

Proximate composition and antioxidant activity in fruits of jurubeba

ABSTRACT

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The fruit of jurubeba (*Solanum paniculatum*) is a bitter spherical green berry, which is yellowish when ripe. The fruits are used for cooking in some regions of Brazil. The plant is considered an official drug in the Brazilian Pharmacopoeia. It can be used in various ways, such as infusion of leaves, fruits, stems, and roots. Its fruits may undergo blanching process followed by immersion in vinegar (acidification) or "in natura". There are only few studies on this plant. The crops are still not of selected species that are in need of both agronomic and physico-chemical composition studies of their fruits, leaves and roots. This study aimed to verify the centesimal composition, quantify phenolic compounds, and determine the antioxidant activity in dried fruits of this plant. The fruits were harvested during the months of July and August of 2012 and samples were prepared, dried and with one and three bleaching processes (A and B), a total of 18 samples, consisting of 3 treatments and 6 repetitions. There was no significant difference in the moisture content, lipids, fibers and carbohydrates of the samples in the different treatments, whereas for ash and protein there was significant difference between treatments. Both for the antioxidant activity and for phenolic compounds, there was no significant difference ($p < 0.05$) between treatments.

KEYWORDS: Bleaching; Canning; Chemical analysis; *Solanum paniculatum*.

INTRODUCTION

Jurubeba occurs in Brazil in Minas Gerais and in the south of the country, most often in the states of Rio Grande do Sul and Santa Catarina. It is a weed plant growing in derelict lots, roadsides and degraded pastures. It can occur in almost exclusive placements and reach up to 3 m tall, with small thorns, leaves very variable in shape, relatively large flowers and solanum fruits (KISSMANN; GROTH, 2000).

The plant known as Jurubeba (*Solanum paniculatum*) is shrubby, perennial, with thorny stems and branches, sinuous leaves and may be reproduced by seed, and vegetatively by rhizomes. It is a frequent plant in semi-sandy and acidic soils, the shrub being a small tree with short curved thorns. The inflorescence appears at the back of the branches, which concentrate many leaves located close together, rising long stalks with up to 15 cm in length, as presented in Figure 1.



Figure 1. Green fruits of jurubeba (*Solanum paniculatum*)

SOURCE: <http://goo.gl/erLNEc>

It is considered an invasive plant, due to its ease of colonization of various types of environments (PANIZZA, 1997; FURLAN; KATO; OLIVEIRA, 1999). The jurubeba fruit is a spherical green berry, yellowish when ripe, attached to a long stem, and produced in clusters.

Jurubeba is considered an official drug in the Brazilian Pharmacopoeia as a specific product to treat anemia, liver disorders, and digestive disorders. The roots, leaves and fruits are used as a tonic, and decongestant. It stimulates the digestive functions and reduces swelling of the liver and spleen. It is a remedy for chronic hepatitis, uterine tumors and hydrops (SIMÕES, 1998).

The infusion of its stem and its root in sugar cane is popularly used as an aperitif, and as a digestive as well. Traditional medicine recommends its tea as: a cardiovascular tonic, an appetite stimulant, liver and spleen problems, against problems of digestion, as a diuretic, as a hypoglycemic, antianemic, febrifuge and healing agent. It is also effective in the following cases: fever, dropsy, liver disease, diabetes, tumors of the uterus and abdomen, anemia, inflammation of the spleen, bladder problems and hangover (CORRÊA, 1969; FURLAN; KATO; OLIVEIRA, 1999).

Despite the importance and wide use of native medicinal plants by the poorer population, its cultivation is still incipient, with no information allowing cultivation on a large scale. Most of the species is simply collected and made into herbal remedies or sold in street markets. Jurubeba is frequently recognized as a weed, but its fruits are consumed as spice, in pickles, and additive, in sugar cane liquor, in several regions of Brazil (LORENZI; MATOS 2002; GARCIA *et al.*, 2008).

Among the few studies, some analysis of growth developed on this species can be verified. Garcia *et al.* (2008) studied the effectiveness of methods to increase the germination rate of *jurubeba* (*solanum paniculatum* L.) seeds, while Antônio *et al.* (2004) have studied the Antiulcerogenic activity of ethanol extract of *Solanum variable* (false "jurubeba") and Sabir and Rocha (2008) have studied the antioxidant and hepatoprotective activity of aqueous extract of *Solanum fastigiatum* (false "Jurubeba").

Many steroid compounds have been isolated from these species, including jurubebine, jubebine and solanine, and jupebine and jupebenine resins. Fructose, glucose and galactose have been detected in fruits, and solanine has been isolated from the roots and stems. Saponins have also been identified in the roots of these species as isojuripidine, isopaniculidine and jurubidine, which is a sugar-free steroid obtained via acid hydrolysis from jurubina glycoside, also isolated from the roots of *S. Paniculatum* (MEDA *et al.*, 2005).

The main functions that antioxidants play are related to the inhibition of free radicals resulting from cellular metabolism. The antioxidants help to prevent age-related diseases and cardiovascular risk. They also act as food preservatives to inhibit oxidation reactions, responsible for degradation of food (POKORNÝ; YANISHLIEVA, 2001, PIENIZ *et al.*, 2009).

For consumption and longer lifetime of some foods we have used the bleaching process, a mild heat treatment which uses temperatures between 70 and 100°C and periods of time ranging from 1 to 5 minutes. This treatment is applied to fruits and vegetables as the main objective to promote inactivation of natural enzymes besides reducing the number of contaminating microorganisms on food surfaces, and softening texture. Also, it helps in cleaning food, softens and swells the plant tissues, eliminates almost all air and gases contained in plant tissues, and softens and dissolves the dried layer of juice accumulated in the pod. (VASCONCELOS; FILHO, 2010).

Addition of acid, known as acidification, is necessary for the conservation to reach a pH of approximately 4.5, and together with pasteurization they tend to ensure no growth of microorganisms that may cause harm to the health of the consumer. Thus, the professional of the area is in charge to supervise the formulation and production of food, searching for a product with quality that does not cause damage to health (FURTADO; DUTRA, 2012)

As the fruit of jurubeba is still not widely known, this work aims to perform an analysis of some physico-chemical parameters of the fruit being fresh and canned.

MATERIAL AND METHODS

The jurubeba fruits were harvested in uninhabited areas of the city of Uberlândia and in rural areas of this municipality as well. The fruits were small and green colored. Fruits of various plants were collected from July to August 2012, which were homogenized and divided into 6 samples. The raw fruits and the fruits submitted to one (A) or two bleaching processes (B) consisted of the treatments in question. The scheme of sample preparation is presented in Figure 2.

To conduct out the physicochemical analyzes, the “in nature” fruits and the fruits submitted to the bleaching process (A and B) and acidification were dried at 65 °C (Figure 2). The basic difference between the treatment 2 and treatment 3 was the number of processes bleaching. Acidified fruits were stored for seven days prior to the physical and chemical analysis.

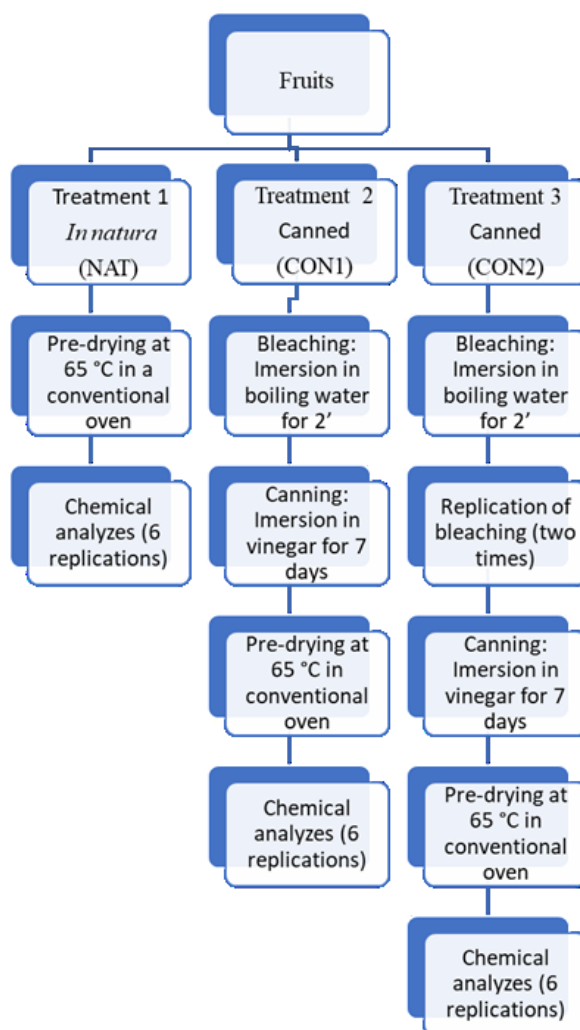


Figure 2 - Scheme of analysis of jurubeba fruits. Chemical analyzes performed on each plot: moisture, ash, protein, lipid, crude fiber, total phenolics, antioxidant activity.

PERCENTAGE COMPOSITION

For the moisture analysis (oven at 105°C to constant weight), approximately 5.0 g of samples were weighed on an analytical balance in a porcelain crucible, which was previously dried and weighed. From the determination of moisture, the crucibles containing the dried extract were taken to muffle furnace at a temperature of 500°C ± 10°C, for incineration to obtain white ash.

The Kjeldahl method was used for protein determination, which consists in quantifying the total nitrogen in the sample using a correction factor of 5.85 for determining the crude protein factor, while the lipid content was determined by the Soxhlet method and the crude fiber content, through the process of basic and acid digestion, according to the Adolfo Lutz Institute (2008). The fraction composed of carbohydrates was obtained by difference from the other fractions analyzed. The calorific value was calculated according to the method described by Atwater, with coefficients 4.0, 9.0, and 4.0 kcal·g⁻¹, for protein, lipid, and total carbohydrate, respectively (CORRÊA, 1969).

PREPARATION OF SAMPLE EXTRACTS FOR ANTIOXIDANT PROPERTY ANALYSIS AND TOTAL POLYPHENOL CONTENT

Each sample was subjected to extraction with 95% ethanol, according to the methodology of Krygier, Sosulski and Hogge (1982), the crude ethanol extract (CEE) being obtained for the determination of total phenolic compounds and antioxidant activity tests.

ANTIOXIDANT ACTIVITY

The antioxidant activity was determined by the spectrophotometric method using the reagent 2,2-diphenyl-1-picryl hydrazyl (DPPH) (BRAND-WILLIAMS; CUVÉLIER; BERSET, 1995; POKORNÝ; YANISHLIEVA, 2001; WU *et al.*, 2005). The method is based on the percentage of decrease in absorbance of the ethanol extract. Reading is carried out in a spectrophotometer at 517 nm. In this reaction, DPPH species is reduced by antioxidant constituents present in organic compounds (MORAIS *et al.*, 2009). The ability of sequestering free radicals will be expressed as an inhibition percentage of radical oxidation.

CONTENT OF TOTAL PHENOLIC COMPOUNDS

The determination of total phenols was done after the ethanol extraction of the samples using the Folin-Ciocalteu method. This method involves reduction of the reagent by the phenolic compounds of the samples with concomitant formation of a blue complex whose intensity increases linearly to

760nm, as described by Swain and Hillis (1959), Wu *et al.* (2005) and Meda *et al.* (2005) with modifications.

The total amount of phenols of the samples was measured by a standard curve prepared with an aqueous solution of gallic acid. The amounts of total phenolics were expressed as gallic acid equivalents (EAG).

STATISTICAL ANALYSIS OF THE RESULTS

Data were analyzed in a completely randomized design with three treatments and 6 replicates, totaling 18 experimental plots, subjected to analysis of variance (F test) and comparison test of Tukey rates, both 5 and 1% probability using the software ESTAT (BARBOSA; MALHEIROS; BARZATTO, 1992).

RESULTS AND DISCUSSION

The results of the centesimal composition and calorific value on a dry basis at 60 °C of the jurubeba samples are shown in Table 1.

Table 1 - Centesimal composition and caloric value (kcal/g) jurubeba sample by treatments: (1) "in nature" (2) preservation process A# (3) preservation process B&.

Treatment	Moisture (%)	Ash (%)	Protein (%)	Fat (%)	Fibre (%)	Carbohydrate (%)	Calories (kcal/100g)
1-NAT	3.56 ^A	7.37 ^{A*}	13.49 ^{A*}	2.567 ^A	33.74 ^A	42.83 ^A	248.41 ^A
2-CON1	3.17 ^A	5.26 ^{B*}	11.55 ^{B*}	2.30 ^A	36.76 ^A	43.19 ^A	240.74 ^A
3-CON2	3.49 ^A	5.86 ^{A^B*}	12.19 ^{A^B*}	2.34 ^A	35.66 ^A	43.956 ^A	245.58 ^A

NOTE: #(1 bleaching process). &(3 bleaching process); * Means in the same column followed by different letters differ ($p < 0.05$) by the Tukey test.

The content of fiber and carbohydrates were similar to the results obtained by Vallilo *et al.* (2006) in their studies of gabioba (*C. adamantium*), a fruit found in cerrado, 37.3% and 48%, respectively, for fiber and carbohydrates, while the ash and protein contents were higher than the results obtained by the same author (1.9% for ash and 6.6 % for protein). It was observed that the ash, protein and fiber contents were higher than the ones compared to the study by Philippi (2001) with acerola (*Malpighia puniceifolia* L.), 3.9% for ash, 4.0 % for protein and 12.6% for fiber.

According to Philippi (2001), for acerola (*Malpighia puniceifolia* L.), lipid values (3.0%) and carbohydrates (76.5%) were higher than the ones compared to the present study and the ash content (3.9%), proteins (4%) and fiber (12.6%) were lower than those obtained with the fruits of jurubeba.

Since there are no studies on the physico-chemical composition of jurubeba fruits the study is justified, because these fruits may have beneficial characteristics, as their herbal benefits have already been described (SIMÕES, 1998; MESIA-VELA *et al.*, 2002). There was no significant difference ($p < 0.05$) in the content of total phenolics analyzed in 3 treatments (Table 2).

Table 2 - Total phenols jurubeba samples by treatments: (1) "in nature" (2) preservation process A, (3) preservation process B.

Treatments	Phenolics Concentrations (mg EAG/g)
1	9.1775 ^A
2	7.7607 ^A
3	7.7622 ^A

NOTE: Means in the same column followed by different letters differ ($p < 0.05$) by the Tukey test.

Bernardes *et al.* (2001) found that the concentration of total phenolics, expressed in terms of tannic acid in extracts of kiwi, pulp and peel of plum were, respectively, 981.87 and 825.95 mg 100 g⁻¹, very close to the values of this study. Neves, Alencar e Carpes (2009) obtained 6.9 mg GAE g⁻¹ and 60.13% of antioxidant activity in samples of pollen, that were lower values if compared to the ones obtained for jurubeba in the different treatments.

It was found that there was no significant difference ($p < 0.05$) if compared to the antioxidant activity of the samples of jurubebas in the different treatments (Table 3).

Table 3 - Antioxidant activity of jurubeba samples by treatments (1) "in nature" (2) preservation process A, (3) preservation process B.

Treatments	Antioxidant activity (%)
1	92.5428 ^A
2	94.3875 ^A
3	94.2175 ^A

NOTE: * Means in the same column followed by different letters differ ($p < 0.05$) by the Tukey test.

As shown in Table 3, the antioxidant capacity of jurubebas was of approximately 90-95%. Similar results were obtained by Bernardes *et al.* (2001) who identified in extracts of kiwi and plum values close to these ones, and were considered at high capacity for sequestering free radicals.

According to Melo *et al.* (2008), in descending order, aqueous extracts of acerola, papaya Formosa, cashew and papaya Hawaii, in addition to having a strong capacity antioxidant, they were very effective in sequestering radical free, whose percentage of kidnapping was higher than synthetic antioxidant BHT, and therefore considered fruits with high antioxidant capacity, since the kidnapping of percentage of DPPH radical was greater than 70%.

As observed in Figure 3, there is a good correlation between the content of total phenolics and antioxidant capacity of fruits in treatments performed.

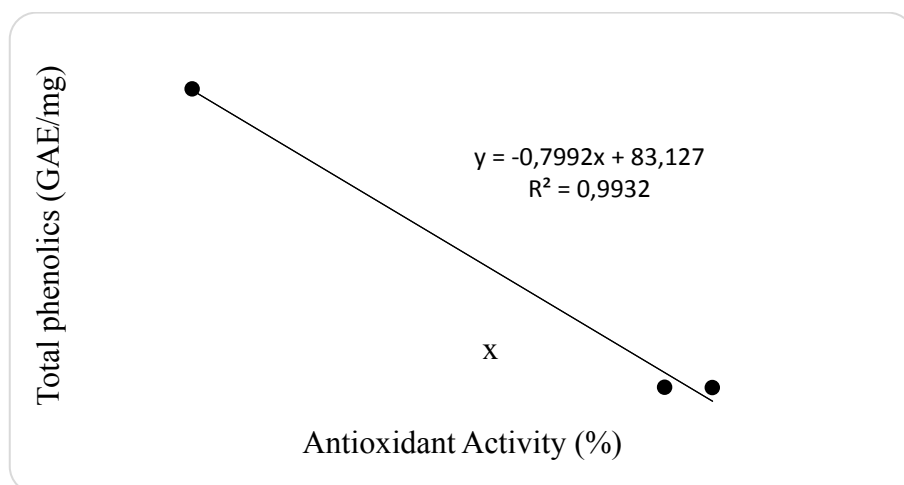


Figure 3 - Correlation between the content of total phenolics and antioxidant activity for treatments performed.

CONCLUSION

The bleaching process and acidification of the fruits did not significantly affect the results of the phenolic compounds, antioxidant activity and centesimal composition, except for ash and protein.

The fruits of jurubeba, regardless of the treatment used, have a high content of phenolic compounds and high antioxidant activity.

In addition to the pharmacological properties, the fruit of jurubeba has a high content of nutrients and functional properties considered, and therefore a potential food for use in home or industrial preparation.

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Composição centesimal e atividade antioxidante de frutos de jurubeba

RESUMO

O fruto da jurubeba (*Solanum paniculatum*) é uma baga esférica verde e de sabor amargo, amarelada quando madura. Os frutos são utilizados na culinária em algumas regiões do Brasil. A planta é considerada uma droga oficial na Farmacopeia Brasileira, pode ser utilizada de diversas formas, infusão de folhas, frutos, caule e raiz e seus frutos são consumidos na forma de conservas ou “in natura”. Ainda são poucos os estudos sobre esta planta, os cultivos ainda são de espécies não selecionadas, portanto há necessidade de estudos agrônômicos e da composição físico-química dos seus frutos, folhas e raízes. Baseado neste fato, este trabalho teve por objetivo verificar a composição centesimal, quantificar compostos fenólicos e determinar a atividade antioxidante em frutos dessecados e em conservas deste vegetal. Os frutos foram colhidos durante os meses de julho e agosto de 2012 e foram preparadas amostras dessecadas e em conservas com um e três processos de branqueamento, num total de 18 amostras, sendo 3 tratamentos e 6 repetições. Não houve diferença significativa quanto ao teor de umidade, lipídios, fibras e carboidratos das amostras analisadas nos diferentes tratamentos; já para cinzas e proteínas houve diferença significativa entre os tratamentos. Tanto para a atividade antioxidante quanto para compostos fenólicos, verificou-se que não houve diferença significativa ($p < 0,05$) entre os tratamentos propostos.

PALAVRAS-CHAVE: Branqueamento; Conservas; Análise química; *Solanum paniculatum*.

REFERÊNCIAS

ANTONIO, J.M.; GRACIOSO, J.S.; TOMA, W.; LOPEZ, L.C.; OLIVEIRA, F. ; SOUZA BRITO, A.R.M. Antiulcerogenic activity of ethanol extract of *Solanum variable* (false "jurubeba"). **Journal of Ethnopharmacology**, Amsterdam, v. 93, n. 1, p. 83-88, 2004.

BARBOSA, J. C.; MALHEIROS, E. B.; BANZATTO, D. A. **ESTAT**: um sistema de análises estatísticas de ensaios agrônômicos. Versão 2.0 Jaboticabal: UNESP-FCAV, 1992.

BERNARDES, N. R.; TALMA, S.V.; SAMPAIO, S.H.; NUNES, C.R.; ALMEIDA, J.A.R. DE; OLIVEIRA, D.B DE. Atividade antioxidante e fenóis totais de frutas de campos dos Goytacazes RJ. **Ciências Biológicas e da Saúde** – Perspectivas online, Rio de Janeiro, v. 1, n. 1, p.53-59, 2011.

BRAND-WILLIAMS, W.; CUVELIER, M. E.; BERSET, C. Use of a free radical method to evaluate antioxidant activity. **Lebensmittel Wissenschaft and Technologies**, London, n. 28, v. 1, p. 25-30, 1995.

CORRÊA, M. P. Dicionário das Plantas Úteis do Brasil e das Exóticas Cultivadas, v. IV. **Ministério da Agricultura, Instituto Brasileiro de Desenvolvimento Florestal**, Rio de Janeiro, 1969.

FURLAN, M. C.; KATO, E. T. M.; OLIVEIRA, F. Caracterização farmacognóstica da droga e do extrato fluido de *Solanum variable*. Parte I, **Lecta**, Bragança Paulista, v. 17, n. 2, p. 9-35. 1999.

FURTADO, A. A. L.; DUTRA, A. S. de. Elaboração de conservas de pimentas. **Informe Agropecuário**, Belo Horizonte, v.33, n.267, p.57-62, 2012.

GARCIA, J.; JACOBSON, T. K. B.; FARIAS, J. G.; BOAVENTURA, R. F. Effectiveness of methods to increase the germination rate of *jurubeba* (*solanum paniculatum* L.) seeds. **Pesquisa Agropecuária Tropical, Goiânia**, v. 38, n. 3, p. 223-226, 2008.

INSTITUTO ADOLFO LUTZ; **Normas Analíticas, métodos físicos e químicos para análises de alimentos**, 1ª Ed eletrônica, v. 1, São Paulo, 2008. 1020p.

KISSMANN, K. G.; GROTH, D. **Plantas infestantes e nocivas**. 2 ed. Tomo III. Rio de Janeiro: BASF, 2000. 724p.

KRYGIER, K.; SOSULSKI, F.; HOGGE, L. Free, esterified and insoluble-bound phenolic acids. **Journal of Agricultural and Food Chemistry**, Washington, v. 30, p. 334-336, 1982.

LORENZI, H.; MATOS, F. J. **Plantas Medicinais no Brasil: nativas e exóticas**. 2.ed. Nova Odessa: Plantarum, 2008. 544p.

MEDA, A.; LAMIEN, C. E.; ROMITO, M.; MILLOGO, J.; NACOULMA, O. G. Determination of the total phenolic, flavonoid and proline contents in Burkina Faso honey, as well as their radical scavenging activity. **Food Chemistry**, Oxford, v.91, p. 571-577, 2005.

MELO, E.A.; MACIEL, M.I.S.; DE LIMA, V.L.A.G.; NASCIMENTO, R.J. Capacidade antioxidante de frutas. **Brazilian Journal of Pharmaceutical Sciences**, v. 44, n. 2, 2008.

MESIA-VELA, S.; SANTOS, M.T.; SOUCCAR, C.; LIMA-LANDMAN, M.T.R.; LAPA, A.J. *Solanum paniculatum* L. (jurubeba): Potent inhibitor of gastric acid secretion in mice. **Phytomedicine**, USA, v. 9, n. 6, p. 508-514, 2002.

MORAIS, S. A. L.; AQUINO, F. J. T.; NASCIMENTO, P. M.; NASCIMENTO, E. A. N.; CHANG, R. Compostos Bioativos e Atividade Antioxidante do Café Conilon Submetido a Diferentes Graus de Torra. **Química Nova**, São Paulo, v. 32, n. 2, p. 327-331, 2009.

NEVES, L. C.; ALENCAR, S. M. de.; CARPES, S. T. Determinação da atividade antioxidante e do teor de compostos fenólicos e flavonoides totais em amostras de pólen apícola de *Apis mellifera* Brazilian. **Journal of Food Technology**, São Paulo, VII BMCFB, P 107-110, 2009.

PANIZZA, S. **Plantas que curam: cheiro do mato**. São Paulo: IBRASA, 1997. 279p.

PHILIPPI, S. T. **Tabela de composição de alimentos: suporte para decisão nutricional**. Brasília, DF: Anvisa, Finattec/Nut-UnB, 2001. 133 p.

PIENIZ, S.; COLPO, E.; OLIVEIRA, V.R DE.; ESTEFANEL, V.; ANDREAZZA, R. Avaliação *in vitro* do potencial antioxidante de frutas e hortaliças. **Ciência e Agrotecnologia**, v.33, n.2, Lavras, 2009.

POKORNÝ, J., YANISHLIEVA, G., GORDON, M. **Antioxidants in food: Practical applications**. 2001. 400p.

SABIR, S.M.; ROCHA, J.B.T. Antioxidant and hepatoprotective activity of aqueous extract of *Solanum fastigiatum* (false “Jurubeba”) against paracetamol-induced liver damage in mice. **Journal of Ethnopharmacology**, v. 120, n. 2, p. 226-232, 2008.

SIMÕES, C. M. O. **Plantas da Medicina Popular do Rio Grande do Sul**. Porto Alegre: Editora Universidade/UFRGS, 1988. 173p.

VALLILO, M. I.; Lamardo, L.C.A.; Gaberlotti, M.L.; Oliveira, E.; Moreno, P.R.H. Composição química dos frutos de *Campomanesia adamantium* (Cambessédes) O.Berg. **Ciência Tecnologia de Alimentos**, Campinas, v. 26, n.4, p. 805-810, 2006.

VASCONCELOS, M. A. da S.; FILHO, A. B. de M. **Conservação de alimentos**. Recife: EDUFPE, 2010. 130 p.: il.

SWAIN, T.; HILLIS, W.E. The phenolic constituents of *Prunus domestica*. The quantitative analysis of phenolic constituents. **Journal of the Science of Food and Agriculture**, London, v.10, n.1, p.63-68, 1959.

WU, J.H.; TUNG, Y.T.; WANG, S.Y.; SHYUR, L.F.; KUO, Y.H.; CHANG, S.T. Phenolic antioxidants from the heartwood of *Acacia confusa*. **Journal of Agricultural and Food Chemistry**, Washington, v. 53, n. 15, p. 5917-5921, 2005.

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