



Original Article

Brazilian flavonoid database: Application of quality evaluation system

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ABSTRACT

Much information on flavonoid content of Brazilian foods has already been obtained; however, this information is spread in scientific publications and non-published data. The objectives of this work were to compile and evaluate the quality of national flavonoid data according to the United States Department of Agriculture's Data Quality Evaluation System (USDA-DQES) with few modifications, for future dissemination in the TBCA-USP (Brazilian Food Composition Database). For the compilation, the most abundant compounds in the flavonoid subclasses were considered (flavonols, flavones, isoflavones, flavanones, flavan-3-ols, and anthocyanidins) and the analysis of the compounds by HPLC was adopted as criteria for data inclusion. The evaluation system considers five categories, and the maximum score assigned to each category is 20. For each data, a confidence code (CC) was attributed (A, B, C and D), indicating the quality and reliability of the information. Flavonoid data (773) present in 197 Brazilian foods were evaluated. The CC "C" (as average) was attributed to 99% of the data and "B" (above average) to 1%. The main categories assigned low average scores were: number of samples; sampling plan and analytical quality control (average scores 2, 5 and 4, respectively). The analytical method category received an average score of 9. The category assigned the highest score was the sample handling (20 average). These results show that researchers need to be conscious about the importance of the number and plan of evaluated samples and the complete description and documentation of all the processes of methodology execution and analytical quality control.

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1. Introduction

The scientific community has significant interest in the quantification and characterization of different flavonoids present in Brazilian foods; however, the information is dispersed in publications or in laboratory internal data and thesis (Genovese and Lajolo, 2002; Arabbi et al., 2004; Santos, 2005; Matsubara and Rodriguez-Amaya, 2006a,b; Genovese et al., 2007; Rosso et al., 2008; Santos, 2009). There are two main reasons for generating this information. The first one is due to the anti-inflammatory,

antioxidative and antimicrobial properties of these bioactive compounds and their possible effects on decreasing the risk for non-transmissible chronic diseases (NTCD) (Kris-Etherton et al., 2004; Gry et al., 2007; Denny and Buttriss, 2007). The second one is related to the Brazilian biodiversity of plant foods, which involves the necessity of knowing the content and type of flavonoids not only in conventional foods but also in region-specific ones (Toledo and Burlingame, 2006; Menezes, 2009; Burlingame et al., 2009).

Researchers from other regions like North America and Europe developed databases of bioactive compounds or specific compounds aiming to unite data that would allow a real evaluation of ingestion of these substances by the population. The Nutrient Data Laboratory (NDL) of the USDA made isoflavones data available in 1999 (Release 1) and in 2008 (Release 2) (USDA, 2008). The USDA Special Interest Database for flavonoid content of selected foods was introduced in the NDL website in March, 2003. This database contained values of 225 foods from different countries and all flavonoid data were critically evaluated according to the USDA's data quality evaluation system (USDA DQES) (Holden et al., 2005). After observing great variability between values of flavonoid data from Europe and other countries in relation to those from the US, researchers from the NDL warned about the necessity of analyzing foods that are commercialized and consumed in the country,

Abbreviations: QI, Quality Index; CC, confidence code; NDL, Nutrient Data Laboratory; BRASILFOODS, Brazilian Network of Food Data Systems; TBCA-USP, Brazilian Food Composition Database-USP; LATINFOODS, Latin American Network of Food Data Systems; INFOODS, International Network of Food Data Systems; EuroFIR, European Food Information Resource project; CV, coefficient of variation; RM, Reference Material; CRM, certified reference material; SRM, standard reference material; NTCD, non-transmissible chronic diseases; USDA-DQES, United States Department of Agriculture's Data Quality Evaluation System.

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which resulted in the increase in available data (Release 2.1) (USDA, 2007).

The EuroFIR (European Food Information Resource) project started the development of harmonized and standardized food composition databases in Europe. The EuroFIR-BASIS database combines critically assessed compositional and biological effects data, including all the most important bioactive groups of plant origin (Gry et al., 2007).

Data from two databases (EuroFIR-BASIS database and USDA Special Interest Database for flavonoids) had their quality evaluated; however, once the systems differ in relation to the evaluation criteria adopted, one same component from an article can be differently classified depending on the system used. The EuroFIR-BASIS critical evaluating scoring system was based in six key components (plant/food description, sampling plan, sample handling, component description, analytical method and analytical performance) (Gry et al., 2007). The evaluation of each component consists of selecting a Yes or No response or assigning a score from one to five. The strength and weakness of the study are expressed through the response to each component and an overall numerical score is automatically calculated from the responses, presenting the user with an immediate overview of the data quality. Other tools have been created by the EuroFIR project to assure the quality of the data compilation process (Westenbrink et al., 2009; Castanheira et al., 2007).

The USDA DQES for flavonoids (Holden et al., 2005) was developed using procedures of multi-nutrient data evaluation module (Holden et al., 2002) and several previous experiences of data quality evaluation (Holden et al., 1987; Mangels et al., 1993). All data of each article were evaluated for five quality categories (number of samples, sampling plan, sample handling, analytical method and analytical quality control). Within each category, specific questions were defined to describe the critical steps necessary for achieving accurate and representative data. The scores for the five categories for each compound were summed to yield a Quality Index (QI). According to the data QI, the confidence code (CC) is assigned, indicating the relative quality of the data and the reliability of the mean. The USDA DQES was validated by Bhagwat et al. (2009). The evaluation of data quality helps to set priorities and further identifies the foods to be analyzed as well as orientate analysts to generate high quality data on flavonoids in foods.

The objectives of this work were to compile and evaluate the quality of national flavonoid data according to the USDA DQES for future dissemination of this information in the TBCA-USP.

2. Methodology

2.1. Description of data compilation and database

Data from foods that are produced and commercialized in Brazil, present in scientific publications and non-published data (thesis) were compiled. In order to facilitate data compilation and to guarantee data harmonization, the Form for Compilation of Food Composition Data, developed by BRASILFOODS (Menezes et al., 2005), was updated. The spreadsheets for identification of foods and analytical quality control were not modified. The INFOODS guidelines (Truswell et al., 1991) to describe foods were adopted with modifications made by LATINFOODS (FAO, 1995; FAO/LATINFOODS, 2004; Menezes et al., 2005). However, a spreadsheet for flavonoid data was created according to the flavonoid subclasses and the most abundant compounds (28) in foods, including: flavonols – isorhamnetin, kaempferol, myricetin, quercetin; flavones – apigenin, luteolin; isoflavones – genistein, daidzein, glycitein; flavanones – eriodictyol, hesperetin, naringenin; flavan-3-ols – catechin and gallic acid esters of catechin,

epicatechin and gallic acid esters of epicatechin, theaflavin and gallic acid esters of theaflavin, thearubigin; anthocyanidins – cyanidin, delphinidin, malvidin, pelargonidin, peonidin, petunidin. The INFOODS tagnames for flavonoids were used to improve data interchange (INFOODS/FAO, 2009). The spreadsheet completed for flavonoid data represents the profile of information as it is presented in the Brazilian flavonoid database.

The Brazilian flavonoid database presents the content of each flavonoid compound as mg/100 g of fresh weight of edible portion (expressed as aglycons) with the respective standard deviation or variation and the content of moisture as g/100 g of edible portion of food. When data on moisture was not provided in the article, the author was contacted or the information of a similar food was taken from the TBCA-USP or a new sample of the same food was analyzed. Data provided as dry weight were transformed into fresh weight, resulting in loss of information regarding the standard deviation or variation. Mostly the authors had to be contacted to provide additional information, such as data in the form of graphics, values expressed as %, total value of a subclass component without its separation, among others. Values for beverages, foods for special diets, infant formulas and others were adjusted by their respective specific gravities and were reported as mg/100 g. In the case of teas, flavonoids were presented as dry weight (mg/100 g of dry tea leaves) and in the form of infusion (mg/100 ml of tea infusions – specific gravities approximately 1.0). Infusions were standardized to 1% (1 g of dry tea leave/100 ml of boiling water). The value identified as n.d. was “not detected” and was provided by the author. This information was included to identify that the component was analyzed but not detected in that food. The lack of values for specific components does not mean that the value is equal to zero, but that the information was not available in the publication. Sources of all information (laboratory or bibliographic reference) were documented in the database. In relation to the information on data quality evaluation, the database includes columns for the total score of each category, for the Quality Index and for the confidence code.

Foods were distributed in the food groups proposed for the LATINFOODS database (FAO, 1995; FAO/LATINFOODS, 2004). Due to flavonoid distribution in foods of plant origin, only the following food groups presented data: B – vegetables and derivatives; C – fruits and derivatives; H – beverages; K – sugar and sweets; N – foods for special diets; Q – infant foods; T – legumes and derivatives.

2.2. Data quality evaluation

The data quality was evaluated through the USDA DQES proposed by Holden et al. (2005) with few modifications, mainly in relation to the distribution conditions of national foods. Also, certain considerations described by Bhagwat et al. (2009) when validating the system were included. The data in each article were evaluated according to five categories: (a) number of samples; (b) sampling plan; (c) sample handling; (d) analytical method; (e) analytical quality control. According to the USDA, these categories represent the major determinants of data quality and this information is essential in order to decide if the data will or will not be included in a database. Scores (0–20 per category) were assigned to the questions, which are specific for each category. The summation of all scores assigned to all categories resulted in the Quality Index (QI) (maximum possible of 100) and a confidence code (CC) was attributed according to the QI range. The CC (A, B, C or D) indicates the relative quality of the data and the reliability of the mean. The CC for flavonoids was assigned as follows (CC, QI value range, meaning of the CC, respectively): A, 75–100, exceptional – the user can have considerable confidence in this value; B, 50–74, above average – the user can have confidence in

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