Some issues and problems in the usefulness of chemical composition data across boundaries

Ricardo Bressani

Abstract

This paper discusses some of the issues and problems of using Latin American food composition tables. Little effort has been made to upgrade the quality of the data and increase the number of nutrients per food since 1960, when most of the tables were published. Four main issues which may cause problems in the interchange of food composition data are discussed: (1) identification, classification, and description of the sample; (2) specific factors that influence the chemical composition of the food; (3) processing factors; and (4) analysis of the sample. The paper concludes that the analytical values of the foods of one region can be used in another region if there is a process of selection that takes into consideration all possible information on the sample. Increased communication between countries would enhance the use of foreign data.

Introduction

Due to the increasing trend in food imports and exports, food aid programmes, preparing and consuming foreign food dishes, studies on the relationship between diet and disease, nutrition intervention projects, nutritional assessment of specific populations, food labelling and food fortification, and other nutrition-related activities, food composition data from various countries should be more useful for local and foreign needs. However, the use of foreign chemical composition data presents many problems due to the complexity of developing and compiling data for food composition tables. The problem becomes more difficult when the data available are relatively old, as is the case for information from most of Latin America. No efforts have been made to upgrade the quality of the data in spite of the fact that today more analytical results on many foods are available than when the tables were first compiled.

In technologically advanced countries, diversity in nutrient composition values for a single food is very small, while in the less technologically advanced countries diversity in composition values of the same food is quite wide. This is, therefore, a very important issue which must be kept in mind. This paper addresses some of the issues and problems that may be encountered in the use of food composition data from Latin America and attempts to provide solutions.

Present food composition data in Latin America

Food analysis in most countries of Latin America was initiated some 40 to 50 years ago for the purpose of studying the nutrient intake of rural and urban populations and to have additional criteria for evaluating the nutrition status of the population at large or of specific population groups. Although many kinds of foods were analysed, the number of samples per food was small because of the urgency for the use of the data at that time. The nutrients analysed included proximate composition, calcium, phosphorus, and iron, carotene and vitamins A, B_1, B_2, niacin, and ascorbic acid. Not many efforts to upgrade the quality of the data and to increase the number of nutrients per food have been made since 1960, when most tables were published. Some activity was initiated when the concept of LATINFOODS was introduced in 1983 [1]. Presently available tables are, in general, relatively good, but most are far from being the kind of documents that are needed now and will be more so in the future, at both local and national levels. Limitations in the analytical data

Ricardo Bressani is the coordinator for LATINFOODS and a research leader in food science and agriculture at the Institute of Nutrition for Central America and Panama (INCAP) in Guatemala City, Guatemala.

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make the process of data interchange difficult, indicating a need to proceed with caution.

Some of the problems

The main issues and problems of using food chemical composition data can be included in any one of four groups. Group 1 is related to the problems which arise due to insufficient sample identification, classification, and description. Group 2 includes aspects related to the food sample itself; the chemical composition of vegetable and animal products is related to genetic factors, environment and cultural practices, post-harvest technology activity, and marketing. Processing techniques and conditions represent a third group of factors. The same kind of food may be prepared at home and at the industrial level, and steps in the process may be different in the two situations. The fourth group includes all activities associated with the actual chemical analysis, which begins with the selection of a representative sample, an appropriate number of samples, sample preparation and preservation, method of analysis, standards used, and expression of the analytical value, both in terms of specific moisture and the units used [2–4].

Sample identification, classification, and description

The problems associated with identification, classification, and descriptions of foods apply to all food groups, but probably more so for those of vegetable origin. This is one of the most important problems which causes difficulties within closely related regions and, more so, between different regions. Before describing the problems, it is important to define the terms *identification*, *classification*, and *description*.

Identification is used as a means to include the food in a specific food group. It should provide the common name and synonyms; the name in other languages is also very useful. Classification is the term used to provide the scientific name and its taxonomic identity. Description is used to indicate the part of the food used, whether from vegetable or animal origin, the method of processing, the type of meat cut, whether the food is consumed fresh or cooked, and the ingredients and amounts in mixed dishes, just to mention a few. To further clarify the value and significance of these terms the following examples are given: Common beans are identified as food grain legumes and classified as *Phaseolus*, while maize is a cereal grain belonging to *Zea*. Although there may be problems in identification and classification, generally these issues can be solved relatively easily. Sample description is very important, but it is more complex and often only minimal information is available. For example, there are light and heavy creams, sweet and sour creams, but only cream is given in the Latin American table. The problem here is that food standards and definitions are not available, and, if they are the standard is not implemented. Processed cheeses and other types of cheese may have well-known names such as cheddar, pecorino, or mozzarella, but, due to the variability in milk composition and to the process, the composition of the product is not the same as the true cheese or the standard of other countries. Standards of identity are usually established from data in which the chemical composition of the raw material plays a very important role, as well as the process, which is useful in adjusting the food to the standard. The standards of identity established in any country for a processed food are often taken from the standards of identity of another country without taking into consideration basic differences in the chemical composition of the raw material.

The importance of the significance of these terms is greater when mixed dishes are examined, because they require more thought and evaluation before the food values are used. For example, tacos and enchiladas from Guatemala are different from those from Mexico or those from the United States. It is important to provide ingredient composition. Ideally the tables or other documents should contain a food description dictionary, which would be of significant help in the application of food composition values by persons using data from other countries who are not familiar with the food. Descriptions for three foods are given in figure 1.

These food descriptions may be drafted in different ways to provide the user with as much information as possible. One example would be a description based on the food chain, so that all descriptions of foods follow a standard system of description.

Food descriptions are useful in the analysis, selection, and acceptance of analytical values. In the case of maize tortillas one would expect a high calcium level since the process uses lime, which may also carry with it other minerals. One may expect low levels of B vitamins because cooking is done at alkaline pH, and dietary fibre may be lower in raw maize since the seed coat is removed.

Industrially produced fried beans may have higher levels of dietary fibre than the home-made product because the seed hulls are not removed. It should be indicated that fried beans may be prepared differently in other countries.

Finally, for atole, protein and calories, as well as other nutrients, will be different if it is made with milk rather than with water, or if it is made from roasted legume grains or flour blends of maize and oilseeds.

Descriptions are needed only for foods that are prepared in ways not common in other countries.

Tortillas de maíz (maize tortillas)– A food purchased in the market or made at home from industrial flour or from hard and soft whole maize, often white, by cooking maize at boiling temperature in a 0.6%–1.0% lime solution based on maize weight for 50–65 minutes, which removes the seed coat, followed by washing, grinding, dough preparation, and baking of 20–50 g portions made into flat cakes on a clay surface sprayed with a thin lime-water solution and heated up to 210° C for up to 2.5–3 minutes on each side, to be consumed warm, reheated, or dried.

Frijoles fritos (fried beans)– Black or red beans are cooked in water until soft. They are then ground and strained with the cooking liquor. The strained beans without most of the seed coat are cooked with 20%–25% of oil and onions to yield a thick soup-like product, which with further water evaporation yields a paste with a shape. They are produced industrially, but seed coats are not removed. The product's preparation differs between countries.

Atol or *atole*– A generic name for a thick drink, served hot, commonly made from maize at the dough-stage by water addition and pressing to produce a milk-like liquid which is then cooked with milk and sugar to a thick consistency. Often annatto flour is sprayed on the top and 3 to 5 cooked black beans are added for appearance. It can also be made from other gelatinized cereals, lime-treated maize dough, roasted food legumes, and cereal/oilseed flour mixtures.

FIG. 1. Examples for a food description dictionary

Foods that are commonly found and consumed in a number of countries need only their true identification and classification if ingredient composition and process are alike, and a minimal description.

The identification, classification, and description of foods will facilitate data interchange and the process of developing a coding system equal or similar to others already available and the means to use it in computer programs [4, 5].

Issues and problems related to the sample

As indicated above, the present chemical data in the tables were obtained some years ago. Since then important changes have taken place in all aspects of the food chain leading to the production, availability, and transformation of the food to be consumed. For example, even though a number of improved varieties of maize and beans have been introduced in agricultural production, there are many land races still being produced. The same applies to other food crops. Likewise, agricultural practices have improved but traditional practices still persist. This applies to animal food products as well. In rural areas, for example, chicken meat and eggs come from unidentified breeds which feed themselves with what they are able to find in contrast to those marketed in large cities which are produced on a large scale with compounded feeds. Rural chickens are often more than twice as old as those, in cities, grown on balanced feeds. About 85% of the swine in Latin America are native swine much different in composition from those of improved breeds. Feeding practices are also different, leading to differences in chemical composition. Most fruits and vegetables are transported without much protection and remain under natural conditions for a few days until consumed. They may be harvested and marketed at different stages of physiological maturity. There are also seasonal effects. For example, during the dry season, milk from cows fed dry and high-fibre grass is more concentrated, while that during the rainy season is more diluted, probably due to the high water content of the fresh grass being consumed. With respect to cattle, not only are meat cuts and breeds different, but all meat comes from animals which have been grass-fed from 2.5 to 4 or 5 years of age.

In addition to this, one must add the activities of post-harvest technology that have changed throughout the years. Therefore, present-day food intake studies for the estimation of nutrient intake using chemical data that are relatively old run the risk of giving untrue estimations. These problems can be solved, however, if the samples are described as indicated before, which will help in selecting the chemical values to be used. A further problem is that many of the chemical analyses are on raw samples, and only a few values are available for mixed dishes.

Issues and problems related to processing

One of the main problems with the Latin American food tables is that about 85% of the values are for raw natural foods, and it is well known that processing affects chemical composition, some processes more than others. Processing may not change the content of macronutrients much, but significant changes take place in the micronutrients. The problem is much more complex because the same food processed at home may have a different composition compared to the food prepared at the industrial level. Even at the home level, in different regions of the same country the same food may be processed differently or with different ingredients, resulting in different values (table 1). This diversity is large enough in single foods, and significantly larger in mixed foods, an example of which is "tamal" made from maize, rice, or potatoes. It may have different types of meat cuts, with or without dried fruits, chili sauce, or tomatoes. It may also have different levels of fat, either from vegetable or animal sources.

TABLE 1. Differences in calcium, iron, and zinc content of maize tortillas in two regions of Guatemala

	Northern [7]		Southern [8]	
	Average	Range	Average	Range
Ca	202 ± 74	99–476	217 ± 41.5	167–250
Fe	2.7 ± 0.8	1.9–6.4	7.0 ± 4.8	4.0–16.0
Zn	3.4 ± 0.1	2.1–4.4	5.4 ± 0.4	4.8–5.7

Values are milligrams per 100 g dry-weight basis.

Issues and problems related to the chemical analysis

There are a number of issues in this group of factors which are of interest: the selection of a representative sample, the number of samples analysed, the preparation of the sample and its preservation, the analytical techniques and standards used, and the expression of the value. The representativeness of the sample may be a problem, since samples of the same material to be analysed may come from different environments and be subjected to many factors which may or may not affect the content of the nutrient to be analysed. In a country like Guatemala, for example, many types of maize are grown, and it is dangerous to use the analytical values obtained on only one or two types. The same applies to other foodstuffs. Many foods are grown at different altitudes and in different seasons. Not all nutrients are affected to the same extent by these environmental factors, macronutrients probably less than micronutrients.

Another problem is that probably not more than five samples are analysed for most foods. Exceptions are some basic foods (table 2). Again, more samples are analysed for macronutrients than for micronutrients. Sample preparation is also a problem, particularly when the sample is not well homogenized before portions are weighed for analysis. The analytical technique used is probably the least of the problems, although there are examples where the analytical method gives conflicting results, such as carotenes. This is proof that the analytical method can become a factor. Finally, the chemical value is expressed on the basis of its moisture content, and in many cases the moisture value is not provided.

TABLE 2. Number of analyses on single foods in the Latin American food composition table [6]

	Macro-nutrients	Micro-nutrients
White rice	32–36	20–38
Maize	51–53	50–53
Arepa (from maize)—3 countries	1–4	1–4
Tortilla (from maize)	3–25	3–25
Chard	65–70	17–70
Amaranth	7	4–7
Spinach	1	1
Common beans (*Phaseolus vulgaris*)	133–270	165–270
Bananas	1–3	2
Guanabana (soursop)	8	5–6
Guava (*Psidium guajava*)	25–27	21–37

A process for the selection and use of chemical data

It is difficult to propose a standard or guidelines to select chemical data from a table of one region to be used in another geographical region. However, there are some steps which can be followed in addition to those already discussed. Potassium analyses, for example, were requested for vegetables, fruits, and root crops from one geographical region to be used for nutrition studies in another geographical region. The steps to be followed include:

1. Identify, classify, and describe the vegetables, fruits, and root crops of interest in both geographical regions to learn if they are the same.
2. Determine if the genetic characteristics, the agricultural practices followed in their production, and handling practices are the same in both regions.
3. Determine how the foods are consumed (fresh or processed). The method of processing used for consumption in both regions must be established.
4. Determine if the chemical analysis was done on a fresh or a processed sample. If more than one process, or a different process, was used, the analysis must be on each or on the one used in the region where the values are to be used.
5. A reference to the method of analysis must be given, and an explanation should be provided on the units used for expression of the results.
6. Once the above sequence of analysis is finished, the values provided could be used.

Implications for the use of data of application programmes

Food composition data should be the best that can be obtained. However, there are various applications that can be met relatively well with what is available in terms of data quality. For example, in studies of nutrient intake based on food intake data, analytical food values do not need to be the best, since food intake data are much less accurate than most analytical values, even in dietary surveys where foods are weighed. On the other hand, specific nutrient intervention programmes would require the best values available to determine the present intake of the nutrient in question, as well as to know what levels to test in the intervention. Other applications such as food fortification or metabolic studies would require the best available values. Likewise, studies between diet and disease also require the best possible values for a better analysis of the cause and effect relationship. Many nutrition intervention studies have failed to support metabolic nutrition results because knowledge has been lacking on the actual nutrient intake of the baseline situation, and because the analytical values of the foods at the baseline situation were not adequately selected.

In conclusion, the available analytical values of the foods of one region can be used in another region if there is a process of selection of the values that takes into consideration all possible information on the sample. The use of foreign data can be enhanced if there is increased communication between countries with more advanced expertise in the problem and those with less experience.

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