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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*

Household Acquisition of the Household Budget Survey (POF 2008–2009) (IBGE, 2010). After this selection, foods of a similar description were identified to allow the comparison of data between the BMD, Taco and USDA. The values were converted to the same unit for each mineral. The 15 foods that were chosen from the BMD were the following: pineapple; pacovã banana; papaya; passion fruit; strawberry; lettuce; raw kale; cucumber; white raw cabbage; natural and strawberry yoghurt; mozzarella cheese; bologna; cooked carioca beans and raw egg. To select foods from the North American database, a similar variety of certain foods were chosen so that comparisons could be performed, but this database does not contain the same foods as the BMD and Taco. As alternatives to the Brazilian food, *Musa paradisiaca* banana was compared with *Musa acuminata* Colla banana (USDA) and passion fruit *Passiflora alata* Dryand was compared to "purple passion fruit" *Passiflora edulis* (USDA). For comparisons with the Taco data, the *Fragaria vesca* L. strawberry was selected given that the same species selected in the BMD and USDA was not found. For the cucumber comparison, BMD did not have the same species as the other databases, so the *Benincasa hispida* (Thunb.) Cogn. was selected, as it is a genus of the same family, the *Cucurbitaceae*. This is a kind of cucumber characterized by its big size and frequent consumption in the Amazon (North region of Brazil), according to the Amazon National Research Institute (INPA) (Yuyama et al., 1997).

Regarding the comparison criteria, the percentage difference was calculated to estimate the difference between the values from the three sources (BMD, Taco and USDA) (Padovani et al., 2007; Vaask et al., 2004). Percentage difference = [(BMD value − Taco or USDA value)/BMD value] × 100. This difference was calculated for each mineral in each product and the BMD values were used as a reference. A negative or positive value result indicates that the BMD value was lower or higher than the compared data, respectively. The percentage differences were classified according to the criteria adopted by Padovani et al. (2007), with modifications. For foods with concentrations ≥1000 mg, a difference of <10% indicate consistent data between databases; for those between 100 and 999 mg, <20%; for those between 10 and 99 mg, <30% and for foods with concentrations ≤9.9 mg, <40%. The highest value was always considered in cases of different concentration ranges.

3. Results and discussion

3.1. Brazilian mineral database (BMD)

The BMD was developed based on the compilation of 162 publications and a total of 860 foods. Among these foods, 26% belong to the fruit group, 25% to the vegetable group and 13% to the legumes group. From the 22 compiled minerals, Fe, Ca and Zn were the most common among the publications (76%, 72% and 66%, respectively). The frequency with which the elements Na, Mg, P, K, Mn and Cu appeared in the publications varied from 43% to 54% and the other elements presented a frequency below 12%. The compilers had to discard 186 publications because they contained excluding factors, such as non-recommended and/or non-validated analytical methodology and analysis of unconventional products (e.g., multimixtures). From the entire compiled data set, 31% are regionally consumed foods (268), which are very relevant due to the diversity of foods in the country.

3.2. Comparison of BMD data and other sources of food composition

Table 1 presents the comparison of the mineral content of 15 selected foods and the percentage difference of the BMD values in relation to Taco or USDA values. Moisture and ash contents were considered to ensure the adequate selection of comparable foods. From these results, certain inconsistent data were found in the food content of minerals, mainly when the comparison was made with the USDA. It is important to highlight that the BMD data did not present values within the variation ranges available in the USDA. The amounts of Zn in the BMD were primarily higher than the other sources, with an inconsistent value in relation to the USDA, and a difference of up to 81% for passion fruit; however, when this fruit was compared to Taco data, the values were consistent (difference of 26%). The same occurred for Ca, which had high levels in the BMD when compared to the other sources, an inconsistent value (difference equal to = 81%) for egg in comparison to the USDA, but a consistent value when compared to the Taco (−14%).

The content of Fe in the BMD (for most foods) was lower than in the other sources; for example, kale presented an inconsistent value when compared to the USDA (difference of −325%), and consistent data (difference of −13%) when compared to the Taco. A similar result was observed for Na in cabbage, which showed inconsistency between data when compared to the USDA, difference of up to −500%, and a consistent value when compared to the Taco (−21%).

A great inconsistency was observed in the values for certain foods when comparing Taco to USDA data and when considering Taco data as a reference for the calculation of the percentage difference (e.g., the content of Na in kale (−617%), Zn in egg (97%) and Fe in cabbage (−213%), among others). In foods of a vegetable origin, important sources of variation include variety, crop, climate, maturation stage during ripening, handling and storage. The water content is particularly affected by storage conditions and its variation can affect the concentration of other food components. Conversely, differences in the contents of vitamins and minerals, mainly trace elements, can be attributed to the composition of the soil and use of fertilizers, in addition to the factors previously described (Rodríguez et al., 2011).

With respect to cucumber, inconsistent data were found in the content of all of the elements in the BMD, for both Taco and USDA comparisons. Inconsistent values were also found in the USDA content of Fe and Zn of passion fruit, and the BMD values were below the lower bound of the USDA. Considering all of the possible interferences cited for foods of vegetable origin, in this case, different species have been used for comparison. Strawberry in the BMD (0.01 mg/100 g) also presented an inconsistent value when compared to the Taco and the USDA for Zn content, reaching −1700% and −1300% of difference, respectively, presenting value below the lower bound observed in USDA database for this element. In the Danish Food Composition Databank (Saxholt et al., 2008), strawberry has a mean value of 0.10 mg/100 g for Zn and a concentration range between 0.04 and 0.19 mg/100 g, while the value found in the BMD is closer to the lower extreme and the values of other sources are closer to the higher extreme. Strawberry in the BMD was the only food among the composition sources used that had a food identification that was complete, including cultivar; therefore, it is possible that the described variation comes from the sample type. According to Pennington (2008), scientific names can facilitate a comparison, but complementing the information with cultivars is also important because it can be different in certain countries, resulting in different composition values.

The nutrient contents can vary as much or more between different varieties of the same foods as between different foods. In the case of iron content of rice varieties, it can range from 1.1 to 2.64 mg/100 g food and zinc content can range from 3.14 to 5.89 mg/100 g (Kennedy and Burlingame, 2003). Calcium content of potato varieties can range from 0.87 to 22.2 mg/100 g and potassium from 250 to 694 mg/100 g; the FAO/INFOODS food composition database on biodiversity (FAO/INFOODS, 2012) provides more examples. Thus, the intake of one variety rather

Table 1
The content of nutrients (in 100 g of edible portion) and comparison of the mineral content and percentage difference (*D*%) between the Brazilian Mineral Database (BMD) data and the Brazilian Food Composition Table (Taco) or the USDA National Nutrient Database (USDA) data.

Id[a]	Original name	*n*[*]	Moisture (g)	Ash (g)	Calcium (mg)	*D* (%)	Iron (mg)	*D* (%)	Sodium (mg)	*D* (%)	Zinc (mg)	*D* (%)
BMD-C1130	Pineapple, raw, pulp, *Ananas comosus* (L.) Merr., Fortaleza-CE	1			14.5		0.69		1.6		0.17	
TACO-164	Pineapple, raw, *Arábic comosus* (L.) Merril	1	86.3	0.37	**22.4**	−55	**0.26**	62	Tr		0.14	18
USDA-09266	Pineapple, raw, *Ananas comosus*, all varieties		86	0.22	13	10	**0.29**	58	1	38	0.12	29
BMD-C1119	Banana, *in natura*, *Musa paradisiaca*, pacovã, Manaus-AM	1	60.8	1.01	1.88		0.45		0.83		0.24	
TACO-181	Banana, pacova, raw, *Musa acuminata* Colla x *Musa balbisiana* Colla, Group AAB	1	77.7	0.67	**5.49**	−192	0.37	18	0.94	−13	**0.14**	42
USDA-09040	Bananas, raw, *Musa acuminata* Colla		74.9	0.82	**5**	−166	**0.26**	42	1	−21	0.15	38
BMD-C1134	Papaya, raw, pulp, *Carica papaya* L., Fortaleza-CE	1			11.1		0.25		1.98		0.03	
TACO-226	Papaya, raw, *Carica papaya* L.	1	88.6	0.4	**22.4**	−101	0.19	24	1.63	18	**0.07**	−133
USDA-09226	Papaya, raw, *Carica papaya*		88.1	0.39	**20**	−80	0.25	0	**8**	−304	**0.08**	−167
BMD-C910	Passion fruit, sweet, raw, pulp, *Passiflora alata* Dryand., Lins-SP	30	70.8 ± 0.7		12.9 ± 2.03		0.78 ± 0.23				0.53 ± 0.11	
TACO-232	Passion fruit, raw, *Passiflora edulis* f. Flavicarpa	1	82.8	0.79	**5.39**	58	0.56	28	1.58		0.39	26
USDA-09231	Passion fruit, purple (granadilla), *Passiflora edulis*		72.9	0.8	12 ± 4.73	7	**1.6**	−105	28		**0.1**	81
BMD-C1080	Strawberries, raw, *Fragaria anassa* Duch., cv. Sweet Charles, Valinhos-SP	1	93.1	0.44	19.8		0.23		22		0.01	
TACO-239	Strawberries, raw, *Fragaria vesca* L.	1	91.5	0.45	**10.9**	45	0.32	−39	Tr		**0.18**	−1700
USDA-09316	Strawberries, raw, *Fragaria x ananassa*		91	0.4	16	19	**0.41**	−78	**1**	95	**0.14**	−1300
BMD-B1165	Lettuce, butterhead, raw, *Lactuca sativa*, Campinas-SP	15	95.3 ± 0.4		47 ± 14		0.5 ± 0.2		5 ± 2		0.33 ± 0.04	
TACO-79	Lettuce, smooth, raw, *Lactuca sativa* L.	1	95	0.76	**27.5**	42	0.61	−22	4.23	15	0.35	−6
USDA-11250	Lettuce, butterhead (includes boston and bibb types), raw, *Lactuca sativa* var. capitata		95.6	0.57	35	26	**1.24**	−148	5	0	0.2	39
BMD-B1168	Kale, raw, *Brassica oleracea* var. acephala, Campinas-SP	15	89.8 ± 1.4		286 ± 43		0.4 ± 0.2		12 ± 4		0.29 ± 0.05	
TACO-115	Kale, “manteiga”, raw, *Brassica oleracea* var. acephala	1	90.9	1.35	**131**	54	0.45	−13	**6**	50	0.4	−38
USDA-11233	Kale, raw, *Brassica oleracea* (acephala group)		84.5	1.53	**135**	53	**1.7**	−325	**43**	−258	**0.44**	−52
BMD-B1152	Cucumber, raw, pulp, *Benincasa hispida* (Thunb.) Cogn., Manaus-AM	2			4.5 ± 0.1		0.09 ± 0		0.65 ± 0.05		0.04 ± 0	
TACO-142	Cucumber, raw, *Cucumis sativus* L.	1	96.8	0.29	**9.62**	−114	**0.15**	−67	Tr		**0.13**	−225
USDA-11206	Cucumber, peeled, raw, *Cucumis sativus*		96.7	0.36	**14**	−211	**0.22**	−144	**2**	−208	**0.17**	−325
BMD-B1171	Cabbage, raw, *Brassica oleracea* var. capitata, Campinas-SP	15	94.2		44 ± 6		0.14 ± 0.03		3 ± 1		0.2 ± 0.1	
TACO-149	Cabbage, white, raw, *Brassica oleracea* var. capitata	1	94.7	0.4	34.6	22	0.15	−7	3.64	−21	0.15	25
USDA-11109	Cabbage, raw, *Brassica oleracea*, capitata Group		92.2	0.64	40	9	**0.47**	−236	**18**	−500	0.18	10
BMD-G306	Yoghurt, natural, São Paulo-SP	1			124		0.36		43.7		0.21	
TACO-448	Yoghurt, natural	1	90	0.94	143	−15	Tr		51.6	−18	**0.44**	−110
USDA-01116	Yoghurt, plain, whole milk, 8 grams protein per 8 ounce		87.9	0.72	121	2	**0.05**	86	46	−5	**0.59**	−181
BMD-G299	Yoghurt, strawberries, São Paulo-SP	1			94.6		0.45		46.2		0.29	
TACO-451	Yoghurt, strawberries	1	84.6	0.63	101	−7	Tr		37.7	19	0.3	−3
USDA	–											
BMD-G292	Cheese, mozzarella, São Paulo-SP	3			674 ± 22.1		0.23 ± 0.01		432 ± 26.3		3.7 ± 0.12	

Table 1 (*Continued*)

Id[a]	Original name	n*	Moisture (g)	Ash (g)	Calcium (mg)	D (%)	Iron (mg)	D (%)	Sodium (mg)	D (%)	Zinc (mg)	D (%)
TACO-463	Cheese, mozzarella	1	45.3	3.78	**875**	−30	0.31	35	**581**	−35	3.52	5
USDA-01026	Cheese, mozzarella, whole milk		50	3.28	**505**	25	**0.44**	−91	**627**	−45	2.92	21
BMD-F477	Bologna, São Paulo-SP	8			36 ± 23		1.43 ± 0.04		1496 ± 238		3.35 ± 0.49	
TACO-424	Bologna	1	56.4	4.14	**66.6**	−85	1.47	−3	**1212**	19	**1.02**	70
USDA-07008	Bologna, beef and pork		51.9	2.85	**85**	−136	1.21	15	**960**	36	2.3	31
BMD-T244	Beans, carioca, cooked, *Phaseolus vulgaris* L., Piracicaba-SP	1	77.2	0.91	33		1.5					
TACO-561	Beans, carioca, cooked, *Phaseolus vulgaris* L.	1	80.4	0.74	26.6	19	1.29	14	1.76		0.7	
USDA-16043	Beans, pinto, mature seeds, cooked, boiled, without salt		63	1.17	**46**	−39	2.09	−39	1		0.98	
BMD-J26	Egg, chicken, white, raw, Campinas-SP	1	78.6	0.82	37		1.56					
TACO-489	Egg, chicken, raw	1	75.6	0.83	42	−14	1.6	−3	168		1.08	
USDA-01124	Egg, white, raw, fresh		87.6	0.63	**7**	81	**0.08**	95	166		0.03	

Data of 15 foods selected from the BMD, Taco (Nepa/Unicamp, 2011) and USDA (USDA, 2011), presented as mean ± standard deviation. n = number of samples.
* When $n = 1$, it means composite sample, without standard deviation.
[a] Identification of food in the respective sources. Values in bold present considerable differences in comparison to the BMD values. Negative values indicate that the BMD data were lower. Empty spaces indicate unavailable information.

than another can mean the difference between micronutrient deficiency and adequacy (Burlingame et al., 2009).

In industrialized foods, consistent data were found in relation to both Taco and USDA data, for Ca and Na in natural yoghurt, for Zn in cheese and for Fe in bologna. Consistent values were also found for Zn in the bologna of USDA, for Fe in the cheese in the Taco and for all of the strawberry yoghurt minerals in the Taco. The greatest observed inconsistent data were found in Zn of natural yoghurt and in Ca of bologna, when comparing BMD to both the Taco and the USDA. The value differences found in industrialized foods, such as cheese, natural yoghurt and bologna, may be due to the type of processing and raw material (i.e. variations in the ingredients and formulations are common). Moreover, products of animal origin can also be influenced by breed, age, breeding technique and ration composition.

In a similar study, Vaask et al. (2004) compared nutrient values among food composition databases from Russia (Russian Institute of Nutrition Food Composition Database) and Slovenia (Finnish Micro-Nutrica Nutritional Analysis program). The authors considered that there was yielded different values for Ca and Fe levels in the evaluated foods, such as white bread, which presented a difference of 56% for Ca and 80% for Fe; roasted chicken, which presented a difference of 67% for Ca and 32% for Fe; potato chips, which presented a difference of 41% for Ca and 50% for Fe; and butter and sour cream (20% fat), which reached a 100% and 900% difference for Ca, respectively. Such differences caused an impact on the calculation of nutrient intake based on food inquiries, with an 18% difference for Ca and a 14% for difference Fe. The authors attributed the variations in mineral values to several factors, such as the use of different analytical methodologies. This factor was also discussed by Moller et al. (2007) and Uusitalo et al. (2011) and may explain part of the variations observed in the present study, once more than one analytical method, since adequate and validated, was selected for data compilation in BMD, which also occurs in the USDA.

Therefore, the variations found cannot be considered to be errors. However, it is very important that the compilation of food composition data is carefully performed, considering that the nutrient content in foods varies not only due to factors that are inherent to crop and process but also to sampling, sample handling and the analytical method (Ramsey and Ellison, 2007). Moreover, it is necessary to take careful actions, from the detailed identification of the food to the control of the analytical quality, to guarantee the quality of the information.

Fig. 1 presents the percentage of BMD mineral data with consistent and inconsistent values, based on element concentration range, in relation to Taco and USDA data. In this comparison, it is evident that the BMD presents a larger number of mineral data with consistent values in relation to Taco data (59%), which is different from the USDA comparison, for which only 38% of the data present consistent values.

The elements that more often exhibit similar values between the BMD and the other sources were Zn and Fe, which justifies the high percentage of the consistent values in the concentration range ≤9.9 mg. When comparing analytical results of raw polished rice with data from 7 food composition tables (3 Brazilian and 4 international tables), Okada et al. (2007) obtained different results for Fe and described the differences in relation to both Taco and USDA data; however, results for Zn, Ca and Na were similar to those found in the present work.

Fig. 2 presents the food percentages in the BMD and Taco according to the food groups. According to this information, the different food distributions in the two databases are evident; while Taco contains more information on the meat group and its derivatives, BMD contains more information on the group of fruits and vegetables. Other groups that present relevant differences are

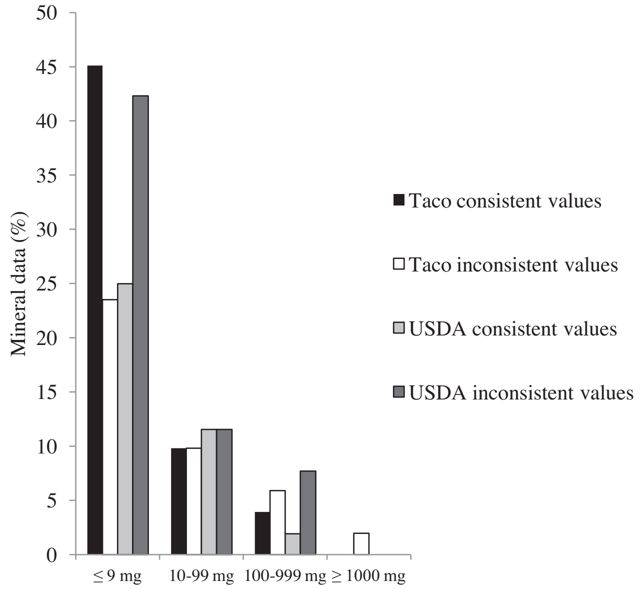

Fig. 1. The percentage of mineral data with a consistent and inconsistent values between the Brazilian mineral database (BMD) and data of the Brazilian Food Composition Table (Taco) (Nepa/Unicamp, 2011) or the USDA National Nutrient Database (USDA) (USDA, 2011).

cereals and their derivatives (from the Taco) as well as legumes, grains and derivatives (from the BMD). Both databases present different food profiles and considering that most of the compared foods present similar results (Fig. 1), it is assumed that the information in BMD and Taco are complementary.

Therefore, as demonstrated for minerals, careful and systematic data compilation is an important cost–benefit process because it permits a centralized and inexpensive dissemination of the existing information, making it a feasible method for obtaining quality data. One of the BMD issues observed in this compilation was the lack of data for certain elements in certain foods. For this reason, BRASILFOODS, NAPAN/USP and FoRC aimed to improve food information through careful data compilation from other sources and analysis. This was also performed in an effort to obtain a database containing a larger number of components of commonly consumed foods in the country, which would widen the social relevance of the database.

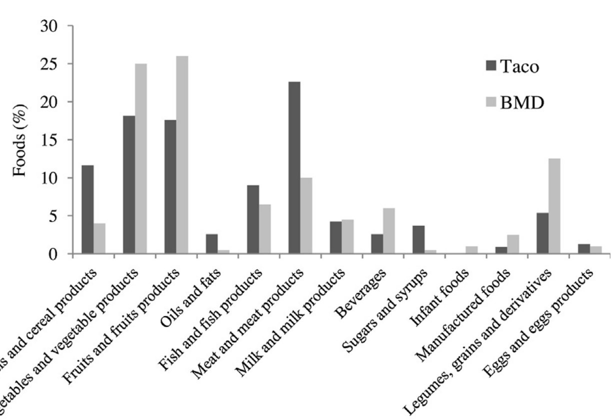

Fig. 2. The comparison of foods (%) by food groups from the Brazilian mineral database (BMD) in relation to the information of the Brazilian Food Composition Table (Taco) (Nepa/Unicamp, 2011).

Data from BMD will be available in the TBCA-USP, NAPAN/USP and FoRC platforms in an effort to widely propagate this information.

4. Conclusion

The BMD contains data on 860 foods, of which 268 are regional foods, for a total data set of 22 minerals, mainly Fe (483 foods), Ca (506 foods) and Zn (454 foods). Mineral data compilation from national foods and products seems to be a feasible method for improving Brazilian food composition databases. Moreover, the comparison between compiled data and national analyzed data showed consistent values for 59% of the mineral data within the established parameters. Conversely, the comparison with North American data resulted in a lower level of consistency (38%); therefore, data from this database must be carefully used, once it may not provide the real composition of certain foods.

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