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Short Communication

Compilation of mineral data: Feasibility of updating the food composition database

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ABSTRACT

The analysis of food components to create national databases is costly and time-consuming; thus, it is necessary to ensure that data compilation in these databases is performed accurately to ensure widespread availability. This research aims to create a Brazilian mineral database (BMD), using an accurate compilation of national information, and to evaluate data coherence by comparing the BMD to two other sources of food composition data. The information was compiled according to the guidelines proposed by the International Network of Food Data Systems. The BMD contains data for 22 minerals of 860 different foods. The data for calcium, iron, zinc and sodium of 15 foods from the BMD were compared with the analytical data available in the USDA National Nutrient Database (USDA) and in the Brazilian Food Composition Table (Taco), which contains data obtained by direct analysis of a representative national sampling. The comparison of the BMD with USDA data resulted in a high percentage of inconsistent values (62%) that result from the different profiles of foods and products consumed in each country and the ecosystem diversity. Moreover, the comparison with the Taco data resulted in consistent values for most evaluated mineral data (59%). Therefore, the compilation of national food data represents a feasible alternative for updating the Brazilian mineral database.

1. Introduction

Food composition databases must present reliable chemical composition information so that they can be used nationally and internationally in public health studies, educational politics, as well as to inform consumers. These databases can be used not only to promote health and reduce the risk for diseases (Egan et al., 2007; Menezes et al., 2013; Pennington et al., 2007) but also provide information for clinical research, product development, among other uses (Yada et al., 2011).

Due to the importance of chemical composition data, the quality and reliability of the information is essential for both analytical and compiled results (Judprasong et al., 2013; Puwastien, 2011). Food composition tables can be elaborated by three methods: direct, indirect and a combination of these two methods (Greenfield and Southgate, 2003). The direct method is ideal once food data are obtained by analysis specifically for databases; however, this method involves high costs, a complex infrastructure (equipment and trained people), methodology standardization and validation, specific sampling plans and other complexities (Menezes et al., 2011). The indirect method, which has a much lower cost, consists of compilation of data from existing information (Greenfield and Southgate, 2003; Yada et al., 2011) that is distributed in different publications and in laboratory internal data. However, the indirect method involves a complex theoretical basis, with pre-established criteria for careful evaluation of information quality (Menezes et al., 2011). The third way to elaborate a food composition table consists of a mixed system,

Abbreviations: BMD, Brazilian mineral database; BRASILFOODS, Brazilian Network of Food Data Systems; FoRC, Food Research Center; INFOODS, International Network of Food Data Systems; LATINFOODS, Latin American Network of Food Data Systems; NAPAN/USP, Food and Nutrition Research Center/University of Sao Paulo; Taco, Brazilian Food Composition Table; TBCA-USP, Brazilian Food Composition Database – University of Sao Paulo; USDA, National Nutrient Database of United States Department of Agriculture.

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involving both direct and indirect methods, which is the system adopted by the Brazilian Food Composition Database – University of Sao Paulo (TBCA-USP)/Brazilian Network of Food Data Systems (BRASILFOODS) (USP, 1998).

Since its launch in 1998, the TBCA-USP/BRASILFOODS (USP, 1998) has been continuously updated (Menezes et al., 2009). The insertion of new foods and nutrients is a complex activity because it depends on the production of good analytical data on national foods. Currently, the TBCA-USP contains data for 2088 foods and products, most of which (58%) refers to proximate composition. Due to the lack of information for vitamins and minerals, BRASILFOODS in collaboration with the Food and Nutrition Research Center/USP (NAPAN/USP) and Food Research Center (FoRC), aim to release data for micronutrients, such as minerals. This is important not only because these components have a role in a variety of metabolic functions (Chekri et al., 2012) but also because there are more sensible and precise analytical techniques available that allow for more reliable results (Phan-Thien et al., 2012). An alternative approach would utilize mineral data published or produced by Brazilian researchers from regional universities who currently use adequate and validated techniques (often in projects that do not exclusively examine the production of food composition tables).

Considering that much of the information regarding the nutrient content of national foods is spread throughout scientific publications or has not been published, the importance of divulging this knowledge, as well as the cost of direct chemical analysis, it is necessary to evaluate how pertinent it is to use data compilation to improve food composition information. We hypothesized that the compilation of food mineral data is a feasible process to update the database. The present research aims to create a Brazilian mineral database, using an accurate compilation of national information, and to evaluate the coherence of the data by comparing them to two other relevant sources of food composition data.

2. Methodology

2.1. Data research

The research for food mineral data was taken from journals, dissertations, theses and internal laboratory data. Publications that contained mineral data of Brazilian foods were selected. With respect to the journals, several national and international electronic databases were researched, such as Scielo (http://www.scielo.org), Science Direct (http://www.sciencedirect.com), PubMed (http://www.ncbi.nlm.nih.gov/pubmed) and Dedalus (http://dedalus.usp.br/). This search was conducted using the advanced mode and was based on search criteria, such as keywords, and a range of articles from January 2009 to December 2011. In international databases, journals that supplied food information were selected and searches for the keywords "Brasil*" and "Brazil*" were conducted throughout the article. In national databases, the keywords used in Portuguese and English were the following: "composição" and "alimento"/"composition" and "food"; "composição" and "química"/"composition" and "chemical"; "nutriente" and "mineral*"/"nutrient" and "mineral", respectively. Dissertations and theses were mainly obtained from the digital libraries in USP, Sao Paulo State University "Júlio de Mesquita Filho" (Unesp) and Campinas University (Unicamp), among other universities or institutes.

2.2. Data compilation

In order to facilitate compilation and guarantee harmonized information, an updated version of the form for food composition data compilation was used (Menezes et al., 2011). This form encompasses independent spreadsheets (Excel) for several nutrient groups, as well as food identification (such as species, variety, maturation degree, type and time of cooking and storage), data quality and other information. The minerals described in the spreadsheet have levels of recommended intake according to Dietary Reference Intakes (Institute of Medicine, 2008) and/or have tagnames or identifiers proposed by the International Network of Food Data Systems (INFOODS) (INFOODS/FAO, 2012): Calcium (Ca); Iron (Fe); Sodium (Na); Magnesium (Mg); Phosphorus (P); Potassium (K); Manganese (Mn); Zinc (Zn); Copper (Cu); Sulfur (S); Selenium (Se); Chromium (Cr); Iodine (I); Fluorite (Fl); Chlorine (Cl); Molybdenum (Mo); Cobalt (Co); Barium (Ba); Bromine (Br); Nickel (Ni); Lithium (Li) and Rubidium (Rb). All of the foods are distributed by food groups proposed by the Latin American Network of Food Data Systems (LATINFOODS) to facilitate information transfer to the LATINFOODS database (LATINFOODS, 2013). The filled spreadsheets forms for mineral data represent the profile of information that will be available in the Brazilian mineral database (BMD).

The entire mineral data in the compilation process (collection, evaluation and data registration) was conducted according to the pre-established INFOODS/LATINFOODS/BRASILFOODS guidelines and criteria (Menezes et al., 2005). This process also considered basic principles of the sampling plan, number of samples, description of sample handling, identification and procedures of the analytical method, analytical quality control, conversion factors and detailed identification of nutrients and foods, among other factors (Holden et al., 2002; Menezes et al., 2011; Pehrsson et al., 2000). In the case of publications in which these parameters were not clearly described, the author was consulted and, if no answers or solutions were obtained, the publication was not used. For data presented as dry weight in the original publications, a conversion into wet weight was applied using the moisture value provided by the author. The methods recommended by Greenfield and Southgate (2003) for minerals were the analytical method accepted following consideration of performance and validation.

BMD presents the average content of each mineral in mg or μg/100 g of the edible portion and its respective standard deviation or variation. Moisture values were introduced if present in the original publication, as they facilitate interchange of information and allow the calculus in different basis. The lack of nutrient values does not mean that the value is equal to zero, only that the information was unavailable in the publication. The sources of all of the information (laboratory or bibliographic reference) are documented in the BMD.

2.3. Comparison of compiled results and established criteria

A national food composition database was chosen for comparison to the BMD data. This database was the Brazilian Food Composition Table (Taco, 4th edition), which contains results of 597 food items that were originally from a national sampling plan and from analyses that were performed by recognized food laboratories (Nepa/Unicamp, 2011). The second source of comparison was the USDA National Nutrient Database (USDA, release 24), which contains 7906 results of food items (146 components) originally from USDA laboratory analysis, collaborative research, scientific literature and information from food industries (USDA, 2011). The USDA National Nutrient Database was the main database used for evaluating the Brazilian population consumption, which was conducted by the Brazilian Institute of Geography and Statistics (IBGE, 2010). Ca, Fe and Zn, which are the minerals that are most frequently deficient in Brazilian diets, were chosen for the comparison. Na was also selected due to its association with non-transmissible chronic diseases when a high amount is consumed. Foods that are more commonly purchased by the population were also chosen, according to the document *per capita*