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RHINOLOGY

The effects of spirulina on allergic rhinitis

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Abstract The prevalence of allergic rhinitis is increasing globally due to various causes. It affects the quality life of a large group of people in all around the world. Allergic rhinitis still remains inadequately controlled with present medical means. The need of continuous medical therapy makes individuals anxious about the side effects of the drugs. So there is a need for an alternative strategy. Effects of spirulina, tinospora cordifolia and butterbur were investigated recently on allergic rhinitis in just very few investigations. Spirulina represents a blue-green alga that is produced and commercialized as a dietary supplement for modulating immune functions, as well as ameliorating a variety of diseases. This double blind, placebo controlled study, evaluated the effectiveness and tolerability of spirulina for treating patients with allergic rhinitis. Spirulina consumption significantly improved the symptoms and physical findings compared with placebo ($P < 0.001$***) including nasal discharge, sneezing, nasal congestion and itching. Spirulina is clinically effective on allergic rhinitis when compared with placebo. Further studies should be performed in order to clarify the mechanism of this effect.

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Introduction

Allergic rhinitis is a global health problem affecting at least 10–25% of the population.

The prevalence of allergic rhinitis is increasing globally due to various causes. It affects the quality life of a large group of people in all around the world. Furthermore geographic location, humidity and around 5,000 plant species, which are present in Turkey, increases the importance of allergy in this country.

Allergic rhinitis still remains inadequately controlled with present medical means. New medication classes, such as various mediator antagonists and biologic response modifiers, are under development. All medical treatment agents aim the relief of symptoms. The need of continuous medical therapy makes individuals anxious about the side effects of the drugs.

So there is a need for an alternative strategy. Effects of spirulina, tinospora cordifolia and butterbur were investigated recently on allergic rhinitis in just very few investigations [1–4].

Spirulina represents a blue-green alga that is produced and commercialized as a dietary supplement for modulating immune functions, as well as ameliorating a variety of diseases. *Spirulina platensis* is a Cyanobacteria which has been eaten by man for hundreds of years in the Kanem region of Chad and the lake region of Mexico now is sold worldwide as a health food and also used in the treatment of protein-energy malnutrition [5]. The aim of this study is to determine the clinical efficacy of spirulina on allergic rhinitis.

Material and methods

Randomized double-blind placebo controlled study

A total of 150 patients ranging between 19 and 49 years of age with a clinical history of allergic rhinitis, and presently having its symptoms and clinically diagnosed as allergic rhinitis, were enrolled in this study between June 2006 and February 2007. This time period was chosen to avoid seasonal exacerbations of symptoms. Patients were excluded from participation in the study if a significant concomitant medical condition was evident, including any disease that necessitates continuous or frequent medication such as hypertension or diabetes or severe physical nasal obstruction or injury, asthma, rhinitis medicamentosa, acute or chronic sinusitis.

The study was designed as randomized, double blind, and placebo controlled. The project was approved by the faculty ethical committee as double blind and placebo controlled. The patients meeting the inclusion criteria were asked if they would be willing to participate in a study aiming to evaluate the effects of spirulina (which is approved as a food supplement and commercially available in the market in Turkey) on allergic rhinitis. The patients who agreed to take part in the study were given a set of boxes containing either spirulina or placebo tablets by the first author. At this stage neither the patient nor the doctor had an idea whether the box given to a particular patient contained placebo or spirulina because the boxes containing the tablets were identical. To avoid bias in evaluation, Ege University, Engineering Faculty, Bioengineering Department was asked to produce these identical boxes prior to the initiation of the study. The numbers written on the boxes were recorded in the patients' files for further evaluation. Patients took five tablets, each day consuming either 2,000 mg/day spirulina or placebo for 6 months. Patients were not permitted to take any anti allergy or rhinitis medication during the study period.

Spirulina tablets

Spirulina platensis was obtained from the Ege University Microalgae Culture collection (EGE MACC-27). Paddle wheel circulated ponds, situated in a greenhouse, were used for the cultivation. The culture was grown in Zarrouk's medium, pH was 9.5–10, illumination was done by the day light (13 h light–11 h dark), and temperature was between 25 and 30°C. Cells were harvested by 30-μm-mesh sized plankton net and squeezed to remove the excess water in the slurry. The algae paste was dried at 60°C for 3 h. Dried paste was grinded and tabletted by pressure without any additives. Tablets were produced regarding the in vitro quality control studies at Ege University, Engineering Faculty, Bioengineering Department [6].

Placebo tablets

Placebo tablets were prepared by using food dye and rice flour at Ege University, Engineering Faculty, Bioengineering Department. Food dye was added in order to obtain the same color with spirulina tablets. The paste was prepared by cooking the rice flour with water and then adding food dye into the cooked paste with a ratio of 2 g/6 kg%10–15 E471 was also added as emulgating agent. The paste was dried and granulated and tabletted in the same machine as the spirulina tablets so that the placebos had the same shape. Placebo tablets were packed identical as spirulina tablets but coded differently. So, only the production team knew whether a box contained spirulina or placebo and this information was not released until the end of the study.

Physical findings

Physical findings were evaluated initially and at the end of the whole treatment course by the same physicians.

Lower turbinate color was classified as Natural (0), Pale (1), Bluish (2),Severely pale or bluish (3). Odema and nasal discharge were evaluated as No (1), mild (2), moderate (3), severe (4)

Symptom scores

Symptoms were investigated initially and at the end of treatment period by the same physicians. In order to evaluate and statistically compare, symptoms such as nasal discharge, sneezing, nasal congestion and itching, these were quantified and coded as: no (0), mild (1), moderate (2), severe (3)

Weekly rhinitis diary card

Recorded on the weekly diary card, the allergic rhinitis symptoms were assessed on a 4-point scale. After initial records, patients evaluated and graded their symptoms and kept diaries for 21 times weekly. The questions pertained to nasal symptoms (stuffy, runny, itchy nose, and sneezing): 0 (not noticeable); 1 (mild symptoms, noticeable but not bothersome); 2 (moderate symptoms, noticeable and disturbing some of the time); 3 (severe symptoms, very disturbing some of the time and/or disturbing most of the time).

Efficacy evaluation

All patients were wanted to evaluate the efficacy of the drug used through a visual analog scale by 0–10 at the end of the whole treatment period.

Satisfaction evaluation

The patients satisfaction of the drug in relief of symptoms were also graded by a visual analog scale from 0 to 10 at the end of the whole treatment period.

Statistical analysis

SPSS for Windows 15.0 was used in analyzing the data. The distribution of variables was checked initially by Shapiro Wilk test. Parametric tests were applied to data showing normal distribution, whereas nonparametric tests were applied to data showing non-normal distribution. Chi square test was used in order to compare the sex distribution and house types of spirulina and placebo groups. Comparison of age distribution of groups was done by using Independent samples t test. The difference of the diaries kept by the groups was compared by repeated measures ANOVA. In addition Bonferoni test was applied for checking the difference.

The initial symptoms such as nasal discharge, sneezing, nasal congestion and itching of cases were compared with Mann Whitney *U* test. The variation on these symptoms and physical findings along the treatment period were compared by Wilcoxon signed ranks test.

Independent samples *t* test was used in order to evaluate the efficacy and satisfaction evaluation scores of spirulina and placebo groups. Results were expressed as mean ± SD and *P* value <0,05 was asstatistically significant.

Results

Although 150 allergic rhinitis patients were enrolled to this study, 129 of them (86%) were finalized the treatment period of six month and kept the diaries properly. Of these 129 patients, 85 patients took spirulina and 44 patients took placebo tablets.

The average ages of spirulina and placebo groups were 30.1 ± 6.69 and 29.9 ± 7.66, respectively. The difference was not significant ($P > 0.05$ ns). Spirulina group consisted of 35 males (41%) and 50 females (59%) while placebo group consisted of 19 males (43%) and 25 females (57%). The difference was not significant ($P > 0.05$ ns). The distribution of patients living in houses and apartments are similar ($P > 0.05$ ns). Although we set up the groups randomly, there was no significant difference in mean baseline values of both symptoms and physical findings of both groups ($P > 0.05$ ns).

When we compared the initial symptoms with the finals, we observed that spirulina consumption significantly improved the symptoms and physical findings compared with placebo ($P < 0.001$***) including nasal discharge, sneezing, nasal congestion and itching (Figs. 1, 2, 3, 4).

When we compared the whole data collected on weekly diary forms together, ($\alpha = 0.05$, Adjustment for multiple comparisons: Bonferroni) spirulina group revealed a significant efficacy compared with placebo. ($P < 0.001$***, observed power = 100%) that were given in Table 1.

Discussion

Actually for thousands of years, humans have been incorporating *Spirulina* as part of their diet on the assumption that this prehistoric plant can combat various ailments. Yet, it has only been within the last decade that the scientific community has corroborated some of the alleged health benefits of Spirulina [1, 2]. In particular, it is well documented that this cyanobacterium exhibits anti-inflammatory properties, and therefore can potentially alleviate certain diseases mediated by inflammation, such as colitis [7] and allergy [8–10].

Weeks	Spirulina	Std. Deviation	Placebo	Std. Deviation
1	2,66	0,48	2,77	0,42
2	2,51	0,50	2,77	0,42
3	2,39	0,49	2,77	0,42
4	2,28	0,50	2,75	0,44
5	2,24	0,45	2,73	0,50
6	2,20	0,46	2,68	0,52
7	2,11	0,44	2,61	0,54
8	2,02	0,51	2,48	0,55
9	1,95	0,49	2,41	0,54
10	1,74	0,49	2,39	0,58
11	1,71	0,51	2,36	0,57
12	1,47	0,57	2,27	0,54
13	1,35	0,61	2,27	0,54
14	1,26	0,64	2,25	0,53
15	1,12	0,66	2,18	0,50
16	1,00	0,67	2,16	0,48
17	0,92	0,62	2,11	0,49
18	0,85	0,59	2,00	0,57
19	0,76	0,50	1,93	0,62
20	0,72	0,48	1,86	0,59
21	0,69	0,46	1,80	0,59

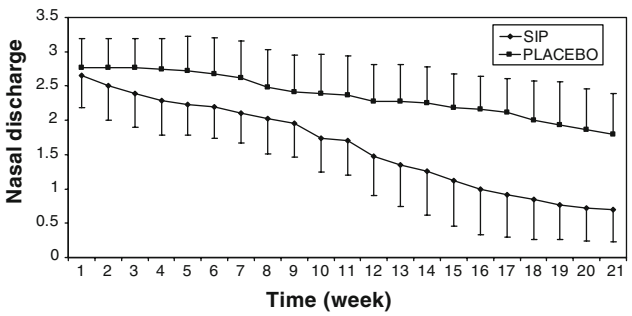

Fig. 1 Nasal discharge in weekly diary-based symptom scores of spirulina and placebo groups

	SIP	Std. Deviation	PLACEBO	Std. Deviation
1	2,79	0,41	2,89	0,32
2	2,69	0,46	2,89	0,32
3	2,47	0,50	2,86	0,35
4	2,36	0,48	2,82	0,39
5	2,27	0,47	2,80	0,41
6	2,18	0,44	2,77	0,42
7	2,11	0,44	2,70	0,46
8	2,02	0,49	2,59	0,54
9	1,95	0,51	2,55	0,55
10	1,82	0,49	2,50	0,55
11	1,78	0,50	2,43	0,55
12	1,60	0,54	2,39	0,54
13	1,48	0,57	2,39	0,54
14	1,35	0,59	2,32	0,52
15	1,24	0,63	2,27	0,50
16	1,12	0,66	2,23	0,48
17	1,02	0,67	2,11	0,49
18	0,85	0,59	2,11	0,49
19	0,76	0,50	2,02	0,55
20	0,66	0,50	1,98	0,55
21	0,58	0,50	1,91	0,56

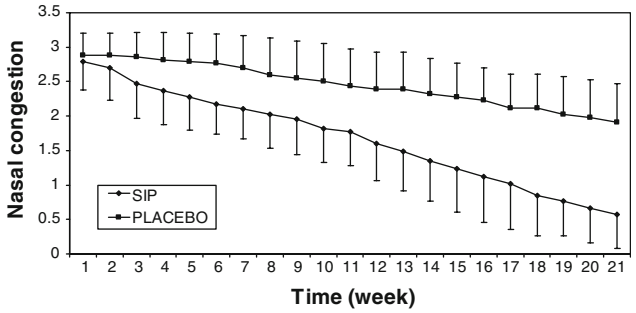

Fig. 2 Nasal congestion in weekly diary-based symptom scores of spirulina and placebo groups

	SIP	Std. Deviation	PLACEBO	Std. Deviation
1	2,73	0,45	2,84	0,37
2	2,62	0,49	2,80	0,41
3	2,42	0,50	2,80	0,41
4	2,33	0,50	2,77	0,42
5	2,24	0,45	2,73	0,50
6	2,18	0,44	2,66	0,53
7	2,11	0,44	2,57	0,55
8	2,02	0,51	2,43	0,55
9	1,95	0,49	2,43	0,55
10	1,79	0,49	2,39	0,58
11	1,69	0,49	2,36	0,57
12	1,53	0,55	2,32	0,56
13	1,39	0,62	2,30	0,55
14	1,27	0,64	2,25	0,53
15	1,18	0,64	2,20	0,51
16	1,06	0,64	2,14	0,51
17	0,95	0,65	2,11	0,49
18	0,85	0,59	2,07	0,55
19	0,76	0,50	2,02	0,59
20	0,66	0,50	1,95	0,57
21	0,58	0,50	1,91	0,52

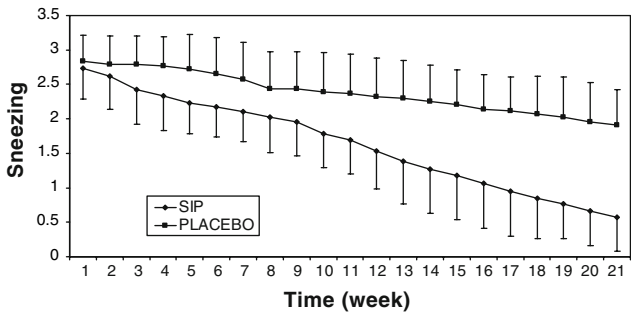

Fig. 3 Sneezing in weekly diary-based symptom scores of spirulina and placebo groups

	SIP	Std. Deviation	PLACEBO	Std. Deviation
1	2,75	0,43	2,86	0,35
2	2,64	0,48	2,82	0,39
3	2,40	0,49	2,77	0,42
4	2,31	0,51	2,77	0,48
5	2,24	0,45	2,70	0,51
6	2,16	0,43	2,66	0,53
7	2,11	0,46	2,64	0,53
8	2,04	0,42	2,57	0,55
9	1,95	0,49	2,52	0,55
10	1,81	0,45	2,41	0,58
11	1,71	0,51	2,34	0,57
12	1,55	0,55	2,27	0,54
13	1,42	0,61	2,27	0,54
14	1,36	0,61	2,25	0,53
15	1,28	0,70	2,18	0,50
16	1,05	0,67	2,16	0,48
17	0,95	0,65	2,11	0,49
18	0,85	0,59	2,07	0,55
19	0,76	0,50	2,00	0,61
20	0,66	0,50	1,93	0,59
21	0,58	0,50	1,89	0,58

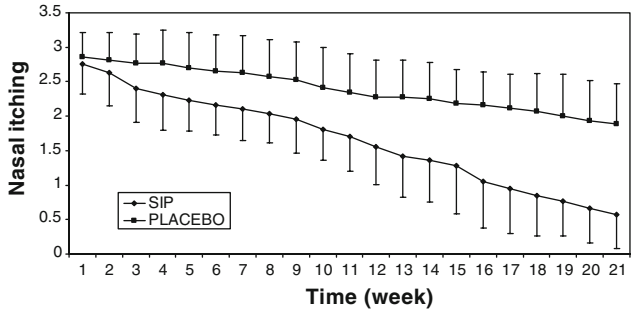

Fig. 4 Nasal itching in weekly diary-based symptom scores of spirulina and placebo groups

Table 1 Satisfaction and effectiveness of spirulina and placebo tablets

	Spirulina	Placebo	*P*
Satisfaction	7.21 ± 1.01	3.40 ± 1.71	$P < 0.001$
Effectiveness	7.44 ± 0.89	3.54 ± 1.37	$P < 0.001$

The first animal experiment was published in China related with the effect of spirulina on allergic rhinitis in 1995. To determine the therapeutic effect of spirulina platensis in allergic rhinitis, ovalbumin sensitized white rats were treated with spirulina platensis. At the end of the experiment they concluded that spirulina platensis can prevent and treat AR in rats, which imply the possibility of using spirulina platensis for AR patients in the future [3]. This initial studies yield us to investigate the effects of spirulina clinically on allergic rhinitis.

Mao et al. examined the therapeutic application of dietary *Spirulina* towards allergic rhinitis by measuring production of cytokines important in regulating IgE-mediated allergy [1]. They reported that *Spirulina* significantly reduced the secretion of IL-4 by 32% only when allergic patients were administered 2,000 mg/day. So we decided to plan our study with the same dosage. Two thousand milligram were given as 5 tablets once a day.

Another issue is the interest of people on complementary and alternative medicines. The use of herbal treatments in the last decade has increased tremendously, often by physicians' recommendation and frequently after requests from patients; consequently, the number of published randomized controlled trials with herbal medicines has increased substantially. High prevalence of the use of complementary and alternative medicines and the tendency to discontinue drug therapy during these treatments were reported in our country. The overall use of complementary and alternative medicines was found to be 38%. The most common alternative therapy treatment was herbal therapy (30.5%) [11]. As being a food supplement, spirulina was easily accepted by the patients. The compliance of the patients was very high.

It is well known that placebo has a positive effect on allergic rhinitis. So we designed the study as double blind and placebo controlled. More than that the diaries kept by the patients revealed a statistically significant positive effect when compared with placebo.

Finally it was concluded that spirulina is clinically effective on allergic rhinitis when compared with placebo. Further studies should be performed in order to clarify the mechanism of this effect.

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