# Some Issues and Problems in the Usefulness of Chemical Composition Data Across Boundries

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Due to the increasing trend in food imports and exports, in food aid programs, in preparing and consuming foreign food dishes, in studies on the relationship between diet and disease, in nutrition intervention projects, in nutritional assessment of specific populations, in food labeling and food fortification and other nutrition-related activities, food composition data from various countries should be more useful to local and foreign needs. However, the use of foreign chemical composition data presents many problems due to the complexity in developing and compiling data for food composition tables. The problem becomes more difficult when the data available is 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 there are more analytical results on many foods that were available in the past when the tables were first compiled.

In this short presentation it will be indicated what are some of the issues and problems which may be encountered in the use of food composition data from Latin America and maybe attempt to provide solutions. However, before discussing that, I like to indicate that 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.

## AN OVERVIEW ON PRESENT FOOD COMPOSITION DATA IN LATIN AMERICA

Food analysis in most countries of Latin America was initiated some 40-50 years ago for the purpose to study the nutrient intake of rural and urban populations and to have additional criteria for the evaluation of the nutritional status of the population at large or of specific population groups. Although many kinds of foods were analyzed, the number of samples per food were small, because of the urgency for the use of the data at the time. The nutrients analyzed included proximate composition, calcium, phosphorus and iron, carotene and Vitamin A, $B_1$, $B_2$, Niacin and Ascorbic acid. Not many efforts to upgrade the quality of the data and to increase the numberof nutrients per food have been made since 1960, when most Tables were published and some activity was initiated since 1983 when the concept of LATINFOODS was introduced (1). Present available tables are in general, relatively good but most are far from being the kind of document which is needed now and more so in the future, at the local level and for use in other countries. Therefore, there are limitations in the analytical data which make the process of data interchange difficult with a need to proceed with caution.

## SOME OF THE PROBLEMS

The main issues and problems a person who would like to use food chemical composition data will find can be included into anyone of four groups (Table 1): Group 1 is related to the problems which arise due to insufficient sample identification, sample classification and sample description. In Group 2 of issues and problems one may include aspects related to the food sample itself. It is well known that chemical composition of vegetable and animal products is highly

**Table 1 - Issues which may cause problems in the interchange of chemical composition of foods**

| | |
|---|---|
| Group 1 | Sample identification, classification and description |
| Group 2 | Issues specific to the factors influencing the chemical composition of the food |
| Group 3 | Processing factors - Industrial, Home |
| Group 4 | Sample Analysis - Units of Expression |

related to genetic factors, environment and cultural practices, postharvest technology activity and marketing. Processing techniques and conditions represent a 3rd 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. Group 4 of factors include all activities associated to 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 term of specific moisture basis and the units used (2,3,4).

## SAMPLE IDENTIFICATION, CLASSIFICATION AND DESCRIPTION

The problems associated with the identification, the classification and the description of the foods apply to all food groups, but probably more so for those of vegetable origin. Possibly this is one of the most important problems which causes difficulties even 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 (Table 2).

Identification is used as a means to include the food into its specific food group. It should provide also a 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, the ingredient composition and amounts in mixed dishes, 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 legume and classified as *Phaseolus*, while maize is a cereal grain belonging to *Zea*. Although there may be problems in identification and classification, in general these issues will not give much of a problem, which if they exist they can be relatively easy to solve. Sample description is very important, but it is more complex and only minimal information is often 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, mozzarella, but due to the variability in milk composition and to the process, composition of the product is not alike to the true kind of cheese or standard of other countries. Standards of identity are usually established from chemical composition 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. Often the standards of identity established in any country for a processed food are taken from the standards of identity of another country without taking into consideration basic differences in chemical composition of the raw material.

**Table 2 - Definition of Terms**

| | |
|---|---|
| Identification | Type of Food; Food Group; Common Name and Synonyms |
| Classification | Scientific Name; Taxonomic Identity |
| Description | Part of food Consumed; Percent utilization; specific process used to make it. Single food - Dish |

The importance of the significance of these terms is greater when mixed dishes rather than single foods are examined, which required more thought and evaluation before the food values are to be used. For example, tacos, enchiladas are different in Guatemala from those from Mexico from those in the U.S. It is important to provide ingredient composition. Ideally the tables orother document 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 and who are not familiar with the food. An example for three foods are given in Tables 3, 4 and 5.

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

**Table 3**

*Tortillas de maiz* - (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 T in a 0.6-1.0% lime solution based on maize weight for 50-65 min, which removes the seed coat, followed by washing, grinding, dough prepartation and baking of 20-50 g protions made into flat cakes on a clay surface sprayed with thin lime eater solution and heated up to 210°C for up to 2.5-3 minutes on each side, to be conusmed warm, reheated or dried.

**Table 4**

*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% oil addition and onions to yeild a thick soup-like product, which with futher water evaporation yeild a pastw with a shape. They are produced industriallly but seed coats are not removed. The product's preparation differs between countries.

**Table 5**

*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 anatto flour is sprayed on the top and 3-5 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.

These 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 use 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 fiber may be lower than in raw maize since the seed coat is removed.

The fried beans industrially produced may have higher levels of dietary fiber than the home-made product because bean seed hulls are not removed. It should be indicated also that fried beans as prepared in other countries may be prepared in a different way.

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

Descriptions are applicable only to foods which receive a type of process not common in foreign countries. Foods which 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 in minimal description.

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

## ISSUES AND PROBLEMS RELATED TO THE SAMPLE

As it was indicated before, present chemical data in the Tables was obtained some yearsago. 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 of 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. The same applies to animal food products. In rural areas for example chicken meat and eggs came from unidentified breeds which feed themselves with what they are able to find in contrast to chicken meat and eggs marketed in large cities which are produced in large scale with compounded feeds. Chicken meat in rural areas comes from chickens more than twice as old as chickens grown on balanced feeds. About 85% of the swine population in Latin America is represented by native swine much different in composition than swine 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 seasonal effects, milk during the dry season (no rain) is more concentrated from cows fed dry and high fiber grass, while milk from the rainy season is more diluted, due probably to the high water content of the fresh grass being consumed. With respect to cattle, meat cuts are different and not only are breeds different, but all meat comes from animals which have been grass fed from 2.5 up to 4 or 5 years of age.

On top of this, one must add the activities of post harvest technology which have changed throughout the years. Therefore, present day food intake studies for estimation of nutrient intake using chemical data that is relatively old runs the risk to give untrue estimations. These problems, however, can be solved

if the samples were to be described as indicated before which will help in selecting the chemical values to be used. A further problem is that many of the chemical analysis are on raw samples, and only a few values are available on mixed dishes.

## ISSUES AND PROBLEMS RELATED TO PROCESSING

One of the main problems in the Latin American Food Tables is that about 85% of the results are on raw natural foods, and it is well known that processing affects chemical composition with some processes more than others. Processing may not change much the content of macro nutrients, but significant changes take place in the micro nutrients. The problem is much more complex because the same food processed at home may have a different composition as compared to the food prepared at the industrial level, and even at home level, in different regions from the same country, the same food may be processed differently or with different ingredients resulting in different values (Table 6). This diversity is large enough in single foods, and significantly larger in mixed foods, an example of which is the "Tamal". This is made from maize, rice or potatoes, may have different types of meat cuts, with or without dried fruits, with and without chili sauce, tomatoes or different levels of fat, from vegetable oil to animal fat.

## ISSUES AND PROBLEMS RELATED TO THE CHEMICAL ANALYSIS

There are a number of issues in this group of factors which are of interest. These are the selection of a representative sample, the number of samples analyzed, 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 the same material to be analyzed may come from a great many number of environments and subjected to many factors which may or may not affect the content of the nutrient to be analyzed. In a country like Guatemala, for example, there are many types of maize being grown, and it is a dangerous situation 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 over sea level in different seasons. Not all nutrients are affected by these environmental factors to the same extent. Macro nutrients possibly less than micro nutrients. Another problem is the number of samples analyzed which for most foods is usually only a few, probably not more than 5. Exception are some basic foods (Table 7). Again, there are more samples analyzed for macro nutrients as compared to the number samples for the micro nutrients. Sample preparation is also a problem, particularly when the sample is not well homogenized beforeportions are weighed for analysis. With respect to the analytical technique used, this is probably the least of the problems, although there are examples where the analytical method gives conflicting results such as carotenes. However, it may be a factor. Finally the chemical value is expressed on the basis of its actual moisture content, and in many cases the moisture value is not provided.

**Table 6 - Differences in Ca, Fe and Zn Content of Maize Tortilla by groups of Households in two regions in Guatemala**

| | North Region** | | South Region*** | |
|---|---|---|---|---|
| Mineral* | 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 |

* mg/100g d.w. basis
** Krause, 1988
*** Bressani et al., 1988

**Table 7 - Number of Analysis on Single Foods (Latin America Table)**

| Food | Macro Nutrients (No. Of Analysis) | Micro Nutrients (No. Of Analysis) |
|---|---|---|
| White Rice | 32-36 | 20-33 |
| Maize | 51-53 | 50-53 |
| Arepa (from maize)-threes countries | 1-4 | 1-4 |
| Tortilla (from maize) | 3-25 | 3-25 |
| Chad | 65-70 | 17-70 |
| Amaranth | 7 | 4-7 |
| Spinach | 1 | 1 |
| Common beans (P.vulgaris) | 133-270 | 165-270 |
| Bananas | 1-3 | 2 |
| Guanabana (Sour sop) | 8 | 5-6 |
| Guava (Psidium guajava) | 25-27 | 21-37 |

Reference (6).

## A PROCESS FOR THE SELECTION AND USE OF CHEMICAL DATA

It is difficult to propose a standard way or guidelines to select chemical data from a table of one region to be used in a situation in another geographical region. However, there are some steps which can be followed, besides those already discussed. An example may help. Potassium analysis, 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. It is important to identify, classify and describe the vegetables, fruits and root crops of interest in both geographical regions to learn if they are the same.
2. A decision has to be reached if the genetic characteristics, the agricultural practices followed in their production, and handling practices are the same in both geographical regions.
3. Knowledge must be available on how the foods are consumed (fresh or processed). The method of processing used for consumption in both regions must be established.
4. It is important to determine if the chemical analysis was done on the fresh or processed sample. If more than one processes, or a different process is 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.

## THE IMPLICATIONS OF THE USE OF DATA WITH RESPECT TO APPLICATION PROGRAMS

It is obvious that for all applications of food composition data, these should be the bestwhich can be obtained, however, there are various applications which can be met relatively well with what it is available in terms of data quality. For example in studies of nutrient intake based on food intake data, analytical food values may be not the best, since food intake data is much less accurate than most analytical values, even with dietary surveys where foods are weighed. On the other hand, specific nutrient intervention programs would require the best values available, as close to the situation as possible. The best values would be needed to know what is 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 would require also the best possible values for a better analysis of 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 selected adequately.

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 taking into consideration for the selection 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 with those with less experience.

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