

Sensory evaluation of cashew (*Anacardium occidentale* L.) and pineapple (*Ananas comosus* L.) Juice with lemongrass (*Cymbopogon citratus*)

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Abstract

This experimental study aimed to analyze the sensory characteristics of cashew-pineapple juice enriched with lemongrass in different proportions in terms of appearance (color) and (degree of clarity), aroma, taste (sweetness), (sourness) and (aftertaste), flavor, and texture. The analyses revolved around the 30 expert evaluators who examined the sensory characteristics of the products. Both descriptive and inferential measures were employed to answer the queries raised in this study. This study revealed that the proportion with high pineapple content (25 grams cashew apple & 75 grams pineapple juice) has a deeper yellow color and is cloudier with visible pulp. This proportion also resulted in a fruity and citrusy aroma with a harmonious blend of natural sweetness but has minimal sourness and a citrusy aftertaste. Furthermore, the findings of this study showed that lemongrass can be used as an enrichment in cashew-pineapple juice in the form of an extract. This added natural component not only improves the nutritious qualities of the juice but also its sensory attributes due to its distinct aroma and pleasant aftertaste. Moreover, a wide dissemination of the results of this study is encouraged through training, seminars, and workshops. Also, since Cashew is regarded as the “One Town, One Product” of Palawan, the province's tourism industry may consider this product as an additional local product that can be commercialized not only by local tourists but also to foreign tourists. This may also provide local cashew farmers with additional income since not only the cashew nuts will be commercialized but also the cashew apples.

INTRODUCTION

Fruits are vital components of a healthy and balanced diet due to their high content of minerals, vitamins, fiber, and beneficial non-nutrient substances known as bioactive compounds. The World Health Organization (WHO, 2020) recommends the consumption of at least 400 grams (about five portions) of fruits and vegetables per day. A high fruit intake is one of the cornerstones of a nutritious lifestyle and has been recommended to the general public to lower the risk of diseases that cause premature death across the world. However, despite these nutrients and health-improving properties,

numerous health studies underscored that the fruit consumption of the general population did not meet the said fruit recommendation (Kalmpourtzidou et al., 2020; Agarwal, 2019). In response, researchers find ways to address this pressing problem in fruit consumption, one of which is through making fruit juices, which is a good option to help increase fruit and vegetable intake by the population (Benton & Young, 2019). In recent years, there has been a significant increase in the demand for fruit juices, which may be attributed to changes in consumers' dietary habits. However, despite their exceptional

nutritional value, certain fruits are still inedible due to their high acidity and astringency. As a result, several studies have combined multiple fruit juices to produce a beverage that substantially improves its nutritional value and flavor (Adeyeye et al., 2014; Das & Arora, 2017).

This captured the researcher's interest in blending cashew apples with pineapple juice to create a beverage with high nutritional value and acceptable sensory characteristics. Given that Palawan's tropical climate and fertile soil make it an ideal location for cultivating a wide variety of tropical fruits, such as cashew (*Anacardium occidentale*). In fact, Palawan is regarded as the top cashew-producing province in the Philippines and has been recognized as the country's cashew capital. According to statistics, Palawan accounts for 90% of total cashew production in the country. With Palawan's abundance of this fruit, cashews have been dubbed the province's One Town, One Product (OTOP). Despite being the country's largest cashew grower, many of Palawan's cashew farmers are still aware of the issue of low income. This was partly caused by the underutilization of the cashew fruit, as only the nuts were used, whereas cashew apples were typically discarded and became waste material.

Due to the high astringency of cashew apple juice, researchers suggest blending it with tropical fruits like pineapple (*Ananas comosus*). Akinwande et al. (2013) highlighted that this

addition adds natural sweetness and unique tropical flavors, creating a refreshing and harmonious blend. The high vitamin C content in pineapple also enhances the juice's nutritional value, making it a healthy and delicious beverage option. This is consistent with the findings of Ogunlade et al. (2018), who noted that the addition of pineapple juice enhanced the flavor and aroma of cashew apple juice by complementing its acidity and sweetness. Furthermore, Akyereko et al. (2023) recommended that the utilization of cashew apples can be enhanced by blending them with pineapple juice to reduce the level of their astringency for better nutrition and food security.

Pineapple is also one of the products in the southernmost part of Palawan. It is a tropical fruit prized for its distinctive aroma and sugary flavor. Like other fruits, pineapple contains vitamins, minerals, fiber, and enzymes which facilitate good digestion and support the maintenance of a healthy body weight and balanced nutrition. Moreover, it is also the researcher's belief that combining cashew apple and pineapple juices can be another notable beverage since the tropical sweetness of pineapple and the mild tanginess of cashew apple result in a refreshing and exotic juice blend with enhanced sensory qualities. In support, Oliveira et al. (2019) found that adding lemongrass to fruit juices enhanced their sensory characteristics, while Kieling & Prudencio (2018) and Bocharé et al.

(2020) also supported this, highlighting the positive impact of lemongrass on customer satisfaction. In addition to its culinary uses, lemongrass is well known for its numerous health advantages. Lemongrass has bioactive chemicals that are beneficial for various medical problems (Olorunnisola et al., 2014). Similarly, it is abundant in anti-inflammatory and antibacterial compounds (Nambiar et al., 2012). Due to the numerous benefits that lemongrass can provide, the researcher asserts that it can be a versatile ingredient that can be blended with cashew apple, and pineapple juice to create delicious and nutritious drinks.

Numerous studies on the nutritional content and sensory qualities of fruit juices have been conducted over the years (Matabura & Kibazohi, 2021; Pinto et al., 2022; & Song et al., 2023). These studies highlighted the importance of analyzing the sensory qualities of fruit juices and determining the relationship between those qualities and the nutritional and health benefits the juices provide. Sensory analysis is a useful method for analyzing these characteristics and understanding the chemical composition of fluids. According to the findings of Adejumo et al. (2017), the sensory properties of fruit juices, such as their sweetness, acidity, and aroma, have a significant relationship with their chemical composition. Wang et al. (2018) established a correlation between sensory characteristics like sweetness, sourness, and

bitterness and the chemical composition of juices, which supported this.

Several research studies have evaluated the sensory characteristics of fruit juices in terms of appearance. These studies often used sensory evaluation panels to assess various characteristics, such as the color and clarity of the fruit juices. According to Russo et al. (2012), appearance is the most important sensory attribute, indicating that consumers rely heavily on visual cues when making decisions about purchasing and consuming fruit juices. Moreover, several studies have shown that sensory evaluation of appearance is an important factor in consumer acceptance of fruit juices (Pinto et al., 2022; & Song et al., 2023). In the same vein, color is one of the primary sensory characteristics that consumers use to evaluate food and beverages as it provides important information about the quality, freshness, and ripeness of a product, and can also affect the perceived flavor and aroma (Santos, et al., 2016). Spence (2015) asserted that when it comes to influencing consumers' expectations about the expected taste and flavor of food and beverages, color is the most significant intrinsic sensory signal found in products. Numerous studies have highlighted the fact that customers typically like uniformly colored fruits and vegetables because they are thought to be more appetizing and nutritious (Marc et al., 2019; Bezerra et al., 2017). Similarly, the study conducted by Silva et al. (2020)

investigated the sensory and physicochemical analysis of pineapple fruit juice at different ripeness levels. This is similar to the study conducted by Santos et al. (2021) which stressed that consumers prefer a bright, yellow-orange juice with a clear appearance. As regards cashew apple juice, the study by Silva et al. (2018) highlighted that consumers prefer cashew apple juice that is typically clear and has a light yellow color. Several studies, though, suggest that the color of cashew apple juice or extract is influenced by a variety of factors, including the presence of pigments, processing methods, and storage conditions (Viera et al., 2016; Bezerra et al., 2017).

Furthermore, a substantial amount of research has been conducted on the nutritional attributes of cashew apples, pineapples, and lemongrass. The literature and studies stressed that the cashew apple is a great source of protein, carbohydrates, minerals, vitamins, and bioactive components, whereas pineapple is a high-fiber fruit that is rich in calcium, potassium, vitamin C, carbohydrates, water, and various minerals that are beneficial for the digestive system and assist in maintaining a healthy weight and diet. Meanwhile, the cashew apple contains a considerably higher concentration of vitamin C than the vast majority of other tropical fruits. In fact, the vitamin C content of the cashew apple is five times that of an orange and ten times that of a pineapple. Furthermore, the

review dealt with the health benefits and nutritional values of mixing fruit juices such as cashew apples and pineapples to produce healthy beverages. Numerous studies on the cashew pineapple's nutrients and contribution to human nutrition have been conducted. Add to these, the literature that emphasized the need for lemongrass, as a notable local ingredient, to be added to cashew-pineapple juice as an enrichment, not only for its nutritional characteristics but also for its sensory attributes, which significantly contribute to the beverage's acceptability.

At present, no studies have been conducted on blending cashew apples and pineapple with lemongrass as a beverage. Thinking along these lines, it is a good opportunity to use local ingredients to develop fruit beverages that could be a valuable carrier for providing additional health benefits by adding functional ingredients. Hence, this became the impetus for this study.

METHODS

Research Design

To answer the queries raised in this study, experimental research was utilized. Experimental design, as defined by Bell (2009), is the process of doing research in a controlled and objective manner to maximize precision and derive certain conclusions about a hypothesis statement. Furthermore, this research strategy aims to ascertain

the noteworthy impact of a component or independent variable on a dependent variable. This study developed juice from cashew apple and pineapple with lemongrass in different proportions and determined the sensory characteristics and level of acceptability of the finished juice.

In order to have a reliable and meaningful result, a completely randomized block design (CRDB) was employed. In this study, each sample was evaluated in three replications (refer to Figure 1). To avoid biases during the evaluation, each replication was randomly selected to make the experimental layout.

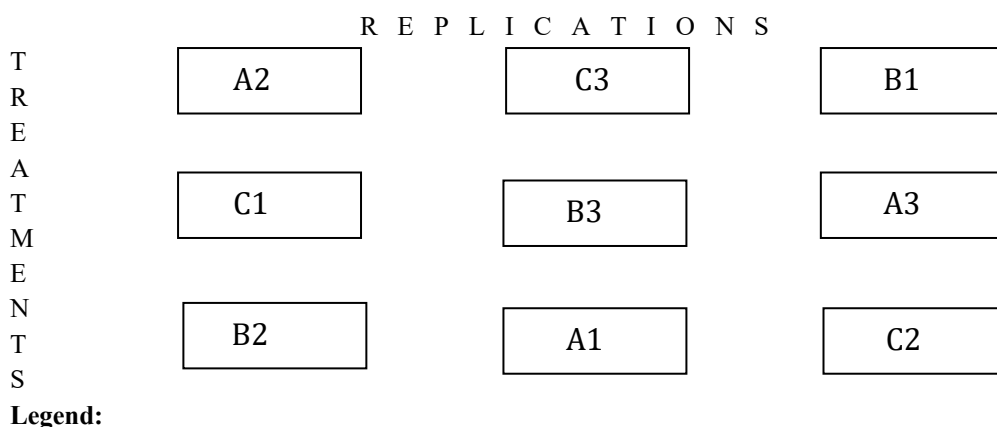


Figure 1. *Experimental lay-out of cashew-pineapple juice with lemongrass.*

Participants of the Study

The study employed 30 respondents who served as expert evaluators. This included Home Economics and Technology and Livelihood Education teachers and experts from food management from Palawan State University, Puerto Princesa, Palawan. They determined the sensory characteristics of the cashew - pineapple juice enriched with lemongrass in different formulations in terms of appearance (color and degree of clarity), aroma, taste (sweetness, sourness, and aftertaste),

flavor, texture, and general acceptability. Prior to evaluation, they were properly oriented on the rationale and objectives of the study as well as their roles as the respondents of the study. Moreover, for ethical consideration, informed consent was also provided.

Data Analysis and Procedure

To determine the sensory characteristics of the product, the Sensory Evaluation Checklist was used. The data were gathered, tabulated,

summarized, and computed using the following statistical tools: Frequency count and percentage were used to determine the sensory characteristics of cashew-pineapple juice with lemongrass in different

formulations in terms of appearance (color and degree of clarity), aroma, taste (sweetness, sourness, and aftertaste), flavor, texture, and general acceptability.

RESULTS

Sensory Characteristics of Cashew-Pineapple Juice with Lemongrass

Table 1. *Cashew and pineapple juice with lemongrass in different formulations in terms of appearance (color)/*

Appearance		Formulations					
		A (75-25)		B (50-50)		C (25-75)	
Color							
1.	The color of the product is pale yellow. 	24	80%	2	7%	2	7%
2.	The color of the product is lively yellow. 	4	13%	20	67%	10	33%
3.	The color of the product is deeper yellow 	2	7%	8	27%	18	60%

As shown in the table, as to appearance, categorized as to color of the juice, 24 or 80% of the respondents evaluated Formulation A as pale yellow, while 20 or 67% of the respondents evaluated Formulation B, as lively yellow, and finally, 18 or 60% of the respondents, evaluated Formulation C as deeper yellow. The pattern indicates that as the amount of pineapple juice in the formulation increases, the color of the cashew-pineapple juice with lemongrass becomes deeper yellow, whereas the formulation with a high content of cashew apple juice yields a pale-yellow color. Furthermore, the deeper-yellow color of juice obtained from Formulation C can be attributed to the deeper yellow

hue of juice extracted from pineapples, while the pale-yellow color of Formulation C can be attributed to the color of juice extracted from cashew apples, which is characterized as a pale to light yellow color. This means that the formulations of cashew apple, and pineapple juice contributed to the results of the juice color. This further means that the color of the juice, in greater amounts, contributed to the color of the finished beverage. This implies that a fruit juice's color has an impact on the color of the beverage where it is mixed, especially if it is presented in a greater amount than the other juices in the mix; it produces a shade of color visible to the eyes. The study by Viera et al. (2016) supports the

findings mentioned above. The findings revealed that cashew apple juice is typically clear and has a light-yellow color. This study further underscores the importance of understanding how ingredients

interact and influence the sensory attributes of beverages, emphasizing the need for a better understanding of ingredient interactions.

Table 2. *Cashew and Pineapple Juice with Lemongrass in Different Formulations in terms of Appearance (Degree of Clarity).*

Appearance	Formulations					
	A (75-25)		B (50-50)		C (25-75)	
Degree of Clarity						
1. It is slightly clear with low opaqueness.	18	60%	6	20%	6	20%
2. It is slightly cloudy with mild opaqueness	8	27%	16	53%	10	33%
3. It is cloudier with visible pulp or fiber.	4	13%	8	27%	14	47%

As to the degree of clarity of the products, Table 2 depicts that Formulation A was characterized by 18 or 60% of the evaluators as slightly clear with low opaqueness, Formulation B was characterized by 16 or 53% as slightly cloudy with mild opaqueness and Formulation C was characterized by 14 or 47% as cloudier with visible pulp or fiber. The trend depicts that the formulation with a high content of cashew apple juice resulted in a slightly clear juice with low opaqueness, while the formulation with a high pineapple content yielded a juice that was cloudier with visible pulp or fiber. This means that the degree of clarity of the juices

depended on the formulation of pineapple juice with lemongrass extract. This further means that the level of opaqueness and visibility of the pulp juice varied depending on the amount of pineapple extract added. The greater the amount of pineapple juice extract, the cloudier and more visible the pulp or fiber. This implies that a greater concentration of pineapple juice yields a cloudier and more visible pulp or fiber in the beverage. This result confirms the findings of Beserra et al. (2019) that pineapple juice tends to be thicker, cloudier, and more viscous, most especially when the pineapple fruit is fully ripe.

Table 3. *Cashew and pineapple juice with lemongrass in different formulations in terms of aroma.*

Aroma	Formulations					
	A (75-25)		B (50-50)		C (25-75)	
1. The product has a fruity and refreshing aroma.	14	46%	8	27%	8	27%
2. The product has a sweet and musky aroma.	8	27%	18	60%	4	13%
3. The product has a fruity and citrusy aroma.	8	27%	4	13%	18	60%

Table 3 shows the evaluation of the three formulations on the aroma of the products. With Formulation A, 14 or 46% of the respondents characterized the aroma of the product as fruity and refreshing; with Formulation B, 18 or 60% of the respondents characterized the juice's aroma as sweet and musky; and with Formulation C, 18 or 60% of the respondents characterized the juice as having a fruity and citrusy aroma. This means that the smell of the juices varied depending on the amounts of cashew apple and pineapple juice that were mixed with lemongrass extract. Formulation A had a fruitier aroma that came from the cashew apple extract, whereas Formulation C had the vibrant and citrusy characteristics of the pineapple. Furthermore, a slight touch of lemongrass became apparent, imparting in the mixture a hint of herbal freshness and tanginess. This also highlighted the fact that adding lemongrass adds a subtle hint of herbal freshness and lemony-ness to the blend. This is parallel with what Oliveira et al. (2019) and Kieling and Prudencio (2018) stressed in their studies - that the aroma of fruit juices can be enhanced through the use of natural ingredients like lemongrass. This

implies that, aside from adding to the nutritive properties of the cashew-pineapple juice, lemongrass significantly improves its smell.

As shown in Table 4, as to taste, in terms of the sweetness of the products, Formulation A, was evaluated by 18 or 60% of the respondents as having a subtle and moderate level of natural sweetness. Formulations B and C were evaluated by 14 or 60% and 18 or 60% of the respondents, respectively, as having a harmonious blend of natural sweetness. This means that a higher amount of pineapple juice mixed with cashew juice and lemongrass extract produces a sweeter beverage. This further means that the natural sweetness coming from the pineapple juice has a great impact on the overall taste of cashew-pineapple juice. This agrees with Krishna et al. (2017) who assessed the acceptability of cashew apple juice. Their study found that sweetness was the most important attribute affecting the overall liking of the juice. Added to this, they found out that consumers preferred cashew apple juice that was moderately sweet, and those that were too sour or too sweet were

less preferred. Added to this, the study by Robbani et al. (2022) revealed that naturally ripened fruits have a sweeter taste than those artificially ripened.

Table 4. *Cashew and pineapple juice with lemongrass in different formulations in terms of taste (sweetness, sourness, and aftertaste).*

Taste	Formulations					
	A (75-25)		B (50-50)		C (25-75)	
SWEETNESS						
1. It has a subtle and moderate level of natural sweetness.	18	60%	8	27%	2	7%
2. It has a harmonious blend of the natural sweetness.	6	20%	14	46%	18	60%
3. It has an intense, vibrant and tangy sweetness.	6	20%	8	27%	10	33%
SOURNESS						
1. It has hint of tartness/sourness.	20	67%	2	7%	4	13%
2. It has a minimal sourness.	6	20%	10	33%	16	54%
3. It has a balance between sweetness and a mild citrus taste.	4	13%	18	60%	10	33%
AFTER TASTE						
1. It has a mild tangy aftertaste	20	67%	6	20%	4	13%
2. It has a refreshing and tropical aftertaste	6	20%	16	53%	8	27%
3. It has rich tropical fruitiness and citrusy aftertaste.	4	13%	8	27%	18	60%

As to the sourness of the cashew-pineapple juice, results showed that Formulation A was characterized by 20 or 67% of the evaluators as having a hint of tartness/sourness, while Formulation B was characterized by 18 or 60% of them as having a balance between sweetness and a mild citrus taste, and Formulation C was characterized by 16 or 54% of the evaluators as having a minimal sourness. This means that a higher concentration of cashew apple juice affected the level of tartness of the beverage. However, increasing the formulation of pineapple extract, with its natural sweetness significantly reduced the

tartness of the juice. This validates the results of Akinwale (2000), who found that when cashew apple juice was blended with pineapple juice, there were significant improvements in its sensory attributes such as sweetness, sourness, and mouthfeel. Similarly, according to Alves et al. (2017), consumers tend to prefer fruit juices with a balanced taste profile, where the sweetness, sourness, and other taste sensations are in harmony with each other. On the other hand, when lemongrass is added, there is a delightful twist to the fruit juice, infusing it with a zesty, citrusy brightness

that complements the cashew apple and pineapple's sweetness.

In terms of aftertaste, based on the results, Formulation A had a mild tangy aftertaste according to 20 or 67% of the evaluators, while Formulation B had a refreshing and tropical taste according to 16 or 53% of the evaluators. Formulation C was characterized by 18 or 60% of the evaluators as having a rich tropical fruitiness and citrusy aftertaste. This means that with a higher cashew apple juice content mixed with lemongrass extract, the result for the juice is a tangier aftertaste. Increasing the pineapple extract significantly improved the

aftertaste of the fruit juice, resulting in a more refreshing and tropical aftertaste. This study further means that the tangy taste of cashew apple juice can be improved when it is combined with other tropical fruits, such as pineapples. The analysis pinpoints that the natural sweetness and citrusy characteristics of pineapples harmoniously blend with the tangy and musky notes of cashew apples. The above findings corroborate the findings of Adelakun and Taiwo (2020) that blending pineapple juice with other fruit juices resulted in improved physicochemical properties and taste, aside from improving its nutritional and therapeutic properties.

Table 5. *Cashew and pineapple juice with lemongrass in different formulations in terms of texture.*

Texture	Formulations					
	A (75-25)		B (50-50)		C (25-75)	
1. It has a refreshing and light mouthfeel with a creamy and velvety texture.	16	53%	6	20%	4	13%
2. It has a balance of creaminess, juiciness, and the refreshing essence of lemongrass.	8	27%	18	60%	10	33%
3. It has a juicy and hydrating sensation.	6	20%	6	20%	16	54%

Results as reflected in Table 5 show that in terms of the texture of the products, Formulation A was characterized by 16 or 53% of the respondents as having a refreshing and light mouthfeel with a creamy and velvety texture, whereas, Formulation B was characterized by 18 or 60% of the respondents as a beverage that has a balance of creaminess, juiciness, and the refreshing essence of lemongrass. Meanwhile, Formulation C was characterized by 16 respondents or 54% as having a juicy and hydrating

sensation. According to Marc et al. (2019), the texture of fruit juices can be influenced by various factors, such as the processing method, the type of fruit used, and the presence of pulp or particulate matter. They further explained that some fruit juices may be filtered or clarified to remove any particles or pulp, resulting in a smooth, uniform texture, whereas other fruit juices may be left unfiltered to retain the pulp or particulate matter, resulting in a more textured product. This means that aside from

improving the flavor of cashew-pineapple juice, the addition of lemongrass affects the texture of the fruit juice, which may result in a high level of acceptability.

This clearly implies that increasing the content of cashew apple extract results in a creamier and more velvety-textured beverage, while a high content of pineapple extract yields a juicier and more refreshing beverage. Likewise, adding lemongrass also introduces a subtle, citrusy edge that dances on the taste buds, adding vibrancy to the

overall experience. In the study conducted by Gomes et al. (2020), consumers tend to prefer fruit juices with a smooth, uniform texture that is free of any particles or pulp. However, some consumers may prefer fruit juices with pulp or other particulate matter, which can provide a different textural experience. The study by Oliveira et al. (2019) revealed that blending lemongrass significantly impacts the overall texture because of its refreshing essence, which boosts the sensory properties of the fruit juices.

Table 6. *Cashew and pineapple juice with lemongrass in different formulations in terms of flavor.*

Flavor	Formulations					
	A (75-25)		B (50-50)		C (25-75)	
1. It has a subtle, nutty undertone flavor.	16	53%	6	20%	4	13%
2. It has a citrusy tang, herbal notes, and a hint of nuttiness.	8	27%	18	60%	10	33%
3. It has a bright and tropical fruitiness with a unique and somewhat creamy sweetness.	6	20%	6	20%	16	54%

Table 6 shows the results of the evaluation of the flavor of cashew-pineapple juice in different formulations. The analysis indicates that Formulation A was characterized by 16 or 53% of the respondents as having a subtle nutty undertone flavor due to the high content of cashew apple extract; Formulation B was characterized by 18 or 60% of the evaluators as a beverage that has a citrusy tang, herbal notes, and a hint of nuttiness; and Formulation C was characterized by 16 or 54% of the respondents as having a bright and tropical fruitiness with a unique and somewhat creamy

sweetness. This means that the formulations of cashew apple and pineapple juice and lemongrass extract affect the flavor of the cashew-pineapple juice. This further means that a formulation with a higher content of cashew apple juice has a hint of nuttiness in its flavor, while the natural sweetness and mild sourness of pineapples harmoniously blend with cashew apples, resulting in a tropical and refreshing flavor. These results are consistent with the study of Alves et al. (2017), when they discussed that consumers preferred fruit juices with a balanced

taste profile, where the sweetness, sourness, and
other taste sensations are in harmony with each other.

DISCUSSION

Discuss this further. Write its implications.

Based on the results of the sensory analyses, the juices from cashew apples and pineapples can be effectively combined to create a cashew-pineapple juice infused with lemongrass, offering various formulations that exhibit distinct sensory characteristics. The formulation with high pineapple content features a deeper yellow hue, which is visually appealing and suggests a rich flavor profile. It is cloudier, with visible pulp or fiber, enhancing the texture and mouthfeel, making it more substantial. The taste is less sour, making it more palatable for consumers who prefer sweeter beverages, with the natural sweetness of the pineapple balancing well with the lemongrass for a refreshing drink.

In contrast, the formulation with high cashew apple content presents a pale yellow color, indicating a lighter flavor and a different aesthetic quality. This version is slightly clearer with lower opaqueness, suggesting a smoother texture that appeals to those who prefer a less fibrous drink. It features a hint of tartness from the cashew apple juice, adding a unique dimension to the flavor. This tartness pairs interestingly with the lemongrass, offering a more complex taste experience. Overall, these contrasting characteristics allow for a diverse range of flavor profiles and textures, catering to various consumer preferences and highlighting the

potential for innovative beverage development using cashew and pineapple fruits, enhanced by the aromatic qualities of lemongrass.

Furthermore, combining cashew apple and pineapple juices, enhanced with lemongrass, holds noteworthy benefits for the advancement of beverage innovation and market expansion. Producers can enhance their market appeal by effectively catering to a wide range of consumer tastes by providing a variety of formulations with diverse sensory characteristics. Manufacturers can target different consumer segments by varying the amount of pineapple and cashew apple juice in their formulations. For example, sweeter formulations may attract people who prefer fruit-forward drinks, while formulations with a higher cashew apple content may appeal to people who want a more tart and complex flavor. The distinct colors of the formulations can also be leveraged in marketing strategies, with the deeper yellow hue of the high pineapple variant marketed as vibrant and refreshing, while the pale yellow of the cashew-heavy formulation can be positioned as a lighter, more refined option.

Moreover, since texture plays a major role in how much a beverage is enjoyed, the different textures—cloudy with visible pulp for the pineapple-rich formulation versus the smoother, clearer cashew apple version—improve the customer experience. When marketed with flavor

and texture, health-conscious customers may be drawn to cashew apples and pineapples due to their distinct health advantages, which include vitamins, antioxidants, and digestive enzymes. Likewise, utilizing locally sourced cashew apples and pineapples might appeal to customers who value sustainability and support local agriculture. This innovative combination not only opens new avenues in beverage innovation that creates appealing products that meet diverse consumer preferences while promoting health benefits and sustainability, contributing to both the beverage landscape and the economic viability of local agricultural practices.

FUNDING

This study was entirely self-funded, meaning that the financial resources required for its execution were provided solely by the researchers themselves. There were no external funding sources, such as grants, sponsorships, or financial support from institutions or organizations, involved in any aspect of the study's design, implementation, or analysis.

ETHICAL CONSIDERATIONS

This study on the sensory analysis of cashew-pineapple juice was conducted in accordance with ethical guidelines. All participants provided informed consent prior to their involvement, and they were informed about the

nature of the study, including any potential risks and discomforts. Measures were taken to minimize any discomfort, and participants had the option to withdraw at any time without any consequences. Throughout the research process, their rights and confidentiality were upheld, ensuring that the study met ethical standards while promoting integrity and respect for all individuals involved

DECLARATION OF COMPETING INTEREST

The author declares that there are no competing interests associated with any of the authors involved in this study.

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REFERENCES

- Adebiyi, O. T., Alamu, E. O., Ogunlade, I., & Adeboye, O. O. (2021). Sensory attributes and consumer acceptance of lemongrass (*Cymbopogon citratus*) and ginger (*Zingiber officinale*) juice. *Journal of Food Quality*, 2021, 1-9. <https://doi.org/10.1155/2021/6690490>

- Adejumo, A. A., Adejoro, S. A., & Odedele, O. J. (2017). Sensory and Chemical Characterization of Mango Juice and Nectar. *Journal of Food Quality*, 2017, 1-10. doi: 10.1155/2017/2920479
<https://doi.org/10.1016/j.lwt.2022.114303>.
- Adou, M., Adjouman, Y. D., Kouadio, K. N., Tetchi, A. F., & Amani, N. G. (2021). Improvement of Cashew Apple Juice (<i>Anacardium occidentale</i>) by Association with Passion Fruit Juice (<i>Passiflora edulis</i>). *Food and Nutrition Sciences*, 12(07), 787–804.
<https://doi.org/10.4236/fns.2021.127059>
- Agbangnan P, Gbohaida V, Mossi I, Adjou ES, Yehouenou BB, Sohounhloué DC. Morphological and physicochemical characterizations of cashew apples from Benin for their use as raw material in bioethanol production. *Int J Pharm Sci Res*. 2015; 35(2): 7– 11.
- Ahmed, M. U., Akter, M. S., Eun, J. B., & Lee, M. H. (2016). Physicochemical and sensory properties of cashew apple (*Anacardium occidentale* L.) juice processed by different techniques. *Journal of Food Science and Technology*, 53(5), 2296-2304. doi: 10.1007/s13197-016-2195-3
- Akinwale, T. O. (2000). Cashew apple juice: its use in fortifying the nutritional quality of some tropical fruits. *European Food Research and Technology*, 211(3), 205–207. <https://doi.org/10.1007/s002170050024>
- Akinwande, O. A., Olusola, O. O., & Adebowale, A. A. (2013). Sensory evaluation of blended cashew apple juice with other tropical fruits. *Journal of Food Science and Technology*, 50(4), 739-744. doi:10.1007/s13197-011-0455-2
- Akyereko, Y. G., Wireko-Manu, F. D., Alemawor, F., & Adzanyo, M. (2022b). Cashew Apples in Ghana: Stakeholders' Knowledge, Perception, and Utilization. *International Journal of Food Science*, 2022, 1–10.
<https://doi.org/10.1155/2022/2749234>
- Ali, M., Hashim, N., Aziz, S. A., & Lasekan, O. (2022). Quality prediction of different pineapple (*Ananas comosus*) varieties during storage using infrared thermal imaging technique. *Food Control*, 138, 108988.
<https://doi.org/10.1016/j.foodcont.2022.108988>
- Alves, R. A. B., Nascimento, A. C., Vieira, M. C., & Monteiro, M. (2017). Physicochemical and sensory characteristics of pineapple juice from conventional and organic production systems. *Journal of Food Quality*, 2017, 1-10. DOI: 10.1155/2017/9734920
- Assunção RB, Mercadante AZ. Carotenoids and ascorbic acid from cashew apple (*Anacardium occidentale* L.): variety and geographic effects. *Food Chem*. 2003; 81(4): 495– 502.
- Benton, D., & Young, H. A. (2019). Role of fruit juice in achieving the 5-a-day recommendation for fruit and vegetable intake. *Nutrition Reviews*, 77(11), 829–843.
<https://doi.org/10.1093/nutrit/nuz031>
- Bezerra, R. C. N., Vieira, C. R. Y., Oliveira, G. H. H., & Maia, G. A. (2017). Sensory and physicochemical properties of cashew apple juice from different geographic origins in Brazil. *Journal of Food Quality*, 40(3), 1-11. doi: 10.1155/2017/8473213
- Bochare, S. B., Kshirsagar, R. B., & Tt, B. (2020). Studies on development of kiwi fruit RTS beverage incorporated with lemongrass. *Journal of Pharmacognosy and Phytochemistry*, 9, 291–296.
<https://www.phytojournal.com/archives/2020/vol9issue4S/PartE/S-9-4-23-304.pdf>
- Burhooa, K., & Ranghoo-Sa, V. (2012). Evaluation of Different Pineapple (*Ananas comosus* Merr L.) Varieties Using Morphological and Genetic Markers in Mauritius. *Biotechnology (Faisalabad)*, 11(5), 272–27
<https://doi.org/10.3923/biotech.2012.272.279>.
- Couto, D., Cabral, L. M. C., Da Matta, V. M., Deliza, R., & De Grandi Castro Freitas, D. (2011). Concentration of pineapple juice by reverse osmosis: physicochemical characteristics and consumer acceptance. *Food*

- Science and Technology, 31(4), 905–910.
<https://doi.org/10.1590/s0101-20612011000400012>
- Edobane, R. (2017). Squash (*Cucurbita maxima*) Bibingka. [Unpublish master's thesis]. Iloilo Science and technology University, La Paz, Iloilo City
- Fernández-Vázquez, R., Hewson, L., Fisk, I. D., Hernánz, D., Mira, F. J. H., Vicario, I. M., & Hort, J. (2014). Colour influences sensory perception and liking of orange juice. *Flavour*, 3(1). <https://doi.org/10.1186/2044-7248-3-1>
- Gawankar MS, Salvi BR, Pawar CD, Khanvilkar MH, Salvi SP, Dalvi NV, et al. Technology development for cashew apple processing in Konkan region—a review. *J Adv Agric Res Technol*. 2018; 2(1): 40–7.
- Gomes, M. K., Ferreira, S. R., Silva, L. M., & Oliveira, E. F. (2020). Sensory evaluation of pineapple juice with different levels of pulp and sugar. *Food Science and Technology (Campinas)*, 40(4), 791-797. doi: 10.1590/fst.14919
- Hanna, M., Jaqua, E., Nguyen, V. T., & Clay, J. T. (2022). B Vitamins: Functions and Uses in Medicine. *The Permanente Journal*, 26(2), 89–97. <https://doi.org/10.7812/tpp/21.204>
- Hikal, W., Mahmoud, A. , Said-Al Ahl, H. , Bratovic, A. , Tkachenko, K. , Kačániová, M. and Rodriguez, R. (2021) Pineapple (*Ananas comosus* L. Merr.), Waste Streams, Characterisation and Valorisation: An Overview. *Open Journal of Ecology*, 11, 610-634. doi: 10.4236/oje.2021.119039.
- Hossain, M. F. (2015). Nutritional Value and Medicinal Benefits of Pineapple. *International Journal of Nutrition and Food Sciences*, 4(1), 84. <https://doi.org/10.11648/j.ijnfs.20150401.22>
- Hounhouigan, M. H., Linnemann, A. R., Soumanou, M. M., & Van Boekel, M. (2014). Effect of Processing on the Quality of Pineapple Juice. *Food Reviews International*, 30(2), 112–133. <https://doi.org/10.1080/87559129.2014.883632>
- Ikram, M., Mizuno, R., Putri, S. P., & Fukusaki, E. (2021). Comparative metabolomics and sensory evaluation of pineapple (*Ananas comosus*) reveal the importance of ripening stage compared to cultivar. *Journal of Bioscience and Bioengineering*, 132(6), 592–598. <https://doi.org/10.1016/j.jbiosc.2021.08.008>
- Jiang, Y., Li, Y., Li, Y., & Wang, Z. (2014). Sensory evaluation and quality analysis of pineapple juice. *Journal of Sensory Studies*, 29(6), 419-425. doi: 10.1111/joss.12131
- Joomwong, J., & Joomwong, A. (2018). Physical, chemical quality and sensory evaluation of ‘Smooth Cayenne’ pineapple fruits. *Acta Horticulturae*, 1213, 495–498. <https://doi.org/10.17660/actahortic.2018.1213.73>
- Khanom, S. a. A., Rahman, M. M., & Uddin, M. N. (2016). Preparation of Pineapple (*Ananas comosus*) Candy Using Osmotic Dehydration Combined with Solar Drying. *The Agriculturists*, 13(1), 87–93. <https://doi.org/10.3329/agric.v13i1.26551>
- Kowalska, M., Konopska, J., Feszterová, M., Żbikowska, A., & Kowalska, B. (2023). Quality assessment of natural juices and consumer preferences in the range of citrus fruit juices. *Applied Sciences*, 13(2), 765. <https://doi.org/10.3390/app13020765>
- Lima, A.S., Nascimento, E.M., Brito, T.A., Oliveira, F.J., & Silva, S.B. (2015). Bioactive compounds and antioxidant capacity of cashew apples (*Anacardium occidentale* L.) of several cultivars during ripening. *Journal of Food Science and Technology*, 52(3), 1539-1545. doi: 10.1007/s13197-013-1236-5
- Lorenzo, J. M., & Barba, F. J. (2020). Food enrichment with bioactive compounds: Health benefits and technological advances. *Foods*, 9(6), 747. doi: 10.3390/foods9060747
- Matabura, V. V., & Kibazohi, O. (2021). Physicochemical and Sensory Evaluation of Mixed Juices from Banana, Pineapple and Passion Fruits during Storage.

- Tanzania Journal of Science, 47(1), 332–343.
<https://tjs.udsm.ac.tz/index.php/tjs/article/view/52>
- Miller, J. K., Collins, J. K., Smith, D. L., & Engle-Stone, R. (2020). Food enrichment strategies for micronutrient fortification: An overview. *Nutrients*, 12(2), 457. doi: 10.3390/nu12020457A
- Nascimento, R. Q., Tavares, P. P. L. G., Meireles, S., Anjos, E. a. D., De Andrade, R. B., Machado, B. a. S., Da Costa Souza, A. L., & De Oliveira Mamede, M. E. (2020). Study on the sensory acceptance and check all that apply of mixed juices in distinct Brazilian regions. *Food Science and Technology*, 40(suppl 2), 708–717. <https://doi.org/10.1590/fst.37619>
- Ogunlade, I., Olayemi, F. F., Adebisi, O. T., & Adeboye, O. O. (2021). Sensory evaluation of lemongrass juice with added ginger and honey. *Journal of Food Quality*, 2021, 1-8. <https://doi.org/10.1155/2021/8823630>
- Oliveira, A. M. B., Santana, A. A., & Lago, A. M. T. (2012). Sensory quality evaluation of cashew apple (*Anacardium occidentale* L.) juice from different maturity stages. *Food Science and Technology*, 32(1), 82-88. doi: 10.1590/S0101-20612012005000005
- Pem, D., & Jeewon, R. (2015). Fruit and Vegetable Intake: Benefits and Progress of Nutrition Education Interventions- Narrative Review Article. *Iranian journal of public health*, 44(10), 1309–1321.
- Pinheiro, A. C., de Santana, A. A., de Oliveira, M. E., Silva, M. A. A. P., & de Souza, E. L. (2020). Sensory analysis and consumer acceptance of cashew apple juice with different sugar concentrations. *Journal of Food Quality*, 2020, 1-9. doi: 10.1155/2020/8829153
- Rajasekar, D., Akoh, C. C., Martino, K. G., & MacLean, D. D. (2012). Physico-chemical characteristics of juice extracted by blender and mechanical press from pomegranate cultivars grown in Georgia. *Food Chemistry*, 133(4), 1383-1393.
- Salehi, F. (2020). Recent applications of powdered fruits and vegetables as novel ingredients in biscuits: a review. *Nutrire*, 45(1), 1. <http://dx.doi.org/10.1186/s41110-019-0103-8>
- Santos, M. R. A., Cunha, C. R., Lima, L. C. O., Silva, M. A. A. P., & Carvalho, A. V. (2016). Sensory quality and acceptability of pineapple juice processed by different technologies. *Food Science and Technology*, 36(2), 321-326. doi: 10.1590/1678-457X.0003
- Shoda, M., Urasaki, N., Sakiyama, S., Terakami, S., Hosaka, F., Shigeta, N., Nishitani, C., & Yamamoto, T. (2012). DNA profiling of pineapple cultivars in Japan discriminated by SSR markers. *Breeding Science*, 62(4), 352–359. <https://doi.org/10.1270/jsbbs.62.352>
- Silva, A. P., de Sousa, P. H. M., de Carvalho, E. B., de Lima, A. C. V., & de Oliveira, J. G. (2018). Consumer acceptance of cashew apple juice. *Journal of Food Science and Technology*, 55(3), 1072-1077. doi: 10.1007/s13197-017-3017-2
- Slavin, J. L., & Lloyd, B. (2012). Health benefits of fruits and vegetables. *Advances in nutrition* (Bethesda, Md.), 3(4), 506–516. <https://doi.org/10.3945/an.112.002154>
- Spence, C. (2015). On the psychological impact of food colour. *Flavour*, 4(1). <https://doi.org/10.1186/s13411-015-0031-3>
- Stiletto, A., & Trestini, S. (2021). Factors behind consumers' choices for healthy fruits: a review of pomegranate and its food derivatives. *Agricultural and Food Economics*, 9(1). <https://doi.org/10.1186/s40100-021-00202-7>
- Turay, F., Lahai, P., Luseni, M. M., Carpenter, P. A., Bayon, & Kallon, V. F. (2020). Cashew (*Anacardium occidentale* L.) Production, Processing Facilities and Quality Assessment in Kafubulum Chiefdom, Sierra Leone. *International Journal of Environment, Agriculture and Biotechnology*. <https://doi.org/10.22161/ijeab.54.22>
- Vieira, C. R. Y., Silva, J. B., Santos, A. D. F., & Borges, S. V. (2016). Sensory evaluation of cashew apple juice using the acceptance and just-about-right scale.

International Journal of Food Properties, 19(3), 656-

666. doi: 10.1080/10942912.2014.950644

ROLE OF AUTHORS: *AHS – conceptualization, data gathering, data encoding, reviewing, editing; MAAL – analysis of data, writing the terminal report.*