Food and Agriculture Organization of the United Nations

Guidelines on the collection of information on food processing through food consumption surveys

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Food and Agriculture Organization of the United Nations
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Foreword

Globalization is fast affecting the food system. Modern food technologies have increased the range of foods available, shortened food preparation time, and improved the shelf life and the safety of products. Despite these advantages, it comes with some costs. Traditional food production systems, where foods are generally processed at household level, are rapidly being ousted by systems where processed foods are largely from commercial entities. The over-reliance on processed foods, especially energy-dense foods high in sugar, fat and salt, is gradually displacing home-prepared meals and the consumption of fresh fruit and vegetables in typical diets.

The rising trends of overweight and obesity prevalence globally, and especially in countries undergoing economic and nutritional transition are reported to be linked to the increased production and consumption of high-energy-dense processed foods and beverages that are high in fat and sugar. For this reason, some researchers are proposing a classification system that would enable information on the nature and extent of food processing to be collected as part of food consumption surveys. This would enable countries to determine the extent to which national diets are dominated by the consumption of processed foods, and enable governments to advise on ways of improving national diets.

At the Second International Conference on Nutrition, held in Rome in November 2014, countries adopted the Rome Declaration on Nutrition[1] which committed countries to address malnutrition in all its forms. The accompanying Framework for Action[2] provides a set of policy and programme options that countries can implement to meet the commitments of the Rome Declaration. Countries reaffirmed that nutrition data collection and indicators needed to be improved in order to contribute to more effective nutrition surveillance, policy-making and accountability. Indeed, the Global Nutrition Report 2014[3] also identified gaps in information on food consumption. Recommendation #14 of the Framework for Action encouraged countries to gradually reduce saturated fats, sugars, salt and trans-fat from foods and beverages to prevent excessive intake by consumers and improve the nutrient content of foods. In this context, food consumption data are essential in providing information on national diets, and can be used to monitor the contribution of processed foods to the normal diets.

The Food and Agriculture Organization of the United Nations has produced this document to provide guidance to countries and researchers on how to incorporate the collection of information on processed foods into their food consumption surveys. These Guidelines have benefited from the contribution and reviews of several public health nutritionists. I take this opportunity to thank them for their time and efforts.

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1 FAO/WHO, 2014a. Rome Declaration on Nutrition. Second International Conference on Nutrition, Rome, 19–21 November 2014.
2 FAO/WHO, 2014b. Framework for Action. Second International Conference on Nutrition, Rome, 19–21 November 2014.
3 IFPRI. 2014. Global Nutrition Report 2014: Actions and Accountability to Accelerate the World's Progress on Nutrition.

Contents

Acronyms and abbreviations

EPIC	European Prospective Investigation into Cancer and Nutrition
FAO	Food and Agriculture Organization of the United Nations
FFQ	Food Frequency Questionnaire
HCES	Household Consumption and Expenditures Survey
IARC-WHO	International Agency for Research on Cancer of the World Health Organization
LPG	Liquefied petroleum gas
NUPENS	Centre for Epidemiological Studies in Health and Nutrition [Núcleo de Pesquisas Epidemiológicas em Nutrição e Saúde]
UPC	Universal Product Code
WHO	World Health Organization
WCRF/AICR	World Cancer Research Fund/American Institute for Cancer Research

About this document

These Guidelines were developed through an FAO Technical Meeting on the collection of information on food biodiversity and food processing in food consumption surveys. The meeting was held 21–22 September 2013, on the occasion of the 20th International Congress on Nutrition, in Granada (Spain). The list of participants is provided in Annex 1. The two results of this technical meeting are the current guidelines and the "Guidelines on measuring food biodiversity in dietary assessment" (FAO, in prep.).

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Introduction

Food preparation and preservation have been essential in the development of the human species (Wrangham, 2013), initially as hunter-gatherers, and then as settled communities and civilizations (Hotz and Gibson, 2007). It more specifically contributed in the creation of food systems and supplies, and to the development of different dietary habits and patterns worldwide. Biological and anthropological evidence suggests cooking might have been practised first by *Homo* sp. around 2 million years ago (Wrangham, 2013). Since the Neolithic era, and all over the world, many staple foods require processing in various traditional ways before being eaten, to ensure edibility and palatability, to detoxify some of their natural components, to ensure their microbiological safety, or to increase availability of some micronutrients (Hotz and Gibson, 2007).

Pre-industrial methods of food processing developed gradually over centuries and millennia, up until the industrial era. In contrast, these methods changed rapidly with increasing industrialization and advances in science and technology. The nature, extent and purpose of food processing have dramatically changed (Pyke, 1972; Goody, 1997; Brock, 1997; Ludwig, 2011). The first phase, beginning with the industrial revolution in the early 19th century, included increasingly efficient mechanized methods for the industrial manufacture of food products such as bread, biscuits, cakes, dairy products, confectionery, jams, syrups, soft drinks, meat products and infant formula. Developments in food science and technology made food products increasingly available and affordable (Pyke, 1970; Potter and Hotchkiss, 1995; Shewfelt, 2009). Later, in the 1950s, a huge increase in the production of relatively cheap food products high in sugar, refined starch and hydrogenated fats was initiated, first in North

America, followed by other Western countries in Europe and elsewhere (Omran, 1971; Popkin, 2002; Popkin, 2006). From the 1970s, a profound change in patterns of food production and consumption was observed worldwide, with a dramatic shift first in high-income countries, and with an accelerated generalization in middle-, and more recently in low-, income countries (Popkin and Slining, 2013; Black *et al.*, 2013). This globalized food system now largely drives food supplies in most countries worldwide, and the share of ready-to-consume and other packaged 'fast' and 'convenience' food products is steadily increasing (Kennedy, Nantel and Shetty, 2004; Wahlqvist, 2011; Monteiro and Cannon, 2012; Stuckler and Siegel, 2011; Stuckler *et al.*, 2012; Monteiro *et al.*, 2013).

Despite these trends, little systematic attention has been paid to food processing in public health, nutrition and epidemiology research, and to consideration of what terms like 'processed foods' or 'industrialized processed foods' mean. Most research in nutrition and epidemiology has been focused on specific food products. For example, conclusions derived from systematic literature reviews are that high consumption of high-energy-dense processed foods that are rich in fat or sugars, or sweetened soft drinks and food described as 'fast food', are convincing or probable causes of obesity and associated chronic non-communicable diseases (WCRF/AICR, 2007; WHO, 2003) and that processed meats are a cause of colorectal cancer (WCRF/AICR, 2011).

In general, the role and impact of food processing in population health has been poorly studied until recently; this is partly due to the fact that food processing categories were not properly defined. There is an increasing agreement that distinctions need to be made between the different degrees of processing (e.g. fresh versus minimally processed foods) and the various types of food products, including energy dense, 'fast food' products, and sweetened soft drinks (FAO/WHO, 1998; Willett, 2003; WCRF/AICR, 2007; Slimani *et al.*, 2009; Mozaffarian and Ludwig, 2010; Mozaffarian, Appel and van Horn, 2011).

More comprehensive and standardized definitions and classifications of processed foods are therefore needed to enable the collection and comparison of consumption data collected through nutritional surveys, particularly at the international level. Such data are necessary to inform the development and implementation of food-based guidelines and approaches to the prevention of chronic diseases that take into account food processing.

1

Purpose of the guidelines

The aim of the present guidelines is to identify the optimal information to be collected in food consumption surveys[4] to allow classification and data analysis according to the extent and purpose of food processing.

These guidelines are primarily aimed for use in the implementation phase of new surveys, to facilitate the incorporation of information on food processing. They can also be used to capture information on food processing from surveys that have already been performed but that had not been planned and designed with this aim in view.

Use of these guidelines will generate the collection of more accurate, standardized and relevant information. This can then be made available to scientists and policy-makers to enhance their understanding of the relevance of food processing to diet quality and the overall nature of food systems, thus facilitating more effective protection of population health and well-being.

The availability of information on food processing within food consumption surveys can serve different purposes. These include:

Assessment of:

- the relationship of food processing with diet quality;
- the relationship of food processing with under-nutrition, obesity and chronic non-communicable diseases;
- the relationship of food processing with energy density and total energy intake for different types of diet;
- the relationship of food processing with food and nutrition security;
- the dietary intake of nutrients, taking into consideration the specific nutrient content and nutrient bio-availability of processed foods (e.g. the increased availability of some nutrients and the reduced content of other nutrients);

[4] Throughout the present guidelines, the term "food consumption survey" is intended to cover both individual food consumption surveys (which provide information on food intakes) and household food consumption surveys (which provide information on food purchases).

- the exposure to food chemicals and to other agents of public health significance, such as processing contaminants, residues of food contact materials, biological hazards, modified constituents (e.g. isomerized nutrients such as trans-fatty acids), taking into account their varying amounts according to the processing methods; and
- the use of natural resources (and in particular energy use) related to food processing and its environmental impact at both household and industry levels.

Monitoring of:

- time trends in consumption of processed foods (seasonal trends and secular trends); and
- differences in consumption of processed foods between population groups (according to geographical area, socio-demographic characteristics, etc.).

Development of:

- food-based dietary guidelines that take food processing fully into account;
- overall indicators of diet quality that incorporate information about food processing; and
- interventions aimed at improving the quality of diets.

2 Target audience of the guidelines

These guidelines are mainly for the use of scientists and workers engaged in one or more of the planning, field work or analysis stages of food consumption surveys, and for use by officials responsible for these surveys at international, regional, national or local levels in United Nations agencies and other development partners, government departments, universities and research centres.

These guidelines are also an opportunity to remind those involved of the importance of good practice in relation to:

- survey design, such as duration, representativeness, methodology for quantifying food intake, or level of details of food description;
- choice among qualitative, semi-quantitative or quantitative dietary assessment methods;
- choice of method to collect information, such as food frequency questionnaire, 24-hour recall, household budget survey, dietary history or dietary record;
- statistical analysis of data; and
- matching food to food composition tables.

In particular, they provide an opportunity to raise awareness on two critical methodological issues:

- the need to choose the most appropriate method according to the aim of the survey (Willett, 2013; Murphy, Ruel and Carriquiry, 2012); and
- the need to repeat measurements of food consumption when using short-term methods (e.g. repeated 24-hour recalls or dietary records) on at least a subsample of each stratum of the population so that appropriate statistical tools can be used to assess the distribution of usual food consumption in the population (Carriquiry *et al.*, 1999; Hoffman *et al.*, 2002; Souverien *et al.*, 2011).

The collection of information related to the composition of food is also outside the scope of the present manual, even if of great interest from a public health point of view, and is sometimes related to the typology of processing. Thus, methods for the collection of information on the presence of added salt, added sugar, added sweeteners and added

nutrients in food will not be discussed in detail. Information on the addition of these ingredients needs to be recorded so that foods are correctly identified and matched to the appropriate food composition data. Guidance on such identification can be found in FAO/INFOODS guidelines (FAO/INFOODS, 2012).

3

Previous work

The most advanced monitoring techniques now permit the collection of detailed information on the processing of food. Nevertheless, this information is lacking in many food consumption surveys. In particular, there is a need for data that enable distinctions to be made between domestic and artisanal methods of preparation (including methods of preparation of street foods), and industrial processing techniques. When collected, the use of such data is hampered by the lack of a commonly agreed definition and classification of processed foods.

Different classification systems that take into account food processing have been developed (Moubarac *et al.*, 2014a). In particular, two of them were developed independently of one another in the second half of the decade 2000–2009, and have been applied to large-scale food consumption datasets.

One has been devised by the International Agency for Research on Cancer (IARC-WHO) and initially applied within the frame of the European Prospective Investigation into Cancer and Nutrition (EPIC) study (see Annex 2). It relies on the use of international interview-based 24-hour dietary recall programme software developed by IARC (GloboDiet©, initially named EPIC-Soft©). This software allows detailed and standardized information to be recorded on home-prepared and industrially processed foods, recipes and their ingredients. The classification system relies on three food categories defined according to the degree of food processing, namely *highly processed foods, moderately processed foods and non-processed foods* (Slimani *et al.*, 2009). This is a non-a priori-oriented classification system (i.e. a data-driven approach). It has been used to provide the first comparable data on the contribution of highly processed foods to the overall food consumption, nutrient intakes and patterns in Europe (Slimani *et al.*, 2009) and to assess associations between intakes of processed foods and concentrations of plasma phospholipid elaidic acid, a trans-fatty acid biomarker (Chajès *et al.*, 2012).

The other classification, named NOVA, has been devised by researchers at the School of Public Health at the University of São Paulo, Brazil, and is based on the extent and purpose of industrial food processing (see Annex 3). It classifies all foodstuffs as they are acquired into four main groups. These are (i) unprocessed and minimally processed

foods; (ii) processed culinary ingredients; (iii) processed foods; and (iv) ultra-processed food and drink products (Monteiro *et al*., 2010; Moubarac *et al*., 2014a).

NOVA has been used to describe and monitor levels of consumption of these four food groups, and their impact on the overall diet quality and diseases outcome in several countries (Martins *et al*., 2013, 2014; Monteiro *et al*., 2011, 2013; Moubarac *et al*., 2013a, b, 2014b; Rauber *et al*., 2015; Canella *et al*., 2014). It has also been used to study the places where food is purchased (Costa *et al*., 2013); the availability of ultra-processed products in urban environments (Marrocos Leite *et al*., 2012); to gauge the healthiness of food environments globally (Vandevijvere *et al*., 2013); and to understand the impact of trade and investment liberalization on diet and health (Baker, Kay and Walls, 2014).

The use of these classifications has allowed assessment of key indicators that allow quantification of the impact of different processed food groups in the diet: their nutrient and caloric share was assessed, for example, by Slimani *et al*. (2009) and Monteiro *et al*. (2011).

4

Elements needed to describe processed foods

There are many types, degrees and purposes of processing. Foods and food products consumed in most countries and settings are processed in some way. It is essential to distinguish between food and dishes processed in industrial settings from those prepared by hand at home or in artisanal settings, since these employ different ingredients, methods and are for different purposes. It is also essential to distinguish between types of processing within these categories.

For the purposes of these guidelines, all foods (including beverages) that are not consumed fresh, but are altered through processes that go beyond simple procedures[5] such as washing, peeling and removal of non-edible parts, cutting, squeezing, mixing or refrigeration, are categorized as "processed".

Many variables can be used to characterize the processing of foods, including:

1. **For foods prepared at the household level or in an artisanal setting (including street foods):**
   - for dishes: ingredients list and preparation methods, including their degree and intensity (cooking method, physical method, preservation method);
   - extent to which dishes include processed foods, and the processing sequence (made from scratch, combination of processed ingredients, ready to eat or heat);
   - person in charge of the cooking or preparation (household member, restaurant, artisanal bakery or street food vendor); and

[5] There is currently no consensus among research groups involved in this area of work regarding the name to be applied to the category of foods that are altered only through some simple procedures such as peeling, cutting, removal of non-edible parts or squeezing. As shown in Annexes 2 and 3, these are termed "unprocessed" by some research groups (Slimani *et al.*, 2009) and "minimally processed" by others (Monteiro *et al.*, 2011). Codex standards do not provide a definition of processed food in general, and the same kind of operation is considered as "processing" or "manufacturing" for some commodities but not for others. Thus, any operation different from post-harvest treatment such as peeling and cutting draws a line between the terms of reference of the Codex Committee on Fresh Fruits and Vegetables and the Codex Committee on Processed Fruits and Vegetables. At the same time, according to the *Code of Hygienic Practice for Meat,* fresh meat is "meat that apart from refrigeration has not been treated for the purpose of preservation other than through protective packaging and which retains its natural characteristics."

- location of preparation or consumption, or both (household, street food vendor, community kitchen, etc.).

2. For foods produced in industrial settings:

- brand- and product names;
- full list of ingredients, including additives;
- preparation methods, including their degree and intensity (cooking method, physical method, preservation method, extraction rate); and
- location of purchase or consumption, or both (the brand name of an industrial fast food entity is key information).

Additional variables are needed when the information on food processing is aimed at assessing the use of environmental resources:

- amounts of and sources of energy (e.g. charcoal, wood, liquefied petroleum gas (LPG), natural gas, electricity) and type of cooking stove (e.g. three-stone fire, natural gas stove with chimney, LPG stove without chimney, etc.) used for food cooking; and
- amounts of and sources of energy used for processing food in household and non-household settings (e.g. electricity, natural gas, other fossil fuels, renewable energy sources).

It will usually not be possible to collect all relevant information, especially when conducting large-scale surveys that necessarily involve simplification. In the case of industrially processed foods, the brand and product name are particularly important data to capture. Such information can be then linked to a database (e.g. the food company Web site) that provide the ingredients list and other information about preparation and processing methods, which will usually be sufficient to characterize the processing of the food. How much additional information can be collected obviously depends on the purpose of the survey, the resources available, and other practical matters, such as the feasibility of the respondent having access to the necessary information and the time needed for such collection (e.g. questionnaire filling).

5

Suitable methods

Some methods that provide information on food available for consumption or on food consumed have very low potential for providing information on food processing.

- Food Balance Sheets provide information on food processing only for a very limited number of foods available for consumption and used as ingredients, for which the processing is implicit in the name of the food (sugar, oil, flour).
- Qualitative surveys, such as household or individual Dietary Diversity questionnaires, often collect qualitative information on the consumption of a few broad food groups and do not allow for the capture of information on the processing of foods.
- The Duplicate Portion Method provides information only on the composition of the whole diet and not on the nature of foods, including processing.
- Methods aimed at assessing food security, such as the food insecurity scales and the Coping Strategy Index method, are qualitative surveys, which do not provide information on food processing.

Various other methods are suitable for the collection of information on food processing, depending on the objectives of the study, the setting (rural versus urban) and the financial, material and human resources available. Table 1 ranks the different methods according to their usefulness or relevance, depending on the circumstances.

Table 1. Comparison of the various methods used to obtain information for survey use.

Method[1]	Potential[2]	Strengths and limitations	Adaptation that can be performed
Food Frequency Questionnaire (FFQ)	**Low to medium**	The potential for providing information depends on the level of detail of the food list. However, FFQ can never capture the same level of detail as methods with open food lists (e.g. food records or 24-hour dietary recalls).	To adapt a FFQ, some foods in the food list can be disaggregated according to food processing (e.g. processed meat can be separated from unprocessed meat) In addition or as an alternative, for some foods in the food list, probing questions can be added to record the type of processing and to specify if the processing was performed before or after purchasing.

Method[1]	Potential[2]	Strengths and limitations	Adaptation that can be performed
Dietary history	**Medium**	Diet history is an open-ended recall of remote diet. Detailed information on the type of processing could be reported through such method. Such information is likely to be less accurate when related to time periods in the distant past.	Additional information on the type of processing can be asked and recorded during the interview for a limited number of products. The information is likely to be more accurate for products which are consumed on a daily basis and to which consumers tend to be loyal (e.g. breakfast cereals, beverages).
Household Consumption and Expenditure Survey (list-recall method, food-account method, inventory method and other techniques) can be open food diaries or closed food list	**Low to medium**	Household Consumption and Expenditure Survey are the most convenient methods to collect information on processing of food "as purchased". Such methods do not provide information on any additional food processing performed at household level. They inform on the use of culinary ingredients (oils, sugar, salt), and therefore are informative of cooking and preparation practices at the household levels. The tools developed to implement this method are country-specific and there might be resistance to change the questionnaire by increasing the food list, especially if the questionnaires are already long and cumbersome for respondents. In most cases food purchased and consumed away from home (e.g. street food or food consumed in canteens) is not considered.	Information on processing can be captured by (i) increasing the length of the closed food list; (ii) using open food diaries providing information on all foods purchased but the data handling may become challenging; and (iii) adding for some foods in the food list, probing questions to record the type of processing and to specify if the processing was performed before or after purchasing. For commercial processed foods, brand and product name and information on the type of processing at the time of purchase should be recorded (fresh, dried, frozen, etc.).
Household Consumption and Expenditures Surveys (HCES) performed through electronic scanning of bar codes on purchased food	**Medium**	HCES performed through electronic scanning of bar codes on purchased food can be extremely useful. These HCES do not provide information on any additional food processing performed at household level. These surveys do not cover the whole diet but only the consumption of purchased food which bear a bar code. Food purchased and consumed away from home (e.g. street food or food eaten in canteens) is not considered.	These surveys do not require any adaptation during the data collection phase since electronic scanning allows for the identification of brand and product name. The information collected can be used by linking bar codes to databases of Universal Product Codes (UPC).

Method[1]	Potential[2]	Strengths and limitations	Adaptation that can be performed
Photographic methods (food consumption assessed through image analysis and volume estimation based on pictures taken with a mobile telephone or digital camera)	Medium to high	These methods record all foods consumed by an individual over a period of time through photographs. They have a high potential for providing information on food processing for industrial products through the name of the brand and product. They can also provide information on domestic or artisanal processing if the picture is taken prior to consumption and includes the packaging, brand name or else shows the dish as hand-made. Such information can also be captured from the record that is usually kept by the respondent, or through probing questions. No information on specific ingredients can be captured through photos in the case of purchased mixed dishes which do not bear labels (e.g. street foods and foods eaten in canteens).	These surveys do not require any adaptation during the data collection phase since brand name, product name and ingredient list would usually be captured in photographs. The information collected can be used by linking bar codes to databases of Universal Product Codes (UPC). In order to specify if the processing was performed before or after purchasing photos need to be taken during the preparation of dishes.
Food records (weighed food records, estimated food records)	High to very high	As it is an open-ended instrument, detailed information on the type of processing can be collected if the food record is structured for this scope. Probing questions need to be asked by the interviewer for detailed description of food processing.	Probing questions can be added to record the type of processing (fresh, dried, frozen, etc.) and to specify if the processing was performed before or after purchasing. Brand and product names need to be collected. Ingredient list should be collected for hand-made dishes.
24-hour recall	Very high	As it is an open-ended instrument and as it is usually administered by an interviewer (face to face or through the phone), 24-hour recalls allow very detailed information to be collected on the type of processing. In case of self-administered 24-hour recalls, the accuracy of the information collected is likely to be much lower than that collected through face to face or phone interview.	Probing questions can be added to record the type of processing (fresh, dried, frozen, etc.) and to specify if the processing was performed before or after purchasing. Brand and product names need to be collected. Ingredient list should be collected for hand-made dishes.

Notes: (1) More information on the listed methods can be found in Willett (2013). (2) Potential for providing information and/or for being adapted (low, medium, high, very high)

Open-ended methods are clearly the most appropriate methods to collect information on food processing. In most high-income countries, due to the dominant contribution of industrial processed food, a large amount of information is implicitly collected when the name of the product and its brand are recorded. The name of the product and its brand can be then be linked to the producer's Web site or to databases of Universal

Product Codes (UPC) in order to retrieve the list of ingredients and the nutrient content of food products and to categorize them according to the typology of processing. It is however important not to underestimate the resources needed for the data handling of the information related to processed food, since the formulation of the same product often changes and new products and new technologies are constantly being developed.

For methods with closed food lists, one starting point for the development of survey tools might be to make a list of the most common foods and products supplied and consumed in the study setting. Inventories of processed products may already be available.

6 Problems and possible solutions

Some problems could be encountered either in the implementation phase of surveys when incorporating information on food processing, or when using existing food consumption data to retrieve such information.

What to do when some key information on the processing of some food items (e.g. extraction rate of flour) is missing?

This information can not always be obtained directly from the subject during the survey, but can be obtained indirectly through brand or product names or by making best guesses based on ancillary information related to the study setting (e.g. market share of certain typologies of processed foods).

How to deal with recipes that include some processed ingredients?

It is important to be systematic in the way recipes are handled, by disaggregating recipes into their ingredients where possible, and by treating the information collected on the processing of ingredients separately from that collected on the recipe preparation. Information describing the processing of ingredients cannot always be collected because it is not available to the respondent or because it would unacceptably inflate the time needed for data collection. In this case, ancillary information related to the use of processed food as ingredients of recipes in the study setting needs to be used in order to make best guesses.

How to incorporate more details on food processing into simpler types of survey?

One needs to make judgements on which information is the most important to collect and for which foods. This is ideally based on pilot studies using open-ended methods among a representative sample of the population to be studied.

In the case of open-ended methods (e.g. 24-hour recall or dietary records): How to capture a large amount of information on each food consumed without leading to a very complex system of categorization and coding?

Food items can be coded using a basic food list which does not include detailed information on food processing. Supplementary detailed information on specific aspects of the food such as the type and extent of processing can collected using additional descriptors of the food, such as the brand name, the cooking method, etc. An example of such coding system is the FoodEx2 developed by the European food Safety Authority (EFSA, 2011).

In the case of methods with closed food lists (Food Frequency Questionnaire or Household Consumption and Expenditure Survey): How to capture detailed information on processing without increasing too much the number of entries for closed food lists?

There is the need to prioritize the foods on which information should be captured in terms of food processing, and to create more entries specifically for these foods. Again, this should be based on pilot studies with open-ended methods. Interactive Food Frequency Questionnaires that use branched questions can make the questionnaire more simple. With this typology of questionnaire, more detailed questions about processing are asked only for foods frequently consumed.

7

Next steps

The present guidelines constitute a first step to advocate the collection of information on food processing. There is need to encourage the incorporation of such information in large-scale surveys. The two food classification systems outlined in Section 4 and for which more details are available in Annexes 2 and 3, are both considered appropriate. Their increased use will allow better assessment of the feasibility of collecting detailed information on food processing in different settings.

It is recommended that scientists engaged in this work collaborate with one another, share their experience on the incorporation of food processing into food consumption surveys and publish their findings on the public health significance of food processing.

The public availability of databases with ingredient lists and nutrition composition of processed food is also a key element to allow a science-based assessment of the health impact of processed food. Data sharing initiatives in this field should be supported.

8

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Annex 1

Participants in the FAO Technical meeting on incorporating food biodiversity and food processing in food consumption surveys, held in Granada, Spain, from the 21st to 22nd of September 2013.

Three groups of experts were invited to this meeting: (1) experts with experience in capturing information on biodiversity within food consumption surveys; (2) experts with experience in capturing information on food processing within food consumption surveys; and (3) experts with experience in large-scale food consumption surveys. These three groups were brought together in order to identify the best methods for capturing information on food processing and biodiversity, taking into account feasibility of the methods when applied to large-scale food consumption surveys. The meeting consisted of plenary sessions and two working groups: one working group focused on biodiversity and the other on food processing.

Overall chair of the FAO technical meeting: **Mark Wahlqvist**
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Annex 2

Food definition and classification system developed by IARC

Food definition and classification of industrially processed foods and beverages used in the study coordinated by the Dietary Exposure Assessment Group of the International Agency for Research on Cancer (IARC, WHO, Lyon, France) in centres of the European Prospective Investigation into Cancer and Nutrition study (EPIC)

The study published by Slimani *et al*. (2009) aimed to investigate the consumption of highly industrially processed foods as opposed to non- and moderately processed foods in a large European epidemiological study (EPIC, involving more than 520 000 individuals). For that purpose, each food reported by means of a standardized computerized interview programme (EPIC-soft©, recently renamed Globodiet©) was recoded according to its degree of processing. In order to make these standardized 24-hour dietary recall data comparable across centres, it was decided to break down all the recipes and compare them at the food and ingredient level. Foods and ingredients of recipes were then classified in three main categories depending on the type of processing undergone, as in the examples reported in the table below. All the ingredients of 'industrial/commercial' recipes were coded as industrially processed foods, whereas those of home-prepared recipes were coded depending on whether the ingredients used were raw, or moderately or industrially processed, using the same definition and classification system across countries.

Highly processed foods

Foods that have been industrially prepared, including those from bakeries and catering outlets, and which require no or minimal domestic preparation apart from heating and cooking (such as bread, breakfast cereals, cheese, commercial sauces, canned foods including jams, commercial cakes, biscuits and sauces).

Moderately processed foods

This category includes two sets of foods. First, industrial and commercial foods involving relatively modest processing and consumed with no further cooking, such as dried fruits, raw food stored under controlled or modified atmosphere (e.g. salads), vacuum-packed food, frozen basic foods, extra virgin olive oil, fruits and vegetables canned in water or brine or in own juice. Second, foods processed at the household level and prepared or cooked from raw or moderately processed foods (e.g. vegetables, meat and fish cooked from raw fresh ingredients, or vacuum-packed, deep-frozen, canned in water or brine or in own juice).

Non-processed foods

Foods consumed raw without any further processing or preparation, except washing, cutting, peeling, squeezing (e.g. fruits, non-processed nuts, vegetables, crustaceans, molluscs, fresh juices).

Foods for which processing is unknown

Foods for which the processing involved is unknown, based on the information provided by the study subjects (such as unknown preservation method for vegetables, milk or meat, or where information is missing in home-prepared or commercially processed foods such as cakes and cream desserts).

The terminology and definitions of the classification used for industrially and commercially processed foods and ingredients have been published by Slimani *et al.* (2009). Some examples are reported in Table A2.1.

Table A 2.1 Examples of categorization of a few food groups

Food group	Highly processed foods[1]	Moderately processed foods[1]		Non processed foods[1], consumed raw
		No further cooking	Cooked foods[1] [2] from raw or moderately processed foods	
Vegetables, legumes	Process: Salting, mixing, pickling, concentration, fermentation, drying, canning in a commercial sauce or in fat Examples: Onion, roasted (commercial); vegetables, dried, in oil; garlic or tomato puree; sauerkraut; beans canned in tomato sauce	Examples: Vegetables canned in own juice or in water or brine; Legumes canned in own juice or in water or brine	Examples: Fresh or frozen cooked vegetables; dried boiled legumes	Examples: Fresh raw vegetables; fresh raw grated vegetables
Cereal products, bread[3]	Process: Intense milling, mixing, use of industrial ingredients, canning in a commercial sauce, drying, bread making, extrusion, fortification Examples: Starch; flakes; flour; wheat germ; wheat bran; ravioli canned in tomato sauce; pasta, enriched or not, fresh or dried, boiled; cooked couscous; white boiled rice; bread; breadcrumbs; cream crackers; crispbread; rusks; breakfast cereals; salty biscuits; popcorn, plain; commercial baked dough		Examples: Boiled grain; wholemeal boiled rice	
Red meat, poultry and game	Process: Mixing, use of industrial ingredients, salting, smoking, curing, canning in a commercial sauce or in fat Example: Meat canned in gravy	Examples: Frozen or vacuum-packed raw meat	Examples: Fresh or vacuum-packed cooked meat	Example: Raw meat

Food group	Highly processed foods[1]	Moderately processed foods[1]		Non processed foods[1], consumed raw
		No further cooking	Cooked foods[1] [2] from raw or moderately processed foods	
Fat	Process: Oil extraction and purification, mixing, hydrogenation, butter making, fortification Examples: Oils; butter; margarine; deep-frying fat; cooking fat	Examples: Virgin olive oil; fat from fried meat; fat from cooked fish or meat; dripping		
Sugar and confectionery	Process: Sugar extraction and purification, mixing, use of industrial ingredients; cocoa bean fermentation, roasting and grinding Example: Sugar; candied fruit or peel; jam; marmalade; chocolate products; confectionery; ice cream; sorbet; syrup			Example: Honey
Non-alcoholic beverages[4] (fruit and vegetable juices, soft drinks, diluted syrups coffee, tea and herbal teas, waters)	Process: Mixing, use of industrial ingredients, fermentation, brewing, roasting, drying, concentration, freeze-drying, pasteurization, fortification		Examples: Green tea; camomile tea	Examples: Freshly prepared fruit juice; tap water; ice cubes
Yeast, spices, herbs, condiments	Process: Mixing, use of industrial ingredients, drying, fermentation, fortification Examples: Bouillon cube or powder; salt; yeast; vinegar; spices	Example: Dried parsley		Example: Fresh parsley

Notes: (1) The term 'foods' refers to both foods and to ingredients broken down from recipes. (2) This includes food processed (cooked) at household level, in restaurants and in cafeterias. (3) Recipes were broken down into their ingredients for analysis at the ingredient level, so a homemade cake may end up as 80% 'highly processed industrial/commercial' and 20% 'moderately processed' ingredients, and a commercial cake will be treated as 100% 'highly processed industrial/commercial' ingredients. (4) Alcoholic drinks are not considered in this classification. (5) The drying process may be considered as moderate, close to the natural process, for some foods such as raisins, legumes, green tea, walnut or parsley, or considered as high for potatoes or when combined with salting, canning in oil, etc.

Annex 3

NOVA Food definition and classification system developed by NUPENS

The NOVA classification has been developed by the Centre for Epidemiological Studies in Health and Nutrition (NUPENS), School of Public Health, University of São Paulo, Brazil (Monteiro *et al*., 2012)

The classification assigns foodstuffs to four groups according to the extent and purpose of the industrial processing used. According to this classification, methods used in households and similar places, restaurants or artisanal settings where fresh culinary preparations are prepared from scratch by hand or with simple tools, are by definition not industrial processing. Home-prepared and artisanal preparations of all types should as far as possible be disaggregated into their components so that each component can then be classified into one of the four groups. Alcoholic drinks are not considered in this classification.

Group 1: Unprocessed and minimally processed foods

Unprocessed foods are of plant origin (such as leaves, stems, roots, tubers, fruits, nuts, seeds), or of animal origin (such as meat, other flesh, tissue and organs, eggs, milk), consumed shortly after harvesting, gathering, slaughter or husbanding.

Minimally processed foods are unprocessed foods altered in ways that do not add or introduce any substance, but that may involve subtracting parts of the food. Processes include cleaning, scrubbing, washing; winnowing, hulling, peeling, grating, squeezing, flaking; skinning, boning, carving, portioning, scaling, filleting; drying, skimming, fat reduction, as well as cooking, pasteurization, sterilizing, chilling, refrigerating, freezing; sealing, bottling (as such); simple wrapping, vacuum and gas packing. Malting, which adds water, is also a minimal process, as is fermenting, which adds living organisms, when it does not generate alcohol.

Group 2: Processed culinary ingredients

These are food products extracted and refined from constituents of foods, such as plant oils, animal fats, starches and sugar; or else obtained from nature, such as salt. Specific processes to produce culinary ingredients include pressing, milling, crushing, grinding and pulverizing.

Processed culinary ingredients are normally not consumed by themselves. Their main role in diets is to be combined with foods to make palatable, diverse, nourishing and enjoyable dishes and meals. Examples are oils and salt used in the cooking of food or added to salads; sugar used to prepare fruit- or milk-based desserts, or added to drinks.

Group 3: Processed foods

Processed foods are made by adding salt or sugar (or other substance of culinary use such as oil or vinegar) to unprocessed or minimally processed foods, in order to preserve them or to enhance their palatability. The resulting products are based on and recognizable as versions of the original foods, and are not reconstituted from them. They include canned or bottled vegetables or legumes (pulses) preserved in brine; whole or sliced fruits preserved in syrup; tinned whole or pieces of fish preserved in oil; some types of processed meat and fish such as ham, bacon and other unreconstituted meat products, smoked fish, cheeses, and breads when made from wheat flour (or other cereal flours), water, ferments and salt.

As with processed culinary ingredients, some processed foods can still be hand-made with simple tools, although now almost all are industrial products. Besides cooking and canning or bottling, specific processes include preservation in oil or syrups, salting, salt-pickling, smoking and curing. Processed foods retain the basic identity and most of the constituents of the original foods, but the substances added infiltrate the foods and alter their nature. They are generally produced to be consumed as part of meals or dishes, but may be used, together with ultra-processed products, to replace food-based freshly prepared dishes and meals.

Group 4: Ultra-processed food and drink products

A defining characteristic of ultra-processed products is that they are formulated mostly or entirely from substances derived from foods, with little or even no whole food content. They typically are not recognizable as versions of foods, although many are designed to imitate the appearance, shape or sensory qualities of food.

Many ingredients used to make ultra-processed products are not available from retailers, and so are not used in the culinary preparation of dishes and meals. Additives are an example. Some of these ingredients are directly derived from foods, such as oils, starches and sugar. Others are obtained by the further processing of food constituents, such as by the hydrogenation of oils, hydrolysis of proteins, and ‘modification’ or ‘purification’ of starches. Ultra-processed products characteristically also contain various combinations of preservatives; stabilizers, emulsifiers, solvents, binders, bulkers; sweeteners, sensory enhancers; processing aids; colours and flavours. Bulk may come from added air or water. Micronutrients may be added to ‘fortify’ the products.

Ultra-processing also includes techniques designed to make ingredients appear to be foods or else to invent novelty products, such as by extrusion, moulding or reshaping. It also involves industrial versions of cooking, such as pre-processing by frying and baking. Such methods simulate domestic cooking but are typically very different, involving a series of processes. Most of the products listed here as ultra-processed are now inventions based on increasingly sophisticated food science and technology. Newer versions are usually initially formulated in industrial laboratories.

Examples are mass-manufactured breads, buns, cakes and pastries, cookies (biscuits), preserves (jams); sauces; meat, yeast and other extracts; ice-cream, chocolates, candies (confectionery); margarines; canned or dehydrated soups; infant formulas, follow-on milk and baby products; breakfast cereals; cake mixes; 'instant' packaged soups and noodles; chips (crisps), and very many other types of fatty, sweet or salty snack products; packaged desserts; sugared or sweetened milk and fruit drinks, soft cola drinks and 'energy' products.

Many products that appear to be much the same as home-cooked dishes, such as 'nuggets' and other reconstituted meat and poultry products, and many 'ready meals', are actually ultra-processed, because of their formulation, the nature of much or most of their ingredients, and the combinations of additives used. Many are commonly termed 'convenience foods'. Typically they are designed to be consumed instead of home-prepared dishes and meals, almost anywhere, such as in fast-food outlets, at home (for example while watching television), at desks or elsewhere at work, in the street, and while driving.

Table A3.1 The NOVA classification

Food groups and definition	Examples
1 Unprocessed and minimally processed foods	
Unprocessed foods are of plant origin (leaves, stems, roots, tubers, fruits, nuts, seeds), or animal origin (meat, other flesh, tissue and organs, eggs, milk), shortly after harvesting, gathering, slaughter or husbanding. Minimally processed foods are unprocessed foods altered in ways that do not add or introduce any substance, but that may involve subtracting parts of the food. Minimal processes include cleaning, scrubbing, washing; winnowing, hulling, peeling, grinding, grating, squeezing, flaking; skinning, boning, carving, portioning, scaling, filleting; pressing; drying, skimming, fat reduction; pasteurizing, sterilizing; chilling, refrigerating, freezing; sealing, bottling (as such); simple wrapping, vacuum- and gas-packing. Malting, which adds water, is a minimal process, as is fermenting, which adds living organisms, when it does not generate alcohol.	Fresh, chilled, frozen, vacuum-packed vegetables and fruits; grains (cereals) including all types of rice; fresh, frozen and dried beans and other legumes (pulses), roots and tubers; fungi; dried fruits and freshly prepared or pasteurized non-reconstituted fruit juices; unsalted nuts and seeds; fresh, dried, chilled, frozen meats, poultry, fish, seafood; dried, fresh, pasteurized full-fat, low-fat, skimmed milk, fermented milk such as plain yoghurt; eggs; flours, 'raw' pastas made from flour and water, teas, coffee, herb infusions; tap, filtered, spring, mineral water.
2 Processed culinary ingredients	
Processed culinary ingredients are food products extracted and purified by industry from constituents of foods, or else obtained from nature, such as salt. Stabilizing or 'purifying' agents and other additives may also be used.	Plant oils; animal fats; sugar and salt; starches.
3 Processed foods	
Manufactured by adding salt or sugar (or other substance of culinary use such as oil or vinegar) to whole foods, to make them more durable and sometimes also to modify their palatability. Directly derived from foods and recognizable as versions of the original foods. Generally produced to be consumed as part of meals or dishes, or may be used, together with ultra-processed products, to replace food-based freshly prepared dishes and meals. Processes include canning and bottling using oils, sugar or salt, and methods of preservation such as salting, salt-pickling, smoking, curing.	Canned or bottled vegetables and legumes (pulses) preserved in brine; peeled or sliced fruits preserved in syrup; tinned whole or pieces of fish preserved in oil; salted nuts; un-reconstituted processed meat and fish such as ham, bacon, smoked fish; cheese; and breads when made from wheat flour (or other cereal flours), water, ferments and salt.
4 Ultra-processed food and drink products	
Formulated mostly or entirely from substances derived from foods or other organic sources. Typically contain little or no whole foods. Durable, convenient, accessible, highly or ultra-palatable, often habit-forming. Typically not recognizable as versions of foods, although may imitate the appearance, shape and sensory qualities of foods. Many ingredients not available in retail outlets. Some ingredients directly derived from foods, such as oils, fats, flours, starches and sugar. Others obtained by further processing of food constituents or synthesized from other organic sources. Numerically the majority of ingredients are preservatives; stabilizers, emulsifiers, solvents, binders, bulkers; sweeteners, sensory enhancers, colours and flavours; processing aids and other additives. Bulk may come from added air or water. Micronutrients may 'fortify' the products. Most are designed to be consumed by themselves or in combination as snacks. Processes include hydrogenation, hydrolysis; extruding, moulding, re-shaping; pre-processing by frying, baking.	Chips (crisps), many types of sweet, fatty or salty snack products; ice cream, chocolates, candies (confectionery); French fries (chips), burgers and hot dogs; poultry and fish 'nuggets' or 'sticks' ('fingers'); mass-manufactured breads, buns, cookies (biscuits); breakfast cereals; pastries, cakes, cake mixes; 'energy' bars; preserves (jams), margarines; desserts; canned, bottled, dehydrated, packaged soups, noodles; sauces; meat, yeast extracts; soft, carbonated, cola, 'energy' drinks; sugared, sweetened milk drinks, condensed milk, sweetened including 'fruit' yoghurts; fruit and fruit 'nectar' drinks; instant coffee, cocoa drinks; no-alcohol wine or beer; pre-prepared meat, fish, vegetable, cheese, pizza, pasta dishes; infant formulas, follow-on milks, other baby products; 'health', 'slimming' products such as powdered or 'fortified' meal and dish substitutes.

Source: Adapted from Monteiro *et al.*, 2012.

I am planning an individual food consumption survey. I need to distinguish foods according to the type of processing. How should I proceed?

Data from a household survey have been made available to me. How can I use these data to assess the proportion of food that has been processed before being purchased?

These guidelines address such and other questions.

Foods and food products consumed in most areas of the world are processed in some way, for various purposes. These purposes range from increasing the digestibility of raw foods (e.g. through cooking) to increasing the palatability of food products (e.g. through the addition of flavourings). Foods and food products processed in industrial settings differ from those prepared by hand at home or in artisanal settings; they employ different ingredients and methods. Food processing has an impact on diet quality. The degree of food processing can vary from raw foods eaten as such (e.g. fresh fruit) to that of food products whose ingredients are derived from food but contain little or no whole food (e.g. extruded cereals).

These guidelines will help the reader to identify the relevant information that will allow classification and data analysis according to the type and degree of food processing.

The use of these guidelines will assist the collection of more accurate, standardized and relevant information on food processing through food consumption surveys. Generating more and better information on how foods are processed will allow development of more effective policies to promote healthy diets.

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