

# Memorandum on terms, definitions, and analytical procedures of protein, fat and carbohydrates in food for basic composition data: issues and recommendations

Based on papers and discussions at the Second International Food Data Base Conference, August 28–30 1995, Lahti, Finland

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## INTRODUCTION

In the papers of the session “Nutritional concepts and recent advances in macronutrient research” of the Second International Food Data Base Conference August 27–30, 1995, Lahti, Finland, extensive emphasis was focused on the need for more accurate terms and definitions, as well as for more specific analytical procedures, in order to identify and measure the protein, fat and carbohydrate fractions quantitatively in foods and mixed diets for basic composition data, and to estimate the energy values of these fractions and of a food (Asp, 1996 (this issue); Englyst & Hudson, 1996 (this issue); Hyvönen, 1996 (this issue); Koivistoinen, 1996 (this issue); Salo-Väänänen & Koivistoinen, 1996 (this issue)). There is a need for detailed compositional data of these nutrients in food tables, i.e. amino acids, fatty acids, individual sugars, and polysaccharide composition. For the purpose of basic composition values and food labeling, a nutritionally relevant grouping of these compounds have to be made. The issues raised are considered to be of international concern for a number of reasons.

## ISSUES

The growing need to reevaluate the concepts, definitions and analytical procedures for protein, fat and carbohydrates in food is supported by the following issues:

1. The current terms fat, protein and carbohydrates in food tables and on food labels still refer, in most

instances, to chemically inconsistent, so called ‘crude’ fractions in foods, which do not behave uniformly in digestion and human nutrition, and are unreliable for energy calculations.

2. The fractions are still commonly quantified by indirect measurements which do not guarantee the chemical identity nor the typical nutritional impact resulting from a specific fraction. For instance, traditional methods for estimating the amounts of macronutrients include:

- Protein content obtained by multiplying the total nitrogen content of a food by a general factor (6.25) is based on the mistaken assumptions that (1) all nitrogen in a food is derived from protein and (2) all proteins in that food contain the same percentage (16%) of nitrogen.
- Fat content obtained by extraction procedures contains not only true fat but also varying amounts of other extractable substances, depending on the method of extraction and the type of substrate. These other substances have only minor or no characteristics of natural fat in either a chemical or nutritional sense. With some methods, on the other hand, polar lipids are extracted incompletely.
- Carbohydrate content obtained by difference (the weight of food minus the sum of weights of water, protein, fat and ash) contains carbohydrates as well as other natural substances and their modifications will vary in nutritional significance. Carbohydrate by difference accommodates errors

arising from the analyses of other components, and all components not measured at all.

3. The traditional concepts of protein, fat, and carbohydrate fractions and the procedures for their quantitative measurement were developed in the last century for estimating energy values of natural products used as feed and food ingredients. According to current knowledge, calculation of energy content based on determination of each one of the crude fractions (protein, fat and carbohydrates) generally causes overestimation of the available energy of these fractions and of a food. The current practices of the analysis of macronutrients are reviewed by, e.g. Greenfield and Southgate (1992) and Sullivan and Carpenter (1993).

4. As discussed by the 1992 FAO/WHO International Conference on Nutrition, food composition data not only have a traditional role in monitoring dietary intake and food adequacy, and in dietary therapy in a country, but also an important role in activities relating to world food trade, international food standards, consumer information, food labeling, food formulation and food marketing.

5. Authorities in both the United States and the European Union have recently issued directives for food labeling that are partially conflicting for protein, fat and carbohydrates, and are mainly applying the traditional definitions and analyses.

6. Efforts for solving the problems described above have not yet lead to a solution at an international level.

## CONCLUSIONS

Taking into account the scientific aspects and the enormous economic value, health implications, and legal responsibilities in trade and consumer policy with which food composition data are increasingly associated, the speakers of the session concluded that the traditional composition measurements of protein, fat and carbohydrates are inadequate. It is also concluded that most of the data obtained by these measurements do not meet criteria of modern scientific knowledge, nor the needs for national and international applications.

## RECOMMENDATIONS

1. For improving the quality and increasing the relevance of food composition data for a variety of purposes, we propose that the following terms and definitions for the basic composition of food be considered for further discussions and research activities:

\* **Protein** as the sum (expressed as polymers) of the bound and free amino acids potentially utilizeable in protein synthesis.

\* **Fat** as the sum (expressed as triacylglycerols) of bound and free fatty acids.

\* **Carbohydrate** two different definitions are proposed for further consideration:

- as the sum of digestible (available, metabolizable) and undigestible (unavailable, dietary fibre) carbohydrates. The carbohydrate content should be based on analyses of individual mono-, di- and oligosaccharides, sugar alcohols, starch (digestible and resistant) and non-starch polysaccharides.
- as the sum of the constituent sugars of dietary carbohydrates, or as the sum of the free sugars, sugar alcohols, oligo- and polysaccharides. Carbohydrates may be further characterized by division or grouping e.g. into sugars, nutritionally significant fractions of starch, and plant cell-wall, non-starch polysaccharides (dietary fibre) for nutritional labeling.

\* **Ethanol**

\* **Water**

\* **Other components** including

- a miscellaneous mixture of natural and modified organic substances as well as products of chemical reactions which are not included in the protein, fat, or carbohydrate fraction as defined above; and
- inorganic macro- and microsubstances.

The proposed classification of the basic composition of food can serve as a basis for nutritionally relevant subdivision when needed.

2. We recommend review and open discussion of the proposed terms within the international community, preferably by an international expert group, in order to reach temporary consensus on the terms, and in turn, on the principles of analytical procedures consistent with current scientific knowledge and the applications of food composition data for national and international activities. Both comprehensive and screening methods should be recognized as useful in obtaining improved data.

3. Based on these outcomes, comprehensive multi-laboratory studies on analytical procedures should be encouraged among research, regulatory and commercial laboratories with particular emphasis on different raw and processed foods, and matrices found in a variety of diets in order to evaluate the feasibility and appropriateness of the suggested approaches.

4. Following these activities, efforts should be made to conduct an international reevaluation of terms, definitions and analytical procedures; changes should be made as needed.

5. We recommend that relevant scientific, professional, and administrative bodies note the concerns outlined in this memorandum and take action to incorporate appropriate discussions within conferences, workshops, and other such meetings where efforts at international harmonization are sought. The role of FAO and WHO is especially emphasised in this respect. We also recommend these efforts in order to foster the development of cheaper, more rapid methods and instruments for the suggested more specific food analysis.

6. We recommend that the upcoming International Food Data Base Conference serve as the follow-up forum to track progress on these recommendations.

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