol and aqueous extract of *S. grandiflora* leaves contain alkaloids, coumarins, flavonoids, saponosids, terpenes, steroids, and tannins

(Outtara et al., 2011). Meanwhile, Bhoumik and Dwivedi (2014) found that phytochemical analysis of *S. grandiflora* revealed presence of arginine, cysteine, histidine, isoleucine, phenylalanine, tryptophan, valine, threonine, alanine, asparagine, aspartic acid and a saponin yielding oleanolic acid, galactose, rhamnose, glucuronic acid, flavonol glycoside, and kaempferol.

Statement of Objectives

This study aimed to determine the antimicrobial property of Katuray leaf extract against *E. coli* and *Rhizopus* spp. as measured by the zone of inhibition.

Specifically, the researchers aimed to answer the following objectives:

1. To determine the effect of Katuray leaf extract and the response of *E. coli* and *Rhizopus* spp. to the different SGELE concentrations.
2. Describe the effect of Katuray leaf extract on *Rhizopus* spp. in terms of zone inhibition diameter by the Kirby-Bauer Assay.
3. To identify the Minimum Inhibitory Concentration of SGELE against *E. coli* and *Rhizopus* spp.

Materials and Procedures:

Collection and Processing of *S. grandiflora* Leaves for Extraction

The mature fresh leaves were initially stored in plastics. Upon arrival in the Natural Products Laboratory of CAS in DMMMSU-SLUC, the leaves were washed with distilled water to remove any adhered dust particles, unwanted materials, or insect parasites. The clean leaves were air dried with no direct contact of sunlight under room temperature. After drying, the leaves were cut into smaller pieces and homogenized using an electric blender. The homogenized dry leaves of *S. grandiflora* were soaked in 95 percent ethanol for two days with occasional stirring in a glass container. The container containing the mixture was also wholly covered with aluminum foil and was kept under room temperature for 24 hours. Specifically, for every 100-gram homogenized dry leaves, the researchers used 250 ml of 95 percent ethanol as extracting solvent.

After soaking for two days, the resulting mixture was filtered using a sterile filter paper. The filtrate was collected and eventually concentrated using a rotary evaporator at 40 degrees centigrade. The collected concentrate was placed in glass container properly labelled as the crude *Sesbania grandiflora* ethanol leaf extract (SGELE) and kept inside a fridge at -4°C.

Antimicrobial Assay

Disc Diffusion Method for Bacteria (*E. coli*). Kirby-Bauer test known as the disc diffusion method is the most widely used antibiotic susceptibility test in determining what treatment of antibiotics should be used when treating an infection. The researchers followed the method described by Ruangpan and Tendencia (2014).

The standardized 0.01 ml inoculums were standardized based on the 0.5 McFarland Standard (correspond to approximate 1.5×10^8 CFU/ml). Standardization was done by comparing the test concentration and standard against white background with contrasting black line then later checking using spectrophotometer for precise adjustment of turbidity. In the process, the tube containing 0.5 McFarland Standard and tube containing saline water with inoculum was shaken to create turbidity. By using a micropipette, the standardized inoculums were transferred into the prepared MH plates.

Then, they were incubated within 15 minutes or allowed to warm at room temperature. Bacteria were uniformly inoculated using L-rod. The sterilized Whatmann no.1 filter paper disc was soaked in the different concentrations (50 µg/ml, 100 µg/ml, 150 µg/ml, 200 µg/ml, and 250 µg/ml) for 30 minutes. The soaked disc was picked up using sterilized forceps. As soon as no sign of dripping was observed, the disc was placed on MH Agar plates with two cm apart. The discs were tapped or slightly pushed to ensure firm contact with the agar. Then MH plates were incubated at 37°C after 24 hours. Using a ruler, inhibition zone diameters were measured. Zone of Inhibition diameter interpretation for *E. coli* was based from the zone of inhibition diameter interpretation breakpoint for Amoxicillin. Results for the antibacterial susceptibility test were classified as susceptible, intermediate, and resistant.

Disc Diffusion Method for Fungi (*Rhizopus spp.*). Standardization of inoculum was acquired using dual beam spectrophotometer with the test inoculum ranging from 0.4×10^4 to 5×10^4 CFU/ml setting up device to 530 nm while read around 0.15-0.17 optical density. By using a micropipette, the 0.01 ml standardized inoculum was transferred to SDA plates. After 24 hours of incubation in 35°C, sterilized disc of Whatmann filter paper no.1 was cut using puncher and autoclaved at 121°C for 15 minutes. Sterile discs were soaked in the different concentrations (50 µg/ml, 100 µg/ml, 150 µg/ml, 200 µg/ml, and 250 µg/ml) for 30 minutes. The soaked discs, were picked up using flamed sterile forceps. Then they were put into agar plates with no sign of drippings. Then the discs were gently pressed on the agar to ensure firm contact. Plates were incubated at 35°C for 24 hours. Procedure described by Cavalierie et al., (2005). By using a ruler and by following the diameters of each exhibited zone of inhibition were measured in millimeters.

Minimum Inhibitory Concentration (MIC) Susceptibility Testing Using Spectrophotometer. The MIC of the extracts were determined according to broth dilution procedure described by Torres (2016), with slight modification. Isolated colonies from a 24-

hour culture of *Rhizopus* spp. served as source of cells in preparing the inoculum suspension. Using spectrophotometer and by using the method described by CLSI (2002), the inoculum was standardized. *Rhizopus* spp. were read as 0.15-0.17 optical density at 530 nm. Afterwards, minimum inhibitory concentrations of effective SGELE was determined through serial dilution method analyzed spectrophotometrically.

To do this, the cuvette was preloaded with 700 µl standardized inoculum suspension. This was followed by the addition of 700 µl of prepared stock solution (i.e. 50 mg/ml, 100 mg/ml, 150 mg/ml, 200 mg/ml, and 250 mg/ml *Sesbania grandiflora* extract's). Addition of stock solution was done separately for each crude extract and controls. Using a digital micropipette, the content of cuvette no.1 was mixed by sucking up and down six-eight times. After which, 700 µl of the suspension in cuvette no.one was transferred to cuvette no. two. This makes cuvette no.2 a two-fold dilution of cuvette no. one. The process was repeated down until

the last cuvette. Lastly, a 700 µl of standardized fungal suspension was added to each cuvette to make the final volume of 1,400 µl. by using incubator, the cuvettes were incubated at 35°C within 24 hours. Using the spectrophotometer, the 24- hour incubated serial dilutions were read at 530 nm wavelength. Three replicates were carried for each concentrations and controls in the serial dilution. The resulting mean absorbance for each cuvette was compared statistically to the breakpoint of *Rhizopus* spp.

RESULTS AND DISCUSSION

Effect of Katuray Leaf Extract and the Response of *Escherichia coli* in Different SGELE Concentrations

Table 1 shows the antibacterial activity of *Sesbania grandiflora* leaf extract against *E.coli*.

Table 1. Zone Inhibition Diameter and Response of *Escherichia coli* to the Different SGELE Concentrations

EXTRACT/ CONTROL	MEAN ZOI (mm)				ZOI INTERPRETATIONS/ RESPONSE
	R1	R2	R3		
T ₀	0	0	0	0	R
T ₁	8.67	5.89	7.33	7.29	R
T ₂	0	0	0	0	R
T ₃	0	0	0	0	R
T ₄	0	0	0	0	R
T ₅	0	0	0	0	R
T ₆	0	0	0	0	R

*R1- replicate no. 1; T₀- Distilled water; T₁- Amoxicillin; T₂- 50µg/ml of SGELE; T₃; 100µg/ml of SGELE; T₄- 150µg/ml of SGELE; T₅- 200µg/ml of SGELE; T₆-250µg/ml of SGELE; R- Resistant; I- Intermediate; S- Susceptible

Antibacterial activity of leaf extract was carried out using Kirby-Bauer Assay (KBA) or the Disc Diffusion Assay (DDA). Table 1 reveals the results of antibacterial susceptibility test of the six treatments against *Escherichia coli*. Results were interpreted based from Andrews (2009) breakpoint interpretation for *Escherichia coli* with Amoxicillin as a reference drug. All SGELE concentrations showed no inhibitory effect against *E. coli*.

The SGELE showed no inhibitory activity on the growth of *E. coli* in all five different concentrations whereas the positive

control produced a zone of inhibition although still interpreted as resistant. It is then suspected that the tested strain might be one of multi-drug resistant strains nowadays.

Effect of Katuray Leaf Extract on *Rhizopus* spp. in Terms of Zone of Inhibition Diameter by the Kirby-Bauer Assay

Table 2, shows the mean of ZOI exhibited by different concentration and the comparison of the effect of SGELE against *Rhizopus* spp.

Table 2. Mean of ZOI of *Rhizopus* spp. as Affected by Different SGELE Concentrations

Controls/Extracts	Mean
T ₀ (Distilled water)	0.00 e
T ₁ (Clotrimazole)	7.85 a
T ₂ (50µg/ml SGELE)	2.22 c
T ₃ (100µg/ml SGELE)	2.07 c
T ₄ (150µg/ml SGELE)	4.74 b
T ₅ (200µg/ml SGELE)	1.67 d
T ₆ (250µg/ml SGELE)	4.37 b

*Any mean value followed by the same letter is not significantly different from each other.

Table 2, reveals that the antifungal drug (Clotrimazole) has the highest inhibitory activity based on the computed average mean of 7.85 mm against all SGELE different concentrations, followed in order by T₄, T₆, T₂, T₃ and T₅. One way ANOVA reveals that there is significant difference ($p < 0.05$) between the treatments wherein all the tested SGELE concentrations are not as effective antifungal agents when compared to the positive control against the growth of *Rhizopus* spp. Meanwhile, there are treatments that are comparable to each other. T₂ (50 µg/ml) is comparable to T₃ (100 µg/ml), while T₄ (150 µg/ml) & T₆ (250 µg/ml) are comparable to each other. In addition, these two treatments are the most effective SGELE concentrations in inhibiting the growth of *Rhizopus* spp. In contrast, T₅ (200 µg/ml) shows the lowest inhibitory response against *Rhizopus* spp.

Minimum Inhibitory Concentration (MIC) of SGELE against *E.coli* and *Rhizopus* spp.

Minimum inhibitory concentration refers to the lowest concentration of antimicrobial agent which can inhibit the growth of the microorganism after 24-hour incubation period. In this study, determination of MIC was done by microdilution of the SGELE through spectrophotometer. Since SGELE showed no inhibitory effect as antibacterial agent in all concentrations, there is no need to do the MIC as there is no occurrence of inhibition on the DDA. The spectrophotometric analysis of fungi was performed at 530 nm absorbance wavelength.

Minimum inhibitory concentration was applied to support the occurrence of growth inhibitory in all concentrations of SGELE in DDA/KBA

These indicate that < 50 µg/ml is effective in inhibiting the growth of *Rhizopus* spp. One-way Analysis of Variance showed significant differences among treatment mean at 0.05 level of significance. It was declared that the 50 µg/ml of SGELE and Clotrimazole are significantly different from T₀ (distilled water). Moreover, T₁ the antifungal drug was comparable to T₂ 50 mg/ml of SGELE. It could be inferred that SGELE has an antifungal property against *Rhizopus* spp. The antifungal property of the SGELE against *Rhizopus* spp. suggests that it can be a good source of compounds to treat diseases or infection caused by *Rhizopus* spp. Result in DDA showed that all SGELE concentrations do not have comparable effect to Clotrimazole but evaluation of MIC revealed that lowest concentration is comparable to the inhibitory effect of Clotrimazole against *Rhizopus* spp.

Antimicrobial Property of *Sesbania grandiflora* Ethanol Leaf Extract

The present study AST (Antifungal/Antibacterial Susceptibility Test) reveals that the crude extract derived from the leaves of *S. grandiflora* is definitely more effective as antifungal against *Rhizopus* spp. but not as antibacterial against *Escherichia coli*.

Several studies support that the extract derived from various species of *Sesbania grandiflora* possess has higher antifungal property than antibacterial property. The study

of Ahmed et al., (2013) revealed that *Sesbania sesban* ethanol bark extract showed less zone of inhibition on antibacterial activity with a mean of 5.9 mm (*E. coli*) than antifungal activity which showed a better inhibition of 8.3 mm (*A. fumigatus*). In a similar way, the study of Manigandan and Muzammil (2013), *S. grandiflora* root ethanol extract against *E. coli* showed lowest zone of inhibition which gave 1.5 mm and 12 mm inhibition against *Candida albicans* a pathogenic fungi. Moreover, in the study of Kumar and Dhanyaraj et al., (2016), *S. grandiflora* showed significant antifungal activity against *Candida albicans* and *Aspergillus niger* rather than as antibacterial.

CONCLUSIONS

1. *Sesbania grandiflora* ethanol leaf extract is not a potential source of antibacterial compounds against *E. coli*.
2. *Sesbania grandiflora* ethanol leaf extract is a potential source antifungal compounds against *Rhizopus* spp.

RECOMMENDATIONS

Based on the findings and conclusions, the researchers recommend the following:

1. It is recommended that the time-bound effect of the extract be evaluated with 24- growth period. This would clarify possible bacteriostatic effect of the extracts.
2. The use of other parts of the *Sesbania grandiflora* plant is strongly suggested. The root, bark, and the flower will be a good candidate for sources of antimicrobial compounds.
3. The researchers recommend to increase the concentrations of *Sesbania grandiflora* ethanol leaf extract (SGELE) on both bacteria (*E. coli*) and fungus (*Rhizopus* spp.).
4. Since the researchers were limited only on the use of ethanol as extracting solvent, other solvents like hexane, aqueous, chloroform, petroleum, acetone, and methanol could be used to extract active compounds of these plants.
5. Since the researchers were limited only on the use of crude extracts, it is recommended that isolate active components of SGELE be purified.

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Growth and Yield Performance of *Abelmoschus esculentus* (Okra) Using Effective Microorganisms (EM)

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ABSTRACT

Effective Microorganisms (EM) has been developed as microbial inoculants to improve soil quality, crop growth, and crop yield which also gained attention worldwide. This study aimed to differentiate if there are significant differences on the growth and yield performance of okra using EM, (EMAS), commercial fertilizers and no fertilizer. Treatments were either used as a soil fertilizer or as foliar fertilizer. Two plots were established: a) plot 1, the treatments were T₀ (no fertilizer), T₁ (commercial soil fertilizer) and T₂ (EM Compost); b) plot 2, the treatments were T₀ (no fertilizer), T₁ (commercial foliar fertilizer) and T₂ (EMAS). One- Way Analysis of Variance (ANOVA) with Dunette test were used as statistical tools.

Results showed significant differences in plant height, but no significant differences in the number and weight of fruits in plot 1. On the other hand, foliar application in plot 2 showed no significant differences in growth and yield.

Keywords: *Effective Microorganisms, EMAS, EM compost*

INTRODUCTION

Okra, also termed as lady's finger, is native in Africa and produces beautiful flowers in a vegetable garden. Okra is a member of the *Malvaceae* family and is an indigenous crop of Africa (Naveed et al., 2009). Okra plant was previously included in Genus *Hibiscus* which was later designated to *Abelmoschus*, distinguished from the Genus *Hibiscus* (Aladele et al., 2008). Taxonomist recognized nine (9) species in *Abelmoschus* based on cytogenetic evidence. The morphological characters such as numbers, dimensions and persistency of the epicalyx segment, form and dimensions of the capsule and the characteristics of the indumentums are unique.

Okra plant grows best on well-drained sandy loam soils and is cultivated under rain fed and the irrigated areas on wide range of soils. Poorly drained soils may result in drowning (low energy) of the plants. Okra plant thrives in slightly acidic soils with a pH between five(5) to eight (8). On clay soils, seedlings have difficulty emerging; thus, transplanting is recommended. It is very sensitive to soils with a hard pan. Soil compaction can severely restrict plant growth. This plant is a hot weather crop. The soil temperature for growth is 24 °C to 32 °C, while the minimum soil temperature is 18 °C.

Damping off and seed decay are likely to happen at soil temperature below 21 °C (Franklin 1982).

EM, which stands for effective microorganisms, became advanced at the University of the Ryukyus, Okinawa, Japan, in early 1980's by way of Prof. Dr. Terou Higa. The enlargement method of effective microorganisms generation commenced in 1989 with the inception of the first global Kyusei Nature Farming conference in Thailand, where the need to scientifically validate this generation and to beautify its use was discussed. Therefore, Asia Pacific herbal Agriculture network (APNAN). It included thirteen (13) international locations ranging from the west coast of the United States thru Asia to Pakistan. Dr. Terou Higa has developed microbial inoculant that has been proven to enhance soil quality, crop boom, and crop yield. This feature gained attention internationally.

Effective microorganism (EM) is a fermented mixed culture of naturally occurring species of co-existing microorganisms in acidic medium (pH below 3.5). Among the main microorganisms in Effective Microorganisms (EM) culture are the species of photosynthetic bacteria (*Rhodospseudomonasplastris* and

Rhodo-bactersphacrodes), lactobacilli (*Lactobacillus plantarum*, *L. casei*, and *Streptococcus lactis*), yeast (*Saccharomyces* spp.), and actinomycetes (*Streptomyces* spp.). Microorganisms in EM improve crop health and yield by increasing photosynthesis, producing bioactive substance such as hormones and enzymes, accelerating decomposition of organic materials and controlling soil-borne disease (Higa, 2002).

Statement of Objectives

This study was conducted to determine the effects of Effective Microorganisms (EM) on the Growth and Yield Performance of okra using soil and foliar fertilizers.

Specifically, it sought to determine the following:

1. The significant difference on the growth and yield performance of okra using EM and different fertilizers when applied in the soil as to:
 - a. Height of plant
 - b. Number of fruits
 - c. Weight of fruits
2. The significant difference on the growth and yield performance of Okra using EM and different foliar fertilizers when applied on the vegetative parts of the plant as to:
 - a. Height of plant
 - b. Number of fruits
 - c. Weight of fruits

METHODOLOGY

Research Design

This study used the Randomized Complete Block Design (RCBD). The study used three treatments and three replicates which incorporated the descriptive design where the quality of the soil was described before the application of Effective Microorganisms (EM). Experimental activity was also included which determined the growth and yield of okra as influenced by different treatments.

The treatments used were as follows:

Plot 1

T0= no fertilizer

T1= commercial soil fertilizer (Di ammonium phosphate and ammonium sulfate)

T2= EM Compost

Plot 2

T0= no fertilizer

T1= commercial foliar fertilizer (Farm Aid)

T2= EM Activated Solution

Materials and Procedures

Materials. In preparing EM® Bokashi, the following materials were used: 1L of water, 12grams of brown sugar, beaker, 13ml of EM⁻¹, 3kg of rice bran, pail, and 0.2kg of rice hull, newspaper and weighing scale. For the preparation of fermented rice rinse water or EMAS, the following materials were used: 25ml of EM⁻¹®, 22grams of brown sugar, 400ml of rice rinse water, 500ml of plastic bottle, funnel, graduated cylinder, beaker and stirring rod. For the fermented food waste or EM compost, the following materials were used: EM bokashi, airtight bucket, food waste (vegetables and fruits), newspaper and spatula. For the preparation of soil the following materials were used: sandy loam soil, 18 plant sacks and 2.5 cm height of gravel. For the preparation of fertilizers, 13.14g of di ammonium phosphate was mixed in 46.29g of ammonium sulphate and commercial foliar fertilizer or farm aid.

Procedures

Preparation of EM Fertilizers. The procedure involved three phases in the preparation of EM fertilizers. The first phase was EM® Bokashi, the second phase was EM activated solution, and the third phase was EM compost.

Phase I

Preparation for EM® Bokashi. In a beaker, one liter of water was mixed with 12grams of brown sugar in order to dissolve it. Then this was mixed with 13mL of EM⁻¹.

The prepared solution was weighed by using weighing scale and was mixed in a pail of 3kg rice bran and 0.2kg rice hull. The mixture

was lightly squeezed and was formed into a ball to check the moisture level. If it holds shape and no extra liquid comes out, the moisture is correct. The mixture was placed into an airtight plastic bag squeezing out excess air and it was covered with a newspaper. It was stored in a warm area away from direct sunlight. The mixture was allowed to ferment for a month and when the color turned darker and it smelled sweet and sour, fermentation was considered complete.

Phase II

Preparation for EM Activated Solution (EMAS). In a clean beaker, twenty two grams (22grams) of brown sugar was mixed with 400ml rice rinse water. The mixture was stirred well using stirring rod, then 25mL EM® was added into the mixture. The mixture was poured into the 500ml of a plastic bottle thru the funnel leaving an extra space (5cm) for gas build-up. The bottle was capped tightly and stored in warm place, for 20-40°C, which is the ideal temperature for fermentation. The cap was loosened when gas was formed after a couple of days. The mixture was stored for two (2) weeks. The gas was released regularly to avoid an overflow. The mixture was ready for use when sweet sour scent was produced and when the mixture changed color from black to reddish brown and the pH dropped below 3.5.

Phase III

Preparation of EM Compost

Collection of Vegetable and Fruit Wastes for EM Compost. The vegetable and fruit wastes were collected from the hypermarket of Agoo. These were sorted and cut into small pieces and were placed in clean plastic containers prior to the preparation of compost.

Preparation of Fermented Food Waste (EM Compost). Newspapers were lined to the filter in the airtight bucket and it was sprinkled with small amount of EM Bokashi. Food waste was added by using spatula. This was sprinkled with EM Bokashi every time food waste was added and mixed thoroughly. Enough EM Bokashi was sprinkled on the food waste and was pressed down to release air before closing the lid of the EM Bokashi. Liquid fertilizer was

removed at the bottom frequently. The procedure was repeated. When the bucket was filled up, it was closed, and was allowed to ferment for at least one week. The mixture was kept at room temperature out of direct sunlight. When the fermented smell sweet and sour was observed, the compost was ready for use. White mold that appeared on the compost means the fermentation is good.

Collection of Soil for Analysis. One (1) kilogram of soil was placed in a clean plastic bag. The soil was brought to the Department of Agriculture in San Fernando, La Union for analysis.

Preparation of Experimental Site. The experimental site having an area of 32 square meters was located at San Agustin East, Agoo, La Union. The whole experimental area was divided into two (2) main plots each having nine (9) sacks. There was a distance of one (1) meter between sacks and one (1) meter from the fence. The fence was made up of bamboo poles surrounded with mosquito nets. Labels were placed for the identification of different treatments and replications.

Preparation of Different Treatments. For all the treatments, gravel was placed at the bottom of sacks of 2.5 cm height. This was done to enhance aeration and drainage of the planting sacks. Then, 10kg of sandy loam soil was mixed and placed in each sack.

Planting of Okra. Seeds were soaked overnight in clean water and then directly sowed into warm soil placed in plastic containers. The okra was grown until 5cm height and was transplanted in the different treatments placed in the plant sacks. Care was observed so as not to damage the roots during transplanting to the sacks. The banana leaf sheath was used to cover the plant to avoid wilting of the plant. After a week, the soil and foliar fertilizers were applied.

Care and Maintenance. The okra plants that need about an inch of water (1250ml) per week to thrive grew large and produced lots of pods. Okra was watered every day at 7 am. Watering was focused at the base of the okra and

the okra was slowly watered enough so as not to erode the soil away.

Application of Fertilizers

Plot 1

For T0, no fertilizer was used. T1, application of soil fertilizer were 4.38g of $(\text{NH}_4)_2\text{PO}_4$ and 15.43 g of $(\text{NH}_4)_2\text{SO}_4$ based from the recommendation of the soil analyst. It was applied twice a month. For T2, EM compost (1kg) was mixed to the 9 kg of sandy loam soil per sack.

Plot 2

For T0, no fertilizer was used. Farm aid foliar fertilizer was applied for T1 while EMAS was sprayed for T2. Three (3) tablespoons of farm aid foliar fertilizer or EMAS was mixed with 500 mL of water. Spraying was done at the upper and lower part of the leaves every seven (7) am early every week.

Harvesting. The fruits were ready for harvest three months after planting. The okra fruits were harvested when they were about five (5) inches long. The fruit stalks were cut just above the cap with a knife. Gloves were used when cutting the okra because most varieties are covered with tiny spines that can irritate skin.

RESULTS AND DISCUSSION

Height of Plant

Table 1. Mean Plant Height (cm) Treated with Soil Fertilizer

Treatment	Mean
T0- no fertilizer	75.67 ^b
T1- commercial soil fertilizer	118.33 ^b
T2- EM Compost	138.67 ^a
Grand Mean	110.89

*Means followed by the same letter are not significantly different from each other at 0.05 level of significance. c.v.=30.59

Table 1 shows the mean plant height treated with soil fertilizers. It can be seen in the table that the control T0 (no fertilizer) had the lowest mean recorded while the T2 (EM Compost) gave the highest mean plant height.

One-Way Analysis of Variance revealed that there was a significant difference in mean height of plants with the various treatments. Dunette test further revealed that the T₂ (EM Compost) was significantly different from the control group T₀ (No fertilizer). On the other hand, T₁ (Commercial soil fertilizer) gave no significant difference from the control. This means that no fertilizer or with commercial fertilizer had similar effect on the height of okra. However, EM Compost was still the best fertilizer when it comes to increasing the height of okra plant.

The recuperation of healthy atmosphere is one of the purposes of effective microorganisms in each soil and water with the use of three (3) primary genera of microorganisms that are found in nature, namely: phototrophic bacteria, (Rhodopseudomonas), lactic acid (Lactobacillus) and yeast (Saccharomyces). EM^o1 contains Lactobacillus delbruekii, Saccharomyces cerevisiae and Rhodopseudomonas palustris (Winget and Gold, 2007).

In a study conducted by Tiarniyu, et al., (2012), it showed that organic manure from poultry, cow and sheep increases plant height. This means that EM as supplement may have similar effects as to organic manure in increasing plant height since the organic manure

contains variety of microorganisms that may be either beneficial or pathogenic.

Similarly, in a study conducted by Mal et al., (2013), the use of organic fertilizers (vermicompost and biofertilizers) also results in

an increase in height in okra (148.97 cm). This means that EM as supplement may have similar effects with organic fertilizers in increasing plant height.

Table 2. Mean Plant Height (cm) Treated with Foliar Fertilizer

Treatment	Mean
T0- no fertilizer	80.00
T1- foliar fertilizer	73.00
T2- EMAS	62.17
Grand Mean	71.72

c.v. = 28.44

Table 2 shows the mean plant height treated with foliar fertilizer. The control T₀ (no fertilizer) recorded the highest mean while the T₂ (EMAS) recorded the lowest mean plant height.

Analysis of Variance on the mean plant height shows that all treatments were not significantly different as to the height of plant. So, application of fertilizers whether commercial fertilizer and EM Compost is no longer needed since plant height is comparable to both with or

without fertilizer. The soil nutrients are enough to have good height of plants.

The EM foliar application results showing no significant difference with the control gave similar result as to the application of foliar fertilizer in rose plant (Gorski et al., 2010) whereas the foliar application has no effect, but when used together with soil application significant increase in diameter and stem length was observed.

Number of Fruits

Table 3. Mean Number of Fruits Treated with Soil Fertilizer

Treatment	Mean
T0- no fertilizer	1.00
T1- commercial soil fertilizer	4.67
T2- EM Compost	4.33
Grand Mean	3.33

c.v. =82.16

Mean number of fruits treated with soil fertilizers are shown in Table 3. T₁ (commercial soil fertilizer) recorded the highest number of fruits while the T₀ (No fertilizer) recorded the lowest number of fruits.

Statistical analysis shows that all the treatments were not significantly different as to the number of fruits. All treatments have similar

effects in the number of okra fruits. This means that no fertilizer, commercial fertilizer, and EM compost gave comparable number of okra fruits, so, application of fertilizers whether commercial fertilizers or EM Compost is no longer needed since number of fruits is comparable to both with or without fertilizer. The nutrient in the soil

is enough to give comparable number of okra fruits.

The results show that EM application is not significant as shown also in previous studies on EM application like the study of Javaid et al., (2010). It revealed that plant growth in EM applied treatments was just good or better, and quality of plant products was superior to conventional farming. The effect of EM crop yield was evident or even negative particularly in the first test crop. It is often difficult to

establish the predominance of effective microorganism cultures in soil with only a single application and during only one season.

Efficacy of effective microorganism (EM) is also affected by soil types. Furthermore, source and amount soil nutrients as well as test crop may affect the establishment and efficacy of these microorganisms when application of these microorganisms is started in a soil for the first time (Javaid et al., 2010).

Table 4. Mean Number of Fruits Treated with Foliar Fertilizer

Treatment	Mean
T0- no fertilizer	0.67
T1- foliar fertilizer	1.00
T2- EMAS	1.67
Grand Mean	1.11

c.v. =105.00

Table 4 reveals the result of mean number of fruits treated with foliar fertilizer. T₂ (EMAS) recorded the highest mean fruits produce while the T₀ (no fertilizer) produced the lowest mean number of fruits. Also, Table 4 shows that there is no significant difference

between the treatments. This means that all treatments gave comparable number of okra fruits.

Again, the soil nutrients are enough to have comparable number fruits whether applying foliar fertilizer or not.

Table 5. Mean Weight (grams) of Fruits Treated with Soil Fertilizer

Treatment	Mean
T0- no fertilizer	16.53
T1- commercial soil fertilizer	164.46
T2- EM Compost	115.72
Grand Mean	98.90

c.v.=97.3

Mean weight of fruits treated with soil fertilizers is shown in Table 5. T₁ (commercial soil fertilizer) produced the highest mean followed by T₂ (EM Compost) while T₀ (no fertilizer) produced the lowest mean weight of fruits. However, as shown in Table 5, One-Way

ANOVA results revealed that there is no significant difference in all treatments. Therefore, all treatments have comparable effects in terms of weight of fruits. Application of fertilizers whether commercial fertilizer or EM Compost is no longer needed since no application of fertilizer gave the comparable

Table 6. Mean weight of fruits (grams) using foliar fertilizer

Treatment	Mean
T0- no fertilizer	9.44
T1- foliar fertilizer (farm aid)	12.13
T2- EMAS	28.34
Grand Mean	16.63

c.v.=111.44

weight of fruits. The soil nutrients are enough in producing comparable amount of okra fruits.

Table 6 shows the mean weight of fruits treated with foliar fertilizer. T₂ (EMAS) can be noted with the highest weight of fruits while the T₀ (no fertilizer) gave the lowest mean weight of fruits. Also, Table 2 and Table 4 are similar showing that all treatments are not significantly different from each other at 0.05 level of significance. This means that all the treatments have comparable effect in terms of weight of fruits of okra plant.

As stated in previous tables, soil nutrients are sufficient for okra to bear comparable amount of fruits (in grams) whether with foliar fertilizer or no fertilizer.

It can be noted that all the coefficient of variance (cv) are greater than 20 percent. Therefore, the experiment is unreliable. Possible errors are due to typhoon Lawin last November 18, 2016 which ended the experiment abruptly. The fertilizers used are also slow-releasing fertilizers. Thus, all were used for the growth of okra.

CONCLUSIONS

Within the limits of the study, the following conclusions were drawn:

1. For plot 1 where soil fertilizers were used to grow the okra plant or in terms of height,

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EM Compost gave tallest okra plant when compared to T₀ (no fertilizer) and T₁ (commercial soil fertilizer). However, applying soil fertilizers produce comparable number of fruits and weight of fruits.

2. For plot 2 where foliar fertilizers are applied to okra plant, results showed that applying foliar fertilizer or no fertilizer to okra plant produced comparable height of plant, number of fruits and weight of fruits. Therefore, okra growers may not apply fertilizer of any kind. The nutrient in the soil is enough for the okra plant to grow into considerable height and yield good fruits.

RECOMMENDATIONS

Based on the foregoing conclusions, the researchers recommend that:

1. Other types of crop plant may be considered as test organism.
2. Conduct series of experiment using the same plot with same treatments.
3. EM Compost and EM Activated Solution should be tried on the next crop since EM restores healthy ecosystem in the soil. EM should be applied for other plants to produce taller plants as an advantage.

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Growth, Reproductive, and Nodulation Responses of String Beans (*Vigna unguiculata*) and Bell Pepper (*Capsicum annuum*) to Rhizobial Cultures from Makahiya (*Mimosa pudica* L.) AND Lalaking Aratilis (*Parasponia rugosa* Blume)

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ABSTRACT

Soil productivity is an important concern. Several processes are used to improve it like green manuring, crop rotation and mix crop farming. In these processes, nutrients used in plant growth are returned to the soil. Rhizobial bacteria are important organisms that fix atmospheric nitrogen for plant use.

This study was conducted to assess how Rhizobia from the nodules of Mimosa pudica L., and Parasponia rugosa Blume affect the growth performance of Vigna unguiculata and Capsicum annuum based on growth rates on the 2nd to the 4th week. Reproductive responses of string beans have no significant differences in terms of the number of days to flowering and fruiting. However, the weights, the number of fruits, and the number of nodules significantly increased when inoculated with mimosa rhizobia. Study suggests that Rhizobia bacteria from M. pudica L. can enhance the soil fertility and can be used as microbial inoculant.

Keywords: *Capsicum annuum, Mimosa pudica L., Parasponia rugosa Blume, Rhizobia bacteria, Vigna unguiculata,*

INTRODUCTION

Soil productivity is an important concern for farmers. Crop rotation, mix farming, and green manuring are often used to improve soil fertility as well as to conserve and improve fertility aids in plant growth (Alberta Agriculture and Forestry, 1993). Crop rotation is temporary alternating legumes and non-legumes whereas mix farming is spatially planting legumes and non-legume plants on same farmland. Green manuring is the plowing under or soil incorporation of any green manure crops while they are green or soon after they flower. Green manures are grown for their leafy materials needed for soil conservation (Boller et al., 2004). Plants commonly used for green manuring have *Rhizobia* bacteria for nitrogen fixation where they used to conserve the fertility of soil.

Most plants need nitrogen from various sources, one of which is fixed by a group of bacteria known as *Rhizobia* (Herridge et al., 2008). *Rhizobia* have the ability to fix nitrogen in plant and help their growth. *Rhizobia* chemically convert the nitrogen from the atmosphere to make it available in plants. If there is not enough

nitrogen available in the soil, plants look pale in color and their growth development is reduced (Ngakou, 2009).

Mimosa pudica L. is a leguminous plant with root system, the *Rhizobia* bacteria colonize. This *Mimosa pudica* L. plant is found in the countries of Asia with a tropical climate. It grows in grassland. Root nodules of *Mimosa pudica* L. can be a good source of *Rhizobia*.

Meanwhile, *Rhizobia* can nodulate the touch-me-not plant, locally known as makahiya (*Mimosa pudica* L.), as well as the lalaking aratilis (*Parasponia rugosa* Blume) because they have a symbiotic relationship. *Parasponia rugosa* Blume are non-leguminous plants known as small trees that grow up to 15 meters high and are found in tropical climate. They mostly grow in mountainous areas of Indonesia, Malaysia and Papua New Guinea (Akkermans & Van Dijk, 1981). They are also found in the Philippines.

Statement of Objectives

This study was conducted to assess the responses of the nodules of *Mimosa pudica* L. and

Parasponia rugosa Blume, and how they affect the growth performance of *V. unguiculata* (string beans) and *Capsicum annuum* (bell pepper) based on biomass productivity.

Specifically, this study also measured the productivity of leguminous string beans and non-leguminous bell pepper with bacterial inoculation from a leguminous plant, (MR - *Mimosa Rhizobia*) and from a non-leguminous plant (PR - *Parasponia Rhizobia*). It also aimed to do the following:

1. To compare the growth response of the crops to the three different treatments in terms of the growth rate and in terms of plant height at two week intervals and total number of leaves.
2. To evaluate the reproductive responses of *V. unguiculata* inoculated with rhizobial culture in terms of the number of days from sowing to flowering and the number of days from sowing to fruiting.
3. To evaluate the productivity of the crops in terms of the numbers of fruits, weight of fruits, and plant biomass.
4. To examine the colonization response of *V. unguiculata* in terms of the number of nodules in secondary roots

MATERIALS AND PROCEDURE

Preparation of Soil Sterilization

The soil was collected at Sta. Rita East Agoo, La Union. Each 25 kg of soil was sterilized in a *pot* for four (4) hours in high heat. Ten (10) kilograms of sterilized soil was placed in a seedling bag.

Preparation of Potato Dextrose Solution (PD)

Potato dextrose was prepared boiling 1,000 ml of purified water, 200 g of potato, and 20 g of dextrose powder. After boiling the potato, cheesecloth was used to filter the effluent liquid. The mixture was sterilized in an autoclave for 121°C and 15psi at 15 minutes to kill the other microorganisms (BAM Media M127: Potato Dextrose).

Preparation of Rhizobia Culture

Ten fresh root nodules of *Mimosa* and *Parasponia* were washed thoroughly in mineral water to remove soil and other adhering foreign materials. Root nodules were air-dried to remove excess water and the nodules of *Mimosa* and *Parasponia* were sterilized with 70 percent ethanol and sterilized water in four petri dishes. The scalpels with nodule exudates indicated by a colloid material were dipped in the test tube with 5 ml of PD to culture the *Rhizobia*. After three (3) days, colloid solution was observed and the rhizobial cultures in the test tube were placed in a bottle with 3,200 ml of PD. The culture media was adopted from Martyniuk et al., (2011) with some modifications.

Germination of seeds with and without Rhizobial Culture

Seeds of bell pepper and string beans were washed with lukewarm water for 10 seconds. Tissue paper with and without rhizobial culture were used to germinate the seeds. The nine seeds of sitaw and nine seeds of bell pepper were placed on tissue paper with rhizobial culture from makahiya (MR). Similarly, nine seeds of sitaw and nine seeds of bell pepper were placed on tissue paper with rhizobial culture from lalaking aratilis (PR) while nine seeds of sitaw and nine seeds of bell pepper were placed in tissue paper with potato dextrose without any rhizobial culture.

Application of Treatments after Germination

Syringes were used in measuring 25 ml of PD with and without *Rhizobia* in watering the plants every afternoon. Starting on the fifth day from sowing, the seeds were inoculated with and without rhizobial culture depending on their assigned treatments. Watering was at the base of the stem of the seedling.

Plant Measurements

Every two weeks from germination, the plant height was measured as well as the total number of leaves, the biomass of the plants, the number of days to flowering, the number of days to fruiting, the number of fruits and the weight of fruits. The fruits were counted and the dried plant

and fruits were weighed to determine their biomass. However, the number of days to flowering, the number of days to fruiting, the number of fruits, the weight of fruits and nodulation were not measured in bell peppers due to unfavorable climate during the experiment.

Growth Response of String Beans and Bell Pepper

Figure 1 shows the height of string beans from the 2nd week to the 10th week. Result shows that plant inoculated with rhizobial culture from *Mimosa* (MR) was the tallest at 67.93 cm after the 10th week, followed by plants inoculated with rhizobial culture from *Parasponia* (PR) at 63.96 cm, and PD at 59.52cm. Based on the table, there are some weeks where plants treated with PD are taller like in the 2nd week. However, ANOVA with repeated measures using CROP STAT v.7.2 shows that treatments are not significantly different. This means that the heights are comparable for all treatments.

RESULTS AND DISCUSSION

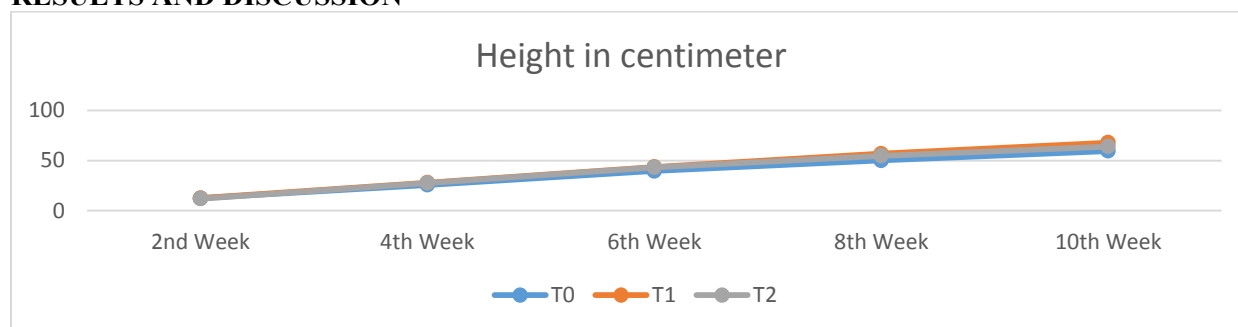


Fig. 1. Growth in Height of *String Beans* at Two-Week Intervals

Table 1 Weekly Growth Rates in Percent of String Beans (*V. unguiculata*)

Treatment	2 nd to 4 th	4 th to 6 th	6 th to 8 th	8 th to 10 th
T ₀ control (PD)	106.88 ^b	51.92	27.99	18.64
T ₁ <i>Mimosa Rhizobia</i> (MR)	124.64 ^a	55.26	27.40	22.20
T ₂ <i>Parasponia Rhizobia</i> (PR)	131.94 ^a	55.60	26.34	17.38

Table 1 shows the growth rates of string beans inoculated with three different treatments. Plant inoculated with PR had the highest mean growth rate compared to two different treatments on the 2nd to the 4th week and the 4th to the 6th week, while on the 8th to the 10th week, the growth rate of plant was highest in the treatment MR. On the 6th to the 8th week, the growth rate of plant inoculated with PD had the highest mean.

However, ANOVA shows that treatments are significantly different only on the 2nd to the 4th week of growth rate. Growth rates on the 4th to the 6th, the 6th to the 8th and the 8th to the 10th week are

not significantly different in all treatments. This means that the growth of string beans inoculated with PR on the 2nd to the 4th week was induced.

The mechanism of *Rhizobia* is to enhance the soil fertility and to form system flexibility (Sessirsch et al., 2002). According to Herridge et al., (2008), nitrogen fixer bacteria known as *Rhizobia*, the atmospheric nitrogen will convert to ammonia NH₃

Figure 2 presents the height of *C. annuum* inoculated with MR, PR and the control PD. During the first two (2) weeks, plants inoculated with PD had the highest mean height while on the

fourth (4th) and the tenth (10th) week, plants that were inoculated with MR had the highest mean height. However, on the sixth (6th) and the eight (8th) week on the plant inoculated with PR had the highest mean height.

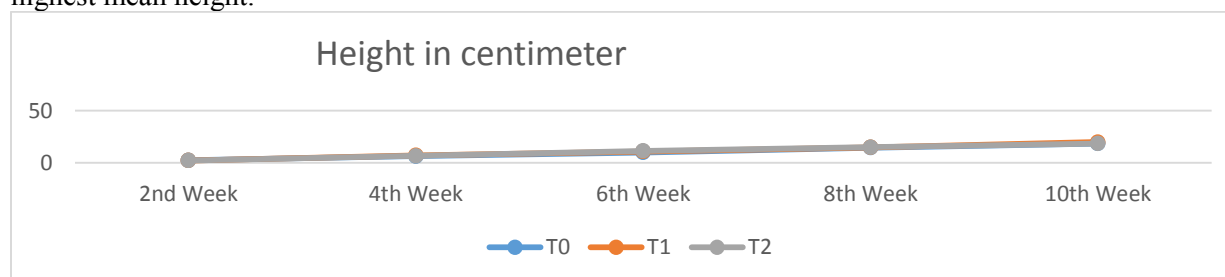


Fig. 2. Growth in Height of Bell Pepper (*C. annuum*) at Two-week Intervals

This means that the height differs weekly in the various treatments. However, ANOVA shows that the various treatments T₁ (MR) and T₂ (PR) including T₀ (PD) control are not significantly different. This means that the two rhizobial sources from *Mimosa* and *Parasponia* were not able to induce the actual height difference in bell pepper. About 78 percent of air is nitrogen which *Rhizobia* fixes in plants. Plant growth promoted by *Rhizobia* PGPR also serves as bioenhancer and biofertilizer (Kloepper et al., 1980).

Table 2 shows that the growth rate of bell pepper on the 2nd to the 4th week are the highest in treatment MR while on the 4th to the 6th week, the treatment PR has the highest growth rate. The computed growth rate on the 6th to the 8th and the 8th to the 10th week, PD is the highest compared with the two treatments.

Table 2. Weekly growth Rates of (*C. annuum*)

Treatment	2 nd to 4 th	4 th to 6 th	6 th to 8 th	8 th to 10 th
T ₀ control (PD)	158.88 ^b	46.49	38.18	27.30
T ₁ <i>Mimosa Rhizobia</i> (MR)	231.40 ^a	51.23	35.89	25.98
T ₂ <i>Parasponia Rhizobia</i> (PR)	189.50 ^{ab}	55.32	32.04	22.25

This shows that the growth rates differ per week in the various treatments. However, ANOVA shows that the various treatments T₁ (MR) and T₂ (PR) including T₀ (PD) control are significantly different on the 2nd to the 4th week. Bell pepper inoculated with MR has significantly different growth rate while PR does not have a significant difference within MR. The succeeding weeks of growth rate is not significantly different in all treatments. Although, the rhizobial culture from *Mimosa* was able to induce the

growth rate on the 2nd to the 4th week while in the succeeding weeks, the rhizobial culture had the same effect in PD.

Total Number of Leaves

The total number of leaves of the string beans was recorded to determine the effect of the three treatments as to the difference in the number of leaves. Rhizobial culture from *Mimosa* (MR) had the highest number of leaves as compared to the other two treatments. The lowest number of leaves was found in the treatment T₀ (control PD).

Table 3. Mean Number of Leaves in String Beans (*V. unguiculata*)

Treatment	Mean Number of Leaves
T ₀ control (PD)	18.56
T ₁ <i>Mimosa Rhizobia</i> (MR)	24.00
T ₂ <i>Parasponia Rhizobia</i> (PR)	23.78

c.v. = 25.85

Statistical analysis reveals that the P-value corresponding to the F-statistical of One-Way ANOVA is higher than 0.05, suggesting that the various treatments are not significantly different as to the number of cumulative leaves of string beans. This means that the three treatments are comparable to each other having the same effect on the number of leaves of the plant crop.

Rhizobia bacteria can exert beneficial effect on plant growth and their development of leaves. According to Zahir et al., (2003), *Rhizobia* bacteria can affect the growth and induce the number of leaves by releasing secondary metabolites, (plant growth regulators,

phytohormones or simply bioactive substance). The secondary metabolites can induce the number of leaves and growth of plant and prevent deleterious effects of phytopathogenic organisms in rhizosphere or in the root system of the plant. However, in this experiment, the number of leaves was slightly induced but not significant.

Table 4 presents the total number of leaves of bell pepper collected at the end of experiment to determine the effect of the three treatments. The MR had the highest mean number of leaves and PR had the lowest mean number of leaves.

Table 4. Number of Leaves of Bell Pepper (*C. annuum*)

Treatment	Mean Number of Leaves
T ₀ control (PD)	9.89
T ₁ <i>Mimosa Rhizobia</i> (MR)	12.00
T ₂ <i>Parasponia Rhizobia</i> (PR)	8.22

c.v. = 32.69

Statistical Analysis of Variance ANOVA of the STAR reveals that there is no significant difference among the three treatments. This means that the three treatments used did not induce the number of leaves of the host plant.

Reproductive Responses of String Beans (*V. unguiculata*) with Inoculated Rhizobial Culture

Table 5 shows the mean number of days from sowing to flowering inoculated with various treatments. The MR had the lowest mean in the number of days from sowing to flowering and the highest mean number of days from sowing to flowering was the PD control.

Table 5. Mean Number of Days to Flowering of String Beans (*V. unguicula*)

Treatment	Mean # of Days to Flowering
T ₀ control (PD)	50.33
T ₁ <i>Mimosa Rhizobia</i> (MR)	45.78
T ₂ <i>Parasponia Rhizobia</i> (PR)	50.89

c.v. = 12.92

ANOVA reveals that there is no significant difference among the three treatments.

This means that the three inoculants were not affected in terms of the number of days from

sowing to flowering of the string beans as compared to T₀ (control). This means that T₁ (MR) had the fastest time to flower while the T₂ (PR) had the slowest. According to Grunert (n.d.), the general numbers of days in flowering of beans are 45 to 60 days or 6 to 8 weeks.

Number of Days from Sowing to Fruiting

Table 6 shows the mean number of days from sowing to fruiting of the various treatments. Plant inoculated with T₁ (MR) had the lowest mean number of days from sowing to fruiting while T₀ (control) had the highest mean.

Table 6. Number of Days from Sowing to Fruiting of String Beans (*V. unguiculata*)

Treatment	Mean Number of Days to Fruiting
T ₀ control (PD)	57.56
T ₁ <i>Mimosa Rhizobia</i> (MR)	54.44
T ₂ <i>Parasponia Rhizobia</i> (PR)	59.00

c.v. = 12.84

The number of days from sowing to fruiting had no significant difference between the three treatments used to inoculate the string beans. This means that the T₁ (MR) and T₂ (PR) did not hasten the number of days of fruiting. However, the *Rhizobia* inoculants slightly hastened the days to flower.

Productivity of String Beans (*V. unguiculata*) Inoculated with Rhizobial Culture

Table 7 shows the mean number of fruits of string beans inoculated with various treatments. String beans inoculated with T₁ (MR) produced high number of fruits compared to control and those inoculated with T₂ (PR).

Table 7. Mean Number of Fruits of (*V. unguiculata*)

Treatment	Mean Number of fruit
T ₀ control (PD)	4.44 ^b
T ₁ <i>Mimosa Rhizobia</i> (MR)	7.33 ^a
T ₂ <i>Parasponia Rhizobia</i> (PR)	4.56 ^b

c.v. = 34.86

One-Way Analysis of Variance ANOVA reveals that there is a significant difference in the various treatments. Based on the Post Hoc analysis (LSD), T₁ (MR) had significantly higher number of fruits compared to T₀ PD and T₂ (PR). Based on the result, the MR increased the number of fruits as compared with PD (control). This is similar with the study of Verma et al., (2010), where the plant growth promoted by *Rhizobia* (PGPR) increased the yield response of the crop plant.

The weights of the dried fruits of the string beans were measured and recorded to

determine the effect of various treatments. Rhizobial culture from *Mimosa* had the highest mean weight at 5.21 grams since the number of fruits is also related to the weight of fruits as seen in Table 8.

Table 8. Mean Weight (in grams) of Fruits in (*V. unguiculata*)

Treatment	Mean Weight of Fruit (grams)
T ₀ control (PD)	2.82 ^b
T ₁ <i>Mimosa Rhizobia</i> (MR)	5.21 ^a
T ₂ <i>Parasponia Rhizobia</i> (PR)	3.78 ^b

c.v. = 37.1

Significant differences were observed among the treatments means. The T₁ (MR) is significantly different to T₀ (control) and T₂ (PR). This means that the T₁ (MR) had increased the weight of fruits. However, PR inoculants slightly induced the weight of fruits.

Biomass of Plant

Table 9 presents the mean dry weight of string beans inoculated with three different treatments. Plant inoculated with MR had the highest mean weight among the three treatments while the lowest mean weight was seen in treatment PD.

Table 9. Mean Weight (in grams) of String Beans (*V. unguiculata*)

Treatment	Mean Weight of Plant (grams)
T ₀ control (P.D)	5.2
T ₁ <i>Mimosa Rhizobia</i> (MR)	6.75
T ₂ <i>Parasponia Rhizobia</i> (PR)	5.97

c.v. = 26.18

Dry weight of string beans was recorded and tabulated by One-Way ANOVA of STAR application. It reveals that there is no significant difference in the weight of plants inoculated with the three different treatments. This means that the treatment in rhizobial culture from *Mimosa* and rhizobial culture from *Parasponia* are not able to induce significant increase in the weight of the plants.

Table 10 presents the mean weight of bell pepper inoculated with three various treatments. The highest weight is treatment MR which is 3.05 g followed by PD which is 2.18 g. The lowest mean weight of bell pepper is treatment PR.

Table 10. Mean Weight (in grams) of Bell Pepper (*C. annum*)

Treatment	Mean Weight of Plant (grams)
T ₀ control (PD)	2.18
T ₁ <i>Mimosa Rhizobia</i> (MR)	3.05
T ₂ <i>Parasponia Rhizobia</i> (PR)	1.92

c.v. = 61.89

However, ANOVA reveals that there are no significant differences among the three treatments. This means that the three treatments from two rhizobial sources from root nodules of *Mimosa* and *Parasponia* including control, are not able to induce significant increase in the weight of the plants.

Number of Nodules in Secondary Roots Colonized by *Rhizobia* Bacteria

Table 11 presents the nodules of the secondary root of string beans after being inoculated with the three different treatments T₀ (control P.D), T₁ (MR), and T₂ (PR). Result shows that plant inoculated with T₁ (MR) has the highest number of nodules with a mean of ten followed by

T₂ (PR) with a mean of 7.67 and T₀ (control) with the lowest mean of 6.11.

Table 11. Mean Number of Nodules in Secondary Roots of String Beans (*V. unguiculata*)

Treatment	Number of Nodules
T ₀ control (PD)	6.11 ^b
T ₁ <i>Mimosa Rhizobia</i> (MR)	10.00 ^a
T ₂ <i>Parasponia Rhizobia</i> (PR)	7.67 ^b

c.v. = 26.63

The One – Way Analysis of Variance (ANOVA) reveals that there is a significant difference in the number of nodules in the secondary roots inoculated with various treatments. According to LSD, T₁ (MR) had significantly high number of nodules compared with T₀ (control) and T₂ (PR). This means that T₁ (MR) was more effective in enhancing nodulation in secondary roots while the T₀ (control) and T₂ (PR) had the same capacity of nodulation.

According to Glick (2012), inoculation of *Rhizobia* in plants promote the root elongation and enhance the rhizobial nodulation and absorption of nutrients in the soil. Inoculum PR lessens the nodulation in legumes (Camacho et al., 2001). This is similar in the study of Elkoca et al., (2008).

CONCLUSIONS

Growth Response of String Beans and Bell Pepper

The highest number of growth rates on the 2nd to the 4th week in string beans was seen in treatment PR while in bell pepper, the highest was in treatment MR. The growth of string beans and bell pepper inoculated with MR and PR was not able to induce higher. The same with the growth rates on the 4th to the 10th week and the total number of leaves.

Reproductive Responses String Beans (*V. unguiculata*) Inoculated with Rhizobial Culture

The number of days from sowing to flowering and fruiting are not significantly different in all treatments.

Productivity of *V. unguiculata* and *C. annuum*

Higher number of fruits was observed in the plant inoculated with MR as compared to PD

and PR. The heaviest in terms of dry weight was observed in plant inoculated with MR. However, in terms of the weight of the whole plant, rhizobial culture did not induce plant weight.

Number of Nodules in Secondary Roots Colonized by *Rhizobia*

The highest number of nodules in secondary roots of string beans was seen in plant treated with (MR) as compared to PR and control. No nodule was formed in bell pepper.

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Platelet Response of Mice to Tawa-Tawa (*Euphorbia hirta*), Kamote(*Ipomoea batatas*), PAPAIT (*Glinus oppositifolius*) Leaf Decoctions

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ABSTRACT

Dengue virus is the most common cause of thrombocytopenia in the Philippines. Herbal medicines are often used as alternative treatment since no drugs has yet been discovered. The study was conducted to: 1) differentiate the platelet count in mice after 24, 48, and 72 hours, and after 2 days without treatment using tawa-tawa, papait, and kamote leaf decoctions; 2) compare the platelet count of mice in the different treatments within days; 3) determine the overall trend of platelet count of mice during the administration of treatment. Twenty male albino mice weighing 30-40 g were randomly separated into five treatments namely: T1- distilled water, T2- 5mg prednisone, T3- 150 g E. hirta, T4- G. oppositifolius and T5- I. batatas. Two way ANOVA with Repeated Measures was used to analyze the trend of platelet count of mice of the treatments at time intervals, while t-test and One-way ANOVA were used to test differences in interval treatments respectively. Result showed that tawa-tawa had the highest increase in platelet count of mice and had the most potential in the management of increasing platelet count and is not significantly different to kamote followed by papait. Although these leaves contain different phytochemicals, they have the possibility to increase platelets.

Keywords: tawa-tawa, papait, kamote, thrombocytopenia, platelet

INTRODUCTION

Platelets function as inflammatory marker while keeping interactions with leukocytes and endothelial cells. Platelets have emerged to be important markers for disease pathophysiology in recent time. They are primarily associated with hemostasis which is to initiate or cause the beginning of blood coagulation. Blood coagulation or homeostasis is not the sole function of platelets; rather it is employed in many multifunctional attributes monitoring the homeostasis of the body like high sensitivity to different disease and it is assigned to be one of the most accessible markers (Ghoshal K et al., 2013).

A persistent decrease in the number of blood platelets that may be associated with hemorrhagic tenderness is called thrombocytopenia. Low platelet count or thrombocytopenia is a key to the patients' survival. Low platelet count or thrombocytopenia can be inherited or acquired. Furthermore, thrombocytopenia may be due to one of the following factors: cancer, aplastic anemia, toxic chemicals, medicines, alcohol, viruses, genetic

conditions, autoimmune diseases, infection, surgery, and pregnancy. The bone marrow does not make enough platelets. The body destroys its own platelets and also rare and serious conditions that cause blood clots (U.S. Dept. of Health & Human Services, 2012).

The most common cause of thrombocytopenia in the Philippines is dengue fever. Dengue fever is caused by the arthropod-borne flavivirus named dengue virus, which is transmitted by the *Aedes* genus mosquito. Occasionally the patient suffering from dengue may develop complications such as bleeding from the nose, gums or skin.

Plants produce a great variety of secondary products of which the most important group is called phenolic compounds. Phenolic compounds display a defensive, growth and developmental effects. One of these various plants is the *Euphorbia hirta*. The water decoction of leaves from *Euphorbia hirta*, locally known as gatas-gatas, is used in the Philippines as a folk medicine to treat dengue fever. The Department of Science and Technology of the Philippine Council for Health

and Development is conducting several studies and researches on this plant to determine the curative component of tawa-tawa (*Euphorbia hirta*) for dengue and tuberculosis (Enerva et al., 2015).

Tawa-tawa, apparently, does not directly kill the dengue virus. But it has immunomodulatory activity. It promotes the development of blood platelets and minimizes the effect of the viruses which attack the blood but it does not fight the virus (Enerva et al., 2015). It acts by promoting the development of blood platelets. It stops hemorrhage and prevents further bleeding. It also improves the nausea and abdominal cramps. This herbal treatment makes the effects of dengue virus more bearable to the patient and hastens recovery.

Another type of plant is the *Glinus oppositifolius*, commonly called papait. *Glinus oppositifolius* is a medicinal plant used against various types of illnesses related to immune response like joint pains, inflammations, fever, malaria and wounds (Debes et al., 2005). *Glinus oppositifolius* is used also in the treatment of skin disease, increase appetite, cures vata, kapha, piles, leucoderma, tonic to intestine, urinary infections, fever, cough, and liver problems. It is also used as antioxidant due to its excellent properties and potent phytoconstituents (Sahu et al., 2012).

G. oppositifolius has a lot of therapeutic values in traditional medicine. It is reported to have analgesic, antidiabetic, antihyperlipidemic, antihelminthic, antidiarrheal, diuretic, antimalarial, antiviral, antimicrobial and antioxidant properties.

Sweet potato leaves (*Ipomoea batatas*) decoction is a folk remedy for asthma, bugbites, burns, catarrh, diarrhea, fever, nausea, stomach distress and tumours. It has been used in the treatment of anemia and other related ailments because this plant has haematinic effects. *Ipomea batatas* are excellent source of dietary polyphenols such as anthocyanins and phenolic acids (Karna et al. 2011). It also contains tannins that arrest bleeding from damaged or injured vessels by precipitating proteins to form vascular plugs (Bamidele et al., 2010).

There are many anecdotal reports of the use of kamote (*Ipomoea batatas*) in dengue, producing an improvement in platelet counts. In some countries, a variety of sweet potato has been eaten raw to treat anemia, hypertension and diabetes (Milind, et al., 2015).

METHODOLOGY

Tawa-tawa (*E. hirta*) and papait (*G. oppositifolius*) leaves were collected at Barangay Pong Pong Sto Tomas, La Union. Purple variety of kamote (*I. batatas*) was collected at San Jose Sur, Agoo, La Union. The plant samples were separately placed in clean plastic bags and submitted at the National Museum Botany Division in Metro Manila for authentication of their identity. Twenty (20) male albino mice were divided randomly among each treatment. Each treatment had 4 replicates but each mouse was placed in separate cages. Fresh mature leaves of tawa-tawa (*E. hirta*), papait (*G. oppositifolius*), purple variety of kamote (*I. batatas*) were prepared. The leaves were washed with running water and were cleaned to remove dirt. The leaves were cut into small pieces and weighed. For every 150 grams of leaves, the researchers added 200 ml distilled water. The mixture was prepared in a beaker. This was covered with foil and then for 15-30 minutes, it was placed in water bath of boiling water with a temperature of 100°C. The decoction was filtered and poured separately in a beaker until exact amount needed for each treatment was measured. The same procedure was applied to the other leaves. The three different plant extracts were refrigerated for later use.

For Treatment 1, distilled water was administered per day for every mouse.

For Treatment 2, one tablet (5 mg) of prednisone was pounded with a mortar and pestle and was diluted to 10 ml of distilled water.

For Treatment 3, 150 grams of leaf of *E. hirta* was cut into small pieces and was added with 200 ml of distilled water that was boiled for 30 minutes.

For Treatment 4, 150 grams of leaf of *G. oppositifolius* was cut into small pieces and was added with 200 ml of distilled water that was boiled for 30 minutes.

For Treatment 5, 150 grams of leaf of *I. batatas* was cut into small pieces and was added with 200 ml of distilled water that was boiled for 30 minutes.

Platelet count was initially determined prior to the start of the study. Twenty grams of furosemide was then administered for four (4) days to decrease the platelet count of mice. After the administration of furosemide, blood samples were again collected for initial platelet count. One (1) ml of treatments per 30 grams body weight of mice was continuously administered every day for three (3) days. One hour before and after the administration of all treatments, the mice were not allowed to eat and drink. Administration of treatments was done three times a day at 7 o'clock in the morning, 12:30 and 4 o'clock in the afternoon. After 24 hours, 48 hours and 72 hours, blood samples were then collected with continuous administration of treatments. The administration of treatments was ceased after the 72nd hour.

Collection of blood was done via cutting of the tail. The mouse was placed in an improvised restraining tube to reduce stress among them. The feet of the mouse were held and the tail was wiped using with alcohol cotton before it was cut with a sterilized scissor. The blood was collected using micro blood tube. 0.25 ml of blood was collected from every mouse. After collecting the blood, pressure was applied to the tail using cotton to stop the bleeding.

RESULTS AND DISCUSSION

Table 1 shows the mean platelet counts in mice as the effect of the different treatments. One way Analysis of Variance revealed that there are significant differences within the treatments per day and LSD as Post hoc test shows where those differences lie.

After 24 hours of administering the decoctions, prednisone and water, all treatments are almost significantly different in comparing the different plant treatments. Tawa-tawa ranks the highest in terms of mean increase in platelets (1295), followed by kamote (1065) then papait (850). Kamote and prednisone are not significantly different. This means that kamote and prednisone (a commercial drug) have similar effect in the increase of platelet count. After 48 hours of administering treatments, all treatments are not significantly different in increasing the platelet count, which means they have comparable effects. This also means that kamote, papait and prednisone have somewhat delayed effects in increasing platelet count making them not significantly different from tawa-tawa. At 72nd hour of administering the treatments, tawa-tawa and kamote have comparable effects in the platelet count and kamote has comparable effects to prednisone. With this result, it shows that kamote has similar effects with tawa-tawa but with slightly delayed effect or response from the mice to increase platelet levels.

Table 1. Mean Platelet Counts of Male Albino Mice in Different Treatments from 24, 48, 72 Hours and after 2 Days without Treatment

Treatments	Mean Platelet Count					
	Initial	Furosemide	24 hours	48 hours	72 hours	After 2 days w/o Treatments
T ₁ - Water	587.50	367.50	670.00 d	727.50	705.00 c .	610.00
T ₂ - Prednisone	587.50	375.00	1147.50 b	900.00	932.00 b .	590.00
T ₃ - Tawa-tawa	597.50	387.50	1295.00 a	1152.00	1107.00 a .	552.00
T ₄ - Papait	595.00	380.00	850.00 c	950.00	762.50 c .	580.00
T ₅ - Kamote	632.50	385.00	1065.00 b	1045.00	952.50 a, b.	602.50

Papait is not significantly different from water. Ranking the plants after 72 hours, tawa-tawa has the highest increase mean platelet count, followed by kamote, then papait. However, tawa-tawa is comparable to kamote.

After two (2) days without administering the treatments, all treatments are comparable which means that the treatments have no more effect and the platelets had returned to the initial levels.

Herbal medicines play a major role in treatment of many diseases in humans and animals. These medicinal plants are useful for healing because of the presence of phytochemical constituents (Wadood, et al., 2013).

Phytochemical analysis shows the presence of flavonoids, tannins, alkaloids and phenolics in the leaves which could be important in their effectiveness for thrombosis.

Phytochemical analysis shows that flavonoids were detected in all plant samples. Flavonoids are water soluble polyphenolic molecules containing 15 carbon atoms. Furthermore, flavonoids were detected to have their anti-thrombocytopenia property which helps to increase the platelet count of induced thrombocytopenia rat models (Apostol, et al., 2012). Additionally, flavonoids have been shown to reduce platelet adhesion and aggregation, to prevent thrombosis and thus improve microcirculation (Pati, et al., 2013).

Table 2 presents the mean differences of the different treatments on the platelet count of mice between time intervals. (Between initial and furosemide, between furosemide and 24 hours,

between 24 hours and 48 hours, between 48 hours and 72 hours and between 72 hours and after two (2) days without treatments. T-test between time intervals reveals that there are significant differences in the platelet count in some of the intervals per treatment.

Table 2 shows that after the mice were treated with furosemide, all show significant decrease from the initial count. After 24 hours of administering treatments, all treatments show significant increase from the platelet count treated with furosemide. After 48 hours of administering treatments, there is neither significant increase nor decrease from the 24th hour platelet count.

After 72 hours of continuous administration, almost all treatments are not significantly different from the 48th hour count. Only tawa-tawa significantly decreases the platelet count of mice at 72nd hour as compared to the 48th hour.

After two (2) days without the treatments, as expected, prednisone, tawa-tawa and kamote show significant decrease in platelet count in mice, however papait and water show no significant decrease of platelet count similar.

Table 2. Mean Platelet Count Difference between Time Intervals in Mice.

Time Interval	T ₁ - Water	T ₂ - Prednisone	T ₃ - Tawa-tawa	T ₄ - Papait	T ₅ - Kamote
Initial to Furosemide	-220 ^s	-212.5 ^s	-210 ^s	-215 ^s	-247.5 ^s
Furosemide to 24 hrs.	302.5 ^s	772.5 ^s	907.5 ^s	470.0 ^s	680.0 ^s
Prev. 24 to 48 hrs.	57.5 ^{ns}	2.5 ^{ns}	-142.5 ^{ns}	100.0 ^{ns}	-20.0 ^{ns}
Prev. 48 to 72 hrs.	-22.5 ^{ns}	-217.5 ^{ns}	-45.0 ^s	-187.5 ^{ns}	-92.50 ^{ns}
Prev. 72 to after 2 days	-97.0 ^{ns}	-342.5 ^s	-555.0 ^s	-182.5 ^{ns}	-350.0 ^s

Trends of Platelet Counts of the Different Treatments

The trend of platelet count in mice treated with water, shows the normal response of mice to the decrease of platelets as induced by furosemide, then increasing back to its initial levels after five (5) days. Mice treated with tawa-tawa shows the highest increase of platelet count after 24th hour of administration yet not significant to the increase nor decrease after 48th and 72nd hour of continuous administration. Mice treated with prednisone also shows the

increase of platelet count after 24th hour of administration followed by kamote and papait yet not significant to the increase nor decrease after 48th and 72nd hour of continuous administration. However, after two (2) days without treatments, platelet count decreased and returned back to its initial levels except for water. With the other treatments with higher platelet count response, this means that the plants have thrombocytotic effect, yet in tawa-tawa and kamote, the effect is better as compared to papait.

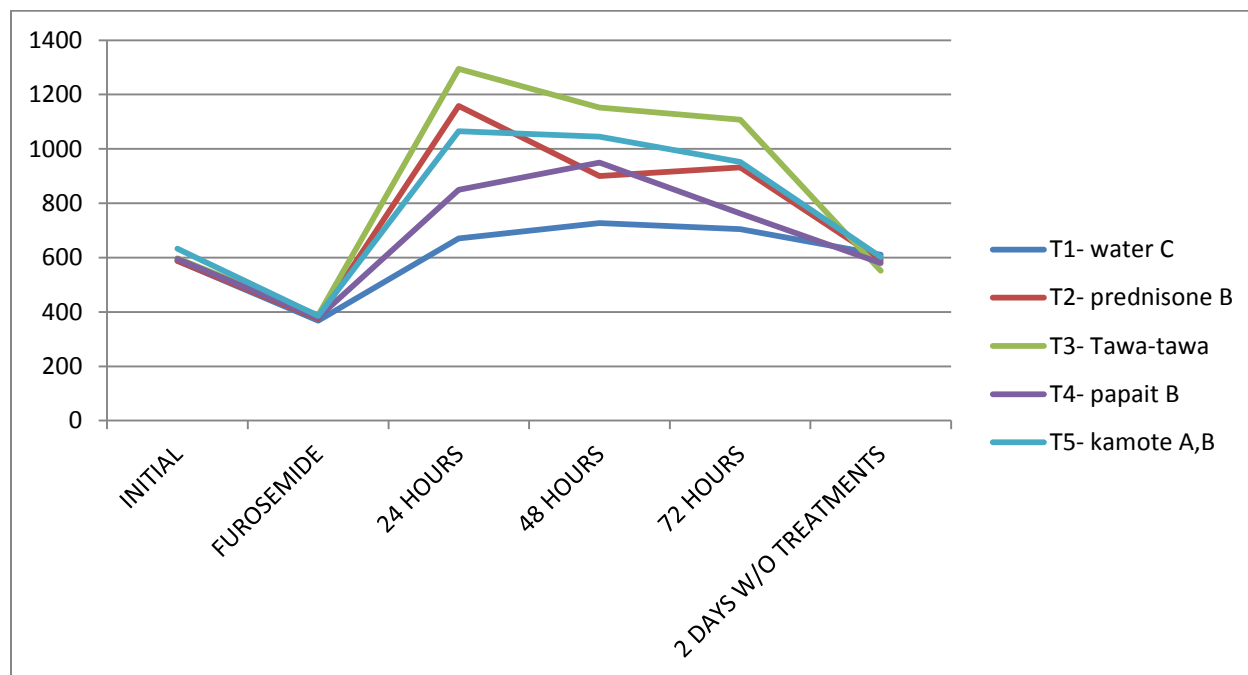


Fig. 1 Trend of Platelet Count in Mice

CONCLUSIONS

Based on the findings of the study, the following conclusions were drawn:

1. There is an increase of platelet count of mice after the administration of tawa-tawa, kamote and papait. Ranking the plant treatments, tawa-tawa has the highest mean increase, followed by kamote and papait. Although phytochemical analysis shows that kamote and papait contain more chemical compounds than in tawa-tawa, the analysis could not be enough to correlate that platelet count increase.

2. After 24 hours of administering treatments, all treatments show significant increase of platelet count, with tawa-tawa showing the highest increase. On the 48th hour of continuous treatments, all treatments are not significantly different, which means other treatments have delayed effects. On the 72nd hours, tawa-tawa and kamote are not significantly different, which means that kamote may have delayed but have similar effects.

3. All treatments significantly increase in platelet count of mice after administering treatments. After 48th and 72nd hour, there is neither significant increase nor decrease of platelet count in mice; however, after two (2)

days without treatments, all treatments decrease in platelet count returning to its initial level. This means that treatments have no longer effect.

RECOMMENDATIONS

Based on the summary of the findings and the conclusions, the researchers recommend the following:

1. To test possible toxic effects of the tawa-tawa plant if given in a more concentrated solution or preparation.

2. Furthermore, replication of the study is recommended to verify the efficacy of the leaf decoctions for continuous use.

3. Protocol for the animal care and use should follow before the start of experiment.

4. Use of other extraction techniques like expressed juice and use of ethanol or methanol for extracting with different dosage

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Production of Biogas Using Different Animal Manure

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ABSTRACT

Fossil fuels as primary energy source have led to myriads of problems such as global climatic change, environmental degradation and various human health problems. Moreover, the recent rise in natural gas prices has called for researchers towards alternative sources.

This study investigated the production of gas called methane from cow, carabao, pig, and chicken dung for composition for 15 days. The study was conducted through anaerobic fermentation using different types of dung separately as substrate. The fermentation was separately done using 12 bio-digesters and fermentation carried out at temperatures between 27-37°C for a period of 15 days. The biogas produced during this period was measured by the change/decrease of the water level in the level hose every after two days and tested the gas produced using flame test. They are all effective in producing methane gas except for the negative result in flame test of treatment four (4) (chicken dung).

Keywords: *Anaerobic fermentation, Animal manure, Biogas, Methanogens*

INTRODUCTION

In recent years, studies on the waste recovery and source of energy have been popular in the scientific area such as farms and livestock. Hence, farms and livestock in particular offer tremendous potential for energy recovery in the form of biogas. The increasing size of farms and livestock in animal husbandry and environmental standards for the further exploitation of excrement are two of the main reasons why alternative means of utilizing and treating the solid manure need to be found and studied. Many studies argue about biogas production from different types of organic wastes such as animal manure and other ruminant animals and plants. (Recebli, et al., 2015). Both energy substitution and agricultural land with acceptable capacity are considered as constraint conditions of biogas development (GuoGuo, 2010). Decomposers such as bacteria from different animal manure create methane and carbon dioxide to produce biogas.

The low C:N ratio in animal manure indicates that it could be a good source of protein for the microorganisms involved in

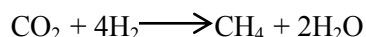
the decomposition of organic matter (Girija, et al., 2012).

Anaerobic bacteria function in absence of free oxygen while aerobic bacteria work where adequate oxygen is available. Facultative anaerobic bacteria can function in either situation, but are more efficient at capturing nutrients through the aerobic process, as are aerobic bacteria. But most life on Earth is dependent on aerobic conditions and aerobic decomposition (Lynd, et al., 2002). In the absence of oxygen, anaerobic microorganisms are favored, and their activities do not cause heat to be generated to the extent needed for sanitation.

Biogas is a combustible gas mixture which consists mainly of carbon dioxide and methane. It is formed from the anaerobic bacterial decomposition of organic compounds. The waste products of the decomposer, microorganisms may form methane gas. The composition of gases depends on the substance that is being decomposed (Jorgensen, et al., 2009). Biogas is a readily available energy resource that significantly reduces greenhouse-gas emission compared to the emission of

landfill gas to the atmosphere (Murphy et al., 2004).

The Phylum Euryarcheota is a microorganism that is capable in methane production (Hook, et al., 2010). This methanogens can be found in the rumen and hindgut of gastrointestinal tract of ruminant animals or non-ruminants animals.



This is the equation for the preparation of methane gas/carbon burns in an excess of air. An excess of air means that there is more than enough oxygen to cause all of the carbon dioxide. The methane gas is burned and this produces a clear blue flame.

Methanomicrobium mobile and *Methanobrevibacter ruminantium* are found in rumen of the ruminants like carabao and cow. The methanogens of the landrace pig can produce methane. In pig growth, there is a small portion of energy that a methane formation may affect the energy metabolism and metabolic pathway network (Luo, et al., 2012).

Studies of methanogenic bacteria present in monogastric animals are still scarce. Methanogens have been isolated from feces of rat, horse, pig, monkey, baboon, rhinoceros, hippopotamus, grand panda, goose, turkey and chicken. The predominant methanogen in all except the chicken and turkey is species of *Methanobrevibacterium*. In pig, the population of methanogenic bacteria is more than 30 times as dense in the distal colon as in the caecum.

In domestic animals such as chicken, the methanogenic bacterium (genus *Methanogenium*) was isolated from chicken and turkey feces (Saengkerdsub, et al., 2006). Only recently a methanogen has been tentatively isolated directly from the chicken caeca which includes *Methanobrevibacter woesei* (Saengkerdsub, et al., 2006). Increasing quantities of chicken waste concerns the poultry industry because of escalating disposal cost and the

potential for environmental pollution. The chicken caeca is difficult to ascertain based on several factors including the presence of other potentially competitive hydrogen user, diet, and age of birds ecologically (Beier, et al., 2008). Dietary changes may influence methane production in chicken. In the form of wheat, barley and oats, the dietary fiber was increased in the diet of chicken; the methane was increased nearly compared with corn (Shrimpton, 1966). Most studies have only detection of methane gas from adult chicken compared to preliminary experiments (Marounek, et al., 1996). They were unable to detect production of methane in young chicken, although it was observed significant with methanogenesis in the laying hens. The age of avians in which methane becomes detectable in the cecum may be dependent on the time course for establishment and stabilization of the adult anaerobic microflora (Beier, et al., 2008). Studies in methanogens present in the caecal microflora of adult birds by an experimental approach link specific microbial population responsible in the formation of methane (Beier, et al., 2004).

The importance of this study is that the biogas used to create bio-energy can contribute to reduce greenhouse gases and reduce the need to use fossil fuels. It provides a non-polluting energy source which is renewable, so the Earth is being kept clean of harmful emissions.

Statement of Objectives:

1. Determine the volume of gas produced by the different treatments.
2. Identify which among the treatments produce the greatest amount of gas.
3. Determine the presence of methane gas by flame test.

MATERIALS AND METHODS

The materials used in the study were as follows: 1) animal manure: cow dung, carabao dung, pig dung and chicken dung; and 3) supplies for biodigestion: 12 pieces of water bottles with the capacity of 20

liters, 120 meters level hose, ruler, scissors, Vulca seal, 1 kilogram old newspapers, 12 pieces of garbage bag, 12 pieces gas valve, 12 pieces brass angle valve, 12 pieces hose clamp, 12 pieces of sando bag, duct tape, teflon tape, mask, gloves, gas hose, record book and pencil.

Preparation of Experimental Sites

In this study, four treatments with three replications were placed in Brgy. San Fermin, Caba, La Union. The different containers (water bottles) were arranged in the said area with a distance of one (1) meter from each to prevent crowding. The different treatments were exposed in the same conditions such as temperature and sunlight. The area was enclosed to prevent trespassers that may destroy the set up.

Preparation of Biogas Digester

Level hose with a diameter of one (1) cm and 10 meters long was inserted into the small hole in the side of the brass angle valve. The brass angle valve and level hose that has been connected was inserted into the cap of the water bottle with a hole. Vulca seal was applied into the side of the hole to make it air tight. Then, the water bottles were covered using an old newspaper and black garbage bag so that light will not penetrate easily preventing the growth of algae that will produce oxygen which may help the bacteria to respire aerobically hindering the production of methane gas. Then biogas digesters were stacked in a safe place until they were used.

Collection of Animal Manure

Nine (9) kilograms of each animal manure was collected in Caba and Naguilian, La Union at 13th day of December, 2016. The cow dung, carabao dung, and pig dung were collected at Barangay San Fermin, Caba, La Union and the chicken dung was collected at Barangay Ambaracao Sur, Naguilian, La Union. The four different animal manures were weighed up to three (3) kilograms. They were air dried for one day and the next day, the animal dung was placed into a sando bag. Each treatment had three replications.

Preparation of treatments

On the same day, the three (3) kilograms of each animal manure was mixed with three (3) liters of water. By using a funnel, the mixture of animal dung and water was poured into the biogas digester. The mixture of animal dung and water was stored in a biogas digester from December 14 to December 29 for fifteen (15) days to allow bacteria to grow from dung to produce gas called methane gas. The flame test was observed on December 29. Each of the treatments was labeled properly and arranged using CRD. They were placed in an area exposed with the same conditions like temperature and sunlight.

RESULTS AND DISCUSSION

The volume of gas produced from the different treatments was measured as to the decrease in the water level in the level hose using the formula: $V=\pi r^2h$, where r is the radius of the level hose and h is the decrease in the water level.

Table 1. Volume of Gas Produced from the Different Treatments in cm³

Treatment	Mean
T ₁ Cow dung	112.33
T ₂ Carabao dung	215.01
T ₃ Pig dung	212.39
T ₄ Chicken dung	51.76

c.v. = 60%

The table shows that the carabao dung has the highest mean in the volume of gas, followed by T₃ then T₁. The lowest among the treatments is T₄. Using one way ANOVA, it was found out that there was no significant difference on its volume of gas produced from the different treatments. It implies that using either pig, carabao, or cow dung, the volume of gas (methane) produced was comparable. The critical value is 60 percent seems to indicate that the results were not reliable due to fact that

observations were done for short duration, only for 15 days.

Flame test was used to determine the presence of methane gas produced from the different treatments. Methane gas burned with a blue flame.

Table 2. Flame Test for the Different Treatments in Seconds.

Treatment	Mean
T ₁ Cow dung	7.00
T ₂ Carabao dung	32.30
T ₃ Pig dung	47.67
T ₄ Chicken dung	0.00

c.v. = 171.96%

Table 2 shows the mean time in seconds elapsed to burn the produced methane gas from the different treatments. An igniter was introduced near the valve and if it produced a blue flame, a methane gas was present. The highest mean was T₃ followed by T₂ and T₁. The 0 result of T₄ indicates that methane gas was absent.

The high c.v. could be attributed to the procedure as to how the valves were opened before the igniter was introduced for the flame test. The gas seems to have escaped before the igniter was introduced causing a shorter time for the gas to burn with a blue flame.

Result showed that the longest time elapsed for the methane gas to burn was observed in T₃ or Pig dung; however; there was no flame produced in T₄ or chicken dung. Furthermore, the cow, carabao and pig have methanogens such anaerobic *Archaea* energy metabolism resulting in production of methane (CH₄).

The results of study showed that the different animal manure through anaerobic

respiration using old manure as source of methanogens can have methane and can be a biogas. It also reveals that the efficiency of the locally made bio-digesters as a biogas production model is possible. The remains of the slurry in the bio-digester after biogas production were also found to be abundantly good pathogens to enriched compost which can be used to improve agricultural soil nutrient productivity. The animal wastes from cow, carabao, pig, and chicken can be generated as biogas. It is used efficiently for direct heat conversion and it produced an energy resource that can be purged and stored in the biogas digester. This alternative energy resource such as biogas should be intensified so that ecological disasters like deforestation, desertification, and erosion can be arrested in our rural areas. The performance of the plastic synthetic bio-digester employed in this study was found to be very satisfactory in the provision of clean fuel (methane gas) and fertilizer.

The absence of methane in chicken dung can be attributed to the source of the chicken dung. According to (Miller, 1991), most studies have only detected methane as from adult chicken (hen) compared to preliminary experiments. Furthermore, (Marounek et al., 1996) were unable to detect production of methane in young chicken. The age of avians in which methane becomes detectable in the cecum may be dependent in the time course for establishment and stabilization of the adult anaerobic microflora (Beier, et al., 2008).

Another reason for the undetected methane gas from the chicken manure used in this study was the dietary intake of chicken. According to (Shrimpton, 1966) as cited by (Beier, et al., 2004), dietary changes

may also influence methane production in chicken. When the dietary fiber was increased, the methane production was also increased. The chicken in this study were fed with corn. It can be inferred that acetate accumulation inhibited acetate conversion and inhibited acetate conversion of methane.

CONCLUSIONS

- 1) There is no significant differences in the volume of gas produced from the different treatment. The volume of gas produced from the different treatments are comparable.
- 2) The flame test revealed that chicken dung produce gas, however not a methane gas.

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Repellent Properties of Essential Oil and Plant Distillates of Selected Plants to *Aedes albopictus*

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ABSTRACT

Control and protection from mosquito bites are important measures against diseases like dengue and malaria. The number of mosquitoes that landed but had not bitten the skin and the number of mosquitoes that had actually bitten were determined. The repellent activities of the different treatments of essential oils and plant distillates from the selected plant species were computed.

This study used the skin test wherein the skin was smeared with 0.5 mL of essential oils, plant distillates and distilled water (control) and was exposed for five (5) minutes against 30 female blood-starved *Aedes albopictus*. Responses varied according to the plant species of essential oil and plant distillate extracts. Repellency of *Cananga odorata* (ylang ylang) flower gave the highest mean of 100 percent, *Cocos nucifera* (coconut) essential oils (83%) and both were comparable to *Cymbopogon citratus* (lemon grass) (73%) and *Plumeria rubra* (kalachuchi) (69%) plant distillates. Relatively, the lowest mean (-99%) was observed in *Tithonia diversifolia* (wild sunflower) plant distillate extract. *Cananga odorata* (ylang ylang) and *Cocos nucifera* (coconut) essential oil are not significantly different; they can be used as a natural mosquito repellent.

Keywords: *Aedes albopictus*, dengue, essential oil, extract, mosquito repellent, plant distillate

INTRODUCTION

Aedes albopictus, also known as “tiger mosquito,” is a mosquito native to Asia. They can be easily recognized by the bold black shiny scales and distinct silver white scales on the palpus and tarsi (Rios et al., 2013). *A. albopictus* is one of the most important vectors of several arboviruses, like dengue, yellow fever and diverse types of encephalitis (Aranda et al., 2006). This species, was rank second on *Aedes aegypti* in importance as a vector of dengue virus (Benedict et al., 2008 and Grtaz, 2004).

Mosquito control and personal protection from mosquito bites are currently the most important measures to control mosquito from biting. Although, repellents based on chemical insecticides are considered to be useful in preventing and reducing the mosquito to vectors, chemical repellents are not safe especially to children because it may cause hot sensation, rashes, allergy, or skin irritation (Soonwera et al., 2014). The repellent properties of plants to mosquitoes and other pest insects are well-known before. The most commonly used insect repellent is synthetic chemicals that contained DEET (N, N-diethyl-3-methylbenzamide) in their formulations. Whereas, DEET is an

effective repellent against a broad spectrum of insects, there are disadvantages in using DEET (Oshaghi et al., 2003) like human toxicity with symptoms varying from mild to severe. It can cause irritation to mucous membranes. DEET may be unsafe for children possibly causing encephalopathy (Phasomkusolsil et al., 2010). Furthermore, the repellents based on essential oil extracts are effective for mosquito control, environment-friendly and are considered harmless to other organisms (Govindarajan, 2011).

In this study, plant distillate and essential oils were used to test the efficacy of the plants as mosquito repellent. *Cymbopogon citratus* (lemon grass), *Cocos nucifera* (coconut), *Cananga odorata* (ylang ylang), *Tithonia diversifolia* (wild sunflower), and *Plumeria rubra* (kalachuhci), respectively, are the plants used in the experiment.

Lemon grass(*Cymbopogon citratus*) is well known to repel mosquitoes. This plant has been widely recognized for its medicinal and ethnobotanical usefulness. Lemon grass belongs to family Poaceae (Oyedele et al., 2002). Lemon grass is a natural repellent, anyone can rub its diluted form on the skin and it can also repel

various insects such as ants and mosquitoes (Wells, 2017). Lemon grass essential oil and extract have been reported to have insecticidal, antimicrobial, and therapeutic properties. It is also an effective insect repellent. Its essential oil has been described to repel mosquito vectors such as malaria (*Anopheles stephensi*), filariasis (*Culex quinquefasciatus*), and dengue fever (*A. aegypti*) (Oyedele et al., 2002). Lemon grass extracts can also be used for production of potent chemical-free and safe mosquito repellent and insecticides (George et al., 2016).

The essential oil from coconut (*Cocos nucifera*) has also been used as a repellent against *A. aegypti* and *C. quinquefasciatus*, but they have mixed it with other oils like ylang ylang oil mixed with coconut oil, and, coconut oil gave the longest lasting period of repellency against *A. aegypti* respectively 76.50 and 96.00 minutes (Duangkamon et al., 2013). In other experiments, coconut shell has also been used as mosquito repellent and it was found to be the best mosquito repellent compared to other extracts (Rinkesh et al., 2010).

Cananga odorata commonly known as “ylang ylang” belongs to the family Annonaceae. Ylang ylang is a perennial tropical tree and grows in South-East Asian countries like Philippines and Malaysia. This plant has been well-known for its fragrant flower which produces intense sweet scent similar to jasmine. Its essential oils has been already widely utilized in the perfume industry as well as in the food industry and aromatherapy. In Java, dried flowers of ylang ylang were used as a treatment for malaria and related symptoms. Meanwhile, in Vietnam, it is also used as medicinal plant against malaria. (Tan et al., 2015). From the study of Oshaghi et al. (2003), the essential oil of ylang ylang clearly showed that the application of this essential oil gave acceptable percentage biting against *Anopheles stephensi*.

Tithonia diversifolia, also known as “wild sunflower,” is a shrub which belongs to a sunflower family, Asteraceae. *Tithonia* was named for ‘*Tithonus*’ which is a legendary Trojan loved by a dawn goddess named Eos, while ‘*diversifolia*’ means ‘separated leaves’, from the Latin word ‘*diversus*’ which means divergent and ‘*folium*’ which means leaf. The

height of this plant varies from 1.2 - 3 meters with upright and sometimes ligneous stem.

In the study of Oyewole et al. (2008) it shows that the effectiveness of this plant extract could be time-dependent and the repellent activity of this plant was found to be dose dependent. However, wild sunflower also possesses oviposition deterrent and skin repellent activity similar to *Solanum trilobatum* against the malaria vector *Anopheles stephensi*.

Plumeria rubra (kalachuchi) is an ornamental tree of Apocynaceae family that grows as a spreading shrub and has large green leaves that can reach up to 30 to 50 cm long. The flowers have five (5) petals, strongly fragrant odor and the colors ranging from common pink to white with shades of yellow in the center. Kalachuchiflower can chase off *A. aegypti* and can help prevent more cases of dengue. This would also help reduce the morbidity and hence the mortality rates of dengue cases (Muthusamy, 2014).

Statement of Objectives

The main purpose of this study is to evaluate the repellent potential of the essential oils and plant distillates of different plants. Specifically, this determined the cumulative number of mosquitoes that landed and had bitten the exposed skin per extract in 15 minutes and the repellency of the different plants such as *C. citratus* (lemon grass), *C. nucifera* (coconut), *C. odorata* (ylang ylang), *T. diversifolia* (wild sunflower), and *P. rubra* (kalachuchi) in terms of landing and biting.

MATERIALS AND PROCEDURES

Test Organisms

The *Aedes albopictus* used in this study were from a legitimate culture that have been maintained for three (3) generations.

Eggs of these mosquitoes were placed in a container with water. After two (2) days, the eggs became larvae, then the larvae to pupae after three (3) days. Adults emerged from pupa after two (2) days. The adult mosquitoes were placed separately in improvised cages that were properly labeled based on the date of emergence of the adult. The cages were made of organza

and empty six-liter plastic bottle. The mosquitoes were fed with sugar solution composed of one (1) part sugar and one (1) part water.

The adults in the cages were allowed to mate but were blood-starved for five (5) days. By using vial and the antennae of the mosquitoes through the naked eye, the females were then separated from the males. Female mosquitoes' antennae were pilose while male mosquitoes were plumose. Researchers counted the number of the female mosquitoes and were placed in testing cages. The testing cages were also made up of organza and plastic with a diameter of 32 cm and a length of 62 cm. Each testing cage contained 30 female blood-starved mosquitoes.

Plants and Sample Preparation

In extracting the essential oils and or plant distillates of lemon grass leaves, coconut fruit, ylang ylang flowers, flowers of wild sunflower, and kalachuchi flowers, one (1) kilogram of each plant samples were placed in a pressure cooker with one (1) L of water. One end of the rubber tubing was placed at the released post of the lid of the pressure cooker and the other end at the condenser. The different plants were boiled separately over a low fire for two (2) hours. The steam passing through the condenser

is cooled and the oil or plant distillate was collected at the other end of the condenser. Essential oils and plant distillates were stored at room temperature.

Bioassay

The method of Schreck (1977) that was adapted by Yang (2004) with a slight modification was used to determine the repellent activity of plants against female blood-starved *A. albopictus*. Yang (2004) conducted bioassay at 12:00 pm to 5:00 pm (1200h to 1700 h). This study was conducted at 6:00 pm to 11:00 pm (1800h to 2300h). The arms of human volunteers were washed thoroughly with soap and water and rinsed 10 times to remove the soap residues and fragrance. The arms were then covered with plastic except a portion left open which is about eight (8) cm by six and a half (6.5) cm. This portion of the arm was exposed to the mosquitoes.

RESULTS AND DISCUSSION

Mosquitoes Landing and Biting

Mosquitoes need a protein source for reproduction after breeding; thus, females will look for a blood source, landing on the skin then piercing their proboscis to the skin of the host.

Table 1. Mean Number of Mosquitoes that Landed and Had Bitten the Exposed Skin to Plant Distillate and Essential Oils

Treatments	Mean Landing	Mean Biting
Plant distillates		
Distilled water	7.67	15.67
Lemon grass	3.33	9.00
Wild sunflower	7.67	17.67
Kalachuchi	7.00	6.67
Essential oils		
Coconut	1.33	0.33
Ylang ylang	0.00	0.00

Table 1 shows the mean number of mosquitoes landing and biting on the skin with the treatments used (plant distillates and essential oils). ANOVA revealed that all the

treatments in plant distillates are not significantly different. Furthermore, in terms of the number of mosquitoes landing in skin treated with essential oils, coconut gave the highest mean followed by ylang ylang. In essential oils, the mean number of the mosquitoes landing and

biting also revealed that it is not significantly different.

Repellency of the Different Plants

A repellent is a substance that keeps away insects or a substance that deters insects or other pests from approaching or settling. Plants

could be an alternative source for mosquito repellents because they constitute a potential source of bioactive chemicals (Yang et al., 2014). The following data is based on repellency to biting and landing using the equation $\% \text{ repellency} = \frac{T_a - T_b}{T_a} \times 100$

Table 2. Repellency of Plant Distillates and Essential Oil in Terms of Landing and Biting.

Treatments	% Repellency Landing	% Repellency Biting
Plant distillates		
Lemon grass	-38	73 a
Wild sunflower	-274	-99 b
Kalachuchi	35	69 a
Essential oils		
Coconut	33	83
Ylang ylang	100	100

Table 2 shows the repellency of plant distillates and essential oils in terms of mosquitoes landing and biting. Mosquitoes landing in plant distillates, lemon grass, kalachuchi, and wild sunflower are not significantly different from each other. Although kalachuchi gave the highest mean of 35 followed by lemon grass (-38) and wild sunflower with a negative repellency of -274. The repellency of the plant distillates in terms of biting are significantly different, like the wild sunflower which is significantly different from the two plant distillates, lemon grass and kalachuchi. However, both lemon grass and kalachuchi are not significantly different. Meanwhile, comparing the essential oils, ylang ylang yielded the highest repellency of 100 in terms of landing and biting, while coconut essential oil gave the repellency of 33 in landing and a repellency of 83 in terms of biting. The two essential oils are not significantly different.

CONCLUSIONS

The following conclusions were drawn based on the findings of the study:

1. Ylang ylang essential oil is one of the best to use as mosquito repellent while wild sunflower distillate cannot be used as repellent because it attracts the mosquitoes. Ylang ylang also shows that it has the lowest mean in terms of mosquitoes landing and biting that further

suggests ylang ylang as an essential oil can be used as mosquito repellent.

2. In terms of the % repellency of any of the plants, lemon grass, coconut, ylang ylang, and kalachuchi can be used as mosquito repellent; however, wild sunflower distillate has the lowest or negative repellency in all the treatments.

RECOMMENDATIONS

Based from the findings and conclusions of the study, the following are recommended:

1. Ylang ylang and coconut essential oils, lemon grass and kalachuchi distillates show deterrent to mosquito biting, and thus can be further explored if combinations of the oils will be used to increase their effectivity.
2. Ylang ylang and coconut essential oils, lemon grass and kalachuchi distillates can be used as a natural mosquito repellent extracts and can be preferred than commercial repellents. Further, they can be added to candles and mosquito coils.
3. Wild sunflower distillate have shown to be more of an attractant than a repellent; thus, further experiments should be done to further verify the result, if consistent, wild sunflowers should be planted in outskirts or away from a populated area.

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Resistance of *Exiguobacterium* Isolate Against Various Plant Extracts

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ABSTRACT

This study was conducted to describe the response of Exiguobacterium isolate from the leaves of rice infected with bacterial leaf blight. This study utilized the experimental method of research and used the standard laboratory diagnostic procedure like bacterial ooze test and antimicrobial assay. The response of the bacterial isolate was measured based on the diameter of the zone of inhibition and microbial index. Result showed that Exiguobacterium was resistant to all the plant extracts tested as well as to the two positive controls as indicated by the absence of the zone inhibition and microbial index.

Keywords: *Exiguobacterium*, bacterial leaf blight, zone of inhibition, disc diffusion method

INTRODUCTION

Probiotics as defined by the World Health Organization (WHO) are live microorganisms that confer a health benefit on the host when administered in adequate amount (Mandal, 2014). In plants, probiotics help in fixing nitrogen, fighting pathogens and also promoting crop yield (Korzekwa, 2015). They are abundant in the rhizosphere soil, roots, plant nodules, stems and even in leaves.

Exiguobacterium is an example of a probiotic living in plants as well as in some invertebrates. It belongs to the major phyla of Firmicutes and is a gram positive facultative anaerobe. It may aid the rice plants infected with bacterial leaf blight to inhibit the growth of the disease-causing pathogen. *Exiguobacterium* can be isolated from diverse sources like rhizosphere of plants, surroundings of food processing plants, hot springs and glacial ice areas (Vishnivetskaya et al., 2009).

Probiotics have to be resistant to antibiotics. There are several mechanisms of antibiosis: inhibition of cell wall synthesis, inhibition of protein synthesis, alteration of cell membranes, inhibition of nucleic acid synthesis and antimetabolite activity (Michigan State University, 2011). Some studies show that probiotic bacteria found in dietary supplements would resist different types of commercially known antibacterial drugs such as streptomycin, gentamycin, ciprofloxacin and vancomycin.

These probiotics have the resistant genes like chloramphenicol acetyltransferases, β -lactamase and lincosamide transferase which help the probiotics resist the transmission of the pathogenic bacteria (Wong et al., 2015; Gueimonde et al., 2013; Ashraf et al., 2011). The importance of the resistance of the probiotics to antibiotics was to prevent multiple resistance to antibiotics of the pathogenic bacteria by fighting or inhibiting the colonization of these bad bacteria.

Commercially, known antibiotics increases the number of pathogenic bacteria with multiple resistance to antibiotics and this may be the reason why the World Health Organization recommended the use of antibiotics derived from plants. Plants are good source of antibiotics. Plants were used by ethnopharmacologists to treat certain diseases without even taking any forms of commercially known antibiotics. A few of the plants with notable medicinal properties are *Datura metel*, *Nicotiana tabacum*, *Abrus precatorious*, *Euphorbia hirta*, *Azadirachta indica*, *Manihot esculenta*, *Lentinula edodes*, *Averrhoa bilimbi*, *Allium sativum*, *Tagetes patula*, *Psidium guajava*, *Eucalyptus globulus*, *Phaseolus vulgaris*, *Colocasia esculenta*, *Ruellia tuberosa*, *Annona muricata*, *Capsicum frutescens*, *Allium cepa*, *Cucurma longa*, *Lantana camara*, *Dieffenbachia*, *Cassia alata*, *Carmona retusa* and *Gliricidia sepium*.

This present study attempts to evaluate the response of *Exiguobacterium* to different plant extracts mentioned earlier with known antimicrobial property. Based on their characteristics, these plants play an important role in pharmaceutical medicine that inhibits the growth of both gram negative and gram positive bacteria. Due to their inhibitory characteristics as shown by some literatures, the researchers would like to test if these plant extracts would inhibit the growth of *Exiguobacterium*. If found otherwise, the result of this study will tell something about the resistance and resiliency of this bacteria proving itself to be an effective plant probiotics.

MATERIALS AND METHODS

Collection of the Diseased Leaves of Rice as Source of Bacteria

Rice leaves showing bacterial leaf blight (BLB) symptoms were provided by the Department of Agriculture (DA) San Fernando, La Union.

Isolation and Identification of *Exiguobacterium* Bacteria from Diseased Rice Plants

The collected samples of the diseased rice leaves were cut into small pieces using a sterile scissors. They were sterilized with 1% sodium hypochlorite solution for three minutes then washed with sterilized distilled water twice. It was then soaked with distilled water for five minutes then allowed the bacteria to ooze. The yellow color of the water indicated the presence of *Exiguobacterium*. The cultures were kept at 4°C in a refrigerator until used. The identity of the isolate was confirmed and verified by the experts in the Philippine Center for Postharvest Development and Mechanization (PhilMech), Department of Agriculture (DA).

Preparation of Ethanol Extract of *R. tuberosa*

Fresh roots and leaves of *R. tuberosa* were collected in an open area at Barangay Tebag, Mangaldan, Pangasinan. The collected roots and leaves of *R. tuberosa* were washed in distilled water then air dried separately. Afterwards, they were pulverized using a

mechanical blender then weighed using a digital scale. An amount of 100 g plant material was suspended in 250 mL of 90 percent ethanol for seven (7) days in a tight sealed container. To obtain the crude extract, the mixture was concentrated in a rotary evaporator. The extracts were placed in air tight container then stored in a refrigerator until use.

Preparation of Aqueous Plant Extracts

The collected roots and leaves of *R. tuberosa*, leaves of *C. alata*, *A. precatorius*, *D. maculata*, *A. indica*, *A. bilimbi*, *G. sepium*, *C. esculenta*, *M. esculenta*, *E. hirta*, *C. retusa*, *P. guajava*, *N. tabacum*, *D. metel*, *T. patula* and *E. globulus* were washed with distilled water then air dried. While the collected rhizome of *C. longa*, bulb of *A. cepa*, clove of *A. sativum*, fruit of *C. frutescens*, seeds of *P. vulgaris* and *L. edodes* were also washed with distilled water and then drained. Afterwards, it would be pulverized using a mechanical blender then weighed using a digital scale. An amount of 100 g of plant material would be diluted in 100 mL of autoclaved distilled water and allowed to stand for two (2) hours. The decocted extract was squeezed through a muslin cloth, then placed in a sterile container then stored in a refrigerator until used (Kala, 2015).

Preparation and Standardization of Bacterial Inoculum

Using five (5) mL sterile water, the isolated bacterium was washed from the surface. The turbidity of the bacterial inoculum was adjusted by adding sterile water which must be equal to a known 0.5 McFarland Standard. Equal disappearance or distortion of the black bar indicates a similar turbidity that contains 1.5×10^8 cells. The prepared inoculum was stored at 4°C until use.

Disc Diffusion Method

The disc diffusion method was employed to test the susceptibility or resistance of *Exiguobacterium* to the plant extracts. A six (6) mm sterilized filter paper disc was needed for the antimicrobial susceptibility test. Using sterilized forceps, each disc was placed equidistant from each other in the TSA

inoculated with *Exiguobacterium*. The plates were incubated at 28±1°C for 24 hours. After incubation, the plates were examined with the presence of zone of inhibition (ZOI) of bacterial growth (clear rings) around the discs.

In order to determine which treatment is most effective in inhibiting the growth of *Exiguobacterium*, microbial index was also computed using the following equation.

$$\text{Microbial index} = \frac{\text{Zone of Inhibition} - \text{Diameter of disc}}{\text{Diameter of disc}}$$

RESULTS AND DISCUSSIONS

Isolation and Identification of *Exiguobacterium*

The bacteria or test organism was isolated from the diseased leaves of rice. The isolated bacteria exhibited the cultural characteristics typical of *Exiguobacterium* such as bright orange color and round or circular configuration. The identity of the isolate was ascertained by the experts in PhilMech, Department of Agriculture.

Response of *Exiguobacterium* to Different Plant Extracts

The resistance of *Exiguobacterium* isolate against the different plant extracts was

assessed based on the diameter of the zone of inhibition and microbial index.

Table 1 shows that ZOI was absent in all the plant extracts tested including two positive controls having mean microbial indices of -0.66 and -0.98 for streptomycin and nordox respectively. This indicates that the response of the bacteria was resistant where the microbial index was below six (6) mm against the treatments. ZOI response reading greater than 10 of the microbial index would indicate that the bacterium would be susceptible while microbial indices between seven (7) and nine (9) would indicate that it was intermediate. The ZOI interpretation was based from Clinical Laboratory Standard Institute (M100-S25).

Twenty-seven plant extracts namely *D. metel*, *N. tabacum*, *A. precatorius*, *D. maculata*, *E. hirta*, *A. indica*, *L. camara*, *M. esculenta*, *A. muricata*, *L. edodes*, *A. bilimbi*, *C. longa*, *C. retusa*, *G. sepium*, *C. alata*, *T. patula*, *P. guajava*, *C. esculenta*, *E. globulus*, *P. vulgaris*, *R. tuberosa*, *A. cepa*, *A. sativum*, and *C. frutescens* with known antibacterial property were used in this experiment. Several studies proved the antibacterial activities of these plant extracts because they contained the secondary metabolites such as phenolic compounds, flavonoids, alkaloids, saponins and glycosides in which it was believed that these compounds were responsible for their antibacterial property.

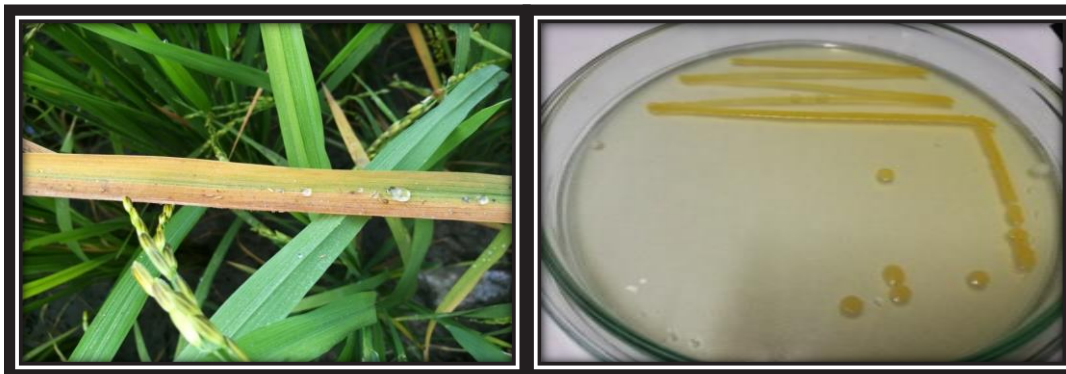


Plate 1. (a) *Exiguobacterium* (b) Rice Leaves Infected with BLB

Table 1. Evaluation of the Different Plant Extracts to *Exiguobacterium*

TREATMENTS	ZOI	Microbial Index	Response
T ₀ = Negative Control (distilled water)	0	0	R
T ₁ = Positive Control (Streptomycin)	2.02	-0.66	R
T ₂ = Positive Control (Nordox)	0.14	-0.98	R
T ₃ = <i>D. metel</i> aqueous leaf extract	0	0	R
T ₄ = <i>N. tabacum</i> aqueous leaf extract	0	0	R
T ₅ = <i>A. precatorius</i> aqueous leaf extract	0	0	R
T ₆ = <i>D. maculata</i> aqueous leaf extract	0	0	R
T ₇ = <i>E. hirta</i> aqueous leaf extract	0	0	R
T ₈ = <i>A. indica</i> aqueous leaf extract	0	0	R
T ₉ = <i>L. camara</i> aqueous leaf extract	0	0	R
T ₁₀ = <i>M. esculenta</i> aqueous leaf extract	0	0	R
T ₁₁ = <i>A. muricata</i> aqueous leaf extract	0	0	R
T ₁₂ = <i>L. edodes</i> aqueous extract	0	0	R
T ₁₃ = <i>A. bilimbi</i> aqueous leaf extract	0	0	R
T ₁₄ = <i>C. longa</i> aqueous rhizome extract	0	0	R
T ₁₅ = <i>A. cepa</i> aqueous bulb extract	0	0	R
T ₁₆ = <i>C. retusa</i> aqueous leaf extract	0	0	R
T ₁₇ = <i>G. sepium</i> aqueous leaf extract	0	0	R
T ₁₈ = <i>A. sativum</i> aqueous bulb extract	0	0	R
T ₁₉ = <i>C. frutescens</i> aqueous fruit extract	0	0	R
T ₂₀ = <i>C. alata</i> aqueous leaf extract	0	0	R
T ₂₁ = <i>T. patula</i> aqueous leaf extract	0	0	R
T ₂₂ = <i>P. guajava</i> aqueous leaf extract	0	0	R
T ₂₃ = <i>E. globulus</i> aqueous leaf extract	0	0	R
T ₂₄ = <i>P. vulgaris</i> aqueous seed extract	0	0	R
T ₂₅ = <i>C. esculenta</i> aqueous leaf extract	0	0	R
T ₂₆ = <i>R. tuberosa</i> ethanol leaf extract	0	0	R
T ₂₇ = <i>R. tuberosa</i> ethanol root extract	0	0	R
T ₂₈ = <i>R. tuberosa</i> aqueous leaf extract	0	0	R
T ₂₉ = <i>R. tuberosa</i> aqueous root extract	0	0	R

Note: ZOI Response: S = Susceptible (≥ 10); I = Intermediate (7 – 9); R = Resistant (≤ 6)

The pharmacological background of the different plant extracts showed that it has a greater potential in inhibiting the growth of the harmful pathogens. However, as shown in the results, *Exiguobacterium* was resistant to the different plant treatments as well as the two positive controls. This only proves that, *Exiguobacterium*, being a plant probiotic was

resistant to different antimicrobials and the different plant treatments were able to kill harmful pathogens but not the beneficial bacteria.

Exiguobacterium contains genes that are similar to some gram positive pathogens such as *Streptococcus uberis*, *S. suis*, *S. aureus*, *Fusobacterium nucleatum*, *Enterococcus*

faecium, and *E. faecalis* as well as *E. coli*, a gram negative bacteria. Genes responsible for antibiotic resistance were identified namely, macrolide phosphotransferase, dihydrofolate reductase, thymidylate synthase, resolvase, oxidoreductase, florfenicol-chloramphenicol transporter and tetracycline efflux pump. These genes were all present in this bacterium and therefore, protect themselves from harmful effects of antibiotics by preventing the entry of these chemicals in the outer membrane. These genes also promote the methylation of the 23S ribosomal unit, activate efflux, and decrease the affinity of dihydrofolate reductase and intrinsic resistance to thymidine and enzymatic cleavage. These would stop antibiotics in *Exiguobacterium* (Yang et al., 2014).

Result of this study proves that this bacterium, being a plant probiotic is well-adapted to its function as plant protector against pathogens. Its presence in the diseased rice leaves may show that it also multiplies and occurs in infected areas to defend the plants against pathogens (Korzekwa, 2015). Resistance to the two positive controls proved that this bacterium would contribute a greater importance in limiting the use of chemical fertilizers as well as the commercially known antibiotics that would imply a negative impact in our environment but also in the health of all living organisms. Additionally, resistance to the plant extracts proved that these plant extracts are of greater importance because they can kill harmful pathogens causing diseases without even harming the beneficial bacteria.

The ability of this bacterium to resist antibiotics benefits the plants since they are probiotics. Their presence in diseased plants proves that they somehow guard plants when stressed (Korzekwa, 2015). Many studies showed the important roles played by *Exiguobacterium* in the growth and metabolism of plants. This bacterium produces a plant growth promoting (PGP) factors which enhance the production of indole-3-acetic acid (IAA), solubilize phosphorus, solubilize zinc and fix nitrogen forming ammonia. These hormones contribute greatly to agriculture because it can improve plant growth even under limiting or stressful conditions and they can also increase the secondary metabolites in plants. Phosphorus

and zinc solubilizing hormone have been employed to improve crop yield. It can also provide the necessary nutrients that plants need. It can also protect the plant from phytopathogens (Kang et al., 2014; Minervini et al., 2015; Bharti et al., 2013; Yadav et al., 2016; Sharma et al., 2015; Chauhan et al., 2015; Wang et al., 2012).

Moreover, *Exiguobacterium* also produces siderophore which provides iron as a nutrient needed for plant growth. It also controls phytopathogens that use these two mechanisms: microbial Fe²⁺ siderophore will be donated and transported to the apoplast of the plant root wherein Fe²⁺ was trapped in the apoplast that leads to high concentration of Fe. Another is microbial siderophore can collect Fe from soil and do a ligand exchange with phytosiderophores (Ahmed et al., 2014; Chithrashreea et al., 2011).

Additionally, the interest of researchers to study *Exiguobacterium* nowadays lies on its ability to withstand different environmental stresses. According to Alam (2012), this bacterium is a potential agent of bioremediation because it can accumulate and absorb heavy metals such as Cd²⁺, Ni²⁺, Cu²⁺, and Zn²⁺.

CONCLUSION

The isolated bacterium, *Exiguobacterium*, although it is a probiotics was also found in diseased rice plants. It contains genes responsible for antibiotic resistance that would protect itself from the harmful effects of antibiotics.

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**Vegetative and Reproductive Performances of *Abelmoschus esculentus* L. (Okra)
as Influenced by Arbuscular Mycorrhizal Fungi (AMF) Inoculum
Associated with *Mimosa pudica* L. (Makahiya)**

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ABSTRACT

The use of biofertilizers is believed to abate the use of harmful chemicals affecting the environment and soil fertility. This study was conducted to determine the vegetative and reproductive performances of okra as influenced by AMF associated with M. pudica. Plant tissue, soil analysis data and percent colonization rate were also measured.

AMF inoculation affected the vegetative performance of okra but did not affect the reproductive phase. Findings seem to imply that AMF inoculation boosted seedling growth but did not affect the flowering and fruiting stages of the plants. All the plants inoculated with mycorrhiza were colonized. Plant analysis showed that inoculated plants have the highest moisture content and total Phosphorus. At the end of the experiment, soil analysis showed that AMF inoculation resulted in the highest percent increase in soil pH and percent decrease in total P next to the control.

Keywords: *AMF, growth and yield of okra, percent colonization rate*

INTRODUCTION

For over three decades, the Philippine agricultural sector has depended and relied on inorganic fertilizers and pesticides for food production. Thus, large amounts of foreign exchange spent on importation have contributed to the stagnant and limited growth of Philippines economy (Javier and Brown, 2011).

Slowly, chemical fertilizers started displaying their ill-effects such as leaching, polluting water basins, destroying microorganisms and friendly insects, making the crop more susceptible to the attack of diseases and causing damage to the overall system (Ibiene et al., 2012; Sharma and Rai, 2014; Kavatagi and Lakshman, 2014). These effects may be reduced by using inoculant biofertilizers which are more environmentally sound. Its introduction in agricultural production systems could be one of the means to mitigate the onset of global warming as well as the reduction in fertilizer input costs of farmers (Kennedy et al., 2004).

Arbuscular mycorrhizal fungi (AMF) are essential symbionts that are non-pathogenic. The symbiotic association of AMF with plant roots has many similarities to the formation of nodules in legumes by non-pathogenic rhizobia (Kawaguchi and Minamisawa, 2010; Bansal et al., 2012; Sharma and Yadav, 2013; Gupta et al., 2014).

Plants provide nutrients like carbohydrates to AMF that colonize their roots and, in exchange, these fungi supply their hosts with macronutrients such as nitrogen and phosphorous. By coming up with this relationship, scientists may be able to increase the biomass and yield of food crops and may reduce the required fertilizer inputs leading to the environmental sustainability of agricultural production systems. They are not as expensive compared to chemical fertilizer and will soon be accessible to the farmers replacing the commonly used chemical fertilizer (South Dakota State University, 2016).

Abelmoschus esculentus L. (okra) is one of the crops which are highly produced in Region 1 (Philstar.com, 2015). It is one of the main ingredients of the Ilocano's local delicacy, pinakbet. Okra is known as a source of calcium and potassium. They have high fiber, vitamin C and folate content and are popular for having high concentrations of antioxidants. Seeds of okra are best planted on summer until September because the crop thrives on steamy and hot climates. Okra bears fruit for about 50-65 days but could extend depending on the weather (Okra Production Guide Phil., 2015).

To get maximum agricultural benefit, inoculation of the soil with a suitable type of AMF is necessary. Hence, processes to culture and maintain mycorrhizal fungi production should become commercially feasible. For this reason, this study was conducted to evaluate the effect of AMF inoculum associated with *M. pudica* L. to *A. esculentus* L. (okra).

Statement of Objectives

This study was conducted to determine the vegetative and reproductive performances of *A. esculentus* as influenced by AMF associated with *M. pudica*. Specifically, it aimed to determine the following: 1) Effect of AMF on the vegetative and reproductive performance of okra, 2) Effect of AMF on the nutrient and mineral uptake of okra and physicochemical properties of the soil, and 3) Colonization rate of okra roots due to Mykovam and AMF associated with *M. pudica*

MATERIALS AND METHODS

Procedures are based on the protocols presented by Osillos (2015) with modifications.

Preparation of AMF Inoculum

The AMF inoculant associated with *M. pudica* from the previous study of de Guzman et al. (2016) was placed in a beaker then added with water. After 20-30 seconds that the soil settled, decantation and

filtration were done by pouring the liquid layer on a common household strainer to remove large pieces of organic matter. Filtrate was collected on a series of stacked sieves arranged as nos. 100, 325 and 500 having the largest sieve at the top and the finest sieve at the bottom. The supernatant was decanted then placed on the finest sieve (no. 500) washed for 1-2 minutes to remove the sucrose solution.

Preparation of Improved Greenhouse

A land area of three by five (3x5) meters was fenced using a screen wire with a height of two (2) meters. A one and a half (1.5) m high bamboo was used as a door to prevent stray animals from entering and destroying the set-up. The roof was covered with a transparent plastic to allow the penetration of sunlight in the screen house.

Preparation of Potting Media and Application of Treatments

The pot soil was obtained by digging 20-cm deep from the topsoil. The soil was sterilized through heating for four hours with occasional stirring.

The *A. esculentus* (okra) seeds were purchased at East-West Seeds, Philippines. The seeds were surface sterilized by soaking them in a 10 percent hypochlorite. After two weeks, three seedlings were transplanted to a pot containing 10 kg sterilized soil. After another two weeks, some of the seedlings were uprooted so that only one seedling was left in each pot. This was also the time when AMF inoculation was done.

Each treatment utilized three (3) replicates wherein nine (9) pots were used per replicate. Each treatment was replicated three times so a total of 36 pots containing 10 kg soil were used in the study. These were the treatments used:

T0 = Control 10 kg sterilized soil + okra seeds

T1 = 10 kg sterilized soil + okra seeds + 10 g Mykovam

T2 = 10 kg sterilized soil + okra seeds + 10 g RS containing AMF associated with *M. pudica*

T3 = 10 kg of sterilized soil + okra seeds + Recommended Rate of Fertilizer (3.92 g urea)

Recommended Rate of Fertilizer (RRF)

Before sowing, NPK content of the pot soil was evaluated at the Bureau of Soils, Fertilizers and Pesticide Analysis Laboratory at San Fernando, La Union. The RRF for okra based on the soil analysis was 90-0-0 which was equivalent to 3.92 g of urea per plant.

Monitoring and Maintenance

The growing seedlings were monitored and watered regularly inside the improvised green house. Weeds were removed and application of any kind of chemical fertilizer was avoided.

Measurement of Growth Parameters and Assessment of the Reproductive Performance of the Plants

The effect of AMF as a biofertilizer was measured in terms of growth and reproductive parameters like plant height, percent increase in height, number of leaves, flower count and fruit count which were recorded every two weeks after AMF inoculation.

Measurement of Nutrient Content of Plant Tissue and Soil

Nine (9) plants from each treatment were harvested for analysis. The fruits of the plants were gathered after the 10-week observation period or approximately three months after sowing. One hundred grams fruit from each treatment was brought to the Regional Feed Testing Laboratory, Department of Agriculture, Sevilla, San Fernando City, La Union for analysis. The soil was subjected to soil analysis using the Soil Test Kit (STK).

Assessment of Root Infection by AMF

Several samples were taken from the roots and were cut to one (1) cm. 120 samples were chopped for every replicate ready for clearing and staining. Extra care was given for plants with fine lateral roots because some contained mycorrhizal structures. After washing the root samples, these were carefully patted dry on a cloth then sealed in a Ziploc bag.

Chemical agents were used to remove the cell contents and the cell wall pigments to view the internal features of plant tissues.

Determination of AMF Colonization Rate in Okra Roots

The stained root segments were selected at random. At least 300, one (1)-cm roots which were mounted on microscope slides in groups of ten (10) and scanned under x320 – 640 magnification. Presence or absence of vesicles or hyphae in each of the ten (10) root pieces was recorded. Count of one (1) was given to root segment colonized by AMF. The presence or absence of infection in root samples was recorded in each of the root pieces. Result was expressed as a percentage.

Data Analysis

The gathered data were tabulated, computed, analyzed and validated using Welch Test and One-Way Analysis of Variance (ANOVA) at 0.05 level of significance to determine if there were significant differences among the treatments. AMF colonization rate used independent samples t-test for their mean comparisons. ANOVA was supported by Tukey HSD for the post-hoc test while Welch Test was followed by Bonferroni and Games-Howell as its post hoc.

RESULTS AND DISCUSSION

Percent Increase in Height

Height is an expression of the full vegetative potential of a plant (Perez-Harguindeguy et al., 2013).

On the 4th week, plants inoculated with Mykovam and RRF-Urea did not significantly differ from each other with mean percent increase in height amounting to 21.47 percent and 21.07 percent respectively. This indicates that growth may be attributed to the presence of mycorrhiza during this period and where AMF might have effected at this period and thus facilitating the fast nutrient uptake like Phosphorous and reducing the distance traveled by nutrients which might have been the reason for the increase in height (Selvaraj and Chellapan, 2006).

Moreover, on the 10th week after AMF inoculation, those applied with Mykovam grew the fastest registering a mean of 17.25 percent although it did not differ from those inoculated with AMF associated with *M. pudica* and those applied with RRF-Urea having mean percent increase in height of 10.53 percent and 14.03 percent, respectively.

Final Height

Table 2 shows the final height of the plants on the 2nd, 4th, 6th, 8th and 10th week after AMF inoculation. Statistical analysis showed significant differences among the treatments on the 2nd, 4th, and 6th week after AMF inoculation. This seemed to indicate that the AMF may have facilitated the uptake of nutrients from the soil. Mycorrhization could have transported nutrients like phosphorous more efficiently from the soil to the plants as compared to the non-mycorrhizal forms (Selvaraj and Chellapan, 2006) due to the presence of fungal hyphae that reduced the distance traveled by phosphorous.

In some cases, high mycorrhizal colonization rate can negatively affect plant growth or can decrease plant mass due to the carbon costs for the maintenance of a fungal symbiont (Smith and Smith 2011). Additionally, it is now recognized that although AMF colonization does not always affect plant growth, it can still have an impact upon the amount of P uptake or the mode of P uptake (Escudero and Mendoza, 2005; Smith et al., 2009; Young et al., 2015; Majewska et al., 2017).

Table 1. Mean Percent Increase in Height of One-Month Old Okra at 2nd, 4th, 6th, 8th, 10th Week after AMF Inoculation

Treatments	2nd week	4 th Week	6th week	8th week	10th week
Negative Control	44.76	30.56 abc	24.71	14.44	5.23 b
Mykovam	46.87	21.47 b	30.22	28.03	17.25 ab
AMF associated with <i>M. pudica</i>	26.54	53.95 a	31.39	30.14	10.53 ab
RRF-Urea	42	21.07 bc	16.74	24.21	14.03 A
c.v.	55.67%	71.84%	59.55%	57.73%	77.72%

Table 2. Mean height of okra (cm) at 2nd, 4th, 6th, 8th, and 10th week after AMF Inoculation

Treatments	2 nd Week	4 th Week	6 th Week	8 th Week	10 th Week
Negative Control	31.67 ab	40.78 a	50.14 a	56.92	59.88
Mykovam	25 b	30.39 b	39.39 b	50.28	59.21
AMF assoc. with <i>M pudica</i>	21.89 ab	32.46 ab	42.42 ab	54.82	60.20
RRF- Urea	29.44 a	35.61ab	41.6 b	51.67	58.68
c.v.	24.3%	19.07%	16.73%	14.94%	14.51%

-Means followed by the same letter are not significantly different at p<.05

Number of Leaves

The number of leaves a plant forms affects its efficiency to photosynthesize. Higher leaf counts is accounted to an enhanced plant uptake of available soil

nutrients such as nitrogen and phosphorus as a result of effective plant root colonization and consequently improved rooting ability especially during the early stage of the plant growth (Elefan, 2015)

Table 3. Mean Number of Leaves of *A. esculentus* as Influenced by AMF Inoculation

Treatments	Mean Number of Leaves
Negative Control	29.89
Mykovam	30.56
AMF associated with <i>M. pudica</i>	30.44
RRF-Urea	27.78

Root Weight

The fresh weight of the root signifies the levels of water and nutrient stored by the plant needed for its metabolism while 90 percent of its dry weight is the result of photosynthesis (Fitter and Hay, 1981; Samanhudi et al., 2014).

Table 4 shows that AMF inoculation did not significantly affect the fresh weight of the roots. However, it has significantly affected the root dry weight of the plants.

The most prominent contribution of AMF to plant growth is mainly the uptake of phosphorus and other elements by extraradical mycorrhizal hyphae, and transference to the root tissues (Sun and Tang, 2013).

Furthermore, AMF have been shown to increase plant resistance to drought which were thought to have a mechanism of higher stomatal conductance, reduced hydraulic resistance in roots and increased root growth (Young et al., 2015).

Table 4. Root Weight of *A. esculentus* (g) as Influenced by AMF Inoculation

Treatments	Mean Fresh Weight	Mean Dry Weight
Negative Control	4.07	0.60c
Mykovam	4.64	1.40ab
AMF associated with <i>M. pudica</i>	6.30	1.56a
RRF-Urea	3.86	0.72bc
c.v.	46.82%	64.89%

Soil Analysis

Soil pH. Soil acidity determines the availability of mineral nutrients for your vegetables. In acidic soil, calcium and magnesium are less available to plants (Grow it Organically, 2013).

Electrical Conductivity (EC). The soil inoculated with AMF associated with *M. pudica* decreased by 30.3 percent. On the other hand, soils obtained from the Negative

control, Mykovam, and RRF-Urea increased their EC. Result showed that there was a decrease in the EC of the soil after.

Organic Matter (OM). OM decreased in all the treatments and Mykovam had lost its OM the greatest with a 23.78 percent change followed by AMF associated with *M. pudica*, RRF-Urea and Mykovam with 18.5 percent, 18.5 percent, and 16.29 percent decrease.

Total P. Mycorrhizal association tends to decrease with increasing tissue P concentrations; therefore, if plant-available

Potassium (K). Evidence shows the existence of potassium solubilizing microorganisms (KSMs) which influence mycorrhizal formation and function.

Interactions between AMF and KSMs are vital in sustainable low-input crop production systems that rely on biological processes to achieve improved plant growth and yield in addition to maintaining soil fertility (Priyadharsini and Muthukumar, 2016).

Table 5. Soil Analysis Result on pH and EC Using Composite Sampling before and after the Experiment

Treatments	pH			EC (mS/cm)		
	Before	After	% change	Before	after	% change
Negative Control	6.38	6.45	1.10	2.64	2.75	4.17
Mykovam	6.38	6.50	1.88	2.64	3.09	17.05
AMF	6.38	6.74	5.64	2.64	1.84	30.30
RRF- Urea	6.38	6.14	3.76	2.64	3.73	41.29

Table 6. Soil Analysis Result on OM, P, and K Using Composite Sampling before and after the Experiment

	% OM			Total P			K		
	Before	After	% change	before	after	% change	before	after	% change
Control	2.3	1.90	16.30	183.6	160.9	12.32	1745.9	1880.1	7.69
Mykovam	2.3	1.73	23.79	183.6	166.83	9.12	1745.9	1936.7	10.93
AMF	2.3	1.85	18.50	183.6	163.97	10.68	1745.9	1879.5	7.65
RRF- Urea	2.3	1.85	18.50	183.6	190.33	3.68	1745.9	1993.3	14.17

Percentage of Colonization Rate of AMF

According to Brundrett et al. (1996), the ability of AMF to infect its host is measured by a parameter known as colonization rate. Root colonization is initiated by the presence of extraradical hyphae which are distributed widely on the rhizosphere soil.

Result showed that plants inoculated by the two treatments were colonized. A colonization rate of 68.56 percent was effected by Mykovam while those inoculated with AMF associated with *M. pudica* registered a 62.78 percent colonization rate. Statistical analysis showed

no significant difference between the treatments.

The capacity of both Mykovam and AMF to colonize is dependent on the nutrients present in the soil. (Douds and Nagahashi, 2000; Wang et al., 2010).

Lastly, results of this study showed that AMF associated with *M. pudica* and those of Mykovam were able to colonize the test plants. This shows that somehow the vegetative performance of the test plants as previously observed can be attributed to the colonization of these fungi.

Table 7. Mean Percentage of Colonization Rate of AMF

Treatments	Means
Mykovam	68.56%
AMF w/ <i>M. pudica</i>	62.78%

CONCLUSIONS

Inoculation of AMF significantly affected the vegetative performance of okra but did not affect its reproductive performance. In addition, AMF inoculation did not significantly affect the nutrient content of the fruits and the physicochemical properties of the soil. Mycorrhization is less effective in promoting reproductive performance of plants in fertile soils

RECOMMENDATIONS

1. In future experiments, similar studies may be conducted to test the effect of AMF associated with *M. pudica* to the growth and reproductive performance of other high value crops using non-fertile soils or soils where Phosphorous is insufficient.
2. In future experiments, similar studies may be conducted to determine the effect of long term use of AMF associated with *M. pudica* on soil pH and other parameters

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Water Quality of DMMMSU-SLUC Wells as Influenced by Effective Microorganisms

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ABSTRACT

Effective Microorganisms use naturally-occurring microorganisms such as lactic acid bacteria, photosynthetic bacteria, yeast, fermenting fungi, and actinomycetes that are claimed to purify and revive nature.

Applications of EM using the formula known as Effective Microorganisms Activated Solution was experimented on water from three wells in DMMMSU Agoo, Campus. This study aimed to determine the quality of water from the wells before and after EM application. The EM's effectiveness in reducing bacteria was noted three weeks after the application while EM's capability to decrease yeast was noted for two weeks after the application. Even though there was a reduction of bacteria and yeast, the number was still too high to pass the standard range for potable water. Moreover, pH was improved within the standard range except in one well three weeks after EM application. Even though the pH of water samples improved after EM application, it still did not affect the bacteriological parameters.

Keywords: *effective microorganisms, water quality*

INTRODUCTION

Water is very important to life. It helps living organisms to survive. Without water, life would not have evolved on earth (Dorilag et al., 2014). Groundwater is fresh water found below the surface of the ground. It soaks into the soil and gets stored in the tiny spaces or pores between rocks and soil. EM or Effective Microorganisms were discovered by the horticultural biologist Dr. Teruo Higa. It was developed at the University of the Ryukyus, Okinawa, Japan in 1982. Effective Microorganisms (EM) are fermented mixed culture of naturally occurring species of co-existing microorganism. EM are all natural blends of beneficial microorganisms, so they are safe, and easy to use. EM are made up of 80 species of microorganisms which can purify and revived nature. These microorganisms are the photosynthesizing bacteria, lactic acid, yeasts, actinomycetes and fermenting fungi (Zakaria et. al., 2010; Emerald Earth; Dr. Teruo Higa; Dongyai et. al., 2010; Szymanski, 2003). According to Diver (2001) as cited in Zakaria et al., (2010), the main species that are normally involved in EM are *Lactobacillus plantarum*, *L. casei* and *Streptococcus lactis* (lactic acid bacteria), *Rhodopseudomonas palustris* and

Rhodobacter spaeroides (photosynthetic bacteria), *Saccharomyces cerevisiae* and *Candida utilis* (yeasts), *Streptomyces albus* and *S. griseus* (actinomycetes), and *Aspergillus oryzae*, *Penicillium sp.* and *Mucor hiemalis* (fermenting fungi).

Water is indispensable to the presence of every single living being. So it is critical that the water we drink is of high quality. In this study, Effective Microorganisms were used to determine if it was really effective and enhances the water quality of water coming from the different deep wells of DMMMSU-SLUC, Agoo Campus.

Statements of Objectives

This study was conducted to determine the water quality of DMMMSU-SLUC wells as influenced by Effective Microorganisms. Specifically, it was conducted to find out the quality of water from different sources before and after applying Effective Microorganism after one day, two weeks, and after three weeks.

The study sought to:

1. Determine the bacteriological parameters and pH of:

a. Bacteriological Parameters

- a.1 Total bacterial count or TBC
 - a.2 Yeast Count
 - b. pH
2. Find out if there are significant differences between treatments.
 3. Find out if there are significant differences between time intervals.
 - a. Before - After one day
 - b. Before - After two weeks
 - c. Before - After three weeks
 4. Find out if there are significant relationships between the bacteriological parameters and pH.

MATERIALS AND METHODS

Preparation of Fermented Rice Rinse Water or EMAS

Twenty (20) g of Brown sugar and 400 ml of rice rinse water were used. The rice rinse water used was fresh as it develops foul odour if stored. The mixture was mixed in the bowl until the brown sugar dissolved, then 20 ml of Effective Microorganisms or EM was added to the mixture. The mixture was poured into the plastic bottle with a capacity of 500 ml using funnel to avoid spillage of the mixture. The bottle was filled with the mixture not until the brim, but a space of five (5) cm was left from the top. The bottle was capped and closed tightly and stored in a warm place at a 40 degree Celsius, the ideal temperature for fermentation. When the mixture formed gas after a couple of days, the cap was loosened slowly to avoid overflow and allowing the gas to be released. This was regularly done whenever the bottle expands. Fermentation after one week was complete when the mixture pH dropped at 3.5; sweet sour aroma was produced and the mixture changed its color from black to reddish brown.

Preparation of Sampling Bottles

The twelve empty catsup bottles with a 100 ml capacity were cleaned thoroughly. The bottles were sterilized for 30 minutes by boiling. Another twelve plastic bottles of six (6)-liter capacity were used for collecting water samples from each source.

Collection and Analyses of Water Samples

Pail and rope were sterilized for 30 minutes. These were used in getting water samples from the three wells. Six liters of water per replication were taken from each well. The water was placed in the plastic bottles. Each plastic bottle was covered with a black cartolina. Collection of 5000 ml water samples per treatment that has been replicated thrice was done at 9 o'clock in the morning. The sample bottles were labelled with date, time, and sources of collection and placed in ice chest box containing ice. These sample bottles were brought to BFAR-NIFTDC Bunoan Binloc, Dagupan City laboratory for qualitative analysis to determine the bacteriological parameters which included the total bacterial count, yeast count and pH.

Application of EMAS

After the first analysis of water, 250 ml of EMAS was added to each of the six (6) bottles containing the 6-liter water sample. After the EMAS was applied, another analysis of water was conducted after one day, after two weeks, and after three weeks.

Experimental Procedure and Analyses

The water samples were analysed using standard methods in Microbiology Laboratory. The laboratory technicians in BFAR-NIFTDC analysed the water samples.

Bacteriological Analysis

Total Bacterial Count and Yeast Count.

Two plates of solidified nutrient agar were inoculated with one (1) ml portion of 10¹ dilution of water sample and the other two plates were inoculated with one (1) ml portion of 10² dilution of water sample. By using a sterilized hockey stick, inoculums were spread evenly across the surface of the agar. Single hockey stick was used for each plate to avoid contamination. Petri dishes were incubated for 48 hours at 35 degree Celsius.

Counting Colonies

A spreader free plate with 25 to 250 colonies was selected and the average number

per plate was multiplied by the dilution and recorded as the total bacterial count.

RESULTS AND DISCUSSION

Table 1 shows that before EM application, Treatment 1 has the highest bacterial count, followed by Treatment 2 and Treatment 3, respectively. Bacterial counts for all treatments increased one day after EM application. In almost all treatments, the bacterial count decreased two to three weeks after EM application. The effectiveness of EM to decrease bacterial count was noted up to three weeks after the application. However, the

decrease in bacterial count is still not within the safe limit for potable drinking water.

Further, as seen in Table 2, before EM application, Treatment 2 has the highest number of yeast count followed by Treatment 1 and Treatment 3, respectively. Treatments 1 and 2 are comparable to each other, while Treatment 3 is much lesser than the two and it is significantly different from them. As seen in Table 2, yeast count of all treatments increased one day after EM application. However, the effectiveness of EM was observed two weeks after the application in almost all treatments. But, the yeast count is still high when compared to the standard yeast count for potable water.

Table 1. Total Bacterial Count of Water from DMMMSU-SLUC Wells at Different Time Intervals

Treatment	Before EM Application	1 Day After EM Application	2 Weeks After EM Application	3 Weeks After EM Application
T ₁	12,866,667	28,000,000	650,000	10,636,667
T ₂	11,566,667	25,866,667	14,050,000	866,667
T ₃	4,966,667	30,000,000	4,000,000	1,903,333

Table 2. Yeasts Count of water from DMMMSU Wells at different time interval.

Treatment	Before EM Application	1 Day after EM Application	2 Weeks after EM Application	3 Weeks after EM Application
T ₁	410,000 ^a	4,080,000	403,333	2,216,667
T ₂	480,000 ^a	14,200,000	60,000	3,933,333
T ₃	240,000 ^b	10,966,667	246,667	67,667

**Any two means having common letter are not significantly different from each other*

As shown in Table 3, Treatment 1 has the highest pH value. All throughout the different time intervals of analysis, Treatment 2, has the lowest value. One day after EM application, the pH of all the treatments were lowered. This was due to the addition of EM. EM has the 3.5 pH level, so it really affects the water samples. Three weeks after EM

application, almost all the treatments passed the standard range for drinking water. The pH level of Treatment 2 increased to 6.3 pH level. It is a level near the 6.5-8.5 level for standard range in drinking water. According to EPA (2002) as cited in Shittu et al. (2008) and Dorilag et al. (2014), water samples having pH value ranges from 6.5 to 8.5 pass the standard range for

drinking water. Before application of EM, T₂ did not pass the standard range. However, Treatment 1 and Treatment 3 have pH within the standard range for drinking water. Treatment 2 is not safe due to U.S EPA (2007) as cited in Dorilag et al. (2014), water with low pH can be acidic, naturally soft and corrosive. Acidic water can leach metals from pipes and fixtures, for example copper, lead and zinc.

In Table 4, the bacterial count before EM application was subtracted from the bacterial count at different time intervals. Positive grand mean difference means that the bacterial count one day after EM application was higher than the bacterial count before EM application. Negative grand mean difference means that the bacterial count before EM application was higher than other time intervals. There is an increase of bacterial count one day after EM application. Bacterial count increase is due to the bacterial content of EM. EM contains lactic acid bacteria such as *Lactobacillus plantarum* and *L. casei* and photosynthesizing bacteria such as *Rhodospseudomonas palustris* and *Rhodobacter spaeroides* (Szymanski et al.,

2003; Zakaria et al, 2010). Likewise an insignificant difference on bacterial counts before and two weeks after EM application is shown in Table 4. According to Higa et al., (1998) and cited in El Karamany et al.(2013), the use of EM does not only enhance the microbes found in EM in that environment but it also acts as a catalyst with a synergistic effect to promote all the beneficial microbes of that environment. When this happens, the microbes that develop harmful effects are excluded from that ecosystem. Moreover, there were no significant differences observed on the bacterial counts between three weeks after EM application and before EM application, even though there is a decrease in bacterial count. According to Johan and Jesper, (2005) as cited in Towett, (2016), the inoculation of EM stimulates rotation effect. It is an occurrence that comes as a result of regeneration of beneficial organisms and elimination of pathogenic bacteria.

Table 3. pH Results of Water from DMMMSU Wells at Different Time Intervals

Treatment	Before Applying EM	After 1 Day of Applying EM	After 2 Weeks of Applying EM	After 3 Weeks of Applying EM
T ₁	8	5.7	6.3	7
T ₂	5.7	5.5	5.8	6.3
T ₃	6.7	5.7	6.2	6.8

Table 4. Comparison of Total Bacterial Count in different Time Intervals and EM before application.

Time Intervals	Grand Mean Difference
One Day After	18,155,555.56 *
Two Weeks After	-3,566,666.67 ^{ns}
Three Weeks After	-5,331,111.11 ^{ns}

*- means significant ns-not significant

In Table 5, the bacterial count before EM application was subtracted from the yeast counts of the different time intervals. Positive grand mean difference means that the yeast count before EM application was lower than the bacterial count one day after EM application and three weeks after EM application. Negative

grand mean difference means that the yeast count before EM application was higher than the yeast count from the other time intervals.

It can be noticed in Table 5 that when the yeast count is compared to one day after EM application and before EM application; three weeks after EM application and before EM

application; results are comparable with each other. This means that EM is not effective in decreasing yeast count. However, at two weeks after EM application it was observed that EM was able to decrease the yeast count of the water samples.

Therefore, the capability of EM to decrease yeast count was observed two weeks after the application, this means that EM is for short term used only and can no longer control the growth of yeast beyond two weeks.

Pearson product-moment correlation in Table 6 reveals that there is insignificant relationship between pH and total bacterial

count as well as pH and yeast count in all different time intervals. Results imply that the bacteriological parameters and pH of the water samples are not correlated with each other or bacteriological qualities of the water were not influenced by the pH.

Different water samples from the wells where they analysed the bacteriological parameters and the physico-chemical parameters where pH were included.

Therefore, the pH level of water samples does not influence the bacterial count and yeast count for all the treatments at different time intervals.

Table 5. Comparison of Yeast Count in different Time Intervals and EM before Application

Time Intervals	Grand Mean Difference
One Day After	9,372,222.22*
Two Weeks After	-140,000.00 ^{ns}
Three Weeks After	1,695,888,89.00 *

*- means significant ns-not significant

Table 6. Correlation between Bacteriological Parameters and pH

Total Bacterial Count vs. pH		Yeast Count vs. pH	
	r. value		r. value
before	0.0663	before	-0.0187
one day	-0.1722	one day	-0.2264
two weeks	-0.2358	two weeks	0.1811
three weeks	-0.2189	three weeks	-0.1106

Conclusions

Within the limits of this study and in view of the foregoing findings, the following conclusions were drawn:

1. The wells in DMMMSU-SLUC is not safe for water consumption because the bacterial and yeast count are too high and it did not pass the standard range for potable water.
2. The treatments are comparable with each other in terms of bacterial count at different time intervals, but in terms of yeast count, only the

treatments one day after EM application were significantly different to each other.

3. The bacterial count increased after EM application but it decreased three weeks after. In terms of yeast count, it increased after EM application it decreased two weeks after. Even though there was a reduction of bacteria and yeast, the number was still too high to pass the standard range for potable water. However, pH of water samples was corrected and within the standard range when EM was applied.

4. Even though the pH of water samples improved after EM application, it still does not affect the bacteriological parameters.

Recommendations

Based on the findings and conclusions of the study, the following recommendations are forwarded:

1. The wells contain high number of bacteria. Identification of bacteria should be done to determine if the bacteria present in water samples are harmful or beneficial. There is a

need for continuous water testing to monitor the quality of water from the wells.

2. EM should be used in other types of water sources aside from wells in order to determine if Effective Microorganisms are really effective.

3. Total bacterial count, yeast and pH are the parameters of this study. Other parameters for the Bacteriological and Physico-chemical Analysis should be considered.

4. The time interval used in this study was weekly. Future researches may consider other time intervals such as monthly to determine if Effective Microorganisms are really effective.

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