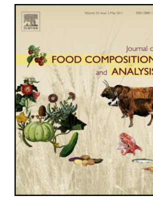
Journal of Food Composition and Analysis 43 (2015) 39–48

Contents lists available at ScienceDirect

Journal of Food Composition and Analysis

journal homepage: www.elsevier.com/locate/jfca



Study Review

Food composition data in Argentina: A systematic review of the literature

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ARTICLE INFO

Article history:
Received 3 July 2014
Received in revised form 31 March 2015
Accepted 6 April 2015
Available online 11 May 2015

Keywords:
Food composition database
Systematic review
Argentina
Food analysis
Diet
Nutrient intake
Nutritional epidemiology
Food policies
Analytical quality control
Food composition

ABSTRACT

Food composition data are essential for the assessment of nutrient intake and the development of food policies. The aim of this study was to conduct a systematic review of available published data not previously included in the national food composition table in Argentina (ARGENFOODS), in order to supplement the existing information. An electronic literature search was conducted of literature published from January 1997 to December 2012. An annotated search for non-indexed 'gray literature' was also completed. Quality of data was assessed in terms of sampling and analytical criteria. A total of 2474 potentially eligible references were identified, out of which 138 articles and reports met inclusion criteria. These studies provided information about energy value, macronutrients, micronutrients, and/or other components, such as phytochemicals, for 82 individual food items and multi-ingredient foods. Cereals, legumes and their derivatives, milk and dairy products, meat, fish and fish derivatives were the most frequently reported food groups. Non-representative sampling and poor description of the analytical quality control used were the most frequent issues found in evaluation of data quality. These results will contribute to the continuous and systematic updating of food composition databases, which are of paramount importance for public health. Collaboration among data generators, compilers, and users is essential.

Contents

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http://dx.doi.org/10.1016/j.jfca.2015.04.006
0889-1575/

1. Introduction

Since chronic diseases are the leading causes of illness, disability and death in Argentina (Institute for Health Metrics and Evaluation et al., 2013), thorough nutritional epidemiology analysis is necessary to understand reasons and implement significant changes. Food composition databases (FCDs) are required for the assessment of nutrient intake at the individual, regional, national, or international level. In addition, they are important sources of information for the development of food policies and for planning and evaluating epidemiological and intervention programs. Their use, however, is not limited to the fields of nutrition science and public health – the food industry, policy-makers, and consumers might also need and use this information (Guenther, 1994; Pennington et al., 2007).

Usually, food composition data are developed by international organizations, governments, universities and/or industries for different purposes. The Latin American Network of Food Data Systems (LATINFOODS) is a Latin American organization affiliated with the International Network on Food Data Systems (INFOODS) involved in the generation and compilation of data on the composition of foods (Masson, 1999; Samman et al., 2009). LATINFOODS includes the Argentine regional center, called ARGENFOODS (2010) whose activities include the analysis of food content and the collection and compilation of food data to enhance the exchange of information through the international electronic network and to increase the dissemination and use of food data. During the last decade, FCDs have been available online in several countries (Machackova et al., 2013; Sugiyama Jogakuen University, 2000; University of Sao Paulo), including Argentina (ARGENFOODS, 2010). The ARGENFOODS FCD has been recently updated to include information provided by a regional project which was sponsored by the Food and Agriculture Organization (FAO) of the United Nations. The project included direct analyses of five priority foods, professional training, revision and compilation of data of 258 foods in the ARGENFOODS Table (Samman and P-M-de-Portela, 2010; Samman et al., 2011; Blanco-Metzler et al., 2014). Despite the importance of these initiatives, information related to food composition in Argentina and other countries in the region is not only a bit dated with respect to latest changes but also incomplete. Thus actions can be taken not only to update the existing data, but also to improve the quality of information by involving food composition data generators, independent researchers, universities, industries, government and non-government organizations to collaborate with the Argentine food database.

Both the growth of global trade of food over the last 40 years in developed and developing countries (FAO, 2002 and FAO, 2004) and the shift toward chronic diseases have added complexity to nutritional epidemiological analyses as more data on nutrients and other components of foods are required. During the last decade, the national food industry has introduced several reformulations of food products for various reasons, mainly: new developments, marketing, and modification or replacement of some components or ingredients in order to comply with food policy regulations. Additionally, the continuous growth in the variety of food products available requires updated, detailed information. For these reasons, it is necessary to supplement the information available in the national food table with other reliable sources. The "Software for Food Surveys Analysis (SARA)," was developed for the first National Health and Nutrition Survey (ENNYS, 2004), conducted in 2004–2005 in Argentina. SARA allowed the calculation of nutrient intake by supplementing information from the ARGENFOODS Table with other food data sources (SARA, 2005). However, one decade after SARA, the food tables must be updated due to the emergence of new food products and modifications in the formulations of foods previously included.

The aim of this study was to conduct a systematic review of available published and non-published literature not currently included in the national food composition table in Argentina in order to complement the existing information on the composition of Argentine foods.

2. Materials and methods

2.1. Search strategy

We conducted a systematic search for articles published from January 1997 to December 2012 in MEDLINE, EMBASE, CAB Abstracts, LILACS, SciELO, FSTA, Agricola, and the Cochrane Library, using generic and academic Internet searches and meta-search engines. In the computer-based searches, we combined search terms related to the foods or subgroups of foods (such as food OR diet OR dietary fats OR cereals OR dairy products, for example) and components of interest (nutritional composition OR nutrients OR fatty acids OR sodium, for example). The complete search strategies used can be found in the Supplementary Data 1. An annotated search strategy for non-indexed 'gray literature' was also conducted to obtain information from relevant sources, such as reports from Ministries of Health, from the libraries of national universities such as the School of Nutrition of Córdoba National University, the University of Buenos Aires, and the National University of Litoral, and from Congresses' annals. The search was conducted according to a protocol based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement (Liberati et al., 2009; Moher et al., 2009). The information retrieved was supplemented by a structured survey administered by telephone and email to experts in the field and to institutions responsible for producing food composition information in the country.

2.2. Selection criteria and data screening

We included nutritional composition studies related to foods, food products, and beverages conducted in Argentina with data collection from 1995 onwards, which used validated analytical methodology. A wide range of quantitative study designs was included, as long as extractable data were available. We considered information about any food/food product included (or not) in the Argentinian database with the aim to update or verify existing information. However, we excluded data already included in ARGENFOODS database in order to prevent duplicate information. Before the information was extracted, we looked for the same product and component/s in the ARGENFOODS Table and checked the nutrient values. If the values reported in the article and the database were identical, we assumed that the source of the information was the same and therefore excluded the article; however, if the article reported data for any of the components not listed in ARGENFOODS Table, we included only these components. Other exclusion criteria were studies about animal feed or experimental foods not included in the Argentinian market and studies with duplicate information.

First, pairs of reviewers independently evaluated assigned articles by title and abstract according to pre-specified criteria. Secondly, the reviewers assessed aspects of the methodological quality, and thirdly, data were textually extracted from full papers. Main extracted variables included: first author, publication year, variables related to the identification of the specific food in the database (such as name/s, part/s, processes, raw/cooked), energy value, macro and micronutrient content, values of other components, analytical methods, and number of samples, among other

Table 1
Quality criteria adapted for data assessment.

Evaluation	Score			
	3	2	1	0
No. of samples	>10, standard deviation (S.D.) and/or standard error (S.E.)	3–10	1–2, not specified	–
Sampling plan	Sampling of multiple geographical areas, with description of statistical basis for sampling, representative sample of brands/varieties consumed or commercially used	1–2 geographical areas, the sample is representative	Incomplete description or without any strategy developed for selecting of foods	Not described
Sample handling	Complete documentation of procedures, description of moisture control, homogenization and characteristics of the portion food	Partial documentation of procedures	Limited documentation of procedures	Not described
Analytical method	Official method or other documented method. Complete documentation of the method with validation, recoveries of 95–100% and coefficient of variation ≤5%	Official method or other documented method. Complete documentation of the method with validation, recoveries of 90–110% and coefficient of variation ≤10%	Not official method or partially described. Recoveries of 80–90% or >110%	Not described or with coefficient of variation >10%
Analytical quality control	Complete documentation and excellent values. Monitoring	Complete documentation and acceptable values	Incomplete documentation and acceptable values	No documentation or no acceptable values

Source: Adapted from Holden et al. (1997).

variables related to quality. Discrepancies were resolved by consensus of the whole team. The authors of the reports were contacted when necessary to obtain missing or supplementary information. Early Review Organizing Software (EROS®) v3.0 was used to perform the first stages of the systematic review (Glujovsky et al., 2010).

2.3. Preliminary data quality assessment

Following data extraction, we evaluated study quality using methodology for selenium, described in detail in Holden et al. (1997). We applied the same approach to assess components other than selenium using the information about management and analytical methods for each individual component, as provided in Greenfield and Southgate (2003) and Charrondiere et al. (2011). First, we conducted a preliminary evaluation based on five criteria/categories: sampling methods, number of samples, sample management, analytical method, and analytical quality control; each criterion was scored on a 0–3 scale. Summary information of the score is shown in Table 1. Next, using the component's scores for each criterion, the quality index (QI), a measure of the overall quality of data from a single study, was derived in two ways: (a) QI became 0 when analytical method was rated 0 or when three or more categories were rated 0, (b) when those conditions did not exist, the ratings for each of the five categories were averaged. Thus, the QI ranged from 0 to a maximum of 3.0.

Using this methodology, during the subsequent compilation process, the mean nutritional values for each food reported from those studies which have a QI greater than or equal to 1.0 are averaged together to obtain a mean value. A confidence code (CC), assigned to the mean value for each food, indicates the degree of confidence a user can have in the mean value. The CC is determined by summing the QIs greater than or equal to 1.0 among the various studies evaluated for a given food item. Then, scores >6.0 are assigned a CC "A" (considerable confidence in this mean value), scores from 3.4 to 6.0 receive a CC "B" (the user can have confidence in this value, however some problems exist regarding the data on which the value is based), and scores between 1.0 and <3.4 are assigned a CC "C" (the user can have less confidence in this value due to limited quantity and/or quality of data). CC is necessary to confirm the results of one report from other researchers, with the aim to evaluate its validity. Thus, data from a minimum of three studies – with a sum of QIs of 6.0 – are required for a mean value to be assigned a CC of "A". In our work, we did not compile the data from the different studies and the quality assessment was conducted by individual study, obtaining as final result only one QI.

Pairs of independent reviewers assessed the methodological quality. Discrepancies were resolved by consensus of the whole team. Microsoft Excel© worksheets were used to record values for each variable.

2.4. Data extraction and analysis

The extracted data were categorized by food groups according to LATINFOODS codes (De Pablo and Morón, 2002; Menezes and Oyarzun, 2008), publication date, and type of source. Data about the same food but from several publications were considered separately.

The nutrients in the database were expressed according to INFOODS tag names (Burlingame, 1996; Klensin et al., 1989). Tag names identified a food component unambiguously and specified a method of analysis. Most of the components were identifiable by tag names, but in two of the articles, the analytical methods were not reported, so they were not assigned. Units and denominators were extracted as they were recorded in the primary report. Most articles reported information per 100 g of edible portion on fresh weight basis and for some beverages the nutritional information was expressed per 100 ml. In those cases, if density value was not reported, we kept component values expressed per 100 ml. When the reported unit of measure was different, the corresponding conversion calculations were performed.

Nutrient values were described using means with standard deviations, as were reported in original sources, when this information was available. Data collected were recorded in a Microsoft Excel© spreadsheet and then analyzed in Stata® statistical software package (v.11.0).

3. Results

The search of the electronic databases identified 2441 potentially eligible references. Additionally, 40 abstracts were

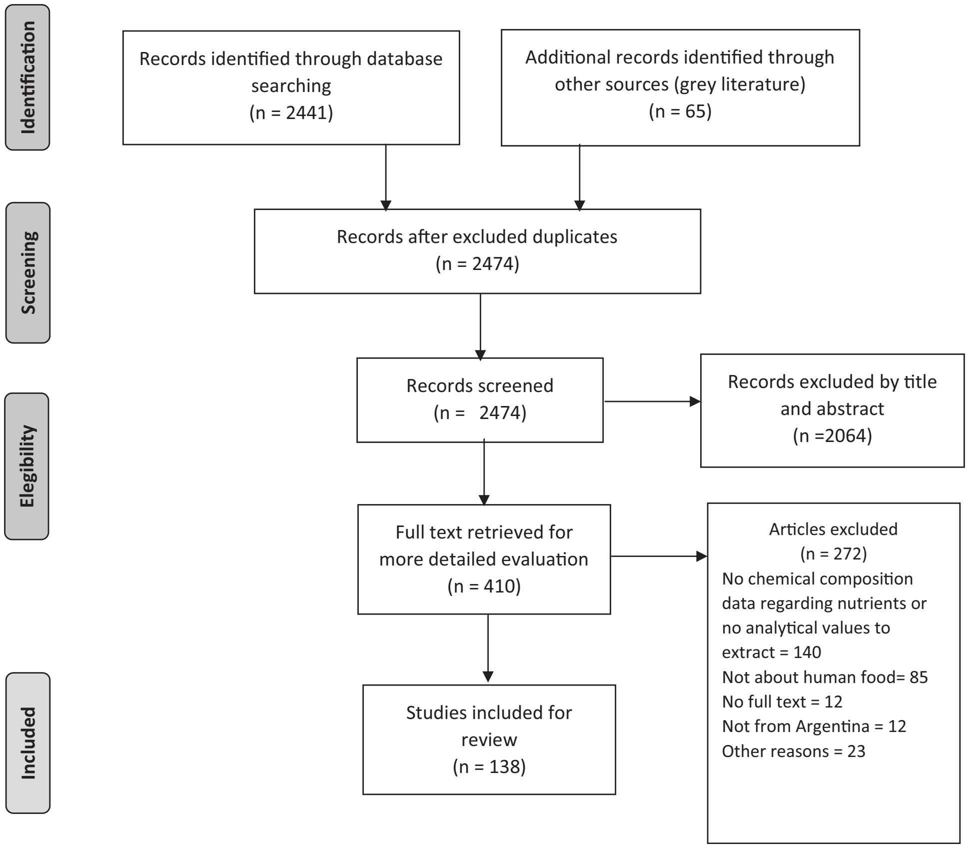

Fig. 1. Flow of studies in review.

Table 2
Main tagnames used in the database.

Nutrient description	INFOODS tagnames
Moisture	<WATER>
Protein, total[a]	<PROCNT>
Lipid, total (fat)[b]	<FAT>
Carbohydrate, total[c]	<CHOCDF>
Fiber, total dietary[d]	<FIBTG>
Ash	<ASH>
Fatty acids, total saturated[e]	<FASAT>
Fatty acids, total monounsaturated[e]	<MUFA>
Fatty acids, total polyunsaturated[e]	<PUFA>
Cholesterol[f]	<CHOLE>
Sodium[g]	<NA>
Potasium[g]	<K>
Calcium[g]	<CA>
Phosphorus[g]	<P>
Iron[g]	<FE>
Zinc[g]	<ZN>
Vitamin A[h]	<VITA>
Thiamine[i]	<THIA>
Riboflavin[i]	<RIBF>
Niacin[i]	<NIA>
Vitamin C[i]	<VITC>

[a] Total protein calculated from total nitrogen by conversion factors.
[b] Total fat derived by analysis using continuous extraction (Soxhlet methods).
[c] Total carbohydrate calculated by difference (100 g – total grams of water, protein, lipids and ash).
[d] Total dietary fiber determined by enzymatic–gravimetric or non-enzymatic–gravimetric methods.
[e] Total of individual fatty acids
[f] Gas chromatography.
[g] Spectrophotometry/fluorometry.
[h] Vitamin A calculated by summation of vitamin A activities of retinol and the active carotenoids. Total vitamin A activity = μg retinol + 1/6 μg β-carotene + 1/12 μg other provitamin A carotenoids.
[i] High performance liquid chromatography/acid hydrolysis.

identified by hand-search of Argentine journals and 22 relevant bachelor, master, or doctoral dissertations/theses were found. We identified additional information from experts and organizations, an extra doctoral thesis, 2 reports from scientific meetings, and information provided directly by CESNI (Centro de Estudios de Nutrición Infantil; www.cesni.org.ar), a non-profit organization related to infant nutrition.

After removing duplicates, we obtained 2474 documents, reports and articles. After the initial screening based on title and abstract, 410 articles remained for further full-text assessment, and 138 articles and reports met inclusion criteria and were ultimately included in the analysis (Fig. 1).

The included articles provided information about energy value, macronutrients, micronutrients, and/or other-components content, such as phytochemicals, for 82 different foods or food preparations. The number of reported values depended on the source, as some articles provided only one nutritional value regarding one or more foods, while others included information about several nutrients. A list of the main included tag names is shown in Table 2. Each reported food or beverage from each article was extracted in a separated row, resulting in data for 537 food items. Data were expressed according to the original denominator used by study authors, generally per 100 g of edible portion, and were specified, if necessary, whether the value was for raw or cooked preparation. Data for beverages were recorded with the same denominator or per 100 ml, as previously explained. The items were grouped into 13 groups encoded alphanumerically, according to LATINFOODS Food Groups classification (FAO, 2014). Concerning food groups, cereals, legumes and derivatives, milk and dairy products, meat, fish and derivatives were the most reported ones in the reviewed publications (Table 3). Table S1 (Supplementary Data 2) shows the frequency of publications according to food

Table 3
Reviewed articles by food group.

Food type	Code of food group[a]	Number of publications	References
Cereals and derivatives	A	30	Ayerza and Coates (2004, 2007), Ayerza (2009), Bassett and Samman (2010), Bueno et al. (2010), Barboza et al. (2010), Carrara and Castel (2010), Coates and Ayerza (1998), Corcuera et al. (2007), Cravero et al. (2003), Dyner et al. (2007), Escudero et al. (1999, 2004), Freyre et al. (2003), George et al. (2004), Gonzalez et al. (2012), Lysionek et al. (1998), Maldonado and Samman (2000), Martinez et al. (2010), Peterson et al. (2006), Pomilio et al. (2010), Robutti et al. (2000), Romera et al. (2000), Rovirosa et al. (2002), Scheiner and Lavado (1999), Sigrist et al. (2012), Tavella et al. (2000), Vazquez et al. (2011), Vidueiros et al. (2011)
Vegetables and derivatives	B	9	Arce et al. (2008), Bassett and Samman (2010), Buchert et al. (2011), Demaría et al. (2010), Fiatti et al. (2009), Gonzalez et al. (2001), Jimenez et al. (2009), Macias de Costa et al. (2003), Nobile et al. (2009)
Fruits and derivatives	C	11	Alvarez et al. (2005), Arena (2008, 2010), Arena and Coronel (2011a,b), Giambastiani and Casanoves (2000), Grosso et al. (1997), Martinez and Maestri (2008), Nepote et al. (2006), Raimondo (2011), Riveros et al. (2009), Soave et al. (2004)
Fats/oils	D	11	Andrada et al. (2009), Ceci and Carelli (2007), Giraudo et al. (2007), Perotti et al. (2005), Peterson et al. (2006), Rondanini et al. (2011), Tavella et al. (2000), Torres et al. (2005, 2009), Torres and Maestri (2006a,b)
Fish/seafood	E	7	Abib et al. (2005), Chiou et al. (2000), Czerner et al. (2011), Fontanarrosa et al. (2004), Paredi et al. (2006), Speranza and Colombo (2009), Sigrist et al. (2012)
Meat and derivatives	F	20	Ayerza et al. (2002), Azcona et al. (2008), Bassett and Samman (2010), Bedotti et al. (2004), Descalzo et al. (2005, 2008), Farfan et al. (2000), Farfan and Samman (2003), Garcia et al. (2008a,b), Latimori et al. (2008), Lloveras et al. (2008), Orellana et al. (2009), Perlo et al. (2008), Pordomingo et al. (2012), Raes et al. (2003), Rossanigo et al. (1999), Rovirosa et al. (2002), Schindler et al. (2004), Sigrist et al. (2012)
Milk and dairy products	G	39	Burns et al. (2008), Candioti et al. (2010), Chavez et al. (2004), Frau et al. (2010), Gagliostro et al. (1997), Gagliostro (1997), Hynes et al. (2003), Luiz et al. (2010), Lysionek et al. (1998), Marin et al. (2005, 2009), Minetti et al. (2002), Nieuwenhove et al. (2007, 2009), Oliszewski et al. (2002, 2007, 2010), Olmos et al. (2009), Patino et al. (1999, 2001, 2002, 2003), Patino (2004), Perotti et al. (2008), Revelli et al. (2004), Roldan et al. (2008), Rossanigo et al. (1999), Rovirosa et al. (2002), Saad de Schoos et al. (1999), Schroeder et al. (2002, 2003), Sigrist et al. (2012), Valtorta and Gallardo (2004), Vasek et al. (2008), Vasquez Fernandez and Balbinotti Zanela (2007), Verdini et al. (2003), Wolf et al. (2010, 2011), Zalazar et al. (2002)
Drinks (alcoholic and non-alcoholic)	H	10	Brumovsky et al. (2005), Di Paola-Naranjo et al. (2011), Fabani et al. (2010), Fanzone et al. (2012), Heck et al. (2008), Lara et al. (2005), Maidana-Petersen and Williner (2009), Olmos et al. (2009), Pomilio et al. (2010), Rovio et al. (2011)
Eggs	J	3	Antruejo et al. (2011), Navarro et al. (2001), Rovirosa et al. (2002)
Sugar/sweetened products	K	6	Aloisi (2010), Baroni et al. (2009), Camina et al. (2008), Finola et al. (2007), Navarro et al. (1999), Peterson et al. (2006)
Miscellaneous	L	2	Peterson et al. (2006), Tavella et al. (2000)
Legumes and derivatives	T	12	Bassett and Samman (2010), Bologna et al. (2011), Carrera et al. (2011), Freyre et al. (2003), Ibanez and Ferrero (2003), Maestri et al. (1998, 2001), Maldonado and Samman (2000), Martin and Salmoral (1999), Meriles et al. (2004), Samman et al. (1999), Alasino (2009)

[a] Code of food group: according to LATINFOODS codes (De Pablo and Morón, 2002; Menezes and Oyarzun, 2008).

Table 4
Distribution of the articles/thesis by year of publication.

Year of publication	*n*	%
1997	3	2
1998	4	3
1999	7	5
2000	7	5
2001	6	4
2002	5	4
2003	10	7
2004	13	9
2005	7	5
2006	6	4
2007	8	6
2008	17	12
2009	14	10
2010	15	11
2011	12	9
2012	3	2
Total	138	100

group and selected reported nutrients. Determinations about protein and lipid profile were the most frequent.

Table 4 shows the distribution of articles by year of publication. As shown, an upward trend in the number of publications was observed, with peaks in 2004, 2008 and 2010.

Fig. 2 presents the institutional origin of the articles/reports extracted. Overall, the Institutes of the National Council of Scientific and Technological Research (CONICET) and various National Universities represented the main sources of articles. The National Institute for Agricultural Technology (INTA) was the institution with the largest number of studies (16.2%), followed by several universities, including the National University of Córdoba (12%) and National University of Litoral (10.4%). Fig. S1 (Supplementary Data 3) shows the geographic distribution of publications according to food groups.

Table 5 shows mean, median, minimum and maximum score given to the five categories used for quality assessment and the QI of the reviewed. QIs ranged from 0 to 3.3% of the data were classified with a QI lower than 1, 59% with a QI from 1 to 1.99, and 38% with a QI

Table 5
Assessment of data reviewed by quality criteria.

Distribution of the score	No. of samples	Sampling plan	Sample handling	Analytical method	Analytical quality control	Quality index
Mean	1.93	1.28	1.95	2.71	0.81	1.73
Median	2	1	2	3	0	1.6
Minimum–Maximun	0–3	0–3	0–3	0–3	0–3	0–3

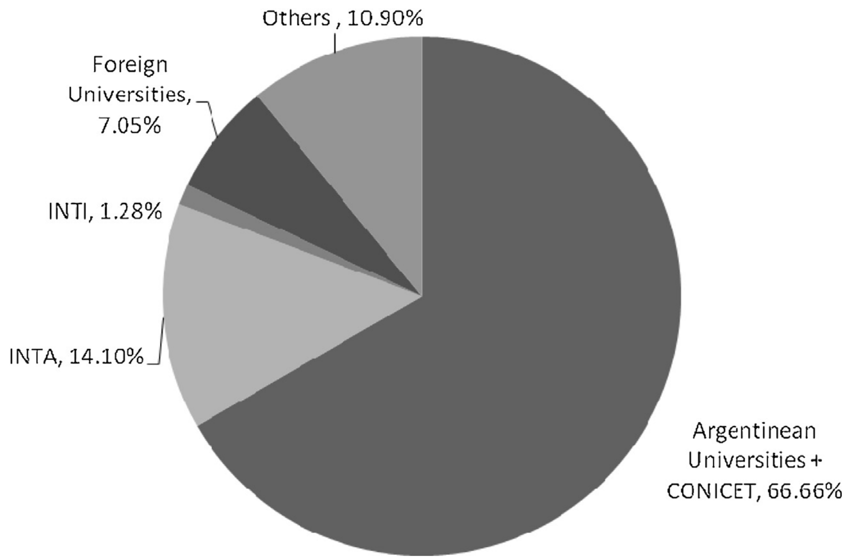

Fig. 2. Reviewed publications by Institution. *Articulated Institutes of CONICET with National Universities. CONICET: National Council of Scientific and Technological Research; INTA: National Institute of Agricultural Technology; INTI: National Institute of Industrial Technology.

between 2 and 3. Applying this quality evaluation system, confidence in results of one study is higher when the QI is higher in the range from 0 to 3. However, because it is only one study, assessing CC of the mean value, the only possible result before compiling is "C." The least reported criterion, and thus worst category in terms of quality, was analytical quality control (60% articles without documentation of this item). Reported sampling plan was not representative at a national level in several articles. Analytical methods were acceptable in most of the cases, but in some articles, sample-handling reports were not sufficiently complete.

4. Discussion

FCDs have become increasingly important in the field of public health nutrition. An ongoing and systematic updating of data is necessary for studying the relationships between diet and disease, for dietary assessment, for nutritional labeling, and for policy development, as well as for the monitoring of the quality of foods in the market and hence consumer protection (Church, 2009; Pennington, 2008). In our study, the information was heterogeneous across the country and the foods studied varied according to the agricultural characteristics of each region. The quality of food composition data is influenced by the ability to capture biological variation in the same item (by the sample plan and the number of samples required), as well as by the accuracy of the description of food items, methods of analysis, and mode of expression of the data (Burlingame, 2002). In this review, sampling plan and analytical quality control were the quality criteria with less confidence and more limitations. Additionally, sample handling information was missing or less clear in many reports. However, these were expected limitations, as we included published data provided by less specialized journals or collected for other purposes Therefore, some of the reviewed data insufficiently addressed the nutrient information from a FCD requirement point of view. In this regard, other researchers have considered the quality of data in their national databases. For example, Menezes et al. (2000) analyzed the quality of dietary fiber data in Brazilian foods. For 180 foods, 29% were assigned with codes A and B (considerable and reasonable confidence) and 71% with code C, meaning that the user might have less confidence because of limited quantity and/or quality of data. The high number of C-graded foods was in part due to the lack of detailed information about the analytical procedures, insufficient number of samples, or poor description of the analytical quality control used. Another factor was related to the non-usage of standard reference material.

Our study does not provide exhaustive data to cover the entire gap in knowledge about all known foods and nutrients in Argentina. However, this review provides useful information to complement the available Argentine food data.

In addition, it could be an important tool for decision making regarding local and regional food policies, since more comprehensive and representative information on available foods will provide more reliable information with which to evaluate the relationship between nutrient intake and health (Leclercq et al., 2001).

The main limitation of this research is the heterogeneity of the selection of components analyzed, of the analytical methods, and of the food production approaches. In order to address these issues, we have kept original data for foods separate instead of compiling it. Even though this work presents quality criteria assessment, re-assessing data quality may be warranted, especially if the information is to be compiled according to other selected criteria. Metadata have been extracted and are available for use in future assessments.

Several strengths of our study are worth mentioning. First, the search was conducted systematically and included a variety of sources (publications, databases, theses, libraries and food experts). Secondly, our study registered the date of the sample collection and adhered to INFOODS guidelines by using tag names as food component identifiers, which will facilitate compilation with other sources (Puwastien, 2002). Finally, our results are available on Internet with free access for the scientific community, decision makers, and the general public at the following link http://www.iecscampus.com.ar/paneles/alimentos/index.php?r=busqueda/index#.

5. Conclusions

In this study, we have systematically searched food composition data from several sources, extracted relevant information (including metadata), and performed a preliminary evaluation of the methodological quality of these data. However, quality has varied across the studies, and thus, a new assessment should be made for the purpose of compilation of a FCD. Our study results are available on Internet and will be useful for compilers, nutrition specialists and researchers to access when needed.

Although FCDs are valuable sources of information for policy-makers, consumers and researchers in different areas, information in those databases is not always updated at the pace of ever changing developments in the world. Despite some weaknesses, this study has provided relevant information available in Internet for those interested in conducting research to address problems related to food intake in Argentina and Latin America. More research and more collaborative work are necessary to develop, increase, and maintain food composition knowledge in a dynamic, sustainable and accurate way.

Acknowledgments

This work was partially supported by the Comisión Nacional Salud Investiga, Ministerio de Salud de la República Argentina [Multicentric Carrillo-Oñativia Research Grant 2012] and by the International Development Research Centre, Canada [IDRC Grant 2012–2015, # 106881-003]. The funding sources had no role in study design, data collection, analysis and interpretation of data, the writing of the report, and in the decision to submit the article for publication.

The authors want to thank Laura B. Lopez for her guidance in several instances of the project, and Alicia Rovirosa, Maria Luz de Portela and Maria Cristina Landeta for the information about food composition in Argentina. Also, we want to thank Melissa Amyx and Alejandra Navarro for checking the English. Finally, we want to thank all the experts and organizations that, with or without unpublished data to include in the revision, were interested in the project and provided information and support.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.jfca.2015.04.006.

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