DOI: 10.12957/demetra.2017.25465

Proximate composition, bioactive compounds and physico-chemical parameters of mama-cadela (*Brosimum gaudichaudii* Tréc) from Cerrado Mineiro

Composição centesimal, compostos bioativos e parâmetros físico-químicos da mama-cadela (*Brosimum gaudichaudii* Tréc) proveniente do Cerrado Mineiro

Lucas Rogério Braz Land[1]
Florença Maria Borges[1]
Danielle Oliveira Borges[1]
Grazieli Benedetti Pascoal[1]

[1] Universidade Federal de Uberlândia, Faculdade de Medicina, Curso de Nutrição. Uberlândia-MG, Brasil.

Correspondence
E-mail: grazi _ nutri@yahoo.com.br

Abstract

Introduction: The Cerrado presents a large diversity of native fruits, many of which are edible and considered sources of nutrients, especially the mama-cadela (*Brosimum gaudichaudii* Tréc). Objective*:* To analyze the chemical composition, some bioactive compounds and physico-chemical parameters of mama-cadela. *Methodology:* Mama-cadela was obtained from a supplier located in Uberlândia (MG), the laboratory analyses were performed according to methodologies proposed by the Association of Official Analytical Chemists and by the Adolfo Lutz Institute. The analyses were performed in triplicate and means and standard deviations were obtained. *Results:* Mama-cadela presented (wet weight): 77.63% moisture; 1.63% proteins; 0.60% lipids; 0.82% ashes; 13.35% "available" carbohydrates; 5.11% dietary fibers; pH 5.96; 5.85% acidity; 28.85% antioxidant activity; 14.92 mg% vitamin C; and 178.65mg GAE% phenolic compounds. *Conclusion:* Mama-cadela stood out in the content of dietary fibers and phenolic compounds. It may be inserted into the diet of the Cerrado populations, which have access to this fruit, contributing to a healthy diet and ensuring food and nutrition security.

Keywords: Cerrado. Fruit. Functional Food. Phenolic Compounds.

Resumo

Introdução: O Cerrado apresenta grande diversidade de frutos nativos, muitos dos quais comestíveis e considerados fontes de nutrientes, com destaque para a mama-cadela (*Brosimum*

gaudichaudii Tréc). *Objetivo*: Analisar a composição centesimal, alguns compostos bioativos e parâmetros físico-químicos da mama-cadela. *Metodologia*: A mama-cadela foi adquirida por um fornecedor de Uberlândia (MG), as análises laboratoriais foram feitas segundo metodologias propostas pela Association of Official Analytical Chemists e pelo Instituto Adolfo Lutz e em triplicata, obtendo-se as médias e desvios-padrão. *Resultados:* a mama-cadela apresentou (na base úmida): 77,63% umidade; 1,63% proteínas; 0,60% lipídios; 0,82% cinzas; 13,35% carboidratos "disponíveis"; 5,11% fibras alimentares; 5,96 pH; 5,85% acidez; 28,85% atividade antioxidante; 14,92 mg% vitamina C; e 178,65 mgEAG% compostos fenólicos. *Conclusão:* A mama-cadela se destacou nos teores de fibras alimentares e compostos fenólicos. Ela pode ser inserida na alimentação de populações do Cerrado, às quais possuem acesso a este fruto, contribuindo para uma alimentação saudável e garantindo a segurança alimentar e nutricional.

Palavras-chave: Cerrado. Fruto. Alimento Funcional. Compostos Fenólicos.

Introduction

In South America, more specifically in Brazil, there is one of the most important biomes in the world: the Cerrado.[1] The Brazilian Cerrado occupies little more than 2 million km² (about 22% of the territory), covering ten States (Goiás, Minas Gerais, Rondônia, Mato Grosso, Mato Grosso do Sul, Bahia, Tocantins, Maranhão, Piauí, Pará) and the Federal District.[2,3]

The Cerrado presents a fairly peculiar fauna and flora and the presence of numerous water tables, which give rise to hydrographic basins, and justifies the need for preservation of this biome, since in the last decades it has been observed that mechanized agriculture has been undergoing great expansion, in addition to fires, provoking a process of degradation of nature.[3,4] On the other hand, agribusiness, focused on the market of fruits of the Cerrado, has grown, favoring the development of the population and of the region, where these fruits are cultivated.[5]

In general, the Cerrado presents a great variety of native fruits, many of which are edible and considered sources of nutrients, such as: proteins, "available" carbohydrates, dietary fibers, lipids, vitamins, minerals and numerous bioactive compounds (highlighting phenolic compounds and carotenoids). The bioactive compounds found in these fruits are associated with reduced risk of development of various chronic non-communicable diseases (obesity, diabetes *mellitus*, cancer and cardiovascular diseases).[1,2,6]

The fruits of the Cerrado have been used by the food, pharmaceutical and cosmetic industries, generating several important products for society. In addition, the cultivation of Cerrado fruits generates income for small and medium-sized local producers, guaranteeing food and nutrition security of their families and slowing deforestation and the disorderly growth of large crops. Among the homemade products with fruits of the Cerrado that may be prepared by the local producers are: jams, compotes, liqueurs, ice creams, popsicles and preserves. An interesting fact is that the fruits of the Cerrado are part of the food culture of the region, being present in various preparations, such as: rice with pequi, jatobá pie, mangaba ice cream and other flavors, cagaita liqueur and buriti paçoca.[7]

Among the various species of fruits of the Cerrado, one may emphasize the mama-cadela (*Brosimum Gaudichaudii* Tréc).[8] Mama-cadela, also known as algodãozinho, bureré, amoreira-do-mato, mamica-de-cachorra, mamica-de-cadela or marjejum, has a fleshy edible part and the wood of its tree is commonly used to manufacture furniture. Other parts of mama-cadela (peels, roots and leaves) are also used in medicine, especially in the treatment of vitiligo, whose active principles are fucoumarins, bergapten and psoralen.[9] On the other hand, mama-cadela is also important to feed the population of Cerrado, being mixed with cassava flour, forming a paste consumed as a food supplement. In addition, mama-cadela also has a sweet taste and texture similar to chewing gum, and is highly appreciated by children.[10]

With the above in mind, the present study aimed to analyze the nutritional characteristics (moisture, "available" carbohydrates, dietary fibers, proteins, lipids and ashes), physico-chemical characteristics (pH, titratable total acidity and antioxidant activity) and to determine some bioactive compounds with potent antioxidant action, such as phenolic compounds and vitamin C in *in natura* mama-cadela (*Brosimum gaudichaudii* Tréc), from Cerrado Mineiro, in order to bring to the scientific community more data about the nutritional composition of this fruit, since only a single study was found, by Rocha,[11] who analyzed the proximate composition (except dietary fibers), physical-chemical parameters (soluble solids, antioxidant, pH) and bioactive compounds (total phenolic compounds, flavonoids, anthocyanins, β-carotene, lycopene and vitamin C) in mama-cadela (called bureré) from Cerrado Piauiense.

Thus, data on nutritional composition, bioactive compounds and physico-chemical characteristics of mama-cadela from Cerrado Mineiro were not found until the present moment. Based on the above, it is important to bring new elements of nutritional composition to regional fruits (particularly mama-cadela), since the same fruit may have differences in its nutritional composition mainly due to the diversification of climate and soil in regions of Brazil, especially in the Cerrado Mineiro and Cerrado Piauiense.

Methodology

The *in natura* mama-cadela (*Brosimum gaudichaudii* Tréc) with peel and ripe was harvested in the 2014 crop, which was between October and November, by a local producer from the city of Uberlândia-MG. Then, the mama-cadela was transported to the Laboratory of Bromatology and Food Microbiology of the Universidade Federal de Uberlândia (UFU - Federal University of Uberlândia) and later stored without processing and frozen at -18 ºC. The experiment consisted of a test portion, a sample unit (about 3.5 kg of mama-cadela), fruit obtained in a single place, and all analyses were performed in triplicate.[12] For the analyses, only the seed was removed, the remainder was used.

The proximate composition (moisture, ashes, proteins, dietary fibers, "available" carbohydrates, lipids and energetic value (in kcal and kJ), the physico-chemical parameters (pH, titratable total acidity and antioxidant activity) and the bioactive compounds (vitamin C and total phenolics) of the mama-cadela were analyzed according to methods proposed by the Association of Official Analytical Chemists[13] and by the Adolfo Lutz Institute[14] and described in detail by Da Paz et al.,[15] Pacheco et al.[12] and Silva et al.,[16] as follows: the moisture determination was based on the weight loss of the sample undergoing oven heating at 105 °C for 24 hours.[14] The ashes were determined by the weight of material remaining after incineration in a muffle oven at 550 °C from 6 to 8 hours.[13,14] For the determination of the protein, the micro-Kjeldahl method[13] was used and for the protein content estimation, the nitrogen content was multiplied by the conversion factor for plants (N x 5.75).[17] The total dietary fiber was established by the enzymatic-gravimetric method.[13] The "available" carbohydrate (CHO) content was defined by difference: "available" CHO (%) = 100% - (%moisture + %proteins + %lipids + %ashes + %dietary fibers).[17] The lipid content was determined by the Goldfish method.[13] Phenolic compounds were stipulated according to the Singleton and Rossi method[18] and their results were expressed in: mg of gallic acid per 100 g of food in the wet weight. The determination of vitamin C was performed by the potassium iodate method.[14] The antioxidant activity was evaluated according to the technique described by Brand-Williams (inhibition percentage of the DPPH radical).[19] The physico-chemical analyses were: power of hydrogen (pH)[13] and titratable total acidity.[14] For the energy calculation, the value of "available" carbohydrates and of proteins was multiplied by 4 kcal/g and the lipid value by 9 kcal/g. The energy value (in kcal) was multiplied by 4.184 to transform it into kJ. The mean and standard deviation of the proximate composition, bioactive compounds and physico-chemical parameters were obtained with the aid of the Microsoft Office Excel software (2010).

Results

The data obtained regarding the proximate composition and the energy value of mama-cadela (*Brosimum gaundichaudii* Tréc) are presented in Table 1.

Table 1. Proximate composition (g/100 g) and energy value (kcal/100 g and kJ/100 g) of *in natura* mama-cadela (*Brosimum gaudichaudii* Tréc), wet weight and dry weight. Uberlândia, Minas Gerais, 2014.

Proximate composition	Wet Weight Mean ± Standard-deviation	Dry Weight Mean ± Standard-deviation
Moisture	77.63±1.46	-
Proteins	1.63±0.05	7.27±0.23
Lipids	0.60±0.02	2.67±0.08
Ashes	0.82±0.01	3.66±0.06
"Available" CHO (by difference)	13.35±2.17	59.66±9.70
TDF	5.11±1.80	22.86±8.05
TEV[1]	65.21±8.34	291.48±37.27
TEV[2]	272.82±34.88	1219.57±155.93

Mean values ± standard-deviation (SD); n=3 (analysis triplicate); TDF= total dietary fibers; TEV[1]= total energy value in kcal/100 g; TEV[2] = total energy value in kJ/100 g.

The data obtained concerning the physico-chemical parameters and bioactive compounds of mama-cadela (*Brosimum gaundichaudii* Tréc) are presented in Table 2.

Table 2. Physico-chemical parameters and bioactive compounds of *in natura* mama-cadela (*Brosimum gaudichaudii* Tréc), in wet weight. Uberlândia, Minas Gerais, 2014.

Physico-chemical parameters and bioactive compounds	Mean ± standard-deviation
pH	5.96 ± 0.03
Titratable total acidity (% citric acid)	5.85 ± 0.18
Antioxidant activity (inhibition percentage of the DPPH radical)	28.85 ± 2.66
Vitamin C (mg/100 g)	14.92 ± 1.68
Phenolic compounds (mgGAE/100 g)	178.65 ± 2.81

n=3 (analysis triplicate).

Discussion

Regarding the proximate composition (Table 1), the moisture content of the present study was 77.63%, evidencing that mama-cadela has a high water content in its composition. Rocha,[11] in a study also conducted with mama-cadela from Cerrado Piauiense (called bureré in this region), found 72.3% of moisture, a value close to that of the present research. Da Paz et al.[15] found 52.4% moisture in pequi, which is also a fruit of the Cerrado. In genipapo, Pacheco et al.[12] found 70%. The moisture in fruits is generally quite high, and this parameter may be indicative of low shelf life due to the high microbiological activity that water provides.[20,21]

The protein content observed in this study was 1.63%, a value lower than the one found in the study conducted by Rocha,[11] which was 2.2%. Silva et al.[22] analyzed several fruits of the Cerrado, such as araticum, cagaita, gabiroba and mangaba, and found, respectively, 1.22%, 0.82%, 0.50% and 1.20%. Comparing the protein values of these fruits with the mama-cadela of the present study, it was possible to observe that the latter has a higher amount of proteins.

The lipid content of the present study (0.60%) was twice as high as that found by Rocha (0.30%).[11] Silva et al.[22] observed similar amounts in other fruits of the Cerrado, such as cagaita (0.44%) and cerrado cashew (0.63%). Pacheco et al.[12] did not find lipids in genipapo.

The amount of ashes of the present study (0.82%) was lower than the one found by Rocha,[11] which obtained 1.3%. Ashes indicate the presence of minerals in a fruit, and their contents may vary according to the quality of the soil. Several factors may interfere with the nutritional quality of soils: differences in relief, altitude in relation to sea level, rainy season and scarcity of the region, air, water quality, vegetation (whether dense or not), presence of living beings (animals from the region or men), among other factors.[23] In comparison to other fruits of the Cerrado, Morzelle et al.[24] obtained 0.84%, 1.32%, 2.31%, in curriola, gabiroba and changunga, respectively. Pacheco et al.[12] found 1.1% of ashes in genipapo. It is observed, in this case, that the ashes values of mama-cadela are lower than the values of other fruits, and this may indicate that it presents few minerals in its chemical composition.

The "available" carbohydrates of the mama-cadela of the present study were 13.35%. Rocha[11] found 23.8% of total carbohydrates ("available" carbohydrates + dietary fibers) in her research, also in the wet weight, since total carbohydrates were calculated by difference and without discounting the value of dietary fibers. If we add the values of "available" carbohydrates and dietary fibers of the present research, we will obtain the value of 18.46%, which is lower than the value found by Rocha.[11] According to other studies with fruits of the Cerrado, it is possible to perceive some variations in the content of "available" carbohydrates, such as in araticum (12.78%), in cagaita (3.08%), in macaúba (35.06%), in gabiroba (15.68%) and in pequi (3.4%).[15,22,24]

The total dietary fiber (TDF) of the mama-cadela of the present study was 5.11% and no values of mama-cadela dietary fibers were found in other studies. In studies with genipapo,[12,21] 1.09% and 6.3% of TDF were observed. In another study, Abreu et al.[25] obtained 5.89% and 6.81% of TDF in samples of white and red pitaya, respectively. The energy value in 100 g of the edible part of mama-cadela was 65.21 kcal (272.82 kJ), which corresponds to 3.26% of the daily needs of a healthy adult (2,000 kcal per day).[26]

Regarding the physico-chemical parameters (Table 2), the pH value (5.96) found in the present study was higher than that described by Rocha (5.7).[11] There are fruits of the Cerrado with pH more acid than that of mama-cadela, such as cagaita (2.97) and gabiroba (3.97).[27] In the present study, the titratable total acidity was 5.85%. Rocha[11] obtained a higher value (7.1%). Perfeito et al.[28] found 0.84% in mangaba. Da Paz et al.,[15] 0.7% in pequi. It is possible to observe that the acidity of mama-cadela was higher than the ones found in other fruits of the Brazilian Cerrado.

The antioxidant activity of the mama-cadela of the present study was 28.85%. Pacheco et al.[12] demonstrated that the antioxidant activity in genipapo was 70.2%. Da Paz et al.[15] obtained 13.7% in pequi. It is worth to elucidate that the discrepant values of antioxidant activity among the different fruits of the Cerrado show the diversity of this biome.

The phenolic compounds of the mama-cadela of the present study (178.65 mg GAE/100 g) were higher than the ones of Rocha's[11] study (20.73 mg GAE/100 g). Comparing the mama-cadela of the present study with other fruits of the Cerrado, Abreu et al.[25] analyzed white and red pitayas and found 116.14 mg GAE/100 g and 77.22 mg GAE/100 g, respectively. Da Paz et al.[15] found in pequi 531.5 mg GAE/100 g. The vitamin C of the mama-cadela of the present study was 14.92 mg/100 g, a much lower value than the one found in Rocha's[11] study (86.5 mg/100 g). Rocha[29] found that vitamin C was present in high amounts in cashew (500 mg/100 g), jatobá (330.4 mg/100 g) and macaúba (185.1 mg/100 g). These substantial differences in the phenolic compounds and in the vitamin C of the present study with the literature may be due to methodological differences (e.g., solvents used), the origin of the sample (Brazil presents continental dimensions and there are soil and climate differences among regions) and the form and time of storage of the fruit.[23]

The mama-cadela of the present study obtained highlights regarding total carbohydrate contents (18.46% on wet weight), particularly dietary fibers, and phenolic compounds. The Brazilian Cerrado may be considered a source of food to the population that lives there, mainly supplying several native edible fruits. Mama-cadela is a well-known fruit in the Cerrado region, however, there is a lack of research regarding its nutritional and functional characteristics.

The incentive to mama-cadela consumption is in line with the public policies of the Brazilian government, which supports the preservation of the Cerrado and encourages the use of regional foods, thus guaranteeing the food and nutrition security of the population.[30] The necessity of

research that deepens the nutritional and functional aspects of mama-cadela is evident, since only one study with mama-cadela from the Cerrado Piauiense was found,[11] whereas the present study was performed with the fruit of Cerrado Mineiro.

Conclusion

Regarding the proximate composition of mama-cadela, the highlights were for dietary fibers (about 5%) and "available" carbohydrates (approximately 13%), totaling almost 18% of total carbohydrates. Concerning bioactive compounds, the highlights were for the phenolic compounds. In general, mama-cadela may be considered a new target of scientific studies, being clear the evidence that it is necessary the deepening of its nutritional and functional characteristics.

Contributors

All authors contributed to the conception and design of the study, data analysis and final writing.

Conflict of interest: The authors declare that there are no conflicts of interest.

References

1. Malta, LG. Avaliação biológica de frutas do Cerrado brasileiro: Guapeva, Gabiroba e Murici. [Tese]. [Campinas]: Universidade Estadual de Campinas. Faculdade de Engenharia de Alimentos; 2011.
2. Brasil. Ministério do Meio Ambiente. O bioma cerrado [Internet]. [accessed on: 05 April 2017]. Available at: http://www.mma.gov.br/biomas/cerrado
3. Santos MAD, Barbieri AF, Guedes GR, Machado CJ, Carvalho JAM. Dinâmica demográfica e uso da terra no cerrado brasileiro: reflexões a partir da experiência do Padap. Rev Econ Sociol Rural 2012; 50(2):319-331.
4. Brasil. Ministério do Meio Ambiente. Programa de Cooperação entre Brasil, Reino Unido e Banco Mundial "Redução do desmatamento e das queimadas no cerrado brasileiro". Marco de gestão social e ambiental. Brasília: MMA; 2014.
5. Souza VR, Pereira PAP, Queiroz F, Borges SV, Carneiro JDS. Determination of bioactive compounds, antioxidant activity and chemical composition of Cerrado Brazilian fruits. Food Chemistry 2012; 134(1)381-386.
6. Ramos MIL, Ramos Filho MM, Hiane PA, Braga Neto JA, Siqueira EMA. Qualidade nutricional da polpa de Bocaiúva Acrocomia aculeata (Jacq.) Lodd. Ciênc Tecnol Aliment. 2008; 28:90-94.
7. Roesler R, Malta LG, Carrasco LC, Holanda RB, Sousa CAS, Pastore GM. Atividade antioxidante de frutas do cerrado. Ciênc Tecnol Aliment. 2007; 27(1):56-60.

8. Faria RAPG, Silva AN, Albuquerque MCF, Coelho MFB. Características biométricas e emergência de plântulas de Brosimum gaudichaudii Tréc. oriundas de diferentes procedências do cerrado mato-grossense. Rev Bras Pl Med. 2009; 11(4):414-421.

9. Silva DB, Vieira RF, Cordeiro MCT, Pereira EBC, Pereira AV. Propagação vegetativa de Brosimum gaudichaudii Tréc. (mama-cadela) por estacas de raízes. Rev Bras Pl Med. 2011; 13(2):151-156.

10. Jacomassi E, Moscheta IS, Machado SR. Morfoanatomia e histoquímica de órgãos reprodutivos de Brosimum gaudichaudii (Moraceae). Rev Brasil Bot. 2010; 33(1):115-129.

11. Rocha MS. Compostos bioativos e atividade antioxidante (in vitro) de frutos do cerrado piauiense. [Dissertação]. [Teresina]: Universidade Federal do Piauí, Programa de Pós-Graduação em Alimentos e Nutrição; 2011.

12. Pacheco P, Paz JG, Silva CA, Pascoal GB. Composição centesimal, compostos bioativos e parâmetros físico-químicos do jenipapo (genipa americana L.) in natura. Demetra 2015; 9(4):1041-1054,.

13. Association of Official Analytical Chemists. Official methods of analysis. 16. ed. Washington: AOAC; 1997.

14. Instituto Adolfo Lutz. Normas analíticas do Instituto Adolfo Lutz: métodos físico-químicos para análise de alimentos. São Paulo: Instituto Adolfo Lutz; 2008. 1020 p.

15. Paz JG, Pacheco P, Silva CO, Pascoal GB. Análise da Composição nutricional e de parâmetros físico-químicos do Pequi (Caryocar Brasiliense Camb) in natura. Rev Científica Linkania Master 2014; 1(8):74-159.

16. Silva ACB, Schuquel LCS, Da Silva CO, Pascoal GB. Qualidade nutricional e físico-química em cenoura (Daucus Carota L.) in natura e minimamente processada. Demetra 2016; 11(2):355-367.

17. Brasil. Agência Nacional de Vigilância Sanitária. Resolução RDC n. 360 de 23 de dezembro de 2003: Regulamento técnico sobre rotulagem nutricional de alimentos embalados. Diário Oficial da União 26 dez. 2003.

18. Singleton VL, Rossi JA. Colorimetry of total phenolics with phosphomolybdic-phosphotungstic acid reagents. Am J Enol Vitic 1965; 16(3):144-158.

19. Brand-Williams W, Cuvelier ME, Berset C. Use of a free radical method to evaluate antioxidant activity. LWT-Food Science and Technology 1995; 28(1)25-30.

20. Hiane PA, Ramos MIL, Ramos Filho MM, Pereira JG. Composição centesimal e perfil de ácidos graxos de alguns frutos nativos do Estado de Mato Grosso do Sul. Centro de Pesquisa de Processamento de Alimentos 1992; 10(1):35-42.

21. Hamacek FR, Moreira AVB, Martino HSD, Ribeiro SMR, Pinheiro-Sant'Ana HM. Valor nutricional, caracterização física e físico-química de jenipapo (Genipa americana L.) do cerrado de Minas Gerais. Alim. Nutr. 2013; 24(1):73-77.

22. Silva MR, Lacerda DBCL, Santos GG, Martins DMO. Caracterização química de frutos nativos do cerrado. Ciênc Rural 2008; 38(6):1790-1793.

23. Gomes RLR, Silva MC, Costa FR, Lima Junior AF, Oliveira IP, Silva DB. Propriedades físicas e teor de matéria orgânica do solo sob diferentes coberturas vegetais. Revista Faculdade Montes Belos 2015; 8(1):72-139.

24. Morzelle MC, Bachiega P, Souza EC, Vilas Boas EVB, Lamounier ML. Chemical And Physical Charecteriztion Of Fruits From Cerrado: Curriola, Gabiroba And Murici. Rev Bras Frutic. 2015; 37(1):96-103.

25. Abreu WC, Lopes CO, Pinto KM, Oliveira LA, Carvalho GBM, Barcelo MFP. Características físico-químicas e atividade antioxidante total de pitaias vermelha e branca. Rev. Inst Adolfo Lutz 2012; 71(4)656-661.

26. Brasil. Ministério da Saúde. Secretaria de Atenção à Saúde. Guia alimentar para a população brasileira: promovendo a alimentação saudável. Brasília: Ministério da Saúde; 2008.

27. Silva AML, Martins BA, Deus TN. Avaliação do teor de ácido ascórbico em frutos do Cerrado durante o amadurecimento e congelamento. Estudos 2009; 36(6):1159-1169.

28. Perfeito DGA, Carvalho N, Lopes MCM, Schmidt FL. Caracterização de frutos de mangabas (Hancornia speciosa Gomes) e estudo de processos de extração da polpa. Revista Agricultura Neotropical 2015; 2(3):1-7.

29. Rocha MS,Figueiredo RW, Araújo MAM, Moreira-Araújo RSR. Caracterização físico-química e atividade antioxidante (in vitro) de frutos do cerrado piauiense. Rev Bras Frutic. 2013; 35(4):933-941.

30. Brasil. Ministério da Saúde. Secretaria de Atenção à Saúde. Departamento de Atenção Básica. Alimentos regionais brasileiros. Brasília: Ministério da Saúde; 2015. 484 p.

Received: 07 September 2016
Revised: 31 March 2017
Accepted: 17 April 2017