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Sustainability in Gastronomy: Production of fermented beverage prepared with coconut green pulp (*Cocos nucifera* Linn.)

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Abstract - This study developed three fermented beverages added with different percentages of green coconut pulp (30%, 50%, and 70%). The formulations were analyzed during 21 days of storage, and the results showed microbiological and physical-chemical parameters very similar to a dairy drink without the presence of coconut. Lactic acid bacteria counts were always higher (7 log10 CFU g−1) on the first day of storage, decreasing after 7 days (6 log10 CFU g−1). The formulations were submitted to sensory evaluation, with similar values obtained for the flavor and aftertaste attributes. The formulations containing 50% and 70% of green coconut pulp obtained the highest scores for the attributes of color and texture, due to the presence of the coconut. The overall acceptance was greater than 70% (AF= 74.90%) for the 50% formulation, with a purchase intention of 45%. The overall acceptance average was 71,75%, a value considered satisfactory, allowing to conclude that the development of products with green coconut pulp is an alternative to combat the waste of this raw material, adding economic value to the coconut chain in the Brazil.

Keywords: Industrial waste. Food wastefulness. Fermented foods.

Sustentabilidade na Gastronomia: Produção de bebida fermentada elaborada com polpa de coco verde (*Cocos nucifera* Linn.)

Resumo - No presente estudo, foram desenvolvidas três bebidas fermentadas adicionadas de diferentes porcentagens de polpa de coco verde (30%, 50%, 70%). As bebidas foram analisadas durante 21 dias de armazenamento, e os resultados demonstraram parâmetros microbiológicos e físico-químicos muito semelhante a uma bebida láctea sem a presença do coco. As contagens de bactérias ácido-láticas foram sempre maiores (7 log10 UFC g−1) no primeiro dia de armazenamento, diminuindo após 7 dias (6 log10 UFC g−1). As formulações foram submetidas à avaliação sensorial, tendo sido obtidos valores semelhantes para os atributos sabor e sabor residual. As formulações contendo 50% e 70% de polpa de coco verde obtiveram as maiores pontuações para os atributos de cor e textura, atribuídos a presença do fruto. A aceitação mensurada foi superior à 70% (AF= 74,90%) para a formulação 50%, com intenção de compra de 45%. A aceitação global média das formulações global foi de 71,65%, valor considerado satisfatório, permitindo concluir que o desenvolvimento de produtos com polpa de coco verde é uma alternativa para combater o desperdício dessa matéria-prima, agregando valor econômico à cadeia do coco no Brasil.

Palavras-chave: Resíduos industriais. Desperdício de alimentos. Alimentos fermentados.

Sustentabilidad en Gastronomía: Producción de bebida fermentada elaborada con pulpa de coco verde (*Cocos nucifera* Linn.)

Resumen - Este estudio desarrollado tres bebidas fermentadas con diferentes porcentajes de pulpa de coco verde (30%, 50%, 70%). Las bebidas fueron analizadas durante 21 días de almacenamiento, y los resultados mostraron parámetros microbiológicos y físico-químicos muy similares a una bebida láctea sin presencia de coco. Los recuentos de bacterias lácticas siempre fueron más altos (7 log10 UFC g−1) el primer día de almacenamiento, disminuyendo después de 7 días (6 log10 UFC g−1). Las formulaciones fueron sometidas a evaluación sensorial, obteniendo valores similares para los atributos de sabor y retrogusto. Las formulaciones que contenían 50% y 70% de pulpa de coco verde obtuvieron los puntajes más altos para los atributos de color y textura, atribuidos a la presencia del fruto. La aceptación medida fue superior al 70% (AF= 74,90%) para la formulación al 50%, con una intención de compra del 45%. La aceptación global promedio de las formulaciones globales fue de 71,65%, valor considerado satisfactorio, lo que permite concluir que el desarrollo de productos con pulpa de coco verde es una alternativa para combatir el desperdicio de esta materia prima, agregando valor económico a la cadena alimentaria. coco en Brasil.

Palabras-clave: Residuos industriales. Residuos alimentarios. Alimentos fermentados.

Introduction

The coconut palm (*Cocos nucifera* Linn.) is cultivated in over 90 tropical countries and it represents an important income source. (Martins and Jesus Júnior, 2014). Indonesia, India, and the Philippines are the major producers with almost 75% of world production. Brazil is the fourth-largest coconut producer in the world (FAO 2020), having reached a total of 1,63 million tons of coconuts produced in 2020 (IBGE 2021).

The products from the mature coconut are widely used and commercialized, as pulp and oil, besides lauric acid, coconut milk, fiber, and flour (Martins and Jesus Júnior 2014; Santana et al. 2020; Da Silva et al. 2021). Applications of these products include the food industry, animal feed, industrial syntheses, soaps, detergents, and cosmetics (Sampaio et al. 2018; Luz et al. 2020).

For many years, the production of coconut in Brazil has been directed to the extraction of the solid endosperm (coconut pulp) for the manufacture of the numerous derivatives already mentioned. However, on the coast of Brazil, there is an increase in the production of green coconut varieties destined for production and consumption of the liquid endosperm (coconut water).

The increasing demand for natural and healthy foods is one factor that has raised the consumption of this beverage (Brainer 2021). Besides being highly appreciated for its taste and freshness, it is considered an excellent natural isotonic, so it is also consumed for its nutritional qualities (Chagas et al. 2017).

Despite the health benefit due to its functional properties, increased consumption of coconut water generates a large amount of solid waste (Nagashree et al. 2017; Vasconcelos et al. 2021). It is estimated that 85% of the weight of a coconut correspond to the bark - which leads to sustainable alternatives as to the use of coconut shell in wastewater treatment or for the production of concrete paver blocks (Pennarasi et al. 2019, Detho et al. 2021, Rodiah et al. 2022).

The solid albumen (green coconut pulp) is known for its good nutritional qualities, and composition, such as water, sugars, proteins, and fats, but there are few actions to combat the waste of this food raw material and use it sustainably (Teixeira et al. 2019).

The few studies in the literature that have developed products using green coconut pulp, like yogurt, ice cream, smoothie (Teixeira et al. 2019; Santana et al., 2020; Silva et al. 2020), were microbiologically safe, with good physicochemical characteristics and sensorial acceptance. However, more research is necessary regarding the composition and properties of green coconut pulp in food production.

In the search to reduce the waste of green coconut pulp that is generated from the commercialization of coconut water on the Brazilian coast, giving this pulp a sustainable destination, the objective of this study was to produce fermented beverages from green coconut pulp and characterize them as for their microbiological, physicochemical and sensory parameters.

Materials and methods

Materials

The solid albumen of green coconut (pulp) was obtained from coconuts destined for sale of coconut water in the city of João Pessoa, Paraiba, Brazil. The coconut fermented beverages were prepared using the thermophilic culture, a mixed lyophilized culture of *Streptococcus salivarius* subsp. Thermophilus (1x106 CFU/g), *Lactobacillus delbrueckii* subsp. Bulgaricus (1x106 CFU/g), and *Bifidobacterium* BB-12 (1x106 CFU/g) (Christian Hansen®, Valinhos, Minas Gerais, Brazil). Cow´s milk with 3% fat and refined sugar were purchased in supermarkets in the city of João Pessoa, Paraiba, Brazil.

Methods

Obtainment of the solid albumen (pulp) of green coconut

The solid albumen of green coconut (pulp) was obtained from street sellers of coconut water in the city of João Pessoa. This material was collected by the research team in the days of greatest sales of coconut water in polyethylene bottles. The opened coconuts waste from the bottled water commercialization were collected in clean plastic bags and brought to the laboratory for further processing. The wasted coconut that were either used with the straw or directly thrown in the garbage were not considered in the present study. Solid albumen of green coconuts was used in the three stages of maturation: Stage I - Very fine and watery pulp, Stage II - Medium thickness, soft texture, and Stage III - Thicker and stiffer pulp.

In a laboratory, the coconuts were opened in the middle with a knife, and with a spoon the solid albumen was removed from the green coconut (pulp), avoiding removing parts of the endocarp. The removed pulp was washed rapidly and frozen in sterile plastic bags until the time of analysis. To guarantee the safety of the elaborated beverages, of the raw material (solid albumen of the green coconut) before the preparation of the products.

Products development

Three different types of fermented beverages were developed, having the base composition as follows: 30% green coconut pulp and 70% cow´s milk, 50% green coconut pulp and 50% cow´s milk, 70% green coconut pulp, and 30% cow´s milk (Table 1). As a control formulation, a fermented beverage was produced without adding the solid albumen of the green coconut, with 100% of cow milk. Refined sugar and thermophilic culture were based upon the 100% milk and green coconut pulp, being equal values in all beverages.

Table 1. Formulations of fermented beverages with different contents of solid albumen of green coconut.

Ingredients	Control	Formulations (g / 100 g)		
		30%	50%	70%
Green coconut pulp	0	27,3	45,5	63,7
Milk	91,0	63,7	45,5	27,3
Refined sugar	9	9	9	9
Thermophilic culture	0,04	0,04	0,04	0,04

The coconut beverages were produced according to the methodology proposed by Machado et al. (2017). Cow´s milk was pasteurized (65 °C / 30 min) using a triple wall-pan (Tramontina, Allegra, São Paulo, Brazil). The amounts of green coconut for each formulation were weighed (Even, B-15-110y, São Paulo, Brazil) and crushed. Coconut and sucrose were added to milk and homogenized, heated (90 ± 1 °C / 15 min), using a triple wall-pan (Tramontina, Allegra, São Paulo, Brazil). and cooled to 45 ºC. The thermophilic lactic culture was added by direct inoculation according to the manufacturer's recommendation. The mixture was incubated at 43 ± 1 °C for 4 h (Solab, B.O.D SL-200, São Paulo, Brazil) and cooled (4 ± 1 ºC). The products obtained were packaged in sterile high-density polyethylene bottles protected against light (100 ml) and stored under refrigeration at 6 ± 1 ºC (Consul, CRM44AB, São Paulo, Brazil) for 21 days. The beverages were evaluated for microbiological and physicochemical parameters after 1, 7, 14, and 21 days of storage, and sensory analysis after 1 and 21 days of storage.

Microbiological assessment

The microbiological parameters of the coconut beverages were assessed according to American Public Health Association, APHA (2001), for coliforms at 45 °C MPN/g, coagulase-positive *Staphylococci* (log_{10} CFU/g), *Salmonella* spp. (presence or absence in 25 g), mold and yeasts log_{10} CFU/g and acid lactic bacteria (BAL) log_{10} CFU/g.

Physicochemical analysis

The coconut fermented beverages were evaluated for general quality parameters according to standard procedures (AOAC, 1995; 2016) consisting of determining the moisture (method 925.09), ash content (method 930.22), fat (method 985.05), protein (method 939.02), total carbohydrates (method by difference), titratable acidity (method 920.124) and pH parameters (method 943.02).

The moisture was assessed by drying the samples at 105 °C in a hot-air oven until constant weight was achieved (Labor, SL-100, São Paulo, Brazil), Ash content was quantified by carbonization followed by incineration in a muffle furnace (Zezimaq, 2000-1, Minas Gerais, Brazil), the fat content was determined according to the Gerber method, the crude protein content (N x 5,30) was quantified using a micro-Kjeldahl method (Jacobis, 1951), and total carbohydrates were determined by difference, subtracting amounts of moisture content, protein, fat, and ash quantified by analyses. The pH values were measured using a calibrated digital pH meter (DIGIMED, pH 300M, São Paulo, Brazil). Titratable acidity (in lactic acid) was determined using phenolphthalein as an indicator agent with 0.1 mol/L NaOH. In both methods, 5 ml samples of each fermented beverage were previously mixed with 50 ml of distilled water.

Sensory analysis

Sensory evaluation was performed throughout the acceptance and purchase intention tests by sixty non-trained panelists, according to the methodology proposed by Meilgaard et al. (1991) and Stone and Sidel (1993).

The panelists received approximately 40 ml of each sample at temperatures between 7 °C and 8 ºC in disposable plastic cups with a capacity of 50 ml, coded with three-digit random numbers. The panelists were asked to eat a salty biscuit and drink water between samples to avoid after-taste effects.

The panelists were instructed to evaluate the fermented beverages formulations for appearance, color, odor, flavor, texture, and overall acceptance using a nine-point hedonic scale where 1 = dislike extremely, 5 = neither like or dislike, and 9 = like extremely. The panelists were also submitted to a purchase intention test, using a five-point hedonic scale where 1 = would definitely buy, 3 = might or might not buy, and 5 = would definitely not buy.

To verify the acceptability of the tested beverages, an acceptability factor (*AF*) (Dutcosky 1996; Prado et al. 2015) using standardized criteria was calculated to evaluate each sensory attribute analyzed: AF= A. 100. B^{-1} where *A* is the mean value obtained for each attribute and *B* is the maximum mean value for each attribute.

Statistical analysis

All measurements were performed using triplicate samples, and results were expressed as the mean value of the three replicates. Statistical analyses were carried out using descriptive statistics (mean and standard deviation - SD) and inferential tests (Analysis of variance - ANOVA followed by Tukey's test) to determine statistically significant differences ($p \leq 0.05$) between formulations and storage times. For the statistical analyses, the computational Sigma Stat® software 2.03 was used.

Results and Discussion

Microbiological evaluation

As seen in Table 2, the results of the microbiological analysis revealed that all fermented coconut beverages maintained a satisfactory microbiological quality during the evaluated storage period, as demonstrated by the total and thermotolerant coliforms, positive coagulase *Staphylococcus* and mold, and yeast counts, as well as the absence of *Salmonella* spp. No differences ($p > 0.05$) were found for BAL counts between types of green coconut beverages. On the other hand, differences ($p < 0.05$) were found for BAL counts over storage (21 days).

Table 2. Mean values for microorganism count and *Salmonella* sp. in green coconut fermented beverages during refrigerated storage. Different superscript lowercase letters, on the same line (formulations) and different superscript uppercase letters on the same columns (times), indicate statistical differences at the 5% probability level in Tukey's test.

Parameters	Time (days)	Formulations			
		Control	30%	50%	70%
Coliforms at 45 °C (MPN/g)	1	< 3,0	< 3,0	< 3,0	< 3,0
	7	< 3,0	< 3,0	< 3,0	< 3,0
	14	< 3,0	< 3,0	< 3,0	< 3,0
	21	< 3,0	< 3,0	< 3,0	< 3,0
Positive coagulase *Staphylococcus* (CFU/g)	1	<100	<100	<100	<100
	7	<100	<100	<100	<100
	14	<100	<100	<100	<100
	21	<100	<100	<100	<100

Parameters	Time (days)	Formulations			
		Control	30%	50%	70%
Salmonella spp. (presence/absence)	1	absent	absent	absent	absent
	7	absent	absent	absent	absent
	14	absent	absent	absent	absent
	21	absent	absent	absent	absent
Mold and Yeasts (CFU/g)	1	<100	<100	<100	<100
	7	<100	<100	<100	<100
	14	<100	<100	<100	<100
	21	<100	<100	<100	<100
Lactic Acid bacteria (CFU/g)	1	8.0^{Aa} x 10^{7}	1.7^{Ab} x 10^{7}	3.6^{Ac} x 10^{7}	3.1^{Ad} x 10^{7}
	7	4.0^{Ba} x 10^{6}	2.9^{Bb} x 10^{6}	4.9^{Bc} x 10^{6}	4.3^{Bd} x 10^{6}
	14	1.3^{Ba} x 10^{6}	1.3^{Ba} x 10^{6}	1.6^{Bb} x 10^{6}	3.5^{Bc} x 10^{6}
	21	2.0^{Ba} x 10^{6}	2.3^{Bb} x 10^{6}	1.2^{Bc} x 10^{6}	4.0^{Bd} x 10^{5}

The microbial counts of fermented coconut beverages were below the limits recommended by Brazilian legislation (Brasil 2019a and Brasil 2019b), characterizing the product as suitable for human consumption. The high microbiological quality of coconut beverages can be attributed to the heat treatment, the quality of raw materials used and the good manufacturing practices applied at all stages of processing. In the 10 formulations of pasteurized green coconut beverages, Teixeira et al. (2019) found coliform counts values lower than 10 CFU/100g, considering the legislation limit, and *Salmonella* spp. was not detected in any sample tested.

When storage time was evaluated, the BAL count in coconut beverages was always higher (7 $\log_{10}$ CFU g^{-1}) on the first day of storage, while after 7 days, these values were decreased (6 $\log_{10}$ CFU g^{-1}). According to Khorshidian et al. (2020), various aspects are related when considering the viability of cultures, such as storage temperature, type of probiotic strain, pH value, presence of organic acids, and level of metabolites.

Physicochemical Evaluation

Physicochemical changes in green coconut fermented beverages were evaluated between types of green coconut beverages and during storage at low temperatures (Table 3). Fermented beverages showed no differences ($p > 0.05$) between the types of green coconut beverages for the parameters of titratable acidity on all days of storage and moisture at 7 days of storage.

There was a statistical difference ($p < 0.05$) between the green coconut beverage formulations and pH and ash parameters. A similarity was observed between the control formulation and the beverage made with 70% green coconut. Moisture was lower in the formulation with a higher amount of coconut and a lower amount of milk at 1, 14, and 21 days of storage. The lower moisture value in the formulation with 70% of green coconut is due to the decrease in the added milk content.

Regarding the parameter of total proteins, differences were observed ($p < 0.05$) between the control formulation for the others, being smaller as the percentage of coconut increased. The values also showed a statistical difference ($p < 0.05$) for the fat parameter, with an increase in the values as the percentages of green coconut increased.

Table 3. Mean values of the physicochemical quality parameters green coconut fermented beverages during refrigerated storage. Data expressed as mean ± SD. Different superscript lowercase letters, on the same line (formulations) and different superscript uppercase letters on the same columns (times), indicate statistical differences at the 5% probability level in Tukey's test.

Parameters	Time (days)	Formulations			
		Control	30%	50%	70%
pH	1	$5.27^{aA} \pm 0.00$	$4.75^{bA} \pm 0.00$	$4.95^{bA} \pm 0.00$	$5.20^{aA} \pm 0.00$
	7	$4.83^{aB} \pm 0.02$	$4.53^{bB} \pm 0.09$	$4.62^{bB} \pm 0.02$	$4.76^{aB} \pm 0.02$
	14	$4.74^{aC} \pm 0.01$	$4.43^{bC} \pm 0.01$	$4.52^{bC} \pm 0.13$	$4.72^{aC} \pm 0.08$
	21	$4.60^{aD} \pm 0.01$	$4.39^{bD} \pm 0.01$	$4.45^{bD} \pm 0.00$	$4.88^{aD} \pm 0.08$
Titratable acid (g/100g^{-1})	1	$0.81^{aA} \pm 0.00$	$0.79^{aA} \pm 0.00$	$0.77^{aA} \pm 0.00$	$0.83^{aA} \pm 0.00$
	7	$0.85^{aB} \pm 0.02$	$0.81^{aA} \pm 0.01$	$0.74^{aA} \pm 0.01$	$0.75^{aA} \pm 0.05$
	14	$1.13^{aB} \pm 0.04$	$1.19^{aB} \pm 0.04$	$1.10^{aB} \pm 0.03$	$1.22^{aB} \pm 0.00$
	21	$1.28^{aB} \pm 0.02$	$1.21^{aB} \pm 0.03$	$1.23^{aB} \pm 0.13$	$1.28^{aB} \pm 0.02$
Moisture (g/100g^{-1})	1	$79.49^{aA} \pm 0.20$	$80.14^{aA} \pm 0.14$	$79.06^{aA} \pm 0.05$	$77.08^{bA} \pm 0.18$
	7	$79.75^{aB} \pm 0.10$	$79.85^{aB} \pm 0.12$	$78.91^{aB} \pm 0.26$	$78.33^{aB} \pm 1.89$
	14	$79.90^{aC} \pm 0.09$	$79.94^{aC} \pm 0.02$	$78.94^{bB} \pm 0.02$	$77.14^{cA} \pm 0.05$
	21	$79.63^{aD} \pm 0.13$	$80.15^{aA} \pm 0.05$	$79.03^{aA} \pm 0.07$	$77.36^{aC} \pm 0.10$
Ash (g/100g^{-1})	1	$0.82^{aA} \pm 0.03$	$0.55^{bB} \pm 0.04$	$0.60^{bB} \pm 0.02$	$0.78^{aA} \pm 0.04$
	7	$0.79^{aA} \pm 0.10$	$0.68^{bA} \pm 0.06$	$0.66^{bB} \pm 0.02$	$0.82^{aA} \pm 0.00$
	14	$0.60^{aB} \pm 0.00$	$0.66^{aB} \pm 0.06$	$0.73^{aB} \pm 0.02$	$0.68^{bB} \pm 0.03$
	21	$0.78^{aA} \pm 0.04$	$0.82^{bA} \pm 0.03$	$0.78^{aA} \pm 0.00$	$0.84^{bA} \pm 0.01$

Parameters	Time (days)	Formulations			
		Control	30%	50%	70%
Total Proteins (g/100g^{-1})	1	3.09^{aA} ± 0.02	2.55^{aA} ± 0.79	2.67^{aA} ± 1.01	2.51^{aA} ± 0.08
	7	2.88^{aA} ± 0.00	2.52^{aA} ± 0.13	2.36^{aA} ± 0.05	2.45^{aA} ± 0.14
	14	2.88^{aA} ± 0.06	2.57^{aA} ± 0.23	2.33^{aA} ± 0.55	2.32^{aA} ± 0.16
	21	2.87^{bA} ± 0.22	2.56^{aA} ± 0.21	2.31^{aA} ± 0.18	2.37^{aA} ± 0.04
Fat (g/100g^{-1})	1	2.10^{bA} ± 0.00	1.95^{bB} ± 0.07	2.65^{aB} ± 0.07	3.35^{aA} ± 0.35
	7	1.85^{bA} ± 0.49	1.80^{bB} ± 0.28	3.35^{aA} ± 0.07	3.40^{aA} ± 0.17
	14	2.05^{bA} ± 0.07	2.65^{bA} ± 0.07	2.90^{aB} ± 0.07	3.35^{aA} ± 0.42
	21	2.55^{bA} ± 0.07	3.35^{aA} ± 0.35	3.40^{aA} ± 0.00	4.00^{aA} ± 0.01
Carbohydrates (g/100g^{-1})	1	14,50^{aA} ± 0.01	14,81^{aB} ± 0.03	15,02^{aC} ± 0.03	16,28^{aD} ± 0.03
	7	14,73^{bA} ± 0.01	15,15^{bB}± 0.00	14,72^{bA} ± 0.02	15,00^{bC} ± 0.02
	14	14,57^{cA} ± 0.02	14,18^{cB} ± 0.02	15,10^{cC} ± 0.01	16,51^{cD} ± 0;03
	21	14,17^{dA} ± 0.00	13,12^{dB} ± 0.02	14,48^{dC} ± 0.02	15,43^{dD} ± 0.04

When analyzing the effect of storage on physicochemical parameters, a statistical difference was observed ($p < 0.05$) for moisture in 50% and 70% green coconut formulations. In the same way, the carbohydrates content presented statistical difference ($p < 0.05$) between all formulation and days of treatment, excepted by control and 50% formulation at 7th day. By the end of the 21st day, the carbohydrate content had decreased compared to the 1st day. The use of carbohydrates as substrate by lactic acid bacteria also justifies the reduced value.

Concerning total proteins parameters, no statistical difference was observed ($p > 0.05$). The fat contents showed variation during the storage times only for the beverages added with 30% and 50% of green coconut. Percentages different in formulations, and characteristics inherent to the green coconut production, efadoclimatic conditions, and maturation stage can influence values (Santos et al. 2020).

The pH values decreased during the 21 days of storage while there was an increase in titratable acidity ($p < 0.05$). The decrease in pH and consequent increase of acidity is due to the action of the microbial culture, since they ferment the sugars present, producing organic acids (Durmus et al. 2021). For titratable acidity, it is observed that from the seventh day there is a stabilization in the values. Stabilization of pH and acidity during storage has also been reported by other researchers who conducted studies with yogurt (Gomes et al. 2013; Pachekrepapol et. al 2021; Jiménez-Redondo et al. 2022). When observed the stabilization of pH and acidity at the end of the storage period for the dairy beverages, it can be assumed to the cessation or inhibition of enzymatic activity and decrease in bacterial population or even the depletion of sugars in the substrates (Gomes et al. 2013; Maní-López et al. 2014).

Sensory Evaluation

The green coconut fermented beverages were subjected to acceptance and purchase intention with 1 day of storage as shown in Table 4. All beverages received similar scores ($p > 0.05$) for flavor, after-taste, and overall acceptance. For the attributes of color and texture, the beverages added with 50% and 70% of green coconut obtained higher scores than the control formulation and the one added with 30% of green coconut. The addition of more than 50% of green coconut in the beverage caused a modification in the texture, making it thicker which was also noticed by the panelists.

The green coconut beverages received scores as “liked slightly” or “liked moderately” categories for all sensory attributes tested. To verify the acceptability of the beverages, the acceptability factor (AF) was calculated, obtaining the following values: Control: AF = 79,9%, 30%: AF = 69%, 50%: AF = 74,9%, and 70%: AF = 71,1%. The average was estimated at 71,75%, a well-accepted value. According to Prado et al. (2015) and Dutcosky (1996), a product needs to get the AF > 70% to be considered satisfactory. For acceptability index, panelists preferred control and formulation at 50%, followed by 70%. By contrast, the formulation with 30% of green coconut pulp obtained lower acceptance rate, demonstrating panelists’ preference for a beverage with mild coconut flavor.

Table 4. Mean values for attributes in the sensory evaluation of green coconut fermented beverages, followed by storage at low temperature. CV (%) = coefficient of variation. Data expressed as mean ± SD. Different lowercase letters, on the same line, indicate statistical differences at the 5% probability level in Tukey’s test.

Attributes	Formulations			
	Control	30%	50%	70%
Appearance	$7.69^{a} \pm 1.35$	$6.50^{b} \pm 1.89$	$6.79^{b} \pm 1.61$	$6.24^{b} \pm 1.96$
Color	$6.10^{a} \pm 1.15$	$6.76^{a} \pm 1.85$	$7.31^{b} \pm 1.33$	$7.38^{c} \pm 1.47$
Flavor	$7.21^{a} \pm 1.51$	$6.60^{a} \pm 1.72$	$6.40^{a} \pm 1.63$	$6.69^{a} \pm 1.74$
After taste	$6.76^{a} \pm 2.05$	$6.40^{a} \pm 1.82$	$6.41^{a} \pm 1.67$	$6.60^{a} \pm 1.54$
Texture	$5.95^{a} \pm 2.06$	$5.93^{a} \pm 2.10$	$6.86^{b} \pm 1.67$	$6.07^{b} \pm 2.15$
Overall acceptance CV (%)	$7.19^{a} \pm 1.73$ 0.10	$6.21^{b} \pm 1.80$ 0.05	$6.74^{c} \pm 1.58$ 0.05	$6.40^{d} \pm 1.94$ 0.07

The purchase intention data of green coconut beverage (Table 5) revealed that the formulation with 30% of green coconut did not receive a higher purchase approval, presenting about 34% of rejection, while the control and 50% formulation demonstrated with greater acceptance (scores attributed from the neutral point “might or might buy” until “would certainly buy”). Teixeira et al. (2019) evaluated the acceptance of green coconut smoothies and obtained results similar to this study (6.45), with average scores of 7.

Table 5. Percentage for purchase intention in the sensory evaluation of green coconut fermented beverages, followed by storage at low temperature.

Scales	Formulations			
	Control	**30%**	**50%**	**70%**
Would definitely buy / Would probably buy	60%	26%	45%	41%
Might or might not buy	19%	40%	34%	22%
Would probably not buy / Would definitely not buy	21%	34%	21%	36%

Conclusion

The results of the present study revealed that the use of solid albumen (pulp) of green coconut is a good option to be used in the development of fermented beverages. For all percentages of green coconut used (30%, 50%, and 70%), beverages of good microbiological quality and physicochemical parameters were obtained, very similar to the composition of dairy beverages made with no coconut. In the sensory tests, the formulation added with 50% coconut was the one that obtained the highest AF and purchase intention. Thus, the development of products with green coconut pulp is an alternative to combat the waste of this raw material of good nutritional quality, in addition to adding economic value to coconut in Brazil and with the possibility of use in gastronomy.

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