Validation of Data Issued from Food Chemistry

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1. General background

Recent regulation taken in Europe [1] and in United States are deeply modifying the role of food chemists: the nutrition labelling is now regulatory. The contents of about 30 nutrients would soon be printed on food packages, for consumer advising. If it is debated by some scientists whether consumers will actually be "advised" by these data, it is certain that food manufacturers will be obliged to have really efficient and validated analytical methods as this labelling will be considered as a requirements act.

An important reference for developing this regulation will the use of food composition tables. It is already possible to evaluate the adequacy between the present food composition knowledge and the pending regulation requirements by evaluating the imprecision of existing food composition tables. A routine goal for many diet studies concurs finally in multiplying two data arrays: the food composition table which contains nutrient values and the food consumption table resulting of a food survey. Many works demonstrate that the resulting nutritional balance sheet is highly variable, depending on the composition table used.

Five sources of error explain the observed discrepancies among these various computations. This does not include computational errors due to wrong algorithms such as a mishandling of missing values or a rounding effect.

- the amount of consumed food was inexactly appreciated;
- the precision of analytical methods is inappropriate;
- the natural variability of foods is large;
- the food name used to retrieve the composition is inadequate.

For instance errors on consumption data are highly difficult to appreciate. Amounts are recorded through some oral questionnaire from a consumer who subjectively recalls the quantities of foods he got (sometimes few years before). Unfortunately the cross-examination of these quantities by the means of an exact weighing of the diet, called the duplicate technique, performed by a specialist is not possible. If this later technique may give a better estimate of foods actually consumed by a single person, it is not adapted to large surveys nor large group studies.

2. Analytical errors control

Concerning the precision of analytical methods used to determine nutrients it is possible to make a clear decision. For many years inter-laboratory studies were

organized by agro-food industry in order to control laboratories [2]. Moreover, international organizations, such as Reference Community Bureau (BCR) from the Commission of the European Communities, were specifically created for preparing certified reference materials. Therefore, it is already possible to summarize all these studies and have a gross estimate of the precision of the analytical methods used for nutrient determination.

A first step to validate a method consists in measuring its precision and accuracy. Thus, if you know that fructose determination is accurate and precise at 5%, you can deduce that any food, which claimed concentration is 5,0 g/100g, will naturally contains, without any analytical error, from 4,5 to 5,5 g/100g.

Method validation may be internal, within a single laboratory, but error theory assumes that accuracy error is a systematic error which can only be accessed either by using a certified reference material, when available, or by the means of an interlaboratory study. For inter-laboratory study, one common sample is sent to several laboratories, accepting to apply exactly the same method; thereafter repeatability and reproducibility of the method is computed. A well known international standard now precisely defines how to compute repeatability and reproducibility [3].

Average reproducibility for major nutrients, was computed from several hundreds of inter-laboratory studies. The concentration range is quite broad, and corresponds to values which are expected in foods; reproducibility can be expressed as a coefficient of variation. Nutrient analytical methods present reproducibilities varying from 5% to 50%. Thus, expected accuracy is above 15% for all nutrients, except moisture, proteins, sucrose and fat ! This results are not satisfactory although they give a correct appreciation about the analytical state of the art in food chemistry.

It is obvious that an important analytical work of standardization and validation is necessary in order to improve this situation and reach an acceptable level of precision for all nutrients.

3. Food naming: towards a descriptive coding system

A commonly distributed prejudice consists in believing that it is easy to explain what you have got for a meal. This is almost true within a same group of people, from the same cultural background. But the situation is much more difficult when different languages or cultures are involved. Even between two people who speak almost the same language, such as American and British or French and French-Canadian, some food names are not used with the same meaning.

This problem was striking for food data banks compilers who needed to consistently interchange data among different countries. Their goal was to assess a better knowledge for foods consumed or produced in their countries. Therefore they developed an international descriptive coding system called LANGUAL. It consists in a thesaurus

of 2 000 standardized describers which are hierarchically organized within 12 facets. Nowadays about 60 000 food names were coded in four languages: English, French, Danish and Hungarian. It is applicable to food but also to the description of samples arriving in a laboratory (see tables).

4. Conclusion

In conclusion, food analysis quality will be improved because regulation is an important motivation. But necessary tool for this improvement will consists in a better control and validation of analytical methods and a better knowledge of foods by the means of a scientific description system.

Annex

Table 1: Facets used for food coding

facet (code and name) definition	occurrences
A Product type Family or group of foods defined by common consumption, functional or manufacturing characteristics.	181
B Food source Animal, plant or chemical source from which the product or the primary ingredient is derived.	1,170
C Part of plant/animal Anatomical part of the plant or animal from which the food product or its major ingredient is derived (meat, milk, root, sugar).	157
E Physical state or shape Physical state of food product as a whole (solid, liquid)	45
F Extent of heat treatment Extent the food has been modified in processing by the application of heat (raw, cooked)	5
G Cooking method Process by which a food product is cooked (broiled or grilled, deep-fried, cooked with steam)	45
H Treatment applied All physical or chemical treatments applied to the product or its major ingredients; also describes additives and ingredients.	214
J Preservation Primary method used to prevent microbial and enzymatic spoilage.	46
K Packing medium Substance in which the food is packed for preservation and handling and/or palatability.	39
P Consumer/dietary group Group for which the food product is marketed (regular diet, low fat)	24
Z Adjunct characteristics Quality criteria (label, meat cut, plant maturity) and other characteristics (type of crust, beverage mix)	90

Table 2: Facets used for sample coding

facet (code and name) definition	occurrences
M Container or wrapping Defines the main container material, the container form and the liner, lids and ends materials.	
N Food contact surface Material or materials which actually touch the food product.	
Q Establishment Origin of the sample type of establishment (factory, catering, store...).	
R Geographical origin Where the food was produced (country, region).	
S Storage conditions Length and conditions of storage preceding the analysis.	
T Production period Year or period of production.	

Literature

[1] Council Directive on nutrition labelling of foodstuffs, O.J.E.C., 6 oct 1990, N° L 276/41.

[2] Horwitz W., Albert R., Deutsch M.J. & Thompson J.N., Precision Parameters of Methods of Analysis Required for Nutrition Labeling, J. Assoc. Off. Anal. Chem., 1990, 73, 661-680.

[3] Standard ISO 5725, Precision of measurements, 1992.