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The International Food Data Systems Project (INFOODS) is a comprehensive effort, begun within the United Nations University's Food and Nutrition Programme, to improve data on the nutrient composition of foods from all parts of the world, with the goal of ensuring that eventually adequate and reliable data can be obtained and interpreted properly worldwide. At present in many cases such data do not exist or are incomplete, incompatible, and inaccessible.

This volume is the second in a series that provide guidelines on the organization and content of food composition tables and data bases, methods for analysing foods and compiling those tables, and procedures for the accurate international interchange of the data. It presents a comprehensive system for identifying food components precisely, with unique tagnames designed for use in computer data bases, both for international data exchange and for the compilation of national food composition tables.

The United Nations University
Toho Seimei Building, 15-1 Shibuya 2-chome, Shibuya-ku, Tokyo 150, Japan
Tel.: (03) 499-2811 Telex: J25442 Cable: UNATUNIV TOKYO

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John C. Klensin is Principal Research Scientist in the Center for International Studies and a member of the INFOODS Secretariat at the Massachusetts Institute of Technology, Cambridge, Massachusetts, USA.

Diane Feskanich and Victor Lin are members of the INFOODS Secretariat at the Massachusetts Institute of Technology, Cambridge, Massachusetts, USA.

A. Stewart Truswell is Boden Professor of Human Nutrition in the Biochemistry Department, University of Sydney, Sydney, Australia.

David A. T. Southgate is Head, Nutrition and Food Quality Division, AFRC Food Research Institute, Norwich Laboratory, Norwich, United Kingdom.

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Contents

1
Introduction

THE TASK

One of the fundamental tasks of INFOODS is the design of procedures for the exchange of food composition data. These activities involve the development of rules and guidelines for the *identification of foods,* the *definition of food components,* and the *description of food component data.* Such formal operations are both directly useful and a critical future part of the interchange operation.

LISTING OF FOOD COMPONENTS

This document is basically a listing of distinct nutritive and non-nutritive components of foods. The list does not presently include all existing food components; however, for those it does include, it is intended that the definitions should be complete and unambiguous. Each food component is represented by an entry which consists of the following information:

1. a single, unique abbreviation called a *tagname,* which is intended for use in interchange,
2. a *name* or descriptive definition,
3. a common or default *unit of measurement* for expressing its quantity per 100 grams of edible portion of food,
4. *synonymous names* by which the component is known (including common abbreviations that occur in standard tables),

5. *comments* for those food components which require further definition or clarification,
6. a listing of *selected tables* in which data on the specific component occur, and
7. additional information, identified as *notes*, *keywords*, and *examples*, which appears with a few entries.

1. Tagname

This entire effort is organized about the fundamental importance of the tagname in food composition data exchange. During interchange, each piece of data needs to be associated with a unique tagname which identifies the specific food component represented by that data point. The underlying constraint, amplified below, is that components represented by different tagnames cannot be directly compared or combined.

2. Name of Food Component

It is intended that each food component entry be described with sufficient specificity to distinguish it from all other entries. Often, a component will have a single entry, such as "copper" (or "cuivre" or "Kupfer"). However, some food components need multiple entries. For example, a food component for which the quantity varies according to the method of analysis must be listed separately for each method, and the method must be a part of the description (e.g., "carbohydrate by difference" versus "carbohydrate by summation"). Alternatively, "fibre" (or "fiber") does not identify a unique food component. The method used to determine the fibre (neutral detergent method, crude fibre method, etc.) must be included as part of its definition, and, as a result, there are multiple fibre entries.

3. Unit

Each food component has a "default" unit of measure associated with it. These units are the ones most commonly employed in food composition tables and they are the units that will be assumed during data exchange. For example, protein is assumed to be expressed in grams of protein per 100 grams of edible portion of food. If the data are expressed in units other than the default units, these units must be specified along with the data.

4. Synonyms

Multiple names or multiple spellings of the same name may exist for a particular food component. In these cases, the preferred name is assigned as the food component name and alternate names are given as synonyms. For example, "moisture" is a synonym for "water". The same tagname is, of course, used for both "moisture" and "water", since this tagname identifies just what the data represent. Common abbreviations used in some of the major tables are also provided.

5. Comments

Comments are included for a food component if a further explanation or description might be helpful in understanding the nature of that food component. For food components that are calculated from other food component data, the comments should include a description or example of these calculations.

6. Food Tables

The goal of this effort is to identify the food components for which data exist and for which data might be exchanged within the nutrition research community. Development of this document began with a review of some major food composition tables from around the world. The food components in these tables were compiled and edited, and similarities or differences between names used in the various tables were examined to ensure a comprehensive list of unique food components. In the accompanying list, each food component definition includes a list of the reviewed food tables in which it was found and could be unambiguously identified. (Consequently, we have not listed tables with "method unknown" tagnames.) In addition, the USDA nutrient number is included with those food components for which data exist in the complete USDA nutrient data base.

7. Notes, Keywords, and Examples

Several food components require additional description, specification, or clarification beyond that provided by the tagname itself. For those components, additional information is provided under "notes", which provide additional information on the food component or tagname; "keywords", which are used with the tagname and data values to provide additional detail; and "examples", which illustrate how the tagname is used.

OTHER GUIDELINES FOR THE NAMING AND ANALYSIS OF FOOD COMPONENTS

Guidelines for how food and nutrient data should be identified and reported have been created by a number of authors and organizations. Notable examples of such guidelines include: Generic Descriptors and Trivial Names for Vitamins and Related Compounds (1976) by the Committee on Nomenclature of the International Union of Nutritional Sciences (IUNS); and Nomenclature and Symbolism of Amino Acids and Peptides (1983) by the Commission on Biochemical Nomenclature of the International Union of Pure and Applied Chemistry (IUPAC). Many of these nomenclature guidelines have already been adopted by major journals of nutritional science. For example, the Committee on Nomenclature of the American Institute of Nutrition (AIN) has designated which nomenclature rules are to be followed in their official journals.

There have also been several important efforts to specify the standard or correct method to use to provide values for a particular nutrient. Perhaps the most important of these have been the specifications of the Association of Official Analytic Chemists (AOAC), the Codex Alimentarius Commission (particularly regarding recommendations

for methods of analysis of pesticide residues in foods), and the International Organization for Standardization (ISO). Another set of recommendations appears in the forthcoming INFOODS handbook, *Guidelines for the Production, Management and Use of Food Composition Data.* As is the case with the naming schemes for nutrients, these different sets of standards draw on a common base: where they overlap, they are more often similar than different.

This listing of food components represents a new approach to the issue of how food and nutrient data should be reported. One aspect of this new approach is that the INFOODS tagnames for food components specify a combination of nutrient names and their relevant methods of analysis that have the following properties:

1. Methods that are obsolete or "not preferred" are provided for, since values representing those methods may well appear in older food composition tables or data bases.
2. Methods that differ in procedures but not in the expected values of the results are not distinguished, since they are then "the same" with regard to comparison of values between food composition data bases.
3. At the same time, for food components for which multiple methods have been used, the identifications or "tagnames" are at the nutrient-and-method level rather than at the level of nutrient names. Without that distinction, there is severe danger of comparing values that, while indicative of the same nutrient, have sufficiently different expected values that accidental direct comparison would be very misleading.

Popular naming conventions, though useful for many purposes, do not distinguish among the methods, conversion factors, and other variations of technique (above and beyond experimental variation) that can result in different values for the same "nutrient" even in the same sample.

A second aspect of this new approach is that the INFOODS food component tagnames are designed for data transfer between computers, especially computers located in different countries. Popular naming conventions are better designed for typesetting or direct communications between people. For a naming system to be convenient and flexible for computer use, it is best to avoid systems that require italics or underlining, Greek characters, subscripts or superscripts, and special uses of upper or lower case. It is not that these cannot be accommodated; rather it is that accommodating them limits the computer and communications systems that can be used.

THE INFOODS INTERCHANGE SCHEME FOR FOOD COMPONENTS

The general context for this document is the INFOODS interchange scheme, a formalized model of how food composition data can be identified and organized so that they can be exchanged between various individuals and organizations within the food composition community. This model is described in memo INFOODS/IS N6 and its addenda, which are currently being transformed into an INFOODS guideline manual, *INFOODS Data Interchange Handbook*, by Klensin, Romberg, and Peterson.

Any scheme for interchange of food composition data requires that the data be identified and, in particular, that each value be associated with the nutrient to which it applies. As the INFOODS work has progressed, it has become clear that this

identification must be quite specific, in order to meet requirements of both the users and the data base compilers for comparison and combination of food composition data. In addition, there are computer-processing requirements which are important in deciding how to organize, name, and structure the food component tagnames. Wherever possible, the tagnames have been chosen to facilitate all uses; however, this attempt to optimize several sets of requirements has led us to several decisions about the organization and structure of the tagnames that may not be obvious from the tagnames themselves but that strongly influenced the scheme. Below we describe the general design principle, and a series of sometimes conflicting considerations. Much of our effort has gone into balancing these considerations and ensuring that they be consistent, if possible, with the general, guiding principle:

> **The primary use for the food component tagnames is to determine whether the associated values can be compared or combined. All other goals and principles must yield to this one.**

The reason for developing food component tagnames that are method specific, rather than using common names for nutrients and other food components, is that often the component names in general use are insufficiently specific to determine if direct comparison of values is appropriate. Even assuming that the units in which values are expressed are consistent, one cannot compare the values of, e.g., "vitamin A". The term vitamin A is ambiguous without precise knowledge of what has been measured and what is being reported. When a sophisticated user of food composition tables encounters values for vitamin A, he or she immediately searches the preface of the table to determine what the values actually represent. The food component tagnames are intended to facilitate that step and, moreover, to permit an equivalent evaluation to be performed by a relatively unsophisticated computer program. The intent is that, if the tagnames match and the units are reconciled, the values will be comparable. A corollary is that different tagnames should not be used for different methods that produce comparable values. Moreover, when several different methods produce different values (e.g., energy or protein), we need to define a "method unknown" tagname for situations where the methods have been lost. This requires cautioning users against comparing two values associated with "method unknown" tagnames, but we hope that it will work toward creating an intellectual climate in which data generators and compilers become more careful about recording their methods.

MAJOR CONSIDERATIONS IN THE DEVELOPMENT OF THIS LIST

1. The INFOODS Context and the User Community

> **CONSIDERATION 1: The interchange scheme itself should not be sensitive to national usage, although some of the data it supports may be.**

Most of the "special characters" that appear in computer character sets or ordinary writing differ from one computerized character set (tied to a national language or national usage) to another. In other words, a given string of bits representing a character may imply different character graphics in different countries once one moves

beyond the simple roman alphabet (without diacritical marks) and beyond a few special characters. As a result, we have prohibited many character conventions that would otherwise make sense, e.g., use of the colon (":") in the names of fatty acids. Clarity and consistency in international usage are more important than conventional usage.

CONSIDERATION 2: This list of food components describes what has been done and is independent of any recommendations about what should be done or reported.

These entries are not offered as a set of suggestions about what should be put in tables - either in terms of nutrients to be reported, or of how these nutrients should be analysed, or of what abbreviations should be placed at the top of the columns of a printed table. Those suggestions are the subject of other documents: the forthcoming book by Greenfield and Southgate in the case of analytic methods, and the recommendations from Southgate and Truswell for the questions of what food components to include in tables and how they should be identified there (see "Related Documents", page 11 below).

Inclusion of an entry in the list implies only that the associated food component and method have been used, and might realistically be expected to appear in a table or data base that one might encounter. The identification of some of the entries as "obsolete approaches" is not intended to imply a recommendation; instead, these comments are descriptive of the fact that the method is no longer being used while providing assistance in the task of retrospectively assigning tags to an early table.

CONSIDERATION 3: It is desirable to finish the initial version of this list, standardize it, start using it, and then to add additional food component tagnames in parallel with other work.

This consideration may appear to be obvious, but it has led to a few extremely pragmatic short-term decisions. In particular:

1. We have received several suggestions that food additives and contaminants, in general, be included in this list. The list is clearly expandable to include contaminants, and we expect this to be done sooner or later; however, we have deferred the task. There are two reasons for this, in addition to our not wishing to delay the present effort. First, INFOODS has no specific mandate in this area at present and, second, we have not yet encountered anyone who is anxious to interchange these data using arrangements compatible with the INFOODS approach.
2. We have defined a separate structure for a number of values that have been identified as reported in food tables but that are not themselves components of foods. The values affected here fall into two broad categories: (i) various "scores" and other indirect measures of bioavailability (e.g., protein quality), and (ii) expressions of a nutrient value as a fraction of some other nutrient value (e.g., amino acids as percent protein). (The latter, on first inspection, appear to be only different types of units, but are actually not, since both numerator and denominator are analytically determined.) Further, we have then deferred defining tags for all of these except the few that appear very widely.

2. The Character of Food Component Information

CONSIDERATION 4: The food component tagname scheme should reflect "nutrients", not just chemistry.

At least some of the food components that we know as nutrients are not, and do not represent, well-defined chemicals for which straightforward analyses exist (e.g., fibre, protein, vitamin A). These components reflect assumptions and conventions about biological impact. The nutrition community's usage is not that of, e.g., food chemistry. Values derived from computational formulae, mixtures of several chemicals, and individual chemicals are all reported the same way in food composition tables. This represents present scientific reality and knowledge; however, it does have an impact on decisions about what food component tagnames will be defined, and which ones will not (at least at this time). While the list we have assembled can be expanded at any time, we have concluded that, at the present time, it is not sensible - and would eventually create confusion - to include entries for chemicals whose existence can be demonstrated, for which analyses exist, but which no one has taken any interest in. While there are tradeoffs involved, and we have not adopted rigid rules, two criteria have been applied:

1. The inclusion of a food component in a published official food table, or a published table that has achieved wide circulation, is sufficient evidence that it should be assigned a tagname.
2. The information that someone, someday, might be interested in a particular component, or a variation on an already-registered component, has not been considered sufficient. Nonetheless, some tagnames have been defined for nutrients or methods that are not now included in tables because we have been persuaded that they are important or because they reflect INFOODS recommendations for methods or presentation.

CONSIDERATION 5: Just as the relationship between nutrients and chemicals is not clear cut, neither is the relationship between nutrients and analytic methods. The definitions and associated tagnames should reflect the varying importance of method specificity in individual food component definition.

As mentioned above, what we call "nutrients" are, in many cases, mixtures of species, rather than specific chemicals for which practical analyses exist. For these nutrients there are often different definitions as well as different ways of measurement. Alternatively, there are a number of nutrients for which the different methods of analysis should yield the same result (e.g., GC and HPLC for vitamin E analyses) and making a distinction between method is of no importance for any use of food composition data that we have been able to identify.

The convention for determining when two methods for the same "nutrient" require separate entries is based on what is essentially a statistical criterion: *if one runs a large number of analyses on identical samples using one method, and runs a large number of analyses, also on identical samples, using a second method, the two methods are considered to be "the same" for food component tagging purposes if the means of the two sets of analyses are statistically indistinguishable.* Stated less formally, if two methods can reasonably be expected to produce the same results if performed well and under good

conditions, then they do not receive separate tags. Conversely, two methods that can be expected to produce different results, on average, would be assigned different tags.

It follows from this consideration that the tagnames cannot be logically structured into a nutrient "part" and a method "part", since different nutrients would have to collapse different methods differently.

> **CONSIDERATION 6: The nutrient identification system should facilitate the transmission of any information that exists and, at the same time, should not suggest the existence of information when information does not exist.**

The reporting of two values for the same basic nutrient in different units, but with an obvious conversion factor (energy in calories and joules) does not add any information to the content of a data base, since the conversion could be performed at the receiving end. Ideally, if two values appear, they should represent different information - different modes of analysis or different ways of getting to the values. Thus, in reporting energy, in spite of the fact that many food tables show both kilocalorie and kilojoule values, only one should appear in an interchange file unless they represent either different measurements or application of different conversion factors. When the two are provided for user convenience, but one results from simply multiplying or dividing the other by a constant, we recommend that only one be included in an interchange file.

3. Specific Form of the Tagnames

> **CONSIDERATION 7: The names chosen for the tags should be optimized for computer use, with human use being secondary.**

The tagnames are central to the food component naming scheme, in that they are in one-to-one correspondence with the nutritionally different food components. Original recommendations for the structure of tagnames (formulated in the first draft of the interchange scheme [INFOODS/IS-N6, December 1985]) included strong suggestions that they should be kept as short as feasible. At the same time, information theory concerns argue strongly against very short names: longer names provide more redundancy and raise the likelihood that errors will be detected rather than mistaken for other nutrients. Moreover, the tagnames should not interfere with processing interchange-format data with simple computer programs; in general, processing of interchange-format data should require the minimum amount of computer sophistication possible, consistent with the other goals of INFOODS data interchange. These three general principles led to two basic rules in tagname construction:

1. The ideal tagname should be three to five characters long. Tagnames consisting of only a single character are strongly discouraged on error-avoidance grounds. (See, however, consideration 8). Tagnames longer than six characters are discouraged on the grounds of unwieldiness. However, occasionally longer tagnames are specified, particularly for the fatty acids, where using shorter ones causes other problems.
2. There is no distinction made between upper and lower case for the alphabetic characters, and characters such as commas and leading digits are prohibited in order to facilitate processing by simple programs.

Two other conventions were proposed but, after consideration, were *rejected* as general principles:

1. It was decided *not* to try to make the tagnames pronounceable by including extra vowels. While pronounceable tagnames might well be an advantage, they would usually be longer, and this was considered an undesirable tradeoff. Moreover, making the names pronounceable would encourage more arguments about "better" and "worse" names, which we have wanted to discourage.
2. It was decided *not* to incorporate "check digits" or some other scheme for detecting transcription errors in the tagnames. While such an approach would have merit, it would increase the effective length of the tagnames and make them more difficult for humans to understand and remember. Moreover, in the anticipated use of the interchange scheme it would probably be preferable to apply such checks at the food record level rather than at the nutrient level.

Additionally, the convention was adopted of reserving tagnames ending in a hyphen for nutrients measured by an unknown method where the method is important to comparison of values. Values associated with these tagnames cannot, in general, be compared across tables and therefore their use is strongly discouraged except in interchanging existing tables for which the method and source information for the data has been lost.

> CONSIDERATION 8: **Standard abbreviations should be used for the tagnames when they exist and when using them would not conflict with other principles.**

Unfortunately, this has not proved to be a very useful guideline. With two exceptions the names of the elements (which are typically based on Latin and date from over a century ago) and the abbreviations for the names of the amino acids - the "standard abbreviations" are standard within rather particular communities of scientists rather than across the entire community of users and producers of food composition data. In earlier drafts of this document, the tagname "H2O" was used, but we have changed it back to "WATER" because the former led to a large number of suggestions of the nature of "if you are going to do that, then, for consistency, there are a lot of other chemical symbols you should use also". We disagree with the conclusion, and now suggest eliminating its cause. Even with the elements, there has been some controversy: many of the relevant names are one character in length, violating a rule against such names (see above). In addition, while "F", and "CL" have been suggested as tagnames, fluorine and chlorine are not measured in foods except in compounds. Consequently, FD and CLD (for fluoride and chloride) are included instead.

In general, "standard abbreviations" on which there is less general agreement than on those for the elements and amino acids, or which violate other principles, have not been used as tagnames.

4. The Units of Measurement

> CONSIDERATION 9: **While the interchange scheme should not require everyone to use the same units of measurement, the notion of "unit" must be treated consistently with the requirements of comparison and interchange.**

Inherent in the describing of food components is the concept of "units". For each entry, we have defined as the "default unit" (the unit that will be assumed if no unit is specified) the unit that we have most frequently encountered (e.g., for protein, the default is grams per 100 grams of edible portion of food). However, users of the interchange scheme are not constrained to use these defaults; they can use whatever units they choose, provided the information necessary for the appropriate comparison of the data with defaulted data is available. With respect to the default, there are three basic types of unit: (i) those which can easily be converted to the default by a universal constant (e.g., ounces per pound), (ii) those which require special information about the particular food in general (e.g., grams per unit volume), and (iii) those which require information derived from the particular samples chosen for analysis (e.g., grams of a particular fatty acid relative to total fat). While certain universal constants can be assumed and built into quite simple computer programs in order to compare data that differ in terms of type i above, types ii and iii require that additional information be included with the data base. We are currently working on the formalization of how this can best be effected.

The underlying consideration here is that an interchange should not include redundant information (consideration 6 above). An example of the complexity that can be encountered is the situation with respect to vitamin A. Classically, both IU (international units) and RE (retinol equivalents) are calculated as linear combinations of micrograms of retinol and beta-carotene. Thus, given any two of the four, one can calculate the other two (e.g., from IU and retinol one can calculate RE and/or beta-carotene), but one cannot determine any of the others if only one measurement is present (e.g., one cannot calculate RE, retinol, or beta-carotene from only IU). Therefore we include all four as entries. This situation has become even more complex with the consideration of additional carotenes.

5. Organization of this document

The following consideration has had to be abandoned.

> CONSIDERATION 10: **Insofar as possible, consistent with other goals, the structure of interchange should reflect the organization of food composition tables. In particular, the organization and order of nutrients should be considered.**

While it is not necessary for interchange purposes, there would be some convenience in having a structure provided for the nutrients. Moreover, the initial review of the interchange model produced repeated requests for some internal organizational structure. However, since different tables are not organized the same way, this goal clearly cannot be satisfied beyond the organization of nutrients into very broad, and traditional, groups. The second draft of the food component tagname list proposed such groupings, but the comments that were received in response, collectively, implied that there is no general agreement on the details of even very broad groupings. Two major problems were identified:

1. It is not clear what should be included in "proximates": all tables that have this category (most do) include moisture and energy; beyond those, there are variations. Several of the reviewers of the first and second drafts of the food component

tagname list pointed out that, in a computer interchange scheme, it was irrational to separate "protein" and the protein components, nitrogen compounds, and amino acids and that, similarly, it was irrational to place "total fat" under proximates and then have a "lipids" category that contained everything *but* "total fat". One possibility would be to have only moisture and energy in the proximate category, but it appears that this would simply cause more confusion.

2. There is an inevitable desire to create a "miscellaneous" category to handle the selection of food components that don't belong in any of the other categories but don't seem to justify a category of their own. At the same time, there are strong classification and information-theory reasons for having "closed" definitions for all categories so that new categories can be added without reshuffling old ones. This criterion is especially important when we realize the potential impact of adding tagnames for contaminants (discussed above), since there appear to be more known contaminants and additives of interest than there are nutrients. This conflict and the desire to avoid "miscellaneous" led to the somewhat arbitrary (and much objected to) AANOA category in the second draft list of the food component tagnames.

We have consequently concluded that, attractive as this goal looks on first glance, it should be abandoned and no intermediate groupings of food components created in the interchange mechanism itself. This, of course, does not prevent creating groupings *external* to the interchange mechanism. In a way, it facilitates such groupings on the basis of local needs and conventions, rather than trying to impose a uniform international convention. However, the interchange scheme does not specify any nutrient ordering since the benefits of such a structure would be outweighed by the difficulties of resorting tables and data bases.

RELATED DOCUMENTS

This description of tagnames and food components is intended to be self-contained. However, it was produced in the context of other INFOODS efforts. The draft manuals and working documents produced as part of those efforts provide additional information. The relevant documents are listed below.

- The interchange model itself is described in a forthcoming manual by Klensin, Romberg, and Peterson, *INFOODS Data Interchange Handbook*, which provides details about the need for the tagnames discussed here, how they are used in data interchange, and the syntax used with them as well as information about other components and tagnames of the interchange system.
- Many of the analysis and calculation methods mentioned here are described in more detail in the forthcoming manual by Greenfield and Southgate, *Guidelines for the Production, Management and Use of Food Composition Data.* Recommendations are also made there about the best methods of data generation. Additional calculation methods are discussed in the forthcoming manual by Rand, Pennington, Murphy, and Klensin, *Compiling Data for Food Composition Databases.*
- Recommendations about which nutrients should be included in a new food composition table will appear in a document prepared by Truswell and Southgate.

- Documents that specify how foods should be described and classified for international interchange are being prepared. No document is yet available on the general-purpose international classification system.
- Preliminary specification for the representation of zero, trace, and unavailable values appears in an INFOODS Secretariat working paper, INFOODS/IS N22. A preliminary set of common tagnames to be used subsidiary to those in this document has also been proposed; both are available from the Secretariat.