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Tocopherols and Fatty Acid Profile in Baru Nuts (Dipteryx *Alata* Vog.), Raw and Roasted: Important Sources in Nature that Can Prevent Diseases

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Abstract

Brazil has extensive biodiversity in their biomes, where the Cerrado, vegetation of the Brazilian interior, contributes a nutritional and medicinal potential still unexplored. The reduced risk of cardiovascular disease and secondary complications, which stand out with a higher incidence rate and prevalence on the world stage, have been positively associated with the consumption of fruits, vegetables and rich oil seeds of antioxidants. This protective potential is attributed to the presence of bioactive compounds that exert antioxidant activity, preventing risks to biological systems. Studies have shown that the constituents of plant foods have recognized ability to chelate divalent metals involved in the production of Reactive Oxygen Species (ROS), which can prevent damage to the organism and the onset of diseases. Recent studies have shown that daily supplementation with Baru nuts [Dipteryx *alata* Vog.] reduced oxidative stress induced by iron in rats protecting biological systems from the harmful effects of free radicals. Baru (Dipteryx *alata* Vog) is a fruit that contains inside nuts with exploration of possibilities for food and pharmaceutical industry, due to the antioxidant content of their bioactive compounds and lipid profile, rich in unsaturated fatty acids. This study aimed to identify by chromatography, the fatty acid profile and tocopherols content in baru nuts, with or without peels, and to evaluate the effect of the roasting process on this composition and antioxidant action. The lipid content in the roasted nuts without peel was 40.2±0.8 mg/100g and in the nuts with peel was 48.6±1.3g/100g. The total content of tocopherols ranged from 2.0±0. 2 at 2.7±0.1 mg/100g in the nuts with peel and without peel. The lipid content in roasted nuts without peels was 40.2±0.8 mg/100 g and that in raw nuts with peels was 48.6±1.3 g/100 g. The total tocopherol content ranged from 2.0±0.2 to 2.7±0.1 mg/100 g in roasted nuts with peels and in raw nuts with peels, respectively. Oleic (C18: 1), linoleic (C18: 2), linolenic (C18: 3), elaidic (C20: 1) and tetracosenoic acids (C24: 1) were the major unsaturated fatty acids, representing approximately 81% of the fatty acids of the nuts, and of these, the oleic and linoleic acids were the major fatty acids. It was concluded that the heat treatment used does not significantly affect the fatty acid profile and tocopherols content Baru nuts, with and without peels, preserving its antioxidant activity along with other bioactive compounds contained therein and previously studied and identified.

Keywords: Lipid content; Fatty acids; Vitamin E; Nuts; Antioxidants

Introduction

Studies in Orthomolecular Medicine, suggest that the compounds contained in plants, are able to prevent and reduce the development of diseases related to oxidative stress because the bioactive compounds present in these foods and dispersed in nature, have a unique mechanism of action or when in combination with others are capable

of increasing the antioxidant activity, preventing the onset of diseases caused by reactive species and harmful to the organism [1-3]. The search for oil seeds has attracted significant attention for application in human health natural sources [4]. These alternative sources of natural oils can assist in the food industry which is derived from materials with a high content of bioactive compounds [5,6]. Lipids play a major role in human nutrition as an energy source due to the presence of natural antioxidants measures to maintain the balance between the various cholesterol fractions and organoleptic properties such as taste, aroma and texture [7]. The main constituents of fats are fatty acids and epidemiological studies suggest that the saturated and *Trans* fatty acids are able to increase the fraction of Total Cholesterol and LDL Cholesterol [8,9]. Furthermore, the intake of *Tran's* fatty acids is associated with the prevalence of hyperlipidemies in populations with an excessive consumption of saturated fats and fried foods which are very harmful to health [8]. Thus, diets rich in fatty acids configuration, *Cis,* along with the low consumption of saturated fatty acids are associated with the control of coronary artery disease and low incidence and prevalence of cardio circulatory disorders [9,10].

The anti-atherosclerotic mechanisms, anti-thrombotic and preventing the formation of atheromatous plaques is attributed to the consumption of foods rich in polyunsaturated fatty acids. The participation of these, it is important not only in processes immunostimulants, but has also been demonstrated in the prevention of chronic degenerative diseases in general, including cancro [11-13]. The ω-6 family is represented mainly by linoleic acid, found in abundance in oil plants. The ω-3 family comprises α-linolenic acid, which is found in some vegetable oils derived from nuts, coconut, flax, rape and soya, and are abundant in marine fish [14]. Vitamin E is a minor compound present in vegetables oils. According to Freitas &Naves [15], this vitamin is part of the defense system of the organism, acting as an antioxidant, through inhibition of lipid oxidation and protection against oxidative stress. The antioxidant capacity is mainly because vitamin E donates its phenolic hydrogens to free radicals (Figure 1) and thus prevents lipid oxidation. The vitamin E molecule has two distinct structures: a chromanol ring with hydrophilic character and a hydrophobic chain consisting of hydrocarbons, which is anchored on the lipid membrane [16].

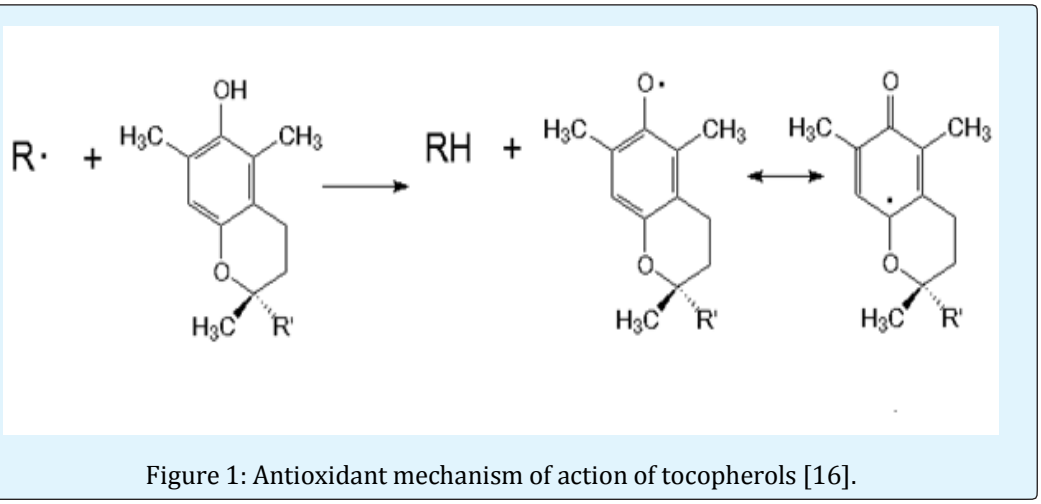

Figure 1: Antioxidant mechanism of action of tocopherols [16].

The tocopherols are present in various sources of vegetable oils such as corn and wheat, and oleaginous fruits, particularly, coconut, almonds, walnuts and some species of palm trees [17]. α-Tocopherol is the most abundant form of tocopherol and most biologically active in nature, but the most labile, rapidly degrade when subjected to thermal processes [18,19]. According to the botanical classification, oilseeds are classified into true nuts and edible seeds. True nuts are dry fruits, thick and often contain spines that cover their seed; the most popular are pecans, cashews, pistachios, hazelnuts, macadamias, walnuts and chestnuts [20,21].

The edible seeds include nuts from baru nuts (Dipteryx *alata* Vog), which is a woody leguminous nut that is native to the Brazilian Cerrado [22,23]. The baru (Dipteryx *alata* Vog), is a fruit of baruzeiro, a tree of the leguminosae family, which reaches approximately 30 m height and 70 cm diameter. The baruzeiro presents intense fruiting in adulthood, producing the drupe fruit, slightly flattened

and brown with the ovoid-shaped seed [9, 24, 25]. The bright color of the peel ranges from a yellowish-brown or reddish to dark tones [24]. Baru nuts possess micro- and macronutrients, levels of tannins, phytic acid, gallic acid, catechin, ferulic acid, epicatechin, p-coumaric, ellagic acid, caffeic and p-hydroxybenzoic, phytosterols, tocopherols and fatty acids with a predominance of 81% of unsaturated fatty acids (oleic and linoleic fatty acids) [9]. A study of *in vivo* tests showed that the reduction of oxidative stress induced by iron and the protection of biological systems, evaluated in rats supplemented with almonds Baru, it was mediated by antioxidant compounds present in these almonds, together with the recognized nutritional potential [9,11,26]. Despite its nutritional potential and the presence of recently bioactive compounds identified in its almonds, the baruzeiro is threatened with extinction because of the Cerrado deforestation and rapid agricultural development that has taken place in the region. In addition to having attractive sensory characteristics such as color, taste and a very distinctive aroma and intense, this native fruit of the Cerrado has a high nutritional value, which has not been fully studied and explored [9]. This study aimed to identify the content of the composition of fatty acids and tocopherols in nuts baru. (Dipteryx *alata* Vog.), with and without peel, and evaluate the effect of roasting process on their antioxidant potential.

Materials and Methods

Plant Materials

Baru nuts were obtained from a Brazilian local market from three regions of the Cerrado (MT, MG and GO). The nuts were selected, discarding the unsuitable ones. The selected nuts were homogenized and distributed randomly into two groups: raw nuts with peels and raw nuts without peels (manually removed). Half of the nuts from both groups were roasted by spreading the nuts on trays which were placed into a dry oven at 150°C for 45 min. After roasting, the baru nuts were ground, packed in colorless plastic bags. Analyses were performed in triplicate, and the results were expressed on a dry basis.

Chemicals

The standards of α-, γ-and δ-tocopherols were obtained from Sigma Aldrich (Steinheim, Germany) with 90-99% purity. All solvents used as the mobile phases were of high purity (HPLC grade) and were filtered using a 0.45 mM PTFE membrane from Millipore (Billencia, USA). For all other analyses and extractions, p.a. grade reagents were used.

Physico-chemical determinations

The physico-chemical analyses were performed according to AOAC [27]. The pH was determined by potentiometry at 20°C. The total acidity was determined by a titration with 0.1 N NaOH and it was expressed as % oleic acid. The moisture was determined gravimetrically by drying at 105°C to constant weight, and the ash content was determined by gravimetric analysis after incineration of the sample in an oven at 550°C. The lipid content was determined by a Soxhlet extraction with hexane. The protein content was determined in a Micro-Kjedahl system using the conversion factor of 6.25 for nitrogen, and the carbohydrate content was determined by difference (Brazil, 2003). The determination of the total caloric content was performed as established by the Resolution of the ANVISA [28].

Determination of Tocopherols

For Tocopherols extraction it was used the method described by Rodriguez-Amaya [29], with some modifications. Twenty grams of each sample and 2 g of celite was added to 20 mL of cold acetone, and the mixture was shaken for 10 minutes. The material was filtered in a Buchner funnel with filter paper, washing the sample with acetone until the extract was colorless. The filtrate was transferred to a separatory funnel to which 30 mL of petroleum ether and 30 mL of distilled water were added. The lower phase was discarded, and then, distilled water was added; this procedure was repeated four times to achieve total removal of the acetone. The upper phase was transferred to a 100-mL volumetric flask and filled to volume with petroleum ether. The extract was transferred to Eppendorf vails and centrifuged at 9000 rpm for 6 minutes; then, 10 μL of the supernatant was used for analysis. The analysis was performed by high-performance liquid chromatography in a Shimadzu HPLC system. The HPLC was equipped with a fluorescence detector using a wavelength of 290 nm for excitation and 330 nm for emission. The separation was performed using a gradient elution with methanol (A), acetonitrile (B) and isopropanol (C) as the mobile phase (Table 1), following a method adapted from Zambiazi [30]. For the identification and quantification of α-tocopherol, δ-tocopherol and γ-tocopherol were used standard curves with the corresponding chromatographic standards. The quantification of β-tocopherol was based on the calibration curve of δ-tocopherol because these two compounds were not separated in the chromatographic

process. The results were expressed in mg of compound per 100 g of nuts (dry weight), and the total tocopherol content was determined by summing the individual tocopherols contents.

Time (minutes)	Solvents*		
	Solvent A (%)	Solvent B (%)	Solvent C (%)
0	40	50	10
10	65	30	5
12	40	50	10
15	40	50	10

Table 1: Tochoferols content or baru nuts whit and without peels, before and after the roasting process.
*Solvent A: Methanol; *Solvent B: Acetonitrile; *Solvent C: Isopropanol

Fatty acid profile

The fatty acid profile was determined by gas chromatography following the esterification of the fatty acids using the derivatizing technique described by Zambiazi [30]. The profile was used as a standard, a mixture of methyl esters containing the acids caproic, caprylic, capric, caproleico, lauric, dodecenoic, myristic, myristoleic, palmitic, palmitoleic, margaric, heptadecenoic, stearic, oleic, linoleic, linolenic, arachidic, gadoleic, eicosadienoic, eicosatrienoic, eicosatetraenoic, behenic, erucic, docosadienoic, docosahexaenoic, docosatrienoic, tetracosenoic, lignoceric and nervonic acid, all purchased from Sigma Chemicals Co. (St. Louis, USA).

The fatty acids were identified by comparison with retention times of standards, and the results were expressed as a relative percentage. Analyses were performed in a gas chromatograph GC Perkin-Elmer (Clarus500) connected to an FID detector with a capillary column (Carbowax 20M) 30m x 0.25 mm in size, coated with 0.25 mm film PEG (Polyethylene Glycol), and an automatic injector with a 5µL capacity syringe. The temperature gradient followed the methodology described by Zambiazi with some modifications. The initial column temperature was 90°C, which was held for 1 minute and then increased to 160 ^{0}C at a rate of 12°C min-1; after holding at this temperature for 3.5 min, the temperature was increased to 190°C at a rate of 1.2°C^{-1} min until 230°C was reached. The temperature was then increased at a rate of 15°C min-1, where it was maintained for 15 minutes. The injector and detector were maintained at 230°C and 250°C, respectively. Nitrogen was used as the carrier gas at a flow of 1.5 mL/m^{-1}. Data were obtained by normalizing the area, which was calculated by the area percentage relative of the fatty acids identified.

Statistical Analysis

All analytical tests were performed in triplicate. Comparisons among the baru nuts from each treatment were performed by ANOVA with a Bonferroni correction using SPSS, version 17.0. Results with $p<0.05$ were considered significantly different.

Results and Discussion

Physico-Chemical Analysis

There was a significant difference ($p < 0.05$) when comparing the moisture content in baru nuts for the four treatments. The loss of moisture of raw nuts with peels in relation to roasted nuts with peels was 41.2%, while losses of moisture between the raw nut without peels compared with the roasted nuts without peels was 39.63% (Table 2).

Analysis[1,2]	Raw With peels	Raw Without peels	Roasted With peels	Roasted Without peels
Moisture Content (g/100g)	9.9±1.9^{a}	10.6±0.8^{a}	5.8±0.8^{b}	6.4±0.9^{b}
Ash (g/100g)	3.1±0.2^{a}	2.9±0.5^{a}	2.9±0.3^{a}	2.6±0.3^{a}
Lipids (g/100g)	48.6±1.3^{a}	43.8±0.7^{b}	46.4±0.5^{a}	40.2±0.8^{b}
Proteins (%N.6,25) (g/100g)	25.2±1.5^{ab}	28.8±1.5^{a}	23.8±0.9^{b}	24.6±0.1^{b}
Carbohydrates[3](CHO)	23.1±3.0	24.5±2.7	26.9±1.5	32.6±2.1
P^{H}	6.0±0.2^{a}	6.1±0.1^{a}	5.9±0.1^{a}	5.9±0.1^{a}
Total Acidity[4] % (Oleic acid)	0.92±0.2^{a}	0.8±0.1^{a}	1.21±0.0^{b}	1.10±0.1^{b}
TCC[5](K.cal/100g)	631	607	620	591

Table 2: Physical and chemical composition of the baru nuts (Dipteryx alata Vog) before and after the roasting process, with data expressed on a dry basis.

[1]Data are expressed as mean±SD weight of Almond. N=3. Except for CHO and TCC;
[2]Values followed by lowercase let us equal the same line do not differ ($p<0.05$) by ANOVA with Bonferroni correction;
[3]CHO-Total carbohydrates were estimated by differece;
[4]Values Acidity analysed Baru nuts oil;
[5]Total calories content (TCC) = (4 k.cal/g protein) + (4 k.cal/ g carbohydrate) + (9k.cal/g lipid) = k.cal/100g.

Several authors have reported a moisture content in raw baru nuts lower than those found in this study, as follows: Vera et al. [31] in baru nuts from the region of Goias (2.93 to 5.07 g.100 g-1), Martins [32] in baru nuts derived from the Cerrado (8.90g.100 g^{-1}), Takemoto et al. [33] in baru nuts from the region of Pirenópolis (6.1 g.100 g^{-1}), Filgueiras & Silva [34] in baru nuts from Bela Vista de Goias, Goiania and Paraúna (mean moisture content of 6.45 g.100 g^{-1}), and Vallilo et al. [35] in baru nuts from São Paulo (5.80 g.100 g^{-1}). However, Melhem [36] analyzed baru nuts from the region of Minas Gerais and reported a moisture content of approximately 10.7 g.100 g^{-1}.

The variation in water loss from roasted grains, originally contained in the raw grains, relates to the application of the thermal processing, where the release of water occurs by heating, and because of pyrolysis reactions, the water loss is associated with the subsequent volatilization of compounds. Another determining factor is the origin of the raw materials, which were obtained from different localities. These data reinforce the assertion that factors such as genetic variations, climatic and geographical conditions, post-harvest, handling and storage can influence the moisture content. Regarding the ash content, it is emphasized that the baru nuts showed no significant difference between treatments. The reported values indicate an important intake mineral in the nuts, corroborating data from Sgarbieri & Togashi [37] and Freitas [38] who reported values of 2.8 g.100 g^{-1} and 3.1 g.100 g^{-1}, respectively, in baru nuts derived from the Cerrado.

It was observed that nuts with peels contained higher lipid content, indicating the presence of fat in the nut peels. With the roasting process, a significant decrease of the content of these compounds in the nuts with peels and in nuts without peels was observed. One factor that may have contributed to this decrease is the moisture content of the nuts. Fernandes & Silva [39] observed a similar behavior by analyzing raw and roasted nuts from Chinchá.

Lima et al. [40] reported a fat content in baru nuts of 41.0 g.100 g^{-1}, which was higher than that found in roasted nuts without peels evaluated in this study. However, the content reported by Martins [32], 35.8 g.100 g^{-1}, was lower than the values found in this study for all samples, independent of the thermal processing or the presence or absence of peels. The lipid content in raw baru nuts exceeds or is equal to those of cashew nuts (42.06 g.100 g^{-1}), peanuts (44.57 g.100 g^{-1}), pistachios (45.83 g.100 g^{-1}) and almonds (45.93 g.100 g-1) but showed lower values than those of pecans (62.14 g.100 g^{-1}), hazelnuts (63.18 g.100 g-1), Brazil nuts (64.94 g.100 g^{-1}), walnuts (65.07 g.100 g^{-1}) and macadamias (66.16 g.100 g^{-1}) [15].

The protein content in raw nuts without peels and roasted nuts without peels showed a significant difference, indicating that this macronutrient is predominantly found in the nut. Furthermore, it was observed that the roasting process influenced the protein losses. In raw baru and roasted nuts, the average protein content values reported in the literature range from 24.5 g.100 g^{-1} [32] to 29.6 g.100 g^{-1} [31, 35,41].

The protein content in baru nuts is higher than those reported by Togashi & Sgarbieri [41], 30 g.100 g^{-1}. In this study, regardless of the treatment used, baru nuts showed higher protein contents higher that that observed in nuts and seeds by Yang [42] and Venkatachalam & Sathe [43], who analyzed Pará-nuts (14 g.100 g^{-1}), Macadamias (8 g.100 g^{-1}), pinions (13 g.100 g^{-1}), pistachios (20 g.100 g^{-1}), walnuts (13g. 100 g^{-1}) and peanuts (22 g.100 g^{-1}).

The carbohydrate content was higher in roasted nuts without peels when compared with other treatments, most likely because of the difference between the lipid and protein contents; in these nuts, these contents were lower, therefore, determining an increase of the carbohydrate content.

It was observed that the pH values between samples of baru nuts did not present significant differences; the average remained at a pH of approximately 5.95 for all samples. Martins [32] conducted a physico-chemical analysis of various fruits of the Cerrado, including baru nuts, and reported pH values of 6.09, confirming the results of the present study. Melo et al. [44] evaluated raw

and roasted cashew nuts from Mossoró-RN and also found a similar pH of approximately 6.20 in raw nuts and 6.14 in roasted nuts.

For the evaluation of the acidity of the oil extracted from the baru nut, there was a significant increase ($p < 0.05$) in acidity between the samples after the roasting process. Acidity is one of parameters for evaluating the quality of oils and fats and indicates the occurrence of hydrolytic reactions [45-47]. These reactions occurred in the nuts during the roasting process, apparently in the same proportion in both nuts with and without peels [48].

Melo et al. [44] reported values of acidity in oleic acid in oil of raw and roasted chestnuts of 0.96 and 1.22%, respectively, confirming the results of this study. Baru nuts showed high protein and lipid contents, indicating that these nuts area great energy source. Studies by Czeder [47] with roasted baru nuts from three regions of the state of Goiás (532 kcal.100 g^{-1}), Takemoto et al. [33] with nuts originating from Pirenópolis (502 kcal.100 g^{-1}) and baru nuts originating from Sao Paulo (561 kcal.100 g^{-1}) showed energy contents lower than those observed in the nuts of the present study, regardless of the treatment to which they were subjected.

Tocopherol Content

The typical chromatogram of the separation of tocopherols obtained in the analysis of oils from baru nuts (by liquid chromatography on a reverse phase column) shows two well-defined peaks identified by external standards, (β+γ-) and α-tocopherol (Figure 2)

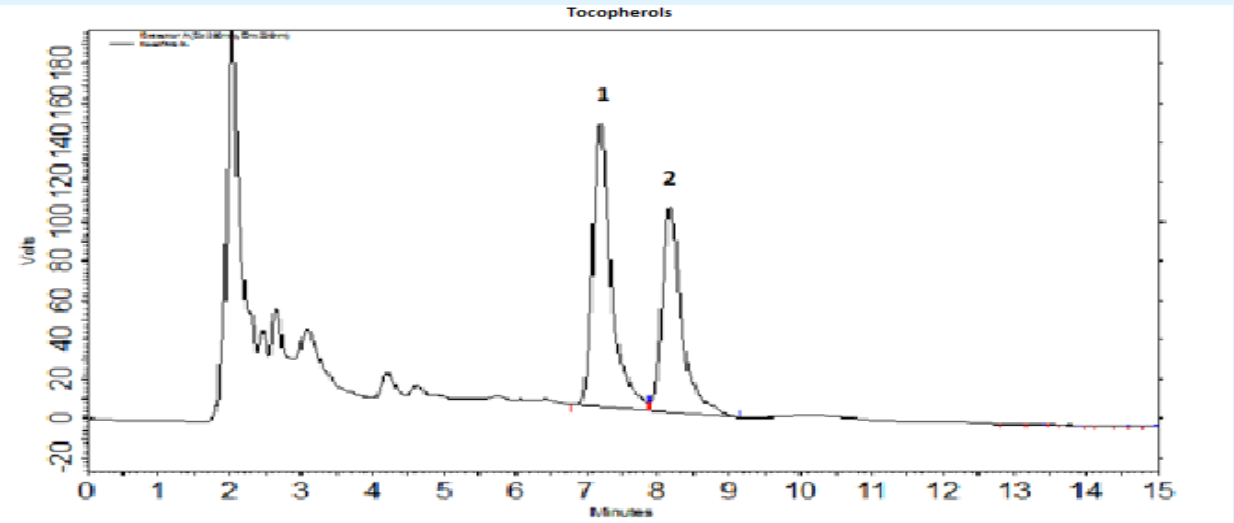

Figure 2: Typical chromatogram of tocopherols contained in almond oil baru (Dipteryx alata Vog). HPLC with a reversed phase column and a fluorescence detector of 290 nm excitation and 330 nm emission; Gradient with acetonitrile: methanol: isopropanol 50:40:10 v/ v /v, flow 1.0 mL / min.- (β + γ)-tocopherol, (2) - α-tocopherol.

Table 3 shows the tocopherol content of baru nuts with and without peels, before and after the roasting process. The total tocopherol content showed a variation between nuts, dependent on the presence or absence of a peel, indicating that the tocopherols are present in higher quantities in nuts without peels. Therefore, it can be inferred that the peels contain a low proportion of tocopherols, which is the opposite of what was found for lipid content. (γ+ β)-tocopherols were the major compounds present in the nuts from all treatments.

BARU NUTS	TOCOPHEROLS (mg. 100g-1)			
	α-tocopherol	δ-tocopherol	(γ+β) tocopherol	*Σ (α, γ+β, δ) tocopherols
Raw with peels	0.7±0.1 [a]	ND*	1.5±0.1 [a]	2.1±0.1 [b]
Raw without peels	0.9±0.1 [a]	ND	1.8±0.0 [a]	2.7± 0.1 [a]

Roasted with peels	0.5±0.1 [a]	ND	1.4±0.2[a]	2.0±0.2[b]
Roasted without peels	0.8±0.2 [a]	ND	1.7±0.2 [a]	2.5±0.2[a, b]

Table 3: Tochoferols content or baru nuts whit and without peels, before and after the roasting process.
*Values followed by the same lowercase letter in the same row do not differ (p<0.05) by ANOVA whit correction of Bonferroni; **ND: Undetected

However, the average of the total tocopherol content (α+(β+ γ)) obtained from the four samples did not show a significant difference (p <0.05), indicating that the roasting process did not affect the total tocopherol content in the samples. These data indicate that the tocopherols were stable when subjected to the roasting process under the conditions of this study. The stability of oleaginous products when subject to heat depends on several factors, including the variety, the degree of maturation and the care used in their production. Furthermore, factors such as the fatty acid composition and the presence of compounds with high antioxidant activity, mainly polyphenols and tocopherols [46,47], also influence the resistance to the thermal process.

The literature cites the presence of α-tocopherol in various products with high fat contents, such as cashew nuts (3.60 mg.100 g^{-1}) and nuts (1.21 mg.100 g^{-1}), all containing higher amounts than that found in the baru nuts. However, the β-tocopherol contents found in seed described by Freitas & Naves [15] for kernels (0.83 mg/100 g), Brazil nuts (0.10 mg.100 g-1) and pistachios (0.32 mg.100 g^{-1}) are lower than the values obtained for (β+γ)-tocopherol found in baru nuts in the present study, regardless of the treatment used. Kornsteiner, Karl-Heinz & Elmadfa [48] studied ten types of nuts and found that the total tocopherol content ranged from undetectable in the extract of macadamia oil to 31.4 mg/100 g extract in the oil from hazelnuts, showing great variability in the content of this compound in relation to the nut type.

Fatty acid profile

Table 4 shows data of the fatty acid profile of the oil extracted from raw and roasted baru nuts, with and without peels. The oil extracted from baru nuts presented high levels of unsaturated fatty acids with a predominance of oleic and linoleic acids. Oleic acid (C18: 1 ω-^{9}) and linoleic acid (C18: 2, ω-^{6}) are present in the oils from nuts of the four treatments evaluated. However, linolenic acid (C18: 3) and tetracosenoic acid (C24: 1) were identified in the oil extracted from baru nuts with peels, regardless whether they were subjected to heat treatment. Therefore, it can be inferred that these unsaturated fatty acids form only a part of the lipid profile of the peels involving the nuts. It was observed that the roasting process did not significantly alter the profile of the fatty acids, especially the unsaturated fatty acids (C18: 1, C18: 2 and C18: 3), independently of the presence of the peel.

TREATMENTS (Baru nuts)*				
	Raw with peels	**Raw without peels**	**Roasted with peels**	**Roasted without peels**
Saturated	**(%)**			
C 16:0	7.58±0.1[a]	6.57±0.0[b]	7.56±0.1[a]	6.61±0.2 [b]
C 18:0	4.33±0.1[b]	4.89±0.2[a]	4.34±0.02[b]	4.84±0.2[a]
C 20:0	1.27±0.3[c]	1.52±0. 2[a]	1.24± 0.1[c]	1.48 ±0.2[b]
C 22:0	2.59±0.0[a]	2.26±0.1[d]	2.51±0.0[b]	2.34±0.1[c]
C 24:0	2.99±0.1[b]	3.38±0.3[a]	2.96±0.1[b]	3.31±0.1[a]
Total	**18.76**	**18.62**	**18.61**	**18.58**
Unsaturated	**(%)**			
C 18:1	44.26±0.1[b]	47.34±0.1[a]	44.58±0.02[b]	47.40±0,1[a]
C 18:2	31.12±0.1[b]	31.34±0.0[a]	30.92±0.02[c]	31.42±0.1[a]
C 18:3	2.18±0.0[a]	ND**	2.19±0.001[a]	ND
C 20:1	2.54±0.1[c]	2.68±0.1[a]	2.55±0.0[c]	2.60±0.0[b]
C 24:1	1.13±0.0[b]	ND	1.14±0.0[a]	ND
Total	**81.23**	**81.36**	**81.38**	**81.42**

Table 4: Fatty acids profile of the oil extracted from baru nuts, with and without peels raw and roasted.
*Data are expressed as mean±SD, n = 3; Means with different letters on the same line are significantly different, p <0.05;

**ND-Not Detected;
***C 16:0 Palmitic acid; C 18:0 Stearic acid; C 18:1 Oleic acid; C 18:2 Linoleic acid; C 18:3 Linolenic acid; C 20:0 Arachidic acid; C 20: 1 Elaidic acid; C 22:0 Behenic acid ; C 24:0 Lignoceric acid, C 24:1 Tetracosenóic acid.

The oleic acid (monounsaturated) confers greater resistance to degradation or thermal action in edible oils. In addition, free fatty acids oxidize at a higher speed than its esters; therefore, they are considered as pro-oxidants. However, when they are present in small quantities, does not significantly act on oxidative stability. The climate in the Cerrado region is characterized by warm and pleasant winters [49]. The high number of hours of exposure light in plants is associated with the highest content of antioxidant contained in them [50,51], which are a defense against free radicals produced during photosynthesis. Therefore, it is correct to say that the oil obtained from plants from the Cerrado region, may have high polyphenol content and consequently the protection against self-oxidation, photo-oxidation and stress. Boskou et al [52] report a positive correlation between the olive oil stability and individual or total content of phenolic compounds, corroborating data from this study in baru nuts (Dipteryx *alata* Vog.).

Aparicio et al [53] demonstrated that the strength and stability of vegetable oils depend on its fatty acid composition and content of tocopherols. These factors may explain the stability Baru nuts oil before the roasting process and possibly its increased resistance to oxidative effects when subjected to heat. The higher content of oleic acid in its formation is related to the content of tocopherols and may be responsible for this oil stability. In all almonds, regardless of the treatment it has undergone, the oleic acid content is higher than that of sunflower oil (25.15%), Brown-nut (28. 92%), and peanut (16.7 %) and lower than in olive oil (74%) in pistachio nuts (55.98%) in macadamia (58.51%) and pecan (53.65%). These positive combination of monounsaturated fatty acids and polyunsaturated potentiate the reduction of total cholesterol and low density lipoprotein (*low-density lipoprotein*-LDL) without reducing the high-density lipoprotein (*high-density lipoproteins*-HDL), and presents protective action cardiovascular important, as a factor in preventing the risk of coronary artery disease [11]. Togashi [54] citing Adams et al [55] of unsaturated fatty acids in proportions Baru nuts (80%), where the major component was oleic acid (44.53%), followed by linoleic acid (31.70%) of palmitic acid (7.16%) and stearic acid (5.33%). Takemoto et al [33] also reported in their studies, unsaturated fatty acid fractions of 81.20% in baru nuts, corroborating our work.

Vallilo [35] considers the Baru nut oil has a high degree of unsaturation and relatively high content of linoleic acid, thus suggesting their use in place of soybean oil in foods. Among the polyunsaturated fatty acids linoleic acid (C18: 2 ω-6) is notable for their importance to the organism, since it is a precursor of arachidonic acid (C20: 4), which is essential for the development of organisms and young people. Among the omega-3 fatty acids, linolenic acid (C18: 3), which is the most important of which, in the elongation and desaturation, begin to generate eicosapentaenoic acid (EPA, C20: 5) and docosahexaenoic acid (DHA, C22 : 6) acids with significant beneficial effects on disease prevention and protection of biological systems. The essential fatty acids, linoleic (C18: 2) and linolenic (C18: 3) ω-6 and ω-3 respectively show effects on various physiological processes and act in the prevention and treatment of cardiovascular disease, reducing atherosclerotic plaque, thrombosis, and therefore, the risk of stroke (CVA). Studies also show a beneficial effect in cases of high blood pressure (hypertension), diabetes, arthritis, inflammation and cancro [9]. Furthermore, the studies show that the acid linoleic acid is essential for the development of nerve cells and glial cells positively interfering in neuronal synapses [9,49]. The constitution mainly oleic and linoleic acids, and the presence of tocopherols and other bioactive compounds, give the baru nuts (Dipteryx *alata* Vog) the status of a nutritious food of high quality and an alternative source to be stimulated in public health. The introduction of diets baru to needy communities, favors the reduction of various diseases and also a possible use in the pharmaceutical industry (formulation of nutraceutical compounds) and the edible oil industry.

Conclusions

Oil from baru nuts contains a high proportion of unsaturated fatty acids, including mainly oleic and linoleic acid. The roasting process did not significantly altered the fatty acid composition and content of tocopherols in baru nuts (Dipteryx alata Vog), processed with the presence or absence of peels, keeping the properties of the raw material under study.

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