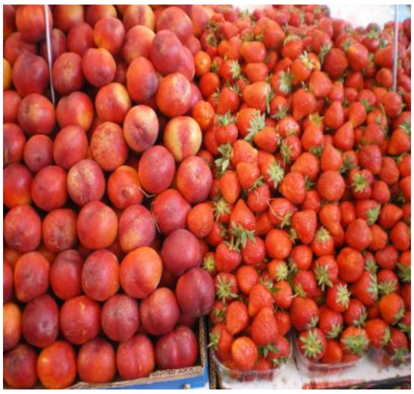
FAO / INFOODS Guidelines

Guidelines for Food Matching
Version 1.2





FAO/INFOODS Guidelines for Food Matching

Version 1.2

FAO, November 2012

Prepared by: Barbara Stadlmayr, Ramani Wijesinha-Bettoni, David Haytowitz, Doris Rittenschober, Judy Cunningham, Renee Sobolewski, Sandra Eisenwagen, Janis Baines, Yasmine Probst, Emily Fitt, U. Ruth Charrondiere

Please cite as: FAO/INFOODS Guidelines for Food Matching. Version 1.2 (2012). FAO, Rome.

E-ISBN 978-92-5-107377-3 (PDF)

Table of Contents

Acknowledgements

The authors express their appreciation to Oliver Lindner for his comments on the previous version of the document.

The authors would like to thank Kristy Ebanks for leading the cover design and Natascia Alessi for the editing and formatting of the document.

Objectives

Food matching links food consumption/supply data with food composition data. As food matching procedures are critical to obtaining high quality estimations of nutrient intakes (for nutrition purposes) or of dietary exposure (for food safety purposes), INFOODS developed these guidelines for a more harmonized approach to food matching while pointing out critical steps and information in order to achieve the most appropriate food matching. These guidelines are intended to assist in selecting the most appropriate foods (for which compositional data are available) to match to foods reported in food consumption surveys (at individual, household, national or international level) or to food supply data (e.g. FAOSTAT, EUROSTAT). In addition, food matching is important when compiling Food Composition Tables/ Databases (FCT/FCDB) including when filling missing data form other sources. More information on criteria on how to choose FCT/FCDB is being prepared and will be published separately as the FAO/INFOODS *Guidelines on the Selection of Appropriate Food Composition Data* (in preparation).

Food matching should aim for the highest quality match possible by identifying the most appropriate food in the most appropriate source of compositional data. As experience demonstrates, this is not always possible to achieve. Therefore, it is recommended to use a stepwise approach, i.e. to search for the highest quality food match. If it cannot be obtained after extensive efforts, the next lower quality level of food match should be explored, before finally choosing the lowest quality food match. To properly assess nutrient intake, there can be no missing food composition values, and therefore, a food match must be made.

Whatever food match is selected for each food, it should be documented and the overall quality of food matching should be discussed in the presentation of the final estimations of nutrient intakes or dietary assessment (see point 4 below).

Throughout the document, the term ***food component*** is used to refer to nutrients, chemicals, additives, contaminants and other components of interest.

The demand for such guidelines was expressed in the past and its realization became possible with the contribution of Multi Disciplinary Funds through FAO ESS division.

I. General aspects to keep under consideration before matching

1. Identify the food component of interest. Decisions with regard to food matching will depend on the food component of interest for the survey/study that is conducted, e.g. if the study does not look at sodium then it does not matter if the salted and unsalted products are matched. If on the other hand, the complete nutrient profile (macro- and micronutrients) is considered, the decisions on food matching will have to take all food components into account. If some food components of interest are not available in the chosen FCT/FCDB, the missing values will need to be imputed from another FCT/FCDB, or other sources of food composition data (e.g. scientific articles, theses, university reports, websites of manufacturers, and information on labels). However, it is necessary to document this match.

Note: Macronutrients are needed to calculate energy intakes (never copy only the energy values for energy intake estimations). See FAO (2003) for recommended energy conversion factors. Often, nutrient intakes are calculated for all food components having a Recommended Daily Intake (RDI) included in the country's dietary guidelines, or are of research or public health interest, e.g. iron, vitamin A or *trans* fatty acids.

2. Identify the amount of foods consumed. The quality of the estimations of nutrient intakes or dietary exposure is mainly determined by the quality of the food matches of foods consumed in significant quantities and those with high concentrations of the food components of interest (even if they are consumed in small amounts). Therefore, special attention needs to be given to these food matches, while a lower quality food match is more acceptable for foods consumed infrequently or containing low amounts of the component of interest. The keyfood approach as proposed by USDA (Haytowitz et al., 2002 or in Charrondiere et al., 2011a, b-Module 3) might be helpful in identifying the foods for which the quality of food matching is most important. The key food approach consists of identifying those foods in the food supply which contribute to 75% of a nutrient intake (e.g. 75% of iron intake).

3. For foods that are not clearly described

Some food consumption or supply data are unspecific, e.g. from Household Budget Surveys (HBS), Food Frequency Questionnaires (FFQ) or FAOSTAT, e.g. *cheese*, *milk,* or *fish.*

3.a Identify the population of interest and their habits

In order to attribute the best food match, the population under consideration needs to be kept in mind as they might have different eating habits which need to be reflected in the food matching. In considering populations of interest, this is not just among countries, but within a country where various population subgroups need to be assessed. These include different ethnic groups, age groups, and gender. For example, infants and children can have very different diets than adults; immigrants to a country will eat different foods (often from their homeland), using different preparation techniques, than the indigenous population.

Examples:

When the cooking method is not indicated in the food consumption or supply data, it needs to be estimated by selecting the most common cooking method(s) for the food in the population. For risk assessment purpose, it would be advisable to choose the cooking method with the highest associated risk. Other examples are food biodiversity (the most likely varieties should be matched if they have different compositions of the components of interest), or the most commonly consumed form of the food (e.g. fortified vs. unfortified) or recipes (ingredients and their amounts may need to be collected from cookery books or through focus groups, and then used to calculate the composition of recipes). Another example would be rural/urban differences or differences owing to economic status: in some countries *milk* in rural areas could be matched to *whole milk* (as it is the only form available in rural areas) or even milk from a different animal species, while in urban settings *semi-skimmed milk* would be a better match, or a mix of *whole* and *semi-skimmed milk* (as these are the two forms of milk sold in urban settings). The availability of enriched/fortified foods is affected by regulation at the national level, and will vary from country to country. It can also be influenced by the urban/rural paradigm, where processed foods (more likely to be enriched/fortified) are more available in urban areas, than in rural areas.

3.b Identify several food matches

If food consumption data are unspecific (e.g. *fish*), it is recommended that **at least 3** food items from the FCT are matched, especially if it is a food consumed in high amounts and/or contains high concentrations of the food components of interest. The matches should reflect the range of different nutrient values available for the food. However, for broad food categories, e.g. vegetables, many more food matches are needed in order to obtain a reliable estimate (often 20-30 foods and sometimes even several hundred, especially for risk assessment). These foods should represent the most consumed foods in the most popular forms for this unspecified food. The food component values of the unspecified food would be calculated as the mean of the food component values of the foods matched. This can be done either through a weighted mean (foods are weighted according to their market share or consumption pattern — preferred option) or an arithmetic mean (if no further information is available of the proportion of foods consumed—less recommended).

An exception can be made for infrequently consumed (unimportant) foods, for which only one food match may be sufficient.

Matching to a specific brand should be avoided (unless the exact brand has been specified in the food consumption survey, which can be matched exactly with the food in the FCT) and it is better to choose several brands and to calculate an average.

4. Document food matches by assigning quality criteria. In order to assess the quality of the food matching and hence of the nutrient intake estimations, it is important to assign quality codes to the food match. It is also important to identity the source (including releases or edition information) and specific item number in the FCT/FDB.

Table 1 Quality criteria

A high quality	**Exact match** • Food and all its descriptors from the food consumption survey (=reported food) match exactly with food and all its descriptors from the FCT/FCDB. This applies to all other sources of food composition data (e.g. FCT/FCDB from other countries, scientific articles, ...) **AND** • The definitions of the food components of interest are in accordance with international quality standards (e.g. not crude fibre but Prosky AOAC fibre. For more information see food component matching section III and Annex 2 of the current document).
B medium quality	If the food and all its descriptors could not be found in a FCT/FCDB and matching was conducted by one of the following means: • Matching the reported food to several food items from the FCT and calculating the mean food component values (arithmetic or weighted mean) ○ e.g. for the reported food *green salad type, not specified,* five kinds of green salads are listed in the national FCT which are matched to the reported food and the mean food component values of the five food items is calculated. ○ e.g. in FFQ, *fish*, *not further specified*, was reported. The three most consumed were selected (*Tuna, canned*, *Cod, baked* and *Salmon, grilled*) and through further information (e.g. from published smaller food consumption studies) a weighted average was calculated of 50% *Tuna, canned*, 20% *Cod, baked* and 30% *Salmon, grilled*). • <u>Recipe calculation</u>. Calculation of recipes is preferable to taking similar cooked foods. Calculating food component values from cooked foods based on raw foods by using appropriate nutrient retention and yield factors. See Charrondiere et al. (2011a, b)-Module 8; ○ choosing recipes that are most representative for the population/subgroup of interest. E.g. from information recorded on food records or through well known and widely used cook books; ○ calculating the food component values from recipes based on raw foods by using appropriate nutrient retention and yield factors. It is preferable to use yield and retention factors based on habitual cooking methods for the region of interest. If this information cannot be obtained, the yield and nutrient retention factors should be taken from the published literature; see Charrondiere et al. (2011a, b)-Module 8; Bognar, A. (2002), McCance and Widdowson`s (2002), EuroFIR (2008). • Matching the food item with a similar food (of a similar botanical origin) e.g. for *cassava leaves*, calculate the mean of different entries of *dark green leaves* (list at least 3 items). Foods which are well known as source of a particular food component should be avoided (in other words, exclude extreme values), because a bias could be introduced.

C low quality	• The food is very different but it is the closest match possible. E.g. *camel meat* matched with *beef (*both are a mammals, and are red meat), while having no other information on *camel meat*[1]. • Recipe calculations without using yield or retention factors • Food component values from raw dishes are applied to cooked dishes, with no adjustment. • Food component definitions are not in accordance with international quality standards (e.g. only crude fibre instead of dietary fibre) independently of the quality of the food match.
Note	• Depending on the circumstances, it may be necessary to have sub-classes for these quality codes e.g. ○ **A**: Single, perfect match, no modifications required; ○ **A2**: Exact match, but multiple selections, need weighting; ○ **B**: Similar, single match; ○ **B2**: Similar match, multiple selections, need weighting; ○ **C**: Poor, single match; ○ **C2**: Poor match, multiple selections, need weighting; ○ **D**: Food component values taken from a Default Table. If food component values are borrowed from a different FCT to the one being matched, a different quality code should be used to indicate this (e.g. D match). It is generally better to take an A-match from another FCT than to put a C-match from the FCT of interest.

The overall quality of the estimations of nutrient intakes (or dietary exposure) depends mainly on the food matches of the foods consumed in high amounts and/or contain concentrations of the food component of interest. If most of these food matches were of medium quality and only a few were of high or low quality, the overall quality of all food matches would be medium.

[1] When the same food description is found, but from a different species, the quality code depends on food and nutrients of interest. For example, gross composition of butter from cow milk and butter from buffalo milk will be similar (B-match), but fatty acid profiles will be different (C-match). If only proximates are required, the quality code B would be given.

II. Food Matching Criteria

The following criteria were developed for food matching. They are explained in detail in the next sections III. Food Identification and IV. Food Component Matching.

For food identification the following points need to be checked:
- food name and food descriptors;
- taxonomic/scientific name; and
- water and fat content as well as components of interest.

For food components the following points need to be checked:
- expression;
- definition;
- analytical methods;
- unit; and
- denominator.

III. Food Identification

Food identification includes food names and food descriptors. They should clearly identify the food its forms and preparation. The food name and descriptors should be comprehensive enough to allow for an unambiguous identification of the food. However, this detailed information for food identification is often not available (neither for the food consumption data nor in FCT/FCDBs).

Food names can vary from country to country (e.g. *maize* versus *corn*, *eggplant* versus *aubergine*, *rockmelon* versus *cantaloupe*) and the same cuts of meat can have different names in different countries. Also the composition of the same brand product can be different among countries and over time. Therefore, care has to be taken with food names to ensure that the correct food for one's own country is selected.

Water/Fat
In general, water is the most important nutrient to check the food description and the concordance between two foods. Therefore, the water contents always have to be compared when matching foods. In addition, the fat content needs to be compared for foods in which the fat content varies substantially, e.g. *milk, cheese* or *meat*.

Table 2 lists characteristics that influence the nutritional value of the food. Ignoring them will result in varying interpretation of what the food represents, which will then lead to different food matching and nutrient intake estimations. When an exact food match cannot be found, general solutions for food matching include:
- calculating data (e.g. mean of different food items, recipe calculation, calculating values from different forms of the same food, calculating values from other components of the same food).
- estimating/imputing data (e.g. values for *peas* used from *green beans*, values for *boiled* used for *steamed,* or assuming a zero value, e.g. no fibre in *meat*). If any food components have been estimated, details should be provided at component value level. It is particularly important to estimate any missing values which are needed for calculating energy. For further information see module 8 of the Food Composition Study Guide (Charrondiere et al., 2011).

- <u>borrowing data from other</u> FCT/FCDBs or other sources of food composition data (e.g. scientific articles, theses, reports). If any component values have been borrowed from a different FCT to the one under consideration, details (source, food code) should be provided. Another option would be to get the information on data from manufacturers, consulting their websites or referring to the information on labels[2] (e.g. for data on processed foods, specific brands of foods).
- <u>Internet search/lexica</u> (e.g. Google or Wikipedia) to identify an unknown food/dish before matching it to foods in FCT/FCDBs.
- When estimating selected nutrients from another food and the difference in the water content is higher than 10 %, it is recommended to adjust all nutrients accordingly. If between the two foods the difference in fat content is higher than 10 %, the fat related components should be adjusted accordingly. The latter is also true for protein, i.e. to adjust values for amino acids.

More specific examples and possible solutions for food matching are given in Annex 1.

Table 2 Food Characteristics influencing the nutrient values

Questions to ask (depending on the purpose)	**Things to watch out for**
PROCESSING and PREPARATION STATE OF THE FOOD	
• Is the food raw, fresh, dried, processed or prepared? • How is the food cooked? o Is it boiled, baked, micro waved, fried, etc.? o Is the visible fat (meat) removed before or after cooking? o Is the peel/skin (vegetables/fish) removed before or after cooking? o How much of the cooking water is absorbed (e.g. rice), or part of the dish (e.g. soup)? o Is the cooking water discarded after cooking? o Is salt added? o Which oil/fat is used for frying? • How is the food processed during manufacturing and what is the impact on the content of the food component? o Are food components containing ingredients added in processing, either for flavouring (salt, seasonings, etc) or functional properties (e.g. preservatives, emulsifiers, anti-caking agents, etc.)? o Is the food canned/preserved in syrup, juice, brine, or oil?	**Influences all food components** • Different cooking methods lead to different values of food components. Users of FCT often apply values of food components for raw foods to prepared foods, without appropriate adjustments (food yield and/or nutrient retention factors), which will lead to major errors in nutrient intake estimations (under- or overestimations). • Different processing methods will have varying impacts on the nutrient profile. o For example, high temperature processing can affect the vitamin content, e.g. Vitamin C. o Discarding of water used in cooking will lead to the loss of water soluble food components (e.g. B vitamins, vitamin C, and certain bioactive components). o Frying: total fat content increases and fatty acid profile changes according to oil/fat used for frying. o In general, high temperature/short time processes have a lesser impact on the content of food components than low temperature/long time processes For more information on the influence of different cooking methods on values of food components see Greenfield and Southgate, 2003, pages 41-42. • Nutrient values are different if the food is canned/preserved e.g. in juice or in oil.

[2] However, data on labels and company web sites is frequently expressed per serving and in terms of some labeling standard (e.g. % Daily Value in the U.S.) and may need to be converted to the 100 grams basis in the appropriate units. Furthermore, nutrition labels and company web sites may contain only a limited set of nutrients, and nutrients of interest for the particular study will probably be missing.

Questions to ask (depending on the purpose)	**Things to watch out for**
COLOUR	
• What is the colour of the food? • What is the intensity of the colour? E.g. is it dark green or pale green?	**Influences selected food components** • Different colours may indicate differences in variety as well as different stages of maturity and spoilage, which may have different values for selected nutrients, in particular micronutrients, e.g. carotenoids in carrots and sweet potatoes; anthocyanins in purple coloured beets and berries.
BIODIVERSITY	
• Can the variety/cultivar (plants) or species/breed (animal) of the food be identified? • Which variety or breed is consumed?	**Influences all food components** • It is increasingly recognized and documented that the food component content of foods is significantly affected by the cultivar, variety or breed. In different varieties of the same species, the composition of macronutrients can vary 10-fold and micronutrients by up to 1000-fold, representing the same variation as found between species. Additionally, biodiversity affects the weight per piece, e.g. the weight of a zucchini can vary according to variety from 100 g to 1 kg.
MATURITY STAGE	
• Is it ripe or unripe, e.g. mango? • Is it an immature or mature form, e.g. beans? • What is the age of the animal, e.g. veal versus beef?	**Influences all food components (e.g. ripe/unripe; immature/mature)** • Immature versus mature form. E.g. common beans (*Phaseolus vulgaris*) can be consumed as a vegetable in the immature form, or as dry bean in the mature form (requiring a longer cooking time). Veal has a different nutrient profile than beef. • Ripe versus unripe: Fruit, e.g. mango, has much higher carotenoid content than the corresponding less ripe or unripe fruit. **Influences selected food components (e.g. different colour due to maturity stage)** • Maturity affects colour E.g. green versus red sweet pepper (capsicum).
WILD vs. DOMESTICATED PLANTS and ANIMALS	
• Is it wild or domesticated?	**Influences all food components** • Nutritional values may differ between wild and domesticated forms of animals and plants. • Within domesticated plants, agricultural practise such as fertilizers, soil type, time of harvest, will influence the nutritional composition of food items. • For domesticated animals, the animal's diet (e.g. grass fed .vs. grain fed) and production practices will influence the nutritional composition of the resulting food items.
PART/SOURCE of the food	
• Which part of the animal/plant is consumed? • Which meat cut is consumed?	**Influences all food components** • The food component values can vary depending on the different parts of the food, so food matching needs to be done carefully based on the detail in the food descriptions. • Examples: o *Chicken* can be *chicken breast* or *chicken leg* o *Beef* has many different "cuts" with varying ratios of fat to lean, which affect the nutrient profile o *Cassava* can mean either the *tube*r or the *leaves*
REFUSE/EDIBLE PORTION	
• Which parts are edible? • Is the food consumed with or without the skin? (e.g. *apple, peach*)	**Influences all food components** • Parts of the food considered edible vary around the world (cultural differences) and among different ethnic, age or gender groups within a country. For example, children may consider the fuzzy skin of a peach inedible, while adults may not. Similarly, peaches may be eaten with the skin in some countries, but not in others. Therefore, it is important to check the food descriptions and the edible portion carefully when borrowing data from other countries. • Examples: o *Tops and bottoms of beets* o *Rind of cheese* o Parts of animals; *fish with and without head or skin* o *Apple, with or without skin*

Questions to ask (depending on the purpose)	Things to watch out for
	o *Walnuts (can be in shell or shelled)* The unit weight and the variety need to be considered as well— e.g. banana: small unit weight = higher refuse factor. (big banana – less refuse)
FORTIFICATION/ENRICHMENT [3] of processed food **Fortification and supplementation [4]**	
• Is the food fortified/enriched? • With what is the food fortified/enriched? • Which fortification/enrichment standards are used in the country? • To which level are food components added? E.g. 25 % of the recommended daily value or exact amount is provided. • Is the food imported from a country where the food is generally fortified/enriched? • Does the food/dish contain an ingredient that maybe fortified/enriched?	**Influences selected food components** • Food fortification/enrichment is widely used in developed countries and increasingly used in developing countries. Food components added include mostly vitamins and minerals. Foods which are commonly fortified/enriched include cereals and cereal based products, milk and milk products, fat and oil items, sugar, tea and other beverages such as fruit juices or sports drinks. The level of fortification/enrichment is country specific because of different food standards in each country. Even for the same brand name, fortification/enrichment can vary among countries. • Some foods e.g. breakfast cereals are voluntarily fortified/enriched foods, while others are mandatorily fortified/enriched, depending on the country. Fortified/enriched foods are usually not reported in FCT/FCDBs. In countries were fortification/enrichment is mandatory, these fortified/enriched foods may be included in the FCT, but not be necessarily specified as such.

[3] Fortification= the addition of one or more essential nutrients to a food, whether or not it is normally contained in the food. Enrichment = the restoration of vitamins and minerals lost during processing (FAO, 1995).
[4] Although food supplements are generally not included in FCTs, it is important to be aware that the inclusion of supplements considerably increase the nutrient intake estimations

IV. Food component matching

Before using sources of food composition data, it is necessary to check the food component identification as well as the units and denominators.

1. Food component identification

The comparability of food components of interest should be checked carefully. There are many food components that informally have the same name but vary because of differences in:

- expression (e.g. carbohydrates available: expressed in monosaccharide equivalents vs. by weight),
- definition (e.g. vitamin A: retinol activity equivalents vs. retinol equivalents) or
- analytical methods resulting in different values (e.g. fibre: AOAC-Prosky vs. crude).

Components for which this is relevant include energy, protein, carbohydrate, fat, fibre, vitamins A, D, E and C, folate, vitamin B_6 and niacin. For more details see Annex 2, the INFOODS tagnames (INFOODS, 2012) and Charrondiere et al., (2011a, b) - Module 4b.

Energy values of foods should always be calculated according to the user's purpose and not be copied from other sources. The calculations are based on the application of energy conversion factors for protein, fat, available carbohydrates, fibre and alcohol (see Table 3; INFOODS recommended metabolized energy conversion factors). For more information on energy conversion factors see FAO (2003).

Table 3 Metabolized energy conversion factors

	kJ/g (recommended unit)	**kcal/g**
Protein	17	4
Fat	37	9
Available/total carbohydrates	17	4
Fibre*	8	2
Alcohol	29	7

* If only a total carbohydrate value is available, no energy is attributed to the fibre value

2. Units and denominators

It is necessary to pay attention to units and denominators when attributing values of food components from FCT to survey data in order to avoid errors in the nutrient intake estimations.

-Units quantify the amount of a component (g, mcg, IU, kJ of a component)

-The denominator indicates in which food quantity the component can be found, e.g. per 100 g edible portion (default denominator in FCT/FCDBs) per kg, per 100 g total food, per 100 g total fat, per 100 g dry matter.

Care should be taken when copying values from different sources of food composition data, e.g. scientific articles, university reports, theses. In particular, in the scientific literature food components are often reported in different denominators such as per 100 g dry matter, per 100 g fat, per 100 g protein or per 100 g total food. To address these issues, FAO and INFOODS developed the *Guidelines for Converting Units, Denominators and Expressions- Version 1.0* (FAO/INFOODS, 2012a)

Special attention needs to be given to liquids as they have different densities. Many surveys and scientific literature, as well as a few FCT/FCDB report liquids and some food such as ice-cream per 100 mL, while in most FCT/FCDBS the units used are per 100 g. Recalculations from mL to mg may be needed using density factors to convert from one unit to another. FAO and INFOODS developed a density DB to convert volumes into weight and vice versa (FAO/INFOODS, 2012b).

Annex 1: Selected examples and possible solutions for food matching

The selected examples listed below are structured according to different characteristics that substantially influence the food component values. In practice, these factors do not always occur separately as outlined below; more than one characteristic can be relevant for a particular food.

Many of the possible solutions listed below, include that more information on the consumption data should be obtained in order to calculate e.g. a weighted mean. Information on the consumption data may be obtained through e.g. consulting Ministries of health/agriculture of the particular country, getting trade or sales data (which however, often need to be purchased), or checking the literature.

Food as reported in FC-Surveys	Related foods in FCT	Problems	Possible Solutions
PROCESSING and PREPARATION STATE OF THE FOOD			
Tomato, pan-fried with olive oil	-Tomato, raw -Tomato, boiled	Data are not available for a specific preparation. If *tomato raw*, or *tomato, boiled* is selected, values of food components will be underestimated, since pan- frying tomatoes leads to a water loss and a higher fat content due to added oil.	The best solution in this case is a recipe calculation. Prepare a recipe with 2 ingredients, applying yield and nutrient retention factors: 1. *Tomato, raw* 2. *Olive oil*, considering the amount that will be absorbed by the tomato, and the amount left in the pan. For more information on recipe calculation see Charrondiere et al. (2011a, b) -Module 8.
Green leaves, sun -dried	Green leaves, raw	Data not available for a specific processed food. Drying of food results in water loss and consequently leads to a concentration of all other food components. Other losses can occur due to oxidation and the destruction of heat-labile components. Therefore, *green leaves raw,* cannot be matched to *green leaves, sun-dried*. This would lead to a major underestimation of food component values.	• Values for dried food may be calculated using values from raw food, if the water content of the dried food is known, or it can be borrowed from another FCT. • Factors for water loss and nutrient retention will need to be applied. However, no official data on nutrient retention factors for drying/sun-drying exist. Therefore, these data need to be developed. Few data are available in the scientific literature, e.g. Ndawula et al. (2004) observed a decrease in beta-carotene content up to 60% and Vitamin C content up to 80% in cowpea leaves, due to sun-drying. Until no official nutrient retention factors exist, the best solution, may be to analyse representative samples (if the food

Food as reported in FC-Surveys	**Related foods in FCT**	**Problems**	**Possible Solutions**
			is widely consumed), or simply to use the closest retention factors one can find (if the food is not widely consumed).
Milk, cow, liquid	-Milk cow, liquid, 3.5% fat -Milk cow, liquid, skimmed, 1.5% fat	Related foods in FCT are more specific than the food reported in the survey. Matching *milk cow, liquid, 3.5% fat* or *milk cow, liquid, skimmed 1.5% fat*, without knowing the actual consumption pattern of the target group, will lead to errors in nutrient intake estimations in particular of energy, fat and fat-soluble vitamins.	• If possible, more information on the consumption data should be obtained (see introductory text of Annex 1) to calculate a weighted mean between the two food entries. • If no information can be obtained, it is advisable to calculate an arithmetic mean of the different entries. • Do not just match to only one food item unless the food is infrequently consumed (see general aspects, page 4, of the current document).Calculating a mean will at least reduce the bias.
Milk, cow	-Milk cow, liquid, 3.5% fat -Milk cow, liquid, skimmed, 1.5% fat -Milk, dry, whole -Milk, dry, non fat	Related foods in FCT are more specific than the food reported in the survey. Milk, cow is a very broad category and could include all the possible foods listed in the FCT. The single food entries vary substantially not only due to different fat contents but also due to their different forms of concentration (liquid versus dry).	
PROCESSING and PREPARATION STATE OF THE FOOD			
Beef steak, without visible fat, grilled	-Beef, corned -Beef, salted, fat removed -Beef, cooked -Beef, medium fat -Beef, fat -Beef, lean	Data not available for the specific preparation method indicated.	Considering the related foods in the FCT, following is observed: • *Beef, corned* - is a salt cured product and does not match the reported item • *Beef, salted*, fat removed - may also be a cured product, but the food description lacks sufficient detail • *Beef, cooked* – is not specific to the fat content or cooking method • *Beef, medium fat* – contains too much fat • *Beef, fat* – The food description is imprecise, and the item may refer to the separable fat ***Beef, lean*** – is probably the best choice, because once the visible fat is trimmed (*beef steak <u>without visible fat</u>*) it is similar to lean meat. However, the food description in the FCT does not indicate if the beef is raw or cooked, and if cooked, which cooking method is used. If the selected food in the FCT is raw, appropriate yield and nutrient retention factors will need to be applied. For more information on recipe

Food as reported in FC-Surveys	Related foods in FCT	Problems	Possible Solutions
			calculation see Charrondiere et al. (2011a, b)-Module 8.
Frozen lasagne (Kraft Foods)	not available	This food is not included in the FCT/FCDB. Generally, data on processed foods are frequently not reported in a FCT. In addition, specific brands of foods identified in a survey may not be reported in the FCT/FCDB.	• One solution would be to get the information from manufacturers, but this can be a major challenge. • Referring to information on the labels or consulting the websites of the manufacturers would be another option. However, data on labels and company websites is frequently expressed per serving in terms of some labelling standard (e.g. % Daily Value in the U.S.) and may need to be converted to the 100 grams basis in the appropriate units. In addition only few nutrients are on the label. • If no data can be obtained, get information of a standard recipe from e.g. national cooking books or websites and conduct a recipe calculation by applying appropriate yield and nutrient retention factors. For more information on recipe calculation see Charrondiere et al. (2011a, b)-Module 8.
COLOUR OF THE FOOD			
Mango, dark orange flesh, very ripe	-Mango, raw -Mango, ripe -Mango, orange flesh	Different colours and different maturity stages indicate different nutrient contents, in particular of micronutrients, e.g. carotenoids	• *Dark orange mango, very ripe* indicates that the food is high in carotenoidss. Therefore, care must be taken in matching the *dark orange mango, very ripe* to the mango with the <u>highest carotenoid values</u>.
Leaves, raw	-Leaves, dark green, raw -Leaves, green, raw	Colour *of leaves, raw* is not indicated in the Food Consumption Survey. Different colours indicate different contents of food components, in particular of micronutrients, e.g. carotenoids. *Leaves, dark green raw*, have a much higher carotenoid content than *leaves, green raw*.	• If possible, more information on the consumption data should be obtained (see introductory text of Annex 1) to calculate a weighted mean between the two food entries. • If no information can be obtained, it is advisable to calculate an arithmetic mean of the different entries. • Do not just match to only one food item unless the food is infrequently consumed (see general aspects, page 4, of the current document).Calculating a mean will at least reduce the bias.
BIODIVERSITY			
Mango Badami, dark orange fleshed	Mango	Food reported in survey is very specific, while FCT has a generic food item. It is known that there are large differences in e.g. beta-carotene among different cultivars. The beta-carotene content for *mango*, reported in the FCT is an average value. Therefore, nutrient intake estimations in	• It is necessary to search in other FCT/FCBSs, or other sources of food composition data (scientific articles, theses, reports) for a more appropriate beta-carotene value for mango, which may allow a better match and a better vitamin A intake estimation.

Food as reported in FC-Surveys	Related foods in FCT	Problems	Possible Solutions
		regard to vitamin A will be substantially underestimated.	
Apple	-Apple, Granny Smith -Apple, own country -Apple, imported Apple, all varieties	The reported food is not specific in terms of variety	• If possible, more information on the consumption data should be obtained (see introductory text of Annex 1) to calculate a weighted mean between the two food entries. • If no information can be obtained, it is advisable to calculate an arithmetic mean of the different entries. • Do not just match to only one food item unless the food is infrequently consumed (see general aspects, page 4, of the current document).Calculating a mean will at least reduce the bias. However, "apple, all varieties" represents a generic apple and could be used.
PART/SOURCE of food			
Lamb meat	-Lamb, loin, separable lean and fat -Lamb, loin, separable lean only -Lamb, shoulder, whole (arm and blade), without visible fat -Lamb rib, separable lean only -Lamb, leg, centre slice, bone-in or boneless	It is not stated which part of the lamb is consumed. Moreover no information is given whether the *lamb meat* is raw or cooked and if cooked, how.	• If possible, more information on the consumption data should be obtained for both, the most consumed part of the meat, as well as the most commonly used cooking method (see introductory text of Annex1). This information will allow calculating a weighted mean between the two food entries. • If no information can be obtained, it is advisable to calculate an arithmetic mean of the different entries. • Do not just match to only one food item unless the food is infrequently consumed (see general aspects, page 4, of the current document).Calculating a mean will at least reduce the bias. • If the reported food is cooked, appropriate yield and nutrient retention factors will need to be applied, after investigating of the most commonly used cooking method. For more information on recipe calculation see Charrondiere et al. (2011a, b)-Module 8.
Apple	-Apple, peeled -Apple, whole with skin	No information is given whether the food is consumed with or without the skin.	• If possible, more information on the consumption data should be obtained (see introductory text of Annex 1) to calculate a weighted mean between the two food entries. • If no information can be obtained, it is advisable to calculate an arithmetic mean of the different entries. • Do not just match to only one food item unless the food is infrequently consumed (see general aspects, page 4, of the current document).Calculating a mean will at least reduce the bias.

Food as reported in FC-Surveys	**Related foods in FCT**	**Problems**	**Possible Solutions**
Milk	-Milk, buffalo, raw -Milk, cow, 3.5% fat, raw -Milk, cow, 1.5% fat, raw -Chocolate milk -Milk, goat, raw -Milk, rice -Milk, soy	It is not known which type of milk is consumed. The term *milk* is very generic. The difference in all values of food components can vary substantially e.g. with different species, fat contents and additions e.g. chocolate.	• If possible, more information on the consumption data should be obtained (see introductory text of Annex 1) to calculate a weighted mean between the two food entries. • Consider cultural aspects. For example, in some countries buffalo and goat milk may be difficult to find in urban areas, or somewhere else rice and soy milk would not be considered as milk. • If no additional information can be obtained, calculate the mean of all the entries, after excluding any implausible food items according to your expert judgement.
EDIBLE PORTION			
Sardine	-Sardine, fillet, -Sardine, whole	It is not known if the fish is consumed whole or as fillet. Values of calcium, vitamin A and fat may vary substantially depending if *sardine, whole* or if just the *sardine, fillet* is consumed.	• If possible, more information on the consumption data should be obtained (see introductory text of Annex 1) to calculate a weighted mean between the two food entries. • If no information can be obtained, it is advisable to calculate an arithmetic mean of the different entries. • Do not just match to only one food item unless the food is infrequently consumed (see general aspects, page 4, of the current document).Calculating a mean will at least reduce the bias
FORTIFICATION			
Wheat flour, white	-Wheat flour, white, all-purpose, enriched, calcium-fortified -Wheat flour white, bread, unenriched -Wheat flour, white, fortified with iron, vitamin B, folic acid	The food reported in the survey does not indicate whether it is fortified/enriched, or not. Micronutrient content varies significantly according to the food components added. It is necessary to have a good idea of the country's food supply to be able to make a decision about what is the most commonly available form of the food. Is the food mainly imported? What are the regulations in this country?	• If considering micronutrients, generally take un-enriched food item when available, rather than enriched. But this will depend on the country and you will need to investigate national food regulations regarding fortification/enrichment. • If the consumed food is fortified/enriched, but no fortified food is found in the FCT look for other sources, e.g. check label information or consult food manufacturers in the country. Note that what is listed on the label are the contents of food components as, they should be present at the end of the shelf-life of the product. So for vitamins, the value from the label may actually be higher than the actual content.

Food as reported in FC-Surveys	Related foods in FCT	Problems	Possible Solutions
BROAD CATEGORIES			
Butter/Cheese	-Butter, salt added -Butter without salt -Cheese, goat hard type -Cheese, low fat, cheddar or Colby -Cheese, mozzarella, whole milk -Cheese, tilsit -Cheese, ricotta, -Parmesan	Very broad category	• If possible, more information on the consumption data should be obtained (see introductory text of Annex 1) to calculate a weighted mean between the two food entries. • If no information can be obtained, it is advisable to calculate an arithmetic mean of the different entries. • Do not just match to only one food item unless the food is infrequently consumed (see general aspects, page 4, of the current document).Calculating a mean will at least reduce the bias. Other examples of broad categories found in different consumption surveys are e.g. biscuits, meat, pasta, milk products.
RECIPE UNKNOWN			
Muri (Product of rice) /Bangladesh	Rice, raw	Food form the consumption survey cannot be found in the FCT. Unknown recipe	• Google, Wikipedia search to identify the food. (E.g. Muri =fried rice. It is a traditional food of Bangladesh and India). Search for a standardized recipes in the particular country/region. Information could be retrieved e.g. trough national cooking books, websites. • Recipe calculation. List all the necessary ingredients for Muri and apply yield and nutrient retention factors appropriately. • For more information on recipe calculation see Charrondiere et al. (2011a, b)-Module 8.
EXOTIC FOODS			
Grasshopper	Not available	Food form the consumption survey cannot be found in the FCT.	• It is necessary to search in other FCT/FCBSs, or other sources of food composition data (scientific articles, theses, reports) for the particular food, e.g. the Chinese FCT contains many different exotic foods.
Insects	Not available	Food form the consumption survey cannot be found in the FCT. Moreover, the requested food item *insects* is a broad category.	• It is necessary to search in other FCT/FCBSs, or other sources of food composition data (scientific articles, theses, reports) for the particular food, e.g. the Chinese FCT contains many different exotic foods (China Food Composition, 2002). • Match at least 3 foods since insects is a broad category and calculate a mean of the different entries, unless it is an unimportant food in which case it can be matched to one food.

FC = Food Consumption

Annex 2: Summary description of components and their INFOODS tagnames.

For more information on the INFOODS tagnames see INFOODS (2012), Charrondiere et al. (2011a, b) - Module 4b and Klensin et al. (1989)

Component	INFOODS taganmes	Unit*	Comments
Protein	**PROTCNT (formerly PROCNT or PROT):** protein, total; calculated from total nitrogen **PROTPL (formerly PROPLA):** protein from plant origin **PROTAN (formerly PROANI) :** protein from animal origin	g	The protein values are most often derived trough total nitrogen determination via Kjeldahl and then multiplied by specific nitrogen conversion factors. List of different conversion factors- see FAO/INFOODS (2012a)
Fat	**FAT** : Fat, total. Sum of triglycerides, phospholipids, sterols and related compounds. The analytical method is a mixed solvent extraction: **FATCE:** Fat, total, Soxhlet. Derived by analysis using continuous extraction. This method does not extract all fat in some food groups and privides therefore a lower fat value. **FAT-:**Fat, total, method of determination unknown or mixed methods **FATNLEA:** Fat, total, by NLEA definition (triglyceride equivalents of fatty acids). This is used for labeling in the United States of America	g	FAT: Fat, total, derived by mixed solvent extraction is the preferred method.
Carbohydrate	**CHOAVL:** Available Carbohydrates by weight. Sum of analytical values of sugars, starch and glycogen **CHOAVLM:** Available Carbohydrates in monosaccharide equivalent. Sum of analytical values of sugars, starch, glycogen. It includes the residual water from the hydrolysis around each monosaccharide. **CHOAVLDF:** Available Carbohydrate by difference. This values is calculated: 100-(Water + Protein +Fat +Alcohol +Ash +Fibre) **CHOCDF:** Total Carbohydrate by difference. This value is calculated: 100- (Water + Protein + Fat + Alcohol +Ash) **CHOCSM:** Total Carbohydrates: Sum of analytical values of sugars, starch, oligosaccharides and dietary fibre	g	The main difference in carbohydrates relates to: - whether or not fibre is included, - if it is analysed or calculated by difference, - if the value is expressed in anhydrous form or monosaccharide equivalents. FCT/FCDBs report different forms of carbohydrates, e.g. - USDA: CHOCDF - UK (McCance &Widdowson`s) : CHOAVLM - Australia: CHOAVL Generally, available carbohydrates by weight is the most recommended method, but many countries without analytical data for carbohydrates use CHOAVLDF. CHOCDF is obsolete and should be avoided.
Fibre	**FIBTG:** Total dietary fibre by AOAC Prosky method. Mixture of non-starch polysaccharides, lignin, resistant starch and resistant oligosaccharides. **FIBTS:** Southgate fibre: mixture of non-starch polysaccharides, lignin and some resistant starch **PSACNS/NSP:** Non-starch polysaccharide, Englyst fibre. This includes non-starch polysaccharides but excludes lignin, resistant starch and resistant oligosaccharides.	g	FIBTG = (FIBTS) > PSACNS/NSP > FIBC Dietary fibre by Prosky (FIBTG) captures most completely the components with dietary fibre functions, followed by FIBTS and PSACNS/NSP. Crude fibre, however is the least recommended method. Values for crude fibre should be avoided.

Component	INFOODS taganmes	Unit*	Comments
	FIBC: Crude fibre		
Vitamin A	**VITA_RAE** : Total vitamin A activity expressed in mcg retinol activity equivalent **(RAE)** = mcg retinol+ **1/12** mcg ß- carotene + **1/24** mcg other provitamin A carotenoids (or RAE= mcg retinol + 1/12 mcg ß- carotene equivalent) **VITA**:Total vitamin A activity expressed in mcg retinol equivalent **(RE)** = mcg retinol+ **1/6** mcg ß-carotene + **1/12** mcg other provitamin A carotenoids (or RE= mcg retinol + 1/6 mcg ß- carotene equivalent) **VITAA**:Vitamin A, determined by bioassay	mcg	Recent research indicates that vitamin A calculated as RAE is more appropriate because the conversion from carotenes into vitamin A is not as effective as originally thought.
Vitamin E	**VITE:** Vitamin E: active tocopherols and tocotrienols, calculated as mg α-tocopherol equivalents = α-tocopherol + 0.4 ß-tocopherol ß-tocopherol + 0.1 γ-tocopherol+ 0.01 δ-tocopherol+ 0.3 α-tocotrienol + 0.05 α-tocotrienol + 0.01 γ-tocotrienol **(mostly used)** = α-tocopherol + 0.5 ß-tocopherol + 0.1 γ-tocopherol+ 0.3 α-tocotrienol = α-tocopherol + 0.4 ß-tocopherol + 0.1 γ-tocopherol + 0.01 δ-tocopherol **TOCPHA :** α-tocopherol. In some databases, e.g USDA (used to represent Vitamin E) **VITEA :** Vitamin E, determined by bioassay	mg	VITE > TOCPHA VITE yields higher results than TOCPHA Generally FCT/FCDBs use VITE. However, some FCT report TOCPHA, as according to the IOM report (2000) α-tocopherol is the only type of vitamin E that the human body can maintain and transfer to cells when needed because it seems to be the only vitamin E form with a good affinity for hepatic α-TTP.
Vitamin D	**VITD:** Vitamin D (D2+D3): sum of ergocalciferol (only occurring in plant foods) and cholecalciferol (occurring in animal foods). This definition is mostly used **CHOCAL:** Cholecalciferol (D3) **VITDEQ:** Vitamin $D_3 + D_2 + 5$ x 25-hydroxycholecalciferol **VITDA:** Vitamin D, determined by bioassay. The nutrient values are generally higher than the values determined chemically.	mcg	D2: occurring in plant foods D3: occurring in animal foods
Niacin	**NIA:** Niacin, preformed **NIAEQ: Niacin** equivalents, total: Preformed niacin plus niacin equivalents from tryptophan **NIATRP:** Niacin equivalents from tryptophan: 1/60 x tryptophan	mg	
Vitamin B_6	**VITB6A**: vitamin B_6, total; determined by analysis **VITB6C**: vitamin B_6, total; calculated by summation **VITB6-:** Vitamin B_6, method unknown or variable	mg	

Component	INFOODS taganmes	Unit*	Comments
Folate	**FOL:** Total folate: food folate + folic acid (determined by microbiological assay) **FOLSUM:** folate, sum vitamers. It includes mostly tetrahydrofolate, 5-methyltetrahydrofolate, 5-formyltetrahydrofolate, 10-formylfolic acid, 10-formyldihyrdofolate and folic acid (determined by HPLC). **FOLAC:** Folic acid. Synthetic folic acid used in fortification **FOLFD:** Food folate: naturally occurring food folate (determined by microbiological assay) **FOLDFE:** Dietary folate equivalent: food folate + 1.7 x synthetic folic acid	mcg	The terms "folate" and "folic acid" are often used as synonyms in FCT which leads to confusion: folic acid does not occur naturally but is used for fortification FOL is in general higher than FOLSUM and is the recommended expression.
Vitamin C	**VITC**: vitamin C: L-ascorbic acid plus L-dehydroascorbic acid. Usually analysed by HPLC **ASCL:** L-ascorbic acid. Values are comparable with vitamin C, in unprocessed foods. Titrimetry can normally analyze L-ascorbic acid only **ASCDL**: L-dehydro-ascorbic acid (=oxidized form of VITC)	mg	VITC generally gives highest values. In fresh food however, VITC and ASCL should give comparable results, since the oxidized form of VITC is, if existing, very low.

* recommended units

References

Bognár, A. (2002) Tables of weight yield of food and retention factors of food constituents for the calculation of nutrition composition of cooked foods (dishes). Bundesforschungsanstalt für Ernährung, Karlsruhe. Available at: http://www.mri.bund.de/fileadmin/Veroeffentlichungen/Archiv/Schriftenreihe_Berichte/bfe-r-02-03.pdf (Accessed November, 2012).

Charrondiere, U.R., Burlingame, B., Berman, S., Elmadfa, I. (2011a) Food Composition Study Guide. Questions and exercises (volume 1) – second revised edition. FAO, Rome. Available at: http://www.fao.org/infoods/infoods/publications/en/ (Accessed November, 2012).

Charrondiere, U.R., Burlingame, B., Berman, S., Elmadfa, I. (2011b) Food Composition Study Guide. Questions, exercises and answers (volume 2) – second revised edition. FAO, Rome. Available at: http://www.fao.org/infoods/infoods/publications/en/(Accessed November, 2012).

Charrondiere, U.R. (2011) Use of food composition data including limitations. PowerPoint. FAO, Rome. Available at: ftp://ftp.fao.org/ag/agn/infoods/use%20of%20FCD%20including%20limitations.pdf (Accessed November, 2012).

China Food Composition (2002) Institute of Nutrition and Food Safety China CDC, Beijing 2002. 393 pp (Chinese & English). Available at: http://www.fao.org/infoods/infoods/tables-and-databases/en/ (Accessed November, 2012).

EuroFIR (2008) Report on collection of rules on use of recipe calculation procedures including the use of yield and retention factors for imputing nutrient values for composite foods. Available at: http://www.langual.org/langual_linkcategory.asp?CategoryID=9&Category=Recipe+calculation+and+nutrient+retention+factors (Accessed November, 2012).

FAO (2003) Food energy - methods of analysis and conversion factors. *FAO, Rome*. Available at: ftp://ftp.fao.org/docrep/fao/006/y5022e/y5022e00.pdf (Accessed November, 2012).

FAO (1995) Technical Consultation on food fortification: Technology and Quality control, Rome Italy, 20-23 November 1995. Available at: http://www.fao.org/docrep/W2840E/w2840e0b.htm#1.2%20food%20fortification:%20a%20definition (Accessed November, 2012).

FAO/INFOODS (2012a) FAO/INFOODS Guidelines on Conversion among different units, denominators and expressions version 1.0. Available at http://www.fao.org/infoods/infoods/standards-guidelines/en/ (Accessed November, 2012).

FAO/INFOODS (2012b) FAO/INFOODS Density Database version 2.0 (2012). Available at: http://www.fao.org/infoods/infoods/tables-and-databases/en/ (Accessed November, 2012).

Greenfield, H. & Southgate, D.A.T (2003) Food composition data – production, management and use. FAO, Rome. Available at: ftp://ftp.fao.org/docrep/fao/008/y4705e/y4705e00.pdf (Accessed November, 2012).

Haytowitz, D.B., Pehrsson, P.R. & Holden, J.M. (2002) The Identification of Key Foods for Food Composition Research. Journal of Food Composition and Analysis 15 (2): 183-194. Available at: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2704478/ (Accessed November, 2012).

INFOODS (2012) Tagnames for food components. Available at: http://www.fao.org/infoods/infoods/standards-guidelines/food-component-identifiers-tagnames/en/ (Accessed November, 2012).

IOM (2000) Dietary Reference Intakes for Vitamin C, Vitamin E, Selenium and Carotenoids. National Academy of Sciences. Institute of Medicine. Food and Nutrition Board. Available at: http://www.iom.edu/Reports/2000/Dietary-Reference-Intakes-for-Vitamin-C-Vitamin-E-Selenium-and-Carotenoids.aspx (Accessed November, 2012).

Klensin, J.C., Feskanich, D., Lin, V., Truswell, S.A. & Southgate, D.A.T (1989) Identification of Food Components for INFOODS Data Interchange. UNU, Tokyo. In PDF file: Introduction pp. 5-15 and pp. 72-90 to find tagnames. Available at: http://www.unu.edu/unupress/unupbooks/80734e/80734E00.htm and as PDF file at ftp://ftp.fao.org/es/esn/infoods/Klensinetal1989Identificationoffoodcomponents.pdf. (Accessed November, 2012).

McCance and Widdowson's (2002) 6th Summary Edition, The Composition of Foods, Food Standards Agency and Institute of Food Research, Royal Society of Chemistry, Cambridge

Ndawula, J., Kabasa, J.D. Byaruhanga, Y.B. (2004) Alterations in fruit and vegetables b-carotene and vitamin C content caused buy open- sun drying, visqueen-covered and polyethylene- covered solar-dryers. African Health Sciences 4 (2): 125-130.

Rand, W.M., Pennington, J.A.T., Murphy, S.P., Klensin, J.C. (1991) Compiling Data for Food Composition Data Bases. United Nations University, Hong Kong. Available at: http://archive.unu.edu/unupress/unupbooks/80772e/80772E00.htm and http://www.fao.org/fileadmin/templates/food_composition/images/Rand_et_al_1991_Compiling_Food_Composition_Data_Bases.pdf

Additional literature

Csizmadi, I., Kahle, L., Ullman, R., Dawe, U., Zimmerman, T.P., Friedenreich, C.M., Bryant, H., and Subar, A.F. (2006) Adaptation and evaluation of the National Cancer Institute's Diet History Questionnaire and nutrient database for Canadian populations. Public Health Nutrition 10 (1):88-96.

Dixon, B.L., Zimmerman, T.P., Kahle, L.L., Subar, A.F. (2003) Adding carotenoids to the NCI Diet History Questionnaire Database. Journal of Food Composition and Analysis 16 (3): 269-280.

FAO/INFOODS (2012) FAO/INFOODS Guidelines for Checking Food Composition Data prior to the Publication of a User Table/Database-Version 1.0. FAO, Rome. Available at http://www.fao.org/fileadmin/templates/food_composition/documents/upload/Guidelines_data_checking.pdf (Accessed November, 2012).

McNutt, S., Zimmerman, T.P., and Hull, S.G (2008) Development of food composition databases for food frequency questionnaires (FFQ). Journal of Food Composition and Analysis 21: S20-S26.

Salvini, S., Gnagnarella, P., Parpinel, M.T., Boyle, P., Decarli, A., Ferraroni, M., Giacosa, A., La Vecchia, C., Negri, E., Franceschi, S. (1996) The Food Composition Database for an Italian Food Frequency Questionnaire. Journal of Food Composition and Analysis 9 (1): 57-71.

Schakel, S.F., Buzzard, I.M., Gebhardt, **S.E.** (1997) Procedures for estimating nutrient values in food composition databases. Journal of Food Composition and Analysis 10:102–114.

Sharma, S., Murphy, S.P., Wilkens, L.R., Au, D., Shen, L., and Kolonel, L.N. (2003) Extending a multiethnic food composition table to include standardized food group servings. Journal of Food Composition and Analysis 16:485-495.

Slimani, N., Deharveng, G., Unwin, I., Vignat, J., Skeie, G., Salvini, S., Moller, A., Ireland, J., Becker, W., Southgate, D.A.T. (2007) Standardisation of an European end-user nutrient database for nutritional epidemiology: what can we learn from the EPIC Nutrient Database (ENDB) Project?, Trends in Food Science & Technology 8 (8) :407-419.

This list is not exhaustive.