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Nutritional Value and Sensorial Attributes of Tucum Paste

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Authors' contributions

This work was carried out in collaboration between all authors. Author JSA designed the study and wrote the manuscript. Author NSF performed the physicochemical and sensorial analysis, and managed literature searches. Author SANF performed the statistical analysis. All authors read and approved the final manuscript.

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ABSTRACT

Aims: The objective was to evaluate different formulations of tucum (*Astrocaryum aculeatum*) paste about the nutritional value, sensory characteristics and acceptability.
Study Design: Physicochemical analysis; sensorial evaluation; analysis of variance and Tukey test ($p \leq 0.05$).
Place and Duration of Study: The ripe fruits of tucum (under the condition of mixed progeny) were purchased in markets in Manaus, Amazonas, Brazil. The experiment was carried out in the Department of Food Technology of the National Institute of Amazonian Research - INPA between

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March 2013 and June 2013.
Methodology: The sliced tucum (SP) was triturated (in a blender) with water (40% w/v) and the tucum paste (TP) was obtained. In the formulations were used tucum paste (TP), milk cream (MC) and curd cheese (CC) with quantities of 1:0:0, 1:1:1, and 2:1:1, respectively, and in half these formulations, dehydrated seasonings (salt, garlic, parsley and oregano) were added. Physicochemical (proximate composition, pH, acidity and total carotenoids) and sensory analyzes (preference test, characteristic profile, acceptability, and also purchase intention) were performed.
Results: Sliced tucum (SP) presented lipids (37.4%), carbohydrate (12.1%), dietary fiber (4.2%), protein (3.7%) and total carotenoids (7.4 mg%) as the principal constituents. The addition of dairy ingredients with TP decreased carbohydrate and increased lipid, protein and calories. The results of the characteristic profile and acceptability were not significantly influenced by seasonings. The pastes had high scores for appearance, color, consistency, taste and smell. The paste with equal quantities (1:1:1) of TP, MC and CC and seasoned was preferred, showed the highest scores for characteristic profile, reached 85% of acceptability, and thus, this formulation was chosen and suggested to tucum paste preparation.
Conclusion: From a nutritional standpoint, the lipids were the major constituents. The presence of seasoning and the use of equal amounts of tucum, milk cream and curd cheese was the best formulation and received the highest scores for the characteristic profile and acceptability. Thus, this formulation was chosen to the tucum paste.

Keywords: Astrocaryum aculeatum; paste formulation; dairy ingredients; seasonings; physicochemical analysis; sensorial evaluation.

1. INTRODUCTION

Foods such as paste and pate are obtained by mixing various ingredients and seasonings for a combination of flavors. The preparing paste is easy and needs no cooking. Usually the pastes are made at home, restaurants and snack bars, but there are those that are industrialized and commercialized in the supermarkets.

The main function of these pasty foods (paste, sauce and also jam) with salty, bittersweet or sweet taste is to add flavor in the food in which it is added. At the moment of use, the pastes are combined with starchy foods (breads, toast, biscuits, “tapioca” and crackers) and usually consumed at breakfast, brunch, and snack, and even as appetizer to the main meal. Their portions are small, but, depending on their ingredients, pastes can contribute significantly to the supply of nutrients from the diet.

The salty and bittersweet flavors occupy, respectively, the first and second position in consumer preference. World's best known pastes are peanut, garlic, sesame, chickpeas and eggplant, but there are also those that are considered ethnic, which are obtained from local ingredients and consumed regionally. Some studies were done with pastes of garlic [1], of cashew nuts (*Anacardium ocidentale* L.) with salt and sugar [2], cashew nuts with chocolate and cinnamon [3], pequi (*Caryocar brasiliense*) [4] and also tucum (*Astrocaryum aculeatum* G. Mey) with hydrogenated fat, salt and sugar [5].

In the Amazon and other tropical regions there are several native palms (Arecaceae) which have been researched for its economic importance in the world market. Among these palm trees, are of the genus *Astrocaryum* commonly found in tropical ecosystems of Central America (in forests near the Pacific and Atlantic) and South America [6]. *Astrocaryum chambira* (western Amazon), *Astrocaryum vulgare* (eastern Amazon) and *Astrocaryum aculeatum* (central Amazon) are the three species of Amazonian *Astrocaryum* that have economic potential because of the different forms of exploitation [7,8].

The tucum (*Astrocaryum aculeatum* G. Mey) occurs in upland regions of Amazon from Bolivia (northern region), Colombia, Venezuela, Guyana, Suriname and Brazil. In Brazil the tucum occurs throughout the western Amazon, and even on the west side of the states of Pará, Mato Grosso and Rondônia [9]. The tucum developed an important market with consolidated and growing demand in Central Amazonian, especially in Manaus [10,8,11].

Tucum form a fruit that has a hard epicarp and a firm-oily mesocarp (pulp). This pulp is rich in lipids (about 32%), dietary fiber and carotenoids and has an orange color. The sliced pulp fruit in

fresh form are consumed by populations of the Amazon region and widely used to prepare sandwiches. Uses also, a more restricted form, it is employed in preparing ice cream and sauces [12,13,14], however, the researches concerning the uses of tucum in food-ready for consumption are few [5].

Although meet market demands by easily and convenience, the tucum paste is a new product and have a few studies regarding formulations, nutritional value and acceptance. The objective of this study was to test different formulations for tucum paste and assess the nutritional value, sensory characteristics and acceptability.

2. MATERIALS AND METHODS

2.1 Obtaining Sliced Pulp

The ripe fruits of tucum (under the condition of mixed progeny) were purchased in markets in Manaus, Amazonas, Brazil. The experiment was carried out in the Department of Food Technology of the National Institute of Amazonian Research - INPA. The fruits were selected (damaged fruits were discarded), washed (with water, detergent and brush), sanitized by immersion for 15 minutes in a 0.01% sodium hypochlorite solution and rinsed in tap water. Manually (with stainless steel knife) the fruits were husked and the sliced pulp (SP) was obtained. A portion of the SP was used for physicochemical analysis and the other for tucum paste preparation.

2.2 Pastes Preparation

In sliced pulp (SP), water was added (40% w/v) and triturating was carried out in a blender until homogeneous and creamy paste (TP) is obtained. In pastes formulations were used: tucum paste (TP), milk cream (MC), curd cheese (CC) and dehydrated seasonings (salt, garlic, parsley and oregano). The ingredients and their quantities are shown in Table 1. The homogenization was carried out in a blender; the pastes were kept for 2 hours in the refrigerator (7°C) and then used in the sensory analysis.

2.3 Sensory Analysis

Sensory analysis (preference test, characteristics profile, acceptability and purchase intention) were performed by a group of 50 untrained panelists. The group was formed by staff and postgraduate students of the INPA. The identity of the panelists was preserved, the Term of Consent was signed, and detailed rules (procedures for food preparation and sensory analysis) were observed. The research project was previously approved by Research Ethics Committee of the Ministry of Health of Brazil.

Samples (±10 g) of paste, water and toast were served in disposable glasses. The pastes were tested with toast. After the preference test, the characteristic profile was evaluated using a six-score scale (very bad, bad, indifferent, good, very good and excellent) from 1 (lowest score) to 6 (highest score) for the following attributes: appearance, color, consistence, smell and taste. The Hedonic scale from 1 ("dislike very much") to 7 ("like very much") also was used and the acceptability index (AI) was calculated by the following formula: *AI = [(medium score x 100)/maximum score].* Two questions were used to intention to buy: if reviewer purchase, or not the product if it would be available in the market. The results (preference test, acceptability and purchase intention) were presented as percentage [15].

Table 1. Ingredients and their quantities used in the formulations of tucum pastes

Formulations	Principal ingredients (g)			Seasonings (mg)
	Tucum paste	Milk cream	Curd cheese	
P1u (1:0:0)	510	0	0	0
P2s (1:0:0)	510	0	0	770
P3u (2:1:1)	255	127.5	127.5	0
P4s (2:1:1)	255	127.5	127.5	770
P5u (1:1:1)	170	170	170	0
P6s (1:1:1)	170	170	170	770

Tucum paste = Paste obtained from sliced tucum, added with water (40% w/v) and triturated in blender; Dehydrated seasonings = salt (500 mg), garlic (20 mg), parsley (50 mg) and oregano (200 mg); Formulations 1:0:0, 1:1:1 and 2:1:1 = tucum paste, milk cream and curd cheese proportions; u = unseasoned; s = seasoned

2.4 Physicochemical Analyzes

Physicochemical analyzes and proximate composition of sliced pulp (SP) were performed (in triplicate) following the methodology described by Ranganna [16]. Moisture was determined by drying in an oven at 105°C (until constant weight). The lipids were extracted with hexane during six hours in a Soxhlet apparatus. Nitrogen content (obtained by micro-Kjeldahl method) was converted into protein using a factor 5.75. The ash content was determined (after carbonization at Bunsen burner) by incineration in an oven for four hours at 550ºC. The dietary fiber was determined using samples (±1 g) previously dried and defatted, nylon-polyethylene bags (1 x 1 cm) and Tecnal® (model TE-149) equipment following the manufacturer's protocol. The 0.255 N H_2SO_4 and 0.313 N NaOH solutions were used for acid and alkaline hydrolysis (at 100°C for 30 minutes), respectively. The bags containing the non-hydrolyzed residue was washed with hexane and dried in an oven (with forced air) at 65°C until constant weight.

The carbohydrates were estimated by difference. The energetic value was calculated using the Atwater method and the following conversion factors, 4 kcal/g, 9 kcal/g, and 4 kcal/g to proteins, lipids and carbohydrates, respectively [16]. For acidity and pH measurement, samples with 5 g were diluted with 20 mL of distilled water and the pH was read at pHmeter (LABMETER, mod. pHS, 3B). The acidity was titrated against 0.01 M NaOH solution (phenolphthalein as indicator), dilution factor was used and the results were expressed as oleic acid percentage. Total carotenoids were measured according to the procedure described by Higby [17] and absorbance was read at 450 nm in spectrophotometer.

2.5 Nutritional Value of Tucum Paste

The nutritional value was estimated based on the chemical composition of the ingredients (except seasonings) and their quantities used in each formulation. The chemical composition of dairy ingredients and sliced tucum (ST) were obtained from Brazilian Table of Food Composition [18] and laboratory analysis, respectively. Dilution factor (0.6) to convert the chemical composition from SP to TP (tucum with 40% of water) was utilized. The caloric value was calculated using the Atwater method and the following conversion factors, 4 kcal/g, 9 kcal/g, and 4 kcal/g to proteins, lipids and carbohydrates, respectively.

2.6 Experimental Design and Data Analysis

The statistical design was a completely randomized factorial system with three levels for the composition paste and two levels of seasonings. The multiple comparisons of average of each treatment and Tukey test ($p \leq 0.05$) were performed. The software STATISTICA version 5.0 (StatSoft, Tulsa OK) was used.

3. RESULTS AND DISCUSSION

3.1 Chemical Composition of Ingredients

Dates of chemical composition of sliced pulp (SP) are showed in the Table 2. The tucum is an oleaginous and not juicy fruit, because nearly equivalent contents were obtained for moisture and lipids. This low moisture/lipid ratio is a characteristic commonly shown by palm fruits, such as patauá (*Oenocarpus bataua*) [19], buriti (*Mauritia flexuosa*) [20] (oleaginous fruits) and it is desirable for the product (paste) of this study, since it contributed to the unctuosity, and also for the stability of the phases, especially when the TP was homogenized with dairy ingredients. From a nutritional standpoint, the lipids contributed substantially to energy intake, supplying 80% of calories from sliced pulp (SP), while carbohydrates contributed with 12%, and proteins only 4%. By being an oleaginous fruit, the amount of protein is low and was estimated from the total nitrogen (protein and no-protein). Besides calories, the lipids are also responsible for containing and facilitate the absorption of carotenoids. The carotenoids are responsible for an attractive and intense orange color of tucum and some of them (α and β) by the intake of pro-vitamin A, since, 62.65 mg g^{-1} of beta carotene was found in tucum pulp [21].

The high dietary fiber content deserves to be highlighted, because together with the carotenoids, contributes to the functionality of tucum and products obtained there from. The near neutral pH and low acidity showed that the tucum is not an acid fruit. The low acidity combined with high levels of lipids and carbohydrates is responsible for the slightly sweet taste.

Traditional and widely, sliced tucum and cheese are used in sandwiches, and thus, milk cream and the curd cheese were used as ingredients in the formulation of pastes. Curd cheese or "Requeijão" is a type of smooth and spreadable cheese, manufactured with heavy cream, reconstituted milk powder, whey, sodium caseinate, water, salt, calcium chloride, lactic ferments, protease enzyme, stabilizer (sodium polyphosphate and sodium diphosphate), and preservative (potassium sorbate). Milk cream is manufactured with standardized milk cream, skimmed milk powder and stabilizers, such as xanthan, jataí, carrageenan and guar gum, disodium phosphate and sodium citrate. Thus, calories, lipids and proteins of these ingredients have been incorporated into the milk cream and curd cheese, which in turn, were incorporated into the tucum pastes. The data used to estimate the nutritional and caloric value of the pastes were: 1.5% (milk cream) and 9.6% (curd cheese) of proteins; 22.5% (milk cream) and 23.4% (curd cheese) of lipids; 4.4% (milk cream) and 2.4% (curd cheese) of carbohydrates (adapted from TACO and package labels of the ingredients) [18].

3.2 Nutritional and Energetic Value of Tucum Paste

Dates of chemical composition and energetic value of tucum paste are showed in the Table 3. Lipids were the main nutrient. The tucum contributed to dietary fiber and dairy ingredients were the main sources of lipids, proteins and calories. When TP/dairy ingredients (milk cream + curd cheese) ratio decreased (1:1 to 1:2) the calories increased (186.28 to 204.99 Kcal). The dairy ingredients and tucum combination, decreased carbohydrates and increased lipids and proteins, and consequently, influenced the nutritional and caloric value. The contribution of each chemical constituent and ingredient for calories intake is shown in Table 4. Lipids have played an important role in the energy intake, with 84 to 85% of contribution. The contribution of carbohydrates was three times greater than of proteins in P1u and P2s (without dairy ingredients). Proteins contribution equated with carbohydrates in pastes with dairy ingredients (P5u and P6s). Regarding the ingredients, curd cheese was more caloric and pastes (P5u and P6s) with equal amounts (1:1:1) only about ⅓ of the calories came from tucum. These results show that the inclusion of dairy ingredients significantly increased caloric value of tucum pastes. The tucum [13] and the dairy ingredients [18] are very caloric foods and this combination produced a caloric paste. However, the amount to be used with other food (bread, toast, tapioca, biscuit cracker) is small, and thus can provide a desirable flavor and adequate intake.

An *in vivo* study was conducted in the treatment of diet-induced dyslipidemic in Wistar rats and rations with 60% (fruit pulp, commercial ration and casein, pellets and dried a stove at 70℃) of tucum (*Astrocaryum aculeatum*). No hypolipidemic effect was observed related to tucum ingestion, since animals presented high lipid concentrations [22]. In this work on tucum (*Astrocaryum aculeatum*) were quantified only the total lipids. Analysis of other tucum (*Astrocaryum vulgare*) showed that its composition has 29% saturated acids and only 1% polyunsaturated. Moniinsaturados acids represent 68%, and the principal is oleic acid, which constituted 67% of the chemical composition [23]. Taking into account high contents of saturated fatty acids in tucum, its consumption should be moderate, especially by individuals with previous history of metabolic disorders (obesity and/or hyperglycemia and/or hypertriglyceridemia).

3.3 Sensorial Attributes and Acceptability

The ingredients used in the formulation were chosen by sensory characteristics, and the likeness to cheese, which is traditionally used to prepare the sandwich with sliced tucum. The tucum has balance between the flavors without predominance of sweet or acid, and thus allows its combination with other ingredients with salty or sweetish taste. The lipids, carbohydrates and acidity contents were high, intermediate and low, respectively Table 2. Regionally, the sliced pulp is used along with sliced cheese (salty taste) and bread giving a sandwich, termed as "X-caboclinho", and also to stuffing “tapioca” (regional food made with cassava starch). Besides tucum and cheese, ripe banana (sliced and fried), with a sweet taste also is used, giving a salt-sweet taste.

The use of water with sliced tucum (SP) for the tucum paste (TP) was another necessary procedure (previously tested) and used in this research. The tucum has a thin layer of pulp with firm texture, adhered in the core and requires the knife to be obtained. Triturating (in a blender) with only the sliced pulp is not sufficient and the addition of water allowed the complete fragmentation and formation of a creamy and

Table 2. Chemical composition and energetic value of sliced tucum used in the paste processing

Constituents (fresh basis)	Average (*n=3*) and SD	CV (%)
Moisture (g 100g^{-1})	40.7±5.1	12.5
Lipids (g 100g^{-1})	37.4±2.7	7.2
Protein (g 100g^{-1})	3.7±0.1	1.5
Ash (g 100g^{-1})	1.9±0.2	13.5
Dietary fiber (g 100g^{-1})	4.2±0.1	0.6
Carbohydrates (g 100g^{-1})	12.1	18.6
Total carotenoids (mg 100g^{-1})	7.4±1.2	16.1
Acidity (% oleic acid)	0.6±0.1	1.9
pH	6.1	0.0
Energetic value (Kcal/g)	399.7	5.4

SD = Standard deviation; CV = Coefficient of variation

Table 3. Chemical composition and energetic value (fresh base) of tucum pastes

Pastes formulations	Chemical constituents (g 100 g^{-1})			Energetic value (Kcal/g)
	Lipids	Protein	Carbohydrates	
P1u (1:0:0)	22.4	2.2	7.3	239.6
P2s (1:0:0)	22.4	2.2	7.3	239.6
P3u (2:1:1)	22.7	3.9	5.3	241.1
P4s (2:1:1)	22.7	3.9	5.3	241.1
P5u (1:1:1)	22.8	4.4	4.7	241.6
P6s (1:1:1)	22.8	4.4	4.7	241.6

Formulations 1:0:0, 1:1:1 and 2:1:1 = tucum paste, milk cream and curd cheese proportions; u = unseasoned; s = seasoned

Table 4. Contribution of each ingredient and chemical constituent in the total calories supplied by pastes

Pastes	Contribution to caloric value (%)					
	Chemical constituents			Ingredients		
	Lipids	Carbohydrates	Proteins	TP	CC	MC
P1u (1:0:0)	84	12	4	100	nc	nc
P2s (1:0:0)	84	12	4	100	nc	nc
P3u (2:1:1)	85	9	6	50	27	23
P4s (2:1:1)	85	9	6	50	27	23
P5u (1:1:1)	85	8	7	33	36	31
P6s(1:1:1)	85	8	7	33	36	31

TP = tucum paste; CC = curd cheese; MC = milk cream; Formulations 1:0:0, 1:1:1 and 2:1:1 = tucum paste, milk cream and curd cheese proportions; u = unseasoned; s = seasoned; nc = not contributed

homogeneous paste. The addition with remaining ingredients increased creaminess and kept the gravitational stability between the components (water, solid and lipids). The curd cheese and milk cream used are manufactured foods, which in turn contains ingredients (milk, gums and stabilizers) that in addition to nutritional value, contributed positively to the sensory characteristics of tucum paste.

The P6s paste (1:1:1 seasoned) was preferred, showing that the seasonings and the equivalence between the amount of ingredients contributed positively to the improvement of sensory characteristics. In the preference rankings, the top three places were achieved by P6s (37.3%), P4s (23.5%) and P1u (15.7%) pastes.

In sensory evaluation, dairy ingredients and seasonings positively influenced in the notes to the characteristic profile Table 5. No significant interactions among formulations and seasonings, showing that they are independent factors. The differences were not statistically significant ($p<0.05$) for most attributes, however, some of the results deserve to be highlighted.

The P5u and P6s received higher scores for all attributes. The tucum has firm texture and fiber (the quantity of fiber varies with the progenies) [13] arranged lengthwise slices. The fibers were completely fragmented and they became undetectable after the crushing (pulp with water) when TP was obtained. Subsequent addition of dairy ingredients (manufactured with additives) gave a creamy consistency, with gravitational stability among solid, aqueous and oil phases. The creaminess, the facility to adhere and to spread evenly on the surface was observed. Thus, this paste is suitable for the stuffing of bread (sandwiches), and also to be used on the external surface of other foods, such as toast, biscuits and crackers.

The combination of dairy ingredients with seasonings has improved the flavor of the pastes. This positive effect resulted from the similarity of the flavor of the ingredients (cream cheese and milk cream) with the flavor of the cheese, which has traditionally been used together with tucum sliced in sandwiches. The taste of P2s showed lowest score and may reflect the local custom in which tucum (sliced pulp) is also consumed (without bread and cheese) only together with coffee. The amount of salt of the pastes was low (0.1%). This quantity was calculated from the salt added, and also, of the salt that came from (Conform package labels and the quantities used of each) the milk cream (0.07%) and curd cheese (0.45%) were considered. This quantity was set and considered optimal in preliminary sensory tests. However, a high quantity (3%) of salt was used in tucum paste [5].

In seasoned pastes, the smell was slightly less acceptable. The flavor was evaluated/scored separately as smell and taste. The score of the smell was higher than the taste, except in P6s. The dairy ingredients contributed to the better consistence. The orange color of the tucum remained, however, the tonality clearer was observed in pastes with dairy ingredients. The results of the Hedonic scale ranged from "dislike slightly" (P1u and P2s) until "like slightly" (P6s) showing that the notes increased proportionally with amounts of dairy ingredients. The seasonings contributed to the better results when dairy ingredients were present Table 6. The P6s (seasoned and with equal amounts of the ingredients) obtained the best acceptability index reaching 85%, while the P2s (seasoned and without dairy ingredients) had the lowest (34.4%). Another regional habit is to consume the sliced tucum alone (without bread and cheese), only together with coffee can be considered to explain the low acceptability index these pastes containing only tucum (without dairy ingredients).

In sensory analysis, the pastes were sampled along with toast, that which is not a regional habit. Sliced tucum, or is eaten alone, or together with cheese, bread and tapioca. The choice of ingredients was right because both are similar to cheese flavor. However, tucum paste without dairy ingredients has also been evaluated. Sobrinho et al. [5] tested six formulations of tucum paste and produced an optimized formulation, but with different formulation: tucum pulp (sufficient quantitative for 100%), hydrogenated vegetable fat (10-30%), sucrose (0-12%), glucose (2%), salt (3%) and emulsification agent (1%). The authors informed that produced an optimized formulation that was very well accepted by seventeen untrained people, and that sugar and fat content improved the acceptance, but the simultaneous increase of both reduced the acceptance.

The hydrogenated fat and high amounts of salt and sugar used by Sobrinho et al. [5] were not used in this work. A small amount (770 mg) of the dried seasonings corresponded to 0.15% of the total weight. This amount was chosen in pilot test (previously conducted) in which the panelists considered as sufficient. The sugar is not used, since the tucum paste was prepared with dairy ingredients (all salty taste) and to be consumed with bread, biscuits, toast, crackers, “tapioca”, and snack, in which the low salt and seasonings is desirable.

As the intention of purchase, 67% responded that the tucum pastes could be bought if it were on the market. This result was good because the tucum paste is a new product not yet known and available on the market. Traditionally sliced fresh pulp is used (with cheese) in sandwiches, and for this, consumers buy the in nature fruit (most common) or sliced pulp (less common). The preparation of the paste caused the fragmentation of the pulp and allowed to uniform particle size, the homogeneity of ingredients, creaminess, spreadability and the adherence in, and hence the possibility of being used not only as a filling of “tapioca” and bread for sandwiches, but also on the surface of small foods as toast, crackers, cookies and other products.

Table 5. Results of the characteristic profile of the tucum pastes

Attributes	Formulations and scores					
	P1u (1:0:0)	P2s (1:0:0)	P3u (2:1:1)	P4s (2:1:1)	P5u (1:1:1)	P6s (1:1:1)
Appearance	3.5a	3.6a	3.7a	3.7a	4.1a	4.2a
Color	4.0a	3.7a	3.8a	3.9a	4.1a	4.0a
Consistence	3.1bc	2.8c	4.0a	3.8ab	4.5a	4.5a
Smell	3.5ab	3.3b	3.9ab	3.9ab	4.2a	4.1a
Taste	2.5b	2.2b	3.6a	3.7a	4.0a	4.3a

Formulations 1:0:0, 1:1:1 and 2:1:1 = tucum paste, milk cream and curd cheese proportions; u = unseasoned; s = seasoned; n= 50; Means in the same column with the same letters are not significantly different (P=0.05)

Table 6. Acceptability index obtained from the sensory analysis of the tucum pastes

Paste formulation	Average scores and acceptability index	
	Scores (*n=50*)	Acceptability index (%)
P1u (1:0:0)	2.8c	40.3c
P2s (1:0:0)	2.4c	34.4c
P3u (2:1:1)	4.2b	60.3b
P4s (2:1:1)	4.3ab	61.6ab
P5u (1:1:1)	4.9ab	69.4ab
P6s (1:1:1)	5.9a	84.8a

Formulations 1:0:0, 1:1:1 and 2:1:1 = tucum paste, milk cream and curd cheese proportions; u = unseasoned; s = seasoned

So with two steps the paste (ready-to-eat) can be obtained. In the first stage use just sliced tucum with water (40%) and make the crushing. In the second step use this first paste with milk cream, curd cheese and seasonings, and make the homogenization. The paste is also advantageous because it has the convenience and ease of the product with dairy ingredient, already prepared and ready for consumption.

4. CONCLUSION

From a nutritional standpoint, the lipids were the major constituents. The presence of seasoning and the use of equal amounts of tucum, milk cream and curd cheese was the best formulation. Based on that formulation, the paste has received the highest marks for the characteristic profile and acceptability. Thus, this formulation was chosen to the tucum paste.

ETHICAL APPROVAL

All authors hereby declare that all experiments have been examined and approved by the appropriate ethics committee and have therefore been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki.

The research project was previously approved by Research Ethics Committee of the Ministry of Health of Brazil (CEP - INPA, Process Number 02611/2011).

COMPETING INTERESTS

Yes, this research contributes to the appreciation of the species (*Astrocaryum aculeatum*), adding knowledge in the treatment of post-harvesting of fruit. Considering that this species is not domesticated also is important, because it can be used to compare with other studies involving production of oil for biofuels and nutritional area with this species. Believe it is a pioneering work.

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