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Protein supplement obtained from almonds of bacuri fruit (Attalea phalerata Mart. Ex Spreng.): elaboration, nutritional characterization and sensory acceptability

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Abstract

Bacuri (Attalea phalerata Mart. Ex Spreng.) is a fruit belonging to Palmae family, found in Mato Grosso do Sul - Brazil with great nutritional potential. The objective of the present study was to perform processing, elaboration, nutritional analysis and sensorial acceptability test of protein supplement formulations with bacuri almonds aiming its use by vegetarian public and sportsmen. Bacuri almonds were processed to lyophilized flour of the protein isolate, and then mixed with other ingredients to produce two supplement formulations: F1 containing 70% bacuri lyophilized almond flour, and F2 containing 35% bacuri lyophilized almond flour and 35% commercial supplement. Nutritional composition analysis, amino acid determination and sensory analysis were performed. Both supplements presented high protein content. F1 and F2 were significant different for energy, moisture, ashes, proteins and carbohydrates content. Amino acid profile was satisfactory for methionine, cysteine, phenylalanine and tyrosine for both. Sensory analysis showed acceptability indexes above the minimum limit of 70%, which is considered accepted. Thus, bacuri almond is an alternative ingredient in plant food supplements. However, its isolated use (F1) still needs further testing for sensory acceptability indices improvement.

Keyword: Cerrado Fruits; Food, Formulated; Food Analysis; Dietary Supplements.

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Protein supplement obtained from almonds of bacuri fruit (*Attalea phalerata* Mart. Ex Spreng.): elaboration, nutritional characterization and sensory acceptability

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Abstract

Bacuri (Attalea phalerata Mart. Ex Spreng.) is a fruit belonging to Palmae family, found in Mato Grosso do Sul - Brazil with great nutritional potential. The objective of the present study was to perform processing, elaboration, nutritional analysis and sensorial acceptability test of protein supplement formulations with bacuri almonds aiming its use by vegetarian public and sportsmen. Bacuri almonds were processed to lyophilized flour of the protein isolate, and then mixed with other ingredients to produce two supplement formulations: F1 containing 70% bacuri lyophilized almond flour, and F2 containing 35% bacuri lyophilized almond flour and 35% commercial supplement. Nutritional composition analysis, amino acid determination and sensory analysis were performed. Both supplements presented high protein content. F1 and F2 were significant different for energy, moisture, ashes, proteins and carbohydrates content. Amino acid profile was satisfactory for methionine, cysteine, phenylalanine and tyrosine for both. Sensory analysis showed acceptability indexes above the minimum limit of 70%, which is considered accepted. Thus, bacuri almond is an alternative ingredient in plant food supplements. However, its isolated use (F1) still needs further testing for sensory acceptability indices improvement.

Keywords: Cerrado Fruits; Food, Formulated; Food Analysis; Dietary Supplements.

1. Introduction

In Brazil there is an increase in the number of exercise practitioners who use dietary supplements, especially in gyms [1]. Many people intake supplements, mainly protein and carbohydrate sources, aiming to improve physical performance at the time of training and competition, as well as body aesthetics [2]. Many of supplements consumers are vegetarian, intending to prevent protein and some micronutrients deficiencies that may arise as a result of vegetarian diet [3]. Vegetarianism can be classified into ovolactovegetarianism, lactovegetarianism, ovovegetarianism and strict vegetarianism, and veganism fits more closely with a matter of choice in the individual's way of life [4].

Practitioners and athletes, in most cases, have a significant protein intake, higher in comparison to nutritional recommendations. This fact can be explained due to the higher protein requirement during training and competition [5].

Given the search for adequate nutrition and supplementation, native fruits of the Cerrado and Pantanal appear as a good option for food intake, offering significant amounts of nutrients that might help achieving daily nutrient requirements in humans [6]. Their use in food products formulation might be of great interest due their potential organoleptic and nutritional characteristics. Furthermore, food products based in Cerrado and Pantanal fruits are an important tool to popularize their intake [7].

Bacuri is a fruit extensively distributed throughout the state of Mato Grosso do Sul - Brazil. Also known as acuri or acurizeiro, presents good amount of proteins, monounsaturated and polyunsaturated fatty acids, fibers, carotenoid pigments, iron, copper, phosphorus and zinc [8]. Its almond has an adequate amount of protein, displaying great potential to be included or used as food supplement, specially as a plant based product and with a lower cost [9]. Similarly to other native fruits of the Brazilian Cerrado and Pantanal, very little is studied about their application in the area of sports nutrition. Futhermore, it is noteworthy that, for the development of new products, sensory analysis is a very important tool, evaluating the quality of the attributes through the sense organs by the use of specific methods [10].

Thus, the present study aimed to elaborate a protein supplement of vegetable source using the bacuri fruit almonds, and to perform its nutritional and sensorial characterization.

2. Material and Methods

2.1 Material

Bacuri fruits were obtained with local producer in the city of Campo Grande in the state of Mato Grosso do Sul - Brazil, in the geographic coordinates -20.4600517, -54.5962478, presenting the SisGen (National Management System) registration number A516D8E Genetic Heritage and Associated Traditional Knowledge). After collection, from March to June, the fruits were taken to laboratories for almonds acquisition and processing.

The vegetable-source protein supplement were formulated with raw materials obtained in Campo Grande (MS): xylitol and dextrose (Atlhetica®), stevia (R&S Blumos®), cocoa powder (Nestlé®), chocolate flavoring (Doremus ®), vanilla flavoring (Robertet®), xanthan gum thickener (Nestlé®); freeze-dried bacuri almond flour were obtained by laboratory processing and protein supplementation of pea and rice Reaction Vegan Cocoa Flavor (Atlhetica®) composed of the following ingredients: isolated pea protein and concentrated rice protein, medium chain triglycerides, cocoa powder, methylcobalamin, vanilla and cocoa natural flavoring and natural sweeteners xylitol, steviol glycosides and thaumatin.

2.2 Methods

2.2.1 Fruit processing

The collected fruits were washed in running water, broken using a hand press and pulped to obtain the almonds, which were then crushed in an electric grinder (brand Bermar®, model BM 77 NR), in order to obtain the whole flour. To remove the oil from this whole almond flour, a chemical method of hot extraction was used, with petroleum ether solvent (brand Neon®) in the Soxhlet.

After obtaining the defatted bacuri flour, the flour was placed in a ventilated oven at 30ºC for 48 hours to preserve the protein value of the product and especially to eliminate any residue of the solvent used for lipid extraction.

To obtain the lyophilized flour, lyophilization procedure was performed: a drying method that extracts the moisture brought into the material by freezing the liquid part followed by subsequent sublimation of ice [11]. Afterwards, aqueous extracts were prepared using defatted bacuri flour and distilled water at a concentration of 1:10 (weight /volume) by mixing them through an industrial blender (Colombo® brand, model JL inox). Subsequently, the product was stirred for 3 hours [12]. After stirring, the suspension supernatant was collected and centrifuged for 15 minutes at 2,000 rpm.

Lyophilization using the LIO1 model L101 lyophilizer and also the ALPHA 2-4 lyophilizer LD Plus from Christ® brand. For the freezing phase of the samples, which precedes the freeze-drying phase, the Christ® Cooling bath model CB 18-40 in LPPFB and liquid nitrogen in LAPNEM were used.

Figure 1 shows the flowchart of the processing of bacuri fruits and almonds until the preparation of the protein supplement formulations.

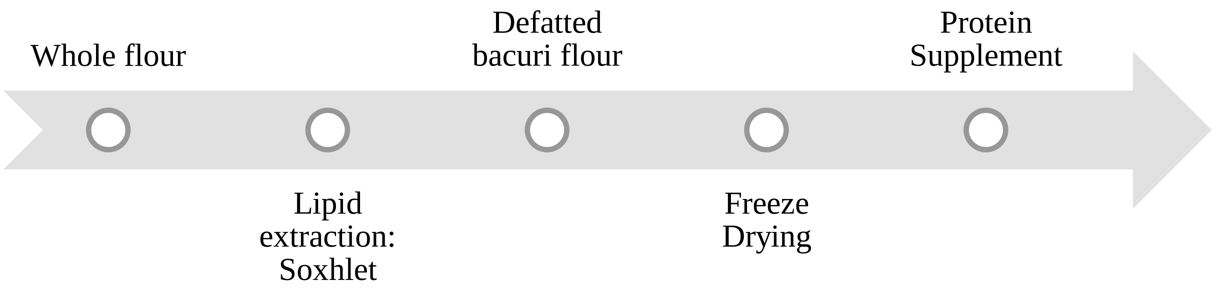

Figure 1. Processing flowchart. Source: own.

2.2.2 Preparation of protein supplement formulations

Supplements were prepared after laboratory pre-tests evaluating different concentrations, sources and proportions of bacuri lyophilized flour, sweeteners, thickeners and flavorings, adapting the characteristics of the formulations for better acceptance of the public. The pre-test formulations were sensorially evaluated by untrained tasters, such as students, teachers and servants of an educational institution. The following attributes were analyzed: appearance, aroma, taste, texture, sweetness, color and general acceptance, as well as the evaluation of the purchase intention of the product. From the unsatisfactory results of sensory acceptance of the first pre-tests, reformulations in ingredients concentrations were performed.

It is important to note that there was no significant difference between the averages of formulations F1 (70% bacuri) and F2 (35% bacuri and 35% commercial pea and rice supplement) for any attribute analyzed in the pre-test, with averages in most of assessed attributes ranked on the hedonic scale between "slightly liked" and "very liked" (data not shown). These results of improved composition and acceptance of the formulations were observed for acceptability indices, which were close to or above 70% for most attributes. Thus, final supplement formulations used in the study were chosen after the pre-test and a final sensory analysis was performed, as described below.

2.2.3 Nutritional composition

Nutritional composition of the final formulations was performed in triplicate following the analytical methodologies defined by the Adolfo Lutz Institute [13]. Moisture was obtained by desiccation at 105ºC until constant weight was obtained. The ashes were determined by incineration in muffle furnace at 550ºC. The determination of total carbohydrates was made by the Lane-Eynon method, based on volume reduction of Fehling to cuprous oxide. Lipid was determined on Soxhlet by extraction with petroleum ether as a solvent. The total protein value was determined by the Kjedahl method, considering the factor 6.25. The amount of total fiber was obtained by difference by theoretical calculation, according to the formula:%

fiber = 100 - (% moisture +% protein +% lipid +% ash +% carbohydrate). The total energy value (kcal) was calculated by the following values: lipids (9.03 Kcal / g), protein (4.27 Kcal / g) and carbohydrates (3.82 Kcal / g) [14].

2.2.4 Total amino acid profile

Determination of the essential and non-essential amino acid profile of bacuri lyophilized flour was carried out at the Laboratory of Protein Sources of FEA/UNICAMP. The constituent proteins of the samples were hydrolyzed with 6 N hydrochloric acid for 24 hours. Amino acids released in acid hydrolysis were reacted with phenylisothilcianate (PITC), separated by reverse phase high performance liquid chromatography (HPLC) and detected by UV at 254 nm. Quantification was performed by multilevel internal calibration with the aid of α-aminobutyric acid (AAAB) as internal standard for total amino acids and methionine sulfone for free amino acids. Fruit samples, where quantitation of free amino acids are required, were deproteinized with 0.1M HCl acidified methanol (80% MeOH / 20% 0.1M HCl) at a ratio of 7: 2: 1 volume / weight / volume. methanol / sample / internal standard respectively. In this paper we present modifications in the methodology proposed by White et al. [15], for total amino acids using a Kinetex C18 100Å 5u 100x4.6mm ME0-9165 column and for free amino acid determinations we used Luna 3u C18 (2) 100A 250x4.6mm 00G-4251-E0 HPLC Column.

Tryptophan determination was performed by spectrophotometric analysis with reading at 590 nm, as proposed by Spies [16].

2.2.5 Chemical score of essential amino acids

Chemical Essential Amino Acid Score was determined using the Henley and Kuster methodology [17], associating FAO / WHO adult reference standard amino acids [18] with the concentration of each of the essential amino acids in the lyophilized flour of the bacuri in the study, using the following expression:

$$EAE = \frac{\text{mg amino acids / g test protein}}{\text{mg amino acids / g standard or reference protein}}$$

2.2.6 Final sensory analysis

Based on pre-tests results and the choice of the most accepted formulations, the final sensory analysis was performed with the target audience at the OnFit academy in Campo Grande - MS. A total of 30 tasters, practitioners of both sexes, not sensorially trained, collaborated with the analysis. Three samples of protein supplement of vegetable origin were analyzed, two formulations developed and one sample of commercial supplement, called F1 (70% bacuri); F2 (35% bacuri and 35% commercial pea and rice supplement) and Commercial Supplement (containing pea and rice proteins).

The attributes appearance, color, flavor, aroma, sweetness, texture and overall acceptance were evaluated using the 9-point hedonic scale: 9 = very much liked, 8 = very liked, 7 = moderately liked, 6 = slightly liked, 5 = neither liked / disliked, 4 = slightly disliked, 3 = moderately disliked, 2 = disliked a lot and 1 = disliked very much; and also a 5-point hedonic scale for purchase intent, where: 5 = surely buy, 4 = possibly buy, 3 = maybe buy / maybe not buy, 2 = possibly wouldn't buy, 1 = certainly wouldn't buy [19, 20].

In the sensory analysis sheet, questions were also verified for the definition of the tasters' profile, such as: sex, age, education, if the fruit was known, if it consumed protein supplements, if it consumed protein supplements of vegetable origin, sport practiced, frequency and time of practiced exercise.

The formulations were coded into 3 digit numbers and supplied in disposable cups, monadic and balanced. Each participant received between 15 and 20 mL of each supplement formulation, a glass of drinking water (white), pen, napkin, Informed Consent (IC) and the analysis form [19, 20].

The calculation of the acceptability index (IA) was determined by the formula: IA (%) = A x 100 / B; A = average grade obtained for the product; B = maximum grade given to the product.

2.2.7 Statistical analysis

Data were organized and analyzed using the Statistical Package for Social Sciences (SPSS) software. The results were submitted to ANOVA analysis of variance, and Tukey's post test was used to compare the means, considering a level of 5% of significance ($p < 0.05$).

3. Results Discussion

3.1 Preparation of protein supplement formulations

The final concentrations of ingredients used in the formulations chosen from the preliminary tests are shown in Table 1.

Table 1. Ingredient concentrations of the plant-based protein supplements.

Ingredients	F1 (%)	F2 (%)
Freeze-Dried Bacuri Flour	70	35
Commercial Supplement*	---	35
Xylitol	7	5
Dextrose	16.3	19.3
Cocoa Powder	3	3
Thickener Xanthan Gum	2	1
Stevia sweetener	0.2	0.2
Chocolate Flavorings	1	1
Vanilla Flavorings	0.5	0.5

**Reaction Vegan* (*Atlhetica®)* chocolate flavor, with pea and rice proteins.

Protein supplements are important for athletes and sport practioners, as they contribute significantly to hypertrophy, since protein is directly involved in the metabolism and development of body tissues, and enzymes activity that regulate energy generation and muscle contraction [21].

In this sense, plant-based protein supplements has emerged as an alternative to animal proteins. Despite their lower biological value, the supply of plant protein is higher[22]. In this context, the use of nutrients derived from native fruits of the Cerrado and Pantanal biomes presents great potential in the food industry, due to their nutritional profile, as well as for the regional population, reducing its waste [23].

The other ingredients, especially xylitol, dextrose and stevia, were chosen aiming the benefit for the consumers, since products with a low glycemic index and low sugar content have a lower impact on postprandial glucose, resulting in stable process during physical exercise, thus becoming a nutritional strategy more suitable for this population [24].

3.2 Nutritional composition

Bacuri has great nutritional value, as previously shown by Lima e Silva et al. [25]. The authors analysed nutritional aspects of different types of bacuri almond flour, showing that the raw bauru flour, on dry basis, presented a protein value of 35.95%. Futhermore, in Table 2, adapted from the study by Cunha (2018), it is possible to observe the nutritional composition of the whole, unfatted and lyophilized bacuri almond flour [26].

Table 2. Nutritional composition of flours obtained from bacuri fruit almonds.

	Bacuri almond flours (g.100g^{-1})			
	Whole	**Unfatted**	**Freeze-dried**	**p-value***
Moisture	4.44 ± 0.07^{b}	6.68 ± 0.61^{a}	3.49 ± 0.19^{c}	0.0001
Ashes	1.74 ± 0,03^{c}	5.20 ± 0.13^{b}	8.49 ± 0.22^{a}	0.0001
Lipids	60.72 ± 1.66^{a}	3.05 ± 0.51^{b}	1.78 ± 0.25^{b}	0.0001
Protein	12.72 ± 1.27^{c}	28.87 ± 2.34^{b}	51.39 ± 0.41^{a}	0.0001
Total Fiber	18.18	55.06	1.99	---
Carbohydrate**	2.20±0.49	1.14±0.16	32.86±0.44	---

Source: Adapted from Cunha (2018)[26]. ** Calculated by difference. * p-value obtained by ANOVA. Averages followed by equal letters on the same line do not differ from Tukey's Post Hoc at 5% probability.

Based on protein content of bacuri flour, the lyophilization process used in the present study was fundamental for supplement formulation, generating greater protein contribution after bacuri almonds processing, highlighting its potential use as a plant-based protein supplement.

The nutritional composition of the final supplement formulations (F1 and F2) were compared and presented in Table 3, which also shows commercial supplement information.

Table 3. Comparison of nutritional information (in 100 g) of formulations F1 and F2.

	F1	F2	p-value	Comercial supplement
Energy (Kcal)	328.85±1.64[b]	352.57±3.55[a]	0.0001	402.65
Lipids (g)	3.59±0.08[a]	4.15±0.33[a]	0.245	2.77
Proteins (g)	39.76±0.31[b]	44.29±0.46[a]	0.0001	61.11
Total Carbohydrates (g)	33.16±0.15[b]	33.73±0.,16[a]	0.012	30.55
Total Fiber (g) *	4.02±0.13[a]	3.49±0.02[b]	0.014	0

F1=70% bacuri; F2 = 35% bacuri and 35% commercial pea and rice supplement; Commercial supplement = commercial supplement of pea and rice. * Calculated by difference. Different letters on the same line indicate significant difference by Student's t-test (p <0.05).

There was significant difference (p<0.05) for moisture, ashes, fibers, protein, carbohydrates and energy value. Only for lipids, no difference was observed (p = 0.245) between F1 and F2.

By comparing the protein content found in the commercial supplement sample and the formulations F1 and F2, it was possible to identify that the commercial supplement presented a higher amount of protein in 100g of product (61.11%) than the two formulations. However. an important point to note is that the percentages used in these formulations were not 100% of freeze-dried bacuri flour, but 70% and 35%. According to IN Supplementary Instruction Nº. 28 of July 26, 2018 [27], the formulations containing bacuri flour are suitable for protein content, containing at least 8.4g of protein per portion of the product and also considered high protein product (minimum 12 g per serving) according to RDC Nº. 54 of 12 November 2012 [28] - F1 contains 14.3g of protein/serving (one serving represents 36g and it is equivalent to a full dosing measure) and F2 contains 15.9g of protein/ serving.

Regarding body composition. Ramos et al. [9] evaluated the effect of diets with vegetable (defatted bacuri flour) and animal protein (whey protein) content in Wistar rats submitted to resistance exercise for three times a week for eight complete weeks. They concluded that bacuri almond protein was of good quality when compared to whey protein, recommending its use in the creation of nutritional supplements, based on a vegetable source.

3.3 Total amino acid profile and chemical score of essential amino acids

Babault et al. [29] conducted a study comparing a pea supplement (59.2% protein) with whey protein in lean mass gain in humans over a 12 week supplementation period. The researchers concluded that protein supplementation of plant origin provided increased muscle thickness in trained individuals, and that the results obtained for both supplementation with plant protein and animal protein were similar in muscle growth, evidencing an adequate amino acid profile. The same adequate amino acid profile of bacuri fruit almond flour is shown in the present study.

In Cunha's study [26], the freeze-dried bacuri almond flour presented 49.84g / 100g of proteins. In the current study, a small difference was observed - the total amount of protein was 44.00g / 100g. This difference can be attributed to several factors, from extraction and processing process to obtain the protein isolate until the harvest and maturation period, fruit, soil type and climate.

Amino acid composition was compared with data found by Babault et al. [29], who used lyophilized pea flour to obtain amino acid values. It was possible to observe that the pea presented higher amino acids concentration, except for methionine, cysteine, asparagine and arginine, as shown in Table 4.

Table 4. Amino acid composition of freeze-dried bacuri flour compared to pea protein.

Amino acids (g.100g of protein)	*Pea	Freeze-dried bacuri
Essential amino acids		
Leucine	6.40	2.75
Valina	4.00	2.22
Isoleucine	3.70	1.73
Histidine	1.90	1.05
Methionine	0.80	1.36
Cysteine	0.80	1.49
Phenylalanine	4.20	2.63
Tyrosine	3.10	1.50
Treonine	2.80	1.64
Lysin	5.70	2.38
Tryptophan	0.70	0.19
Non-essential amino acids		
Asparagin	ND	4.03
Glutamine	13.20	7.40
Serine	3.90	1.96
Glycin	3.10	1.72
Arginine	6.60	6.92
Alanin	3.30	1.52
Proline	3.40	1.50

*Babault (2015) [29].

The amino acid profile of freeze-dried bacuri almond flour was very similar to that found in the study of Togashi and Sgarbieri [30], where the amino acid composition of baru almond was analyzed (48,43g in100g of protein concentrates), confirming the protein potential of bacuri fruit.

The amino acid chemical score of freeze-dried bacuri almond flour was also compared with the FAO/WHO standard recommendations for adults [18], described in Table 5. The amino acid profile was satisfactory for methionine, cysteine, phenylalanine and tyrosine.. Tryptophan was the most limiting amino acid of freeze-dried bacuri flour.

Table 5. Essential amino acid score calculated based on FAO / WHO reference standard (2007) [18].

Essential amino acids (g/100g protein)	FAO/WHO	Freeze-dried bacuri	Amino acid score*
Treonin	2.30	1.64	0.71
Methionine + Cysteine	2.20	2.85	1.29
Valine	3.90	2.22	0.57
Leucine	5.90	2.75	0.46
Isoleucine	3.00	1.73	0.57
Phenylalanine + Tyrosine	3.80	4.13	1.08
Lisine	4.50	2.38	0.52
Histidine	1.50	1.05	0.70
Tryptophan	0.60	0.19	0.31*

*most limiting amino acid

3.4 Final sensory analysis

Final sensory analysis was performed with 30 participants, 93.3% (n = 28) were practitioners of physical exercises. The tasters' profile was mostly female (n = 17; 56.7%), with a mean age of 32.4 ±0.5 years, 73.3% consumed / knew food supplements, but only 23, 3% knew or consumed plant food supplements, as described in Table 6.

Table 6. Profile of the tasters.

	Total tasters (n = 30)	
	n	**%**
Gender		
Male	13	43,30
Female	17	56,70
Know protein supplement		
Yes	22	73,30
No	8	26,70
Know plant-based protein supplement		
Yes	7	23,30
No	23	76,70
Know Bacuri fruit		
Yes	12	40,00
No	18	60,00
Physical activity modality		
Bodybuilding	19	63,30
Bodybuilding + other activity	6	20,00
Other	3	10,00
None	2	6,70
Frequency of physical activity		
1 - 2 times a week	1	3,60
3 - 4 times a week	13	46,40
≥ 5 times a week	14	50,00
Training time		
Up to 1h	10	35,7
1 - 2h	17	60,7
Above 2h	1	3,6

* n = number of participants (absolute frequency); % = percentage of participants (relative frequency).

Among the participants, bodybuilding practice was more frequent (19 practitioners). representing

63.3%. Other modalities practiced included: dance, fitdance, walking, equestrian, running and pilates. The highest frequency of physical exercise was ≥ 5 times a week (50.0%) and the most practiced training time was 1 to 2 hours of exercise (56.7%).

Table 7 shows the mean scores of the sensory analysis parameters. It was possible to observe the acceptance of each attribute of the formulations developed, since there was no significant difference between the samples in most of the evaluated attributes: acceptance, appearance, flavor, texture, color and sweetness.

Table 7. Averages of affective sensory acceptance and purchase intent tests performed for plant-based protein supplement formulations.

	F1*	**F2***	**Comercial Supplement**	**p-value****
Appearence	6.77±1.524	7.23±1.695	6.77±2.063	0.504
Aroma	6.30±2.054^{b}	7.47±1.432^{a}	6.80±1.919^{ab}	0.050***
Flavor	5.07±1.999	5.93±1.893	5.90±2.139	0.174
Texture	6.70±1.841	6.80±1.669	6.00±2.319	0.233
Color	6.63±2.059	7.40±1.545	7.40±1.632	0.156
Sweetness	6.20±2.188	6.67±2.123	6.17±2.069	0.597
Global Acceptance	5.40±2.078	6.43±1.633	6.20±1.901	0.088

*Mean values ± Standard deviation. F1 = 70% bacuri; F2 = 35% bacuri and 35% commercial pea and rice supplement; Commercial supplement = Pea and rice commercial supplement. ** P value obtained by the ANOVA test of variance; *** p <0.05 Equal letters in the same line do not differ (p> 0.05) by the Tukey test.

Means of the aroma attribute (p = 0.050) differed between the samples, being higher for F2 compared to F. Commercial supplement did not differ from any of the formulations with bacuri (Table 7). Regarding the purchase intent, there was a significant difference between the samples (p = 0.032): F1 (70% bacuri) differed from the commercial supplement, with significantly lower average (2.43 versus 3.17, respectively), but did not differ from F2.

Regarding intention to purchase, F2 presented better rates, as well as the commercial supplement sample. F1 did not obtain as good results when compared to the others, as shown in Figure 2.

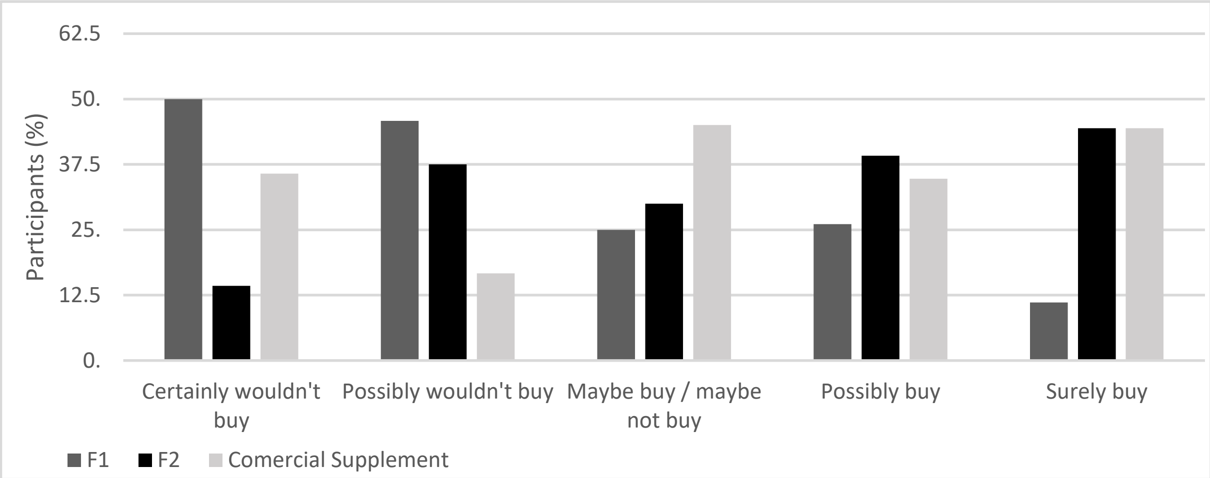

Figure 2. Purchase intention of plant-based protein supplement formulations. Caption: F1 = 70% bacuri; F2 = 35% bacuri and 35% commercial supplement; Commercial Supplement = Commercial Pea and Rice Supplement.

F2 formulation and commercial supplement presented good sensory acceptance by the tasters. In the study of Cunha et al. [31] who elaborated cereal bars with bacuri pulp flour, the formulation containing 10% bacuri obtained 82,2% of acceptability index, showing bacuri can also be used in the manufacture of other products - aiming at its full utilization. Figure 3 shows the acceptability index values of each supplement formulation.

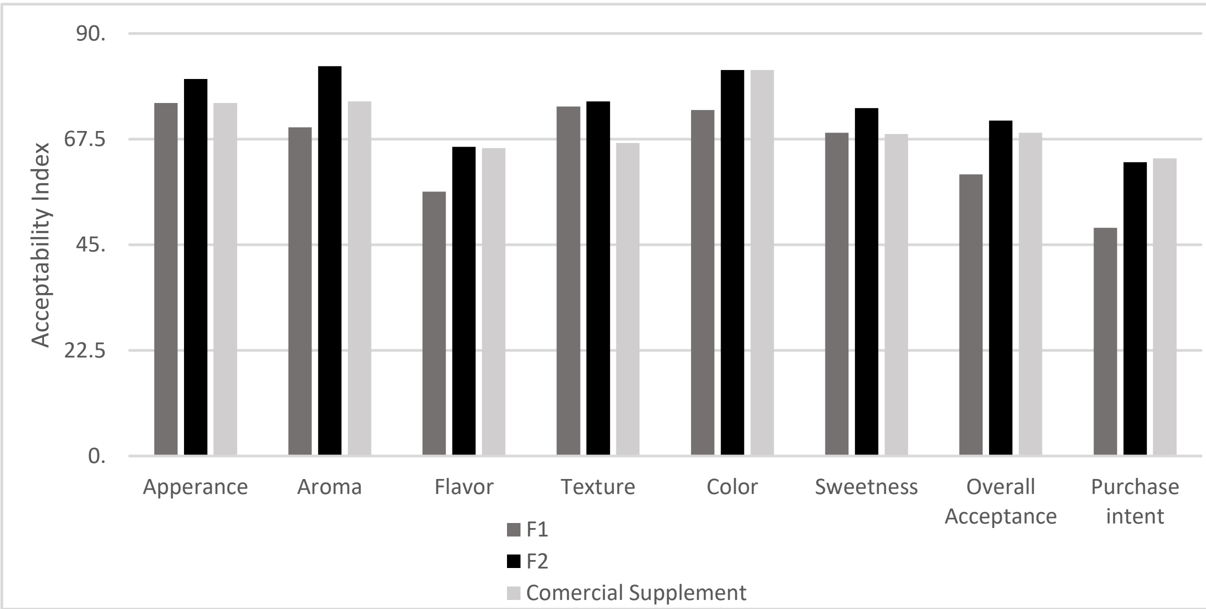

Figure 3. Acceptability index (%) of protein supplement formulations of plant origin. Caption: F1 = 70% bacuri; F2 = 35% bacuri and 35% commercial supplement; Commercial Supplement = Commercial Pea and Rice Supplement.

Regarding the acceptability index criteria, F2 (35% bacuri + 35% commercial supplement) displayed better results for most of the evaluated parameters: appearance, aroma, taste, texture and sweetness. F2 had an overall acceptance rate of 71.44%, above the recommended percentage of 70% by Teixeira (1987) to be considered sensorially accepted.

Product acceptance might have been influenced by the fact that 76.7% of tasters did not know or consumed plant-based supplements. Futhermore, 60% of participants did not know bacuri fruit.

4. Conclusions

The present study provided improvement of the organoleptic characteristics of food plant-based supplement formulations. It is noteworthy that the processing of bacuri fruit almonds to their freeze-dried flour significantly increased protein content, constituting an alternative option in the production of vegetable protein supplements, with good results of sensory acceptability. Further studies to enhance protein extraction and consequently amino acids profile in lyophilization process should be performed in different conditions.

We concluded that sensory analysis was satisfactory, considering the evolution in the products elaborated between the pre-test periods and the final formulations, especially for F2 (blend containing 35% bacuri almond lyophilized flour), which obtained a good acceptance by the target public. In isolation, as a sole protein source, 70% bacuri (F1) formulation needs further testing to optimize its acceptance.

5. References

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