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Report

Harmonisation of recipe calculation procedures in European food composition databases

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ABSTRACT

Within EuroFIR, the European Food Information Resource (EuroFIR) project, the European Network of Excellence on Food Composition Databank systems, a standard recipe calculation procedure has been developed for use with European food composition databases. This project reviewed the most commonly used recipe calculation procedures together with the examples of recipe calculation procedures used by European databases. The review showed that the most commonly used method was a procedure that applies a yield factor for weight at the recipe level and retention factors for nutrient values at the ingredient level. This commonly used procedure was selected as the recommended EuroFIR recipe calculation procedure. The benefits of harmonised recipe calculation procedures include improved quality, availability and compatibility of food composition data through the documentation of the recipe ingredients, the recipe calculation procedures, yield factors and retention factors.

1. Introduction

Composite foods are major dietary items that must be included and managed in food composition databases (Arab, 1987; Schakel et al., 1997; Schlotke et al., 2000; Unwin, 2000). A composite food contains one or more ingredients and is prepared or cooked at home or, by a food industry or catering service. The nutrient contents of composite foods are usually estimated indirectly by using recipes, factors for weight changes in cooking, and factors for changes in nutrient content during cooking (Greenfield and Southgate, 2003). Because of the abundance and ever increasing variety of these kinds of foods, it is practically impossible to carry out chemical analyses for all composite dishes as it would considerably raise the cost of compiling a comprehensive food composition database. However, it is important to have analysed nutrient values for the ingredients of composite foods in food composition databases because these are the basis for calculating the nutrient values of composite foods.

In recipe calculation procedures, the nutrient content of composite foods is based on the nutrient content of each ingredient, information concerning cooking or processing and the sensitivity of nutrients or components to the cooking or processing methods. The changes in weight of the ingredients during cooking and food processing are taken into account by using yield factors (Fig. 1), which are determined by the temperature and time of cooking and by the cooking or processing method (Holcomb et al., 2002; Schakel et al., 1997; Unwin, 2000). Changes in the nutrient content of the ingredients during preparation are taken into account by using nutrient retention factors (Leskova et al., 2006).

The European Food Information Resource (EuroFIR) project, a partnership between 48 universities, research institutes, and small-to-medium sized enterprises from 25 European countries began in 2005 (Denny et al., 2009). EuroFIR will provide the first comprehensive pan-European food information resource to allow effective management, updating, extending and comparability of food composition data. The main aim of EuroFIR is the harmonisation and standardisation of food composition data in Europe. The harmonisation of recipe calculation is also included and is based on the database specifications for food items, food groups, recipes, processing, nutrients and yield and retention factors (Becker et al., 2008).

The purpose of this paper is to review the most commonly used recipe calculation procedures along with examples of recipe calculation procedures within the EuroFIR databases and to present the recommended recipe calculation procedure for the management of European food composition databases.

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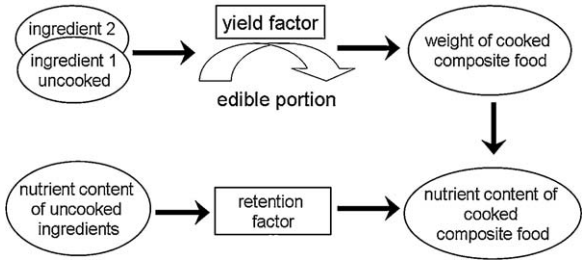

Fig. 1. Overview of the recipe calculation procedure.

2. Previous efforts to harmonise recipe calculation procedures

Several different recipe calculation procedures and factors are currently used in the European countries (Bell et al., 2006); however, a standardised procedure for the management of food composition data is desirable to facilitate comparisons between countries. Hence, the harmonisation of recipe calculation procedures is necessary in Europe. The harmonisation work in EuroFIR is based on the development of previous European harmonisation projects. Since the 1980s, a number of international initiatives have addressed the harmonisation issue. The Eurofoods-Enfant Project within the framework of the Food-Linked Agro-Industrial Research (FLAIR) programme collected and summarised a huge inventory of retention and yields factors (Bergström, 1994), but no guidelines concerning the use of these factors were published. In 1991, the International Network of Food Data Systems (INFOODS), coordinated by the Food and Agriculture Organization (FAO), published guidelines for estimating the nutrient content of multi-ingredient foods based on the nutrient contents of the ingredients (Rand et al., 1991).

In the late 1990s, the recipe calculation procedures were compared between Nordic countries (Becker, 2002; Norfoods, 2002). The comparison showed differences in the principles of recipe calculation procedures and nutrient retention factors. The Norfoods project did not give any recommendations for recipe calculation procedures, although they pointed out that the use of the same yield and retention factors would significantly reduce the observed differences.

The European Prospective Investigation into Cancer and Nutrition (EPIC) project, which investigates diet, health and lifestyle issues in ten European countries, began in the 1990s. This project has significantly contributed to the harmonisation of European food composition data. The EPIC project developed a standardised EPIC nutrient database, in which harmonised retention factors as well as a harmonised recipe calculation procedure are used (Slimani et al., 2007a,b).

3. Experiences with recipe calculation procedures

The review of the recipe calculation procedures was presented and discussed at two annual EuroFIR meetings with a total of 40 persons present. The majority of people were compilers of food composition databases. The review of the methods was published as an internal report, which was delivered to EuroFIR partners before the meetings.

The review covered the most commonly used recipe calculation procedures (Beecher and Matthews, 1990; Bognár and Piekarski, 2000; European Community, 2000; European Economic Community, 1990; Food Standards Agency, 2002; Powers and Hoover, 1989; Rand et al., 1991; Raper et al., 2004; Slimani et al., 2007a). In addition, after the preliminary questionnaire (Ovaskainen et al., 2005), a number of EuroFIR partners ($n = 7$) were asked to describe the recipe calculation procedure that they used.

The review of the recipe calculation procedures showed that there were a number of different ways to calculate recipes. Generally, yield and retention factors were applied at the recipe level or at the ingredient level. Recipe level refers to the application of the yield factor to the whole weight of a dish or the application of the retention factor to the total nutrient content of a dish. Ingredient level refers to the application of the yield factor to the weight of each ingredient or the application of the retention factor to the nutrient content of each ingredient.

The comparison of methods showed that the most commonly used method was a procedure that applied a yield factor at the recipe level and the retention factors at the ingredient level (Tables 1 and 2). The majority of the methods, such as the INFOODS method (Rand et al., 1991), the British method (Food Standards Agency, 2002) and the methods of Beecher and Matthews (1990), Powers and Hoover (1989), Raper et al. (2004) are based on this principle. The same recipe calculation procedure was also used in the EPIC project (Slimani et al., 2007a).

The procedure of applying the yield factor at the recipe level and the retention factors at the ingredient level was selected as the recommended EuroFIR recipe calculation procedure because it was the most commonly used procedure. It was recommended to use this procedure together with EuroFIR retention factors, which will be standardised later in the EuroFIR project. The general compilation process with algorithms for recipe calculation is presented in Table 3.

4. Discussion

The EuroFIR project worked on the recipe calculation procedures in two meetings and selected the most commonly used procedure as the recommended EuroFIR recipe calculation procedure. The implementation of the recommended EuroFIR recipe calculation procedure is the responsibility of national compilers. The implementation is dependent on the structure of food composition data, which has also been harmonised (Becker et al., 2008).

It was also pointed out that the only accurate way to compare the different recipe calculation procedures is to conduct validation studies where values calculated using different methods are

Table 1
Comparison of recipe calculation procedures.

Reference	Yield factor applied at	Retention factor applied at
INFOODS method (Rand et al., 1991)	Recipe level	Ingredient level
British method (Food Standards Agency, 2002)	Recipe level	Ingredient level
Retention factor method (Beecher and Matthews, 1990; Powers and Hoover, 1989; Raper et al., 2004)	Recipe level	Ingredient level
Method used in EPIC (Slimani et al., 2007a)	Recipe level	Ingredient level
Method of Bognár and Piekarski (Bognár and Piekarski, 2000)	Recipe level	Recipe level
Yield factor method (Powers and Hoover, 1989)	Ingredient level	Not applicable
European Union labelling regulation (European Community, 2000; European Economic Community, 1990)	Ingredient level[a]	Not stated
Summing method (Powers and Hoover, 1989)	Not applicable	Not applicable

[a] Applied to fluids only.

Table 2
Examples of recipe calculation procedures.

Food composition database	Yield factor applied at	Retention factor applied at
Slovak database Alimenta (Holcíková, 2000)	Recipe level	Ingredient level
Israeli database BGU (Shai et al., 2003)	Recipe level	Ingredient level
Icelandic database ISGEM (Matis, 2009)	Recipe level	Ingredient level
Dutch Food Composition database NEVO (Voedingscentrum, 2006)	Recipe level	Recipe level
German Nutrient database BLS[a] (Hartmann et al., 2008)	Recipe and ingredient level	Recipe and ingredient level
UK National Nutrient Databank (Food Standards Agency, 2002)	Recipe level	Ingredient level
Finnish food composition database Fineli (National Institute for Health and Welfare, 2008)	Ingredient level	Ingredient level

[a] Flexible; recipe calculation possible both at the recipe and ingredient level.

Table 3
Procedural steps for calculating nutrient content of recipes.

1. Collect recipes from popular cookbooks or recipe archives on the Internet. If none are available, conduct field work to develop recipes.
2. Determine weights of the uncooked ingredients. Convert household measures into gram weights and correct the weight of each ingredient for its edible weight.
3. Sum the weights of uncooked ingredients.
4. Correct weights for the effects of cooking by applying a yield factor to the total uncooked weight [total cooked g weight = (total uncooked g weight) (yield factor)].
5. Calculate nutrient values [nutrient content/100 g cooked weight = (nutrient content of uncooked ingredient) (uncooked g weight of ingredient/total cooked g weight)].
6. Correct nutrient values for effects of cooking by applying retention factors at the ingredient level [nutrient content/100 g cooked weight = (nutrient content of uncooked ingredient) (uncooked g weight of ingredient) (retention factor/total cooked g weight)].
7. Adjust the water content [total water content of cooked dish = total water content of cooked dish − g weight loss].
8. Document sources used for recipes and for yield and retention factors.

compared with analytical values. There have been studies looking at the differences between various databases used in converting food intakes into nutrient intakes (Deharveng et al., 1999; Hakala et al., 2003; Hjartaker, 2007; Vaask et al., 2004); however, only one study compared the calculated nutrient values with values produced by chemical analysis (Vasilopoulou et al., 2003). In this study, five recipes were compared, and no significant differences were found between the analytical and calculated values.

The benefits of harmonised recipe calculation procedures include the improved quality, availability and compatibility of food composition data (Egan et al., 2007). Harmonisation will also reduce any artificial differences, which are attributed to differences for instance in recipe calculation procedures or retention factors (Charrondiere et al., 2002). In the light of a thorough assessment of European foods and diets under the European Food Safety Authority, such differences have to be eliminated. Therefore, a harmonised calculation procedure applied to dietary intakes is recommended. Furthermore, harmonisation has a positive impact on the interchangeability of food composition data across Europe. The application of the harmonised recipe calculation procedure will also standardise the concepts and entities of the databases. Proper documentation of the recipe calculation system together with the applied retention and yield factors is a crucial part of effective management of food composition databases.

5. Conclusions

The recommended EuroFIR recipe calculation procedure applies the yield factor for total weight at the recipe level and the retention factors for the nutrient values of each ingredient at the ingredient level. It is recommended that this procedure be used with the standardised EuroFIR retention factors. The benefits of harmonised recipe calculation procedures include the improved quality, availability and compatibility of food composition data.

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