

PHYSICOCHEMICAL AND SENSORY CHARACTERISTICS OF YOUNG COCONUT MEAT MARSHMALLOW SUPPLEMENTED WITH PANDAN LEAF POWDER

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ABSTRACT

Young coconut meat is a perishable food due to its high moisture content. Therefore, proper processing is required to extend its shelf life. One potential product that can be developed is marshmallow; however, young coconut marshmallow has a relatively pale appearance, which may limit its visual appeal. The addition of pandan leaf powder was considered because it can provide a natural green color and characteristic aroma. This study aimed to evaluate the effect of different concentrations of pandan leaf powder on the physicochemical and sensory characteristics of young coconut meat marshmallow. This study used a non-factorial completely randomized design with five levels of pandan leaf powder addition (0%, 2%, 4%, 6%, and 8%) and three replications, resulting in 15 experimental units. The parameters observed included moisture content, ash content, reducing sugar content, and sensory evaluation using both descriptive and hedonic tests. The results showed that the addition of pandan leaf powder had a significant effect on all observed parameters. P1, with 2% pandan leaf powder, showed the most favorable sensory acceptance among the treatments. This treatment produced moisture content of 25.44%, ash content of 0.34%, and reducing sugar content of 3.93%. Descriptive sensory assessment showed that the selected marshmallow had a light green color, characteristic pandan aroma, sweet taste, and chewy texture. Hedonic assessment showed color score of 4.18 (like), aroma 4.00 (like), taste 3.70 (like), chewiness 3.96 (like), and overall assessment 4.26 (like).

Keywords: marshmallow, pandan leaf powder, young coconut meat

INTRODUCTION

Coconuts (*Cocos nucifera* L.) is one of Indonesia's key plantation commodities, available year-round and possessing significant potential to be developed into various value-added food products. Riau Province has high coconut production, giving it great potential for the development of value-added food products. According to the Badan Pusat Statistik (2026), coconut production in Riau Province in 2025 reached 444,130 metric tons. Nearly every part of the coconut tree can be utilized, whether as food, industrial raw materials, or non-food materials. The most widely used part is the coconut meat because it has high nutritional content and a distinctive flavor. Young coconut meat has a complete nutritional profile, with a moisture content of 83.30%, fat content of 0.90%, protein content of 1%, and carbohydrate content of 14% (Mahmud et al., 2018). Although it is highly nutritious, young coconut meat is classified as a perishable food due to its high water content. Appropriate processing methods are needed to extend shelf life and increase product diversification. One processed product that can be made from young coconut meat is marshmallows.

Marshmallows are soft confectionery products with a light, soft, and chewy texture, making them popular among a wide range of consumers. The use of young coconut meat in the production of marshmallows can enhance the product's nutritional value compared with conventional marshmallow. However, young coconut marshmallows generally have a white color that is not very visually appealing. Therefore, the addition of natural colorants is needed to enhance the visual appeal of the marshmallow.

Fragrant pandan leaves are widely found in Indonesia and are known for their chlorophyll content, which provides a natural green color. Fragrant pandan leaves have a total chlorophyll content of 623.08 mg/g of material (Suryani et al., 2017). Fragrant pandan leaves not only serve as a coloring agent but also contain essential oils that impart a distinctive, pleasant aroma to the product. The components that make up the base aroma of fragrant pandan leaves come from the chemical compound 2-acetyl-1-pyrroline (Faras et al., 2014).

Commercial pandan leaf products are generally in paste form, which is perishable due to its high moisture content (Nurwanto & Suswantinah, 2021). Processing pandan leaves into powder is done to extend their shelf life and facilitate their use. The addition of pandan leaf powder to young coconut marshmallows is expected to improve the product's color, aroma, and physicochemical and sensory characteristics. Therefore, this study was conducted to determine the concentration of pandan leaf powder that produces young coconut marshmallows with the best physicochemical and sensory characteristics. The objective of this study was to determine the optimal concentration of pandan leaf powder to produce young coconut marshmallows with physicochemical and sensory characteristics of young coconut marshmallows that comply with Indonesian National Standard or SNI 3547.02-2008 regarding soft confectionery (Badan Standardisasi Nasional, 2008).

METHODS

Material and Tools

The materials used were young coconut meat and pandan leaves from Simpang Baru Panam Market, Pekanbaru; bovine gelatin (A&W); granulated sugar (Gulaku); mineral water (Le Minerale), cornstarch (Maizenaku), glucose syrup (Koepoe-Koepoe), distilled water, *Luff Schoorl* solution, 1% starch indicator, 25% H₂SO₄, 20% KI, and Na₂S₂O₃. The tools used were oven, wooden tongs, a spatula, a water bath, furnace, analytical balance, 100-mesh sieve, dropper pipette, volumetric pipette, colorimeter, porcelain dish, stirring rod, desiccator, volumetric flask, Erlenmeyer flask, porcelain dish, burette, retort stand, gloves, measuring cup, beaker, label paper, aluminum foil, trays, sensory evaluation booths, bottled water, tissues, sample cups, writing utensils, questionnaire forms, and a camera.

Research Methodology

This study was conducted using a non-factorial completely randomized design (CRD) consisting of 5 treatment levels and 3 replicates, resulting in 15 experimental units. The treatment in this study was the addition of pandan leaf powder in marshmallow production, based on Yunanto et al. (2023), with the following concentrations of pandan leaf powder used:

P0 = Without addition of pandan leaf powder (control)

P1 = Addition of pandan leaf powder 2%

P2 = Addition of pandan leaf powder 4%

P3 = Addition of pandan leaf powder 6%

P4 = Addition of pandan leaf powder 8%

Research Implementation

Preparation of young coconut meat puree

The preparation of young coconut pulp was based on Isma & Fitriani (2021), in which young coconuts were split open and the water was separated from the flesh. The white flesh of the young coconut was scraped out using a spoon. The coconut flesh was then blended to produce young coconut pulp.

Preparation of pandan leaf powder

The preparation of fragrant pandan leaf powder followed the method described by Arimawan & Santoso (2023). The initial step involved washing fresh green fragrant pandan leaves thoroughly to remove any dirt. The leaves were then cut into pieces approximately ± 0.25 cm in size. The leaves were dried in an oven at 50°C for 6 hours. The dried pandan leaves are ground into a fine powder using a dry mill blender. The pandan leaf powder is sifted through a 100-mesh sieve. The pandan leaf powder is stored in a sealed container.

Marshmallow preparation

The first mixture was prepared in a container consisting of 37 g of sucrose, 20 g of glucose syrup, and 18 g of water. The mixture was heated while stirring until dissolved and it reached a temperature of 110°C, then allowed to cool until the temperature dropped to 71°C. The second mixture consisted of 5 g of gelatin, 8 g of water, and 12 g of fruit puree, then was allowed to stand for approximately 5 minutes. The first and second mixtures were combined and beaten with a mixer until a white foam formed (approximately 3 minutes). Fragrant pandan leaf powder was added according to the treatment (0, 2, 4, 6, and 8 g), then stirred again using a mixer for 1 minute until homogeneous. The batter was poured into molds coated with cornstarch, then left at room temperature for 1 hour to produce marshmallows. The marshmallows were coated and dusted with cornstarch to reduce the moisture content on their surface, preventing them from sticking. The marshmallows were cut into smaller, cube-shaped pieces.

Data Analysis

The data obtained from the observations will be statistically analyzed using analysis of variance (ANOVA). If the calculated F-value is greater than or equal to the table F-value, a post-hoc test will be conducted using Duncan's multiple range test (DMRT) at the 5% significance level. Data analysis was performed using IBM SPSS software, version 25.

RESULTS AND DISCUSSION

Moisture Content

Moisture content is the percentage of water present in a food ingredient or food product and determines the quality of a product. Analysis of variance (ANOVA) results show that the addition of pandan leaf powder has a significant effect ($P < 0.05$) on the moisture content of the marshmallows. Table 1 shows that the moisture content of marshmallows with the addition of pandan leaf powder ranged from 24.19 – 26.91%. Treatment P4 had the highest moisture content, which differed significantly from all other treatments. The moisture content of the resulting marshmallows increased with the addition of pandan leaf powder.

Table 1. Average moisture content values of marshmallow

Treatment	Moisture Content (%) $\pm$ SD
P0 = Without addition of pandan leaf powder	24.20 ^a $\pm$ 0.53
P1 = Addition of pandan leaf powder 2%	25.44 ^b $\pm$ 0.76
P2 = Addition of pandan leaf powder 4%	25.66 ^b $\pm$ 0.04
P3 = Addition of pandan leaf powder 6%	26.16 ^b $\pm$ 0.70
P4 = Addition of pandan leaf powder 8%	26.92 ^c $\pm$ 0.46

Numbers followed by different lowercase letters indicate significant differences ($p < 0.05$), $n=3$.

The moisture content of the pandan leaf powder marshmallows in this study did not meet SNI 3547.02-2008 standards for soft confectionery, which specify a maximum of 20%. Nida et al. (2018) stated

that a product's moisture content is determined by the moisture content of the raw materials and other additives used during processing. Young coconut meat has a moisture content of 83.30% (Mahmud et al., 2018), which can increase the amount of water retained in the marshmallow structure during processing. The high moisture content of the marshmallows is also due to the addition of water in the formulation, gelatin's ability to bind water through gel formation, and the absence of a drying process, which causes some water to remain trapped within the product matrix, resulting in a high moisture content in the final marshmallows. The moisture content exceeding the SNI limit may increase the risk of quality deterioration during storage because higher available moisture can support undesirable physical and microbiological changes and may reduce product stability and shelf life. Therefore, although the selected treatment showed favorable sensory acceptance, its moisture content indicates that the formulation and processing conditions still require optimization, particularly through control of water addition and/or an appropriate drying or conditioning step.

Ash Content

Ash content refers to the inorganic residue remaining after the combustion of an organic material. The determination of ash content is closely related to the mineral content present in a material. The analysis of variance (ANOVA) result indicates that the addition of varying amounts of pandan leaf powder had a significant effect ($P < 0.05$) on the average ash content of marshmallows. Table 2 shows that the average ash content of marshmallows ranged from 0.09 to 0.85%. The highest ash content was found in treatment P4, which was not significantly different from treatment P3 but was significantly different from treatments P0, P1, and P2. The ash content of the marshmallows increased as the amount of pandan leaf powder added increased. This is because pandan leaf powder contains minerals derived from leaf metabolism during growth and mineral absorption from the soil (Adhamatika et al., 2023). The ash content of pandan leaf powder is strongly influenced by the ash content of fresh pandan leaves as the raw material.

Table 2. Average ash content valuespaak of marshmallow

Treatment	Ash Content (%) $\pm$ SD
P0 = Without the addition of pandan leaf powder	0.09 ^a $\pm$ 0.02
P1 = Addition of pandan leaf powder 2%	0.34 ^b $\pm$ 0.09
P2 = Addition of pandan leaf powder 4%	0.58 ^c $\pm$ 0.08
P3 = Addition of pandan leaf powder 6%	0.72 ^d $\pm$ 0.07
P4 = Addition of pandan leaf powder 8%	0.85 ^d $\pm$ 0.10

Numbers followed by different lowercase letters indicate significant differences ($p < 0.05$), $n = 3$.

The ash content in the marshmallows does not originate solely from pandan leaf powder but also from other ingredients, such as young coconut meat and bovine gelatin, which were used at a constant concentration in each treatment. Young coconut meat has an ash content of 0.8% per 100 g of material and contains various minerals, such as calcium (17 mg), phosphorus (30 mg), and iron (1 mg) (Mahmud et al., 2018). In addition, beef gelatin contains an ash content of 0.45% (Sugita et al., 2021), which also affects the ash content of the resulting marshmallows. According to SNI 3547.02-2008 regarding the established quality requirements for confectionery, the ash content of soft confectionery is a maximum of 3%. The results of this study show that the average ash content of the marshmallow met the quality requirements because they were less than 3%, ranging from 0.09 to 0.85.

Reducing Sugar Content

Reducing sugar content represents the amount of reducing sugars present in a food product. Reducing sugars are carbohydrates capable of donating electrons to reduce electron-accepting compounds and are

primarily composed of monosaccharides, such as glucose and fructose. The analysis of variance (ANOVA) indicated that different levels of pandan leaf powder addition had a significant effect ($P < 0.05$) on the mean reducing sugar content of the marshmallows.

Table 3. Average reducing sugar content values of marshmallow

Treatment	Reducing Sugar (%) $\pm$ SD
P0 = Without addition of pandan leaf powder	4.14 ^d $\pm$ 0.06
P1 = Addition of pandan leaf powder 2%	3.93 ^c $\pm$ 0.10
P2 = Addition of pandan leaf powder 4%	3.82 ^c $\pm$ 0.08
P3 = Addition of pandan leaf powder 6%	3.64 ^b $\pm$ 0.07
P4 = Addition of pandan leaf powder 8%	3.43 ^a $\pm$ 0.09

Numbers followed by different lowercase letters indicate significant differences ($p < 0.05$), $n = 3$.

Table 3 shows that the reducing sugar content of marshmallows ranged from 3.43 – 4.14%. The lowest reducing sugar content was found in treatment P4 and differed significantly from the other treatments. As the concentration of added pandan leaf powder increased, the reducing sugar content of the marshmallows tended to decrease. The reducing sugar content in the marshmallows produced in this study originated from the use of glucose syrup. According to Jariyah et al., (2019), the reducing sugar content can also be influenced by the hydrolysis of sucrose during the heating process. The reducing sugar content in the final product is also affected by non-sugar ingredients such as gelatin, pandan leaf powder, young coconut pulp, and water, which can lower the proportion of reducing sugars in the product. Therefore, the reducing sugar content of the resulting marshmallows is relatively low.

The resulting reducing sugar content is relatively low. This is likely because the glucose syrup used has a low Dextrose Equivalent (DE) value, meaning it contains more dextrans and oligosaccharides than simple sugars. In addition, the presence of non-sugar ingredients such as gelatin, young coconut pulp, pandan leaf powder, and water also reduce the proportion of reducing sugars in the product. According to National Standardization Agency standard 3547-02-2008, the maximum allowable reducing sugar content for soft marshmallows is 25%. The research results show that the average reducing sugar content of marshmallows meets the quality requirements because it is below the maximum limit, ranging from 3.43 – 4.14%.

Sensory Evaluation

Color

Color is one of the key parameters used by panelists in assessing the acceptability of the produced marshmallows. The color parameter can indicate panelists' interest in a product, which can be assessed descriptively or hedonic. The analysis of variance (ANOVA) results show that the addition of pandan leaf powder at different concentrations has a significant effect ($P < 0.05$) on the sensory evaluation of the marshmallow's color attributes, both descriptively and hedonic.

Table 4 shows that the average descriptive color scores for the marshmallows ranged from 1.00 to 4.77, corresponding to colors ranging from white to dark green. The higher the concentration of pandan leaf powder added, the more intense the green color of the resulting marshmallows. This is because pandan leaves contain the natural pigment chlorophyll, which acts as a natural green colorant in food products.

Table 4 shows that the average hedonic color rating scores for the marshmallow ranged from 2.80 to 4.18 indicating a preference. Panelists preferred the light green *marshmallows*, whereas the green color that too concentrated a solution makes the product appear darker, which can reduce the panelists' preference for the marshmallow's color.

Table 4. Average color assessment of marshmallows

Treatment	Color $\pm$ SD	
	Descriptive	Hedonic
P0 = Without addition of pandan leaf powder	1.00 ^a $\pm$ 0.00	3.43 ^c $\pm$ 0.73
P1 = Addition of pandan leaf powder 2%	2.83 ^b $\pm$ 0.46	4.18 ^c $\pm$ 0.63
P2 = Addition of pandan leaf powder 4%	4.00 ^c $\pm$ 0.53	3.73 ^d $\pm$ 0.76
P3 = Addition of pandan leaf powder 6%	4.63 ^d $\pm$ 0.49	3.15 ^b $\pm$ 0.97
P4 = Addition of pandan leaf powder 8%	4.77 ^d $\pm$ 0.50	2.80 ^a $\pm$ 0.86

Numbers followed by different letters in the same column indicate a statistically significant difference ($P < 0.05$), $n=80$. **Descriptive scores:** 1. White, 2. Greenish white, 3. Light green, 4. Green, 5. Dark green. **Hedonic scores:** 1. Dislike very much, 2. Dislike, 3. Like somewhat, 4. Like, 5. Like very much.

Aroma

Aroma is a parameter used to determine the panelists' level of acceptance of the marshmallow product based on the sense of smell. The aroma of a product is considered acceptable if it possesses a distinctive scent that can be evaluated both descriptively and hedonic. The analysis of variance (ANOVA) results indicate that the addition of pandan leaf powder has a significant effect ($P < 0.05$) on the aroma of the pandan leaf powder marshmallows, as assessed both descriptively and hedonic.

Table 5. Average aroma assessment of marshmallows

Treatment	Aroma $\pm$ SD	
	Descriptive	Hedonic
P0 = Without addition of pandan leaf powder	1.00 ^a $\pm$ 0.00	3.35 ^b $\pm$ 0.89
P1 = Addition of pandan leaf powder 2%	3.27 ^b $\pm$ 0.64	4.00 ^c $\pm$ 0.64
P2 = Addition of pandan leaf powder 4%	4.10 ^c $\pm$ 0.61	3.79 ^c $\pm$ 0.61
P3 = Addition of pandan leaf powder 6%	4.23 ^c $\pm$ 0.68	3.09 ^a $\pm$ 0.93
P4 = Addition of pandan leaf powder 8%	4.67 ^d $\pm$ 0.48	2.91 ^a $\pm$ 0.86

Numbers followed by different letters in the same column indicate a statistically significant difference ($P < 0.05$), $n=80$. **Descriptive scores:** 1. Very weak pandan leaf-like aroma, 2. Weak pandan leaf-like aroma, 3. Slightly pandan leaf-like aroma, 4. Pandan leaf-like aroma, 5. Very pandan leaf-like aroma. **Hedonic scores:** 1. Dislike very much, 2. Dislike, 3. Like somewhat, 4. Like, 5. Like very much.

Table 5 shows that the average descriptive aroma scores for the marshmallows ranged from 1.00 to 4.67, indicating a spectrum from no pandan aroma to a very strong pandan aroma. The higher the concentration of pandan leaf powder added, the stronger and more distinctive the resulting pandan aroma becomes. This is because pandan leaves contain a number of volatile compounds, including alcohols, aromatics (2-acetyl-1-pyrroline), carboxylic acids, aldehydes, esters, and hydrocarbons.

Table 5 shows that the average hedonic rating scores for the aroma of marshmallows made with fragrant pandan leaf powder ranged from 2.91 to 4.00, indicating "somewhat like" to "like." The more fragrant pandan leaf powder added, the more pronounced the characteristic pandan leaf aroma became. The pandan aroma produced at low concentrations was preferred by the panelists because it produced a fragrant, characteristic pandan aroma. However, the addition of pandan leaf powder at high concentrations produced an aroma that was too strong, thereby reducing the panelists' level of preference.

Taste

Taste is a parameter used to determine the panelists' level of acceptance of the marshmallow product based on their sense of taste. The analysis of variance (ANOVA) results indicate that the addition of pandan

leaf powder at different concentrations has a significant effect ($P < 0.05$) on the descriptive and hedonic sensory evaluations of the marshmallow's taste attributes.

Table 6. Average taste assessment of marshmallows

Treatment	Taste Scores $\pm$ SD	
	Descriptive	Hedonic
P0 = Without addition of pandan leaf powder	4.37 ^c $\pm$ 0.72	4.20 ^a $\pm$ 0.80
P1 = Addition of pandan leaf powder 2%	4.13 ^{bc} $\pm$ 0.68	3.70 ^a $\pm$ 0.72
P2 = Addition of pandan leaf powder 4%	3.70 ^{ab} $\pm$ 1.02	3.03 ^b $\pm$ 0.83
P3 = Addition of pandan leaf powder 6%	3.47 ^a $\pm$ 0.94	2.35 ^c $\pm$ 0.89
P4 = Addition of pandan leaf powder 8%	3.33 ^a $\pm$ 0.92	2.14 ^d $\pm$ 0.90

Numbers followed by different letters in the same column indicate a statistically significant difference ($P < 0.05$), $n=80$. **Descriptive scores:** 1. Not very sweet, 2. Not sweet, 3. Slightly sweet, 4. Sweet, 5. Very sweet. **Hedonic scores:** 1. Dislike very much, 2. Dislike, 3. Like somewhat, 4. Like, 5. Like very much.

Table 6 shows that the average descriptive taste scores for the marshmallows ranged from 3.33 to 4.37, indicating “somewhat sweet” to “sweet.” Treatment P4 had the lowest descriptive taste score and was not significantly different from treatment P3, but differed significantly from treatments P0, P1, and P2. Marshmallows generally have a sweet taste derived from sugar and glucose syrup. The addition of fragrant pandan leaf powder at high concentrations caused the pandan flavor to become more dominant, thereby reducing the perceived sweetness of the marshmallows. The more pandan leaf powder added, the stronger the pandan flavor becomes, as pandan leaves have a distinctive, somewhat bitter taste. According to (Sukmawati et al., 2024), the bitterness in pandan is caused by bitter compounds or bioactive compounds such as polyphenols, flavonoids, saponins, tannins, and alkaloids.

Table 6 shows that the average hedonic rating scores for the marshmallows ranged from 2.14 to 4.20, corresponding to “dislike” to “like.” The lowest hedonic rating score for marshmallow flavor was obtained in treatment P4, which differed significantly from all other treatments. As the concentration of added pandan leaf powder increased, the intensity of the characteristic pandan flavor also became stronger, masking the marshmallow's sweetness and reducing the panelists' acceptance of the flavor parameters. Thus, the lower flavor acceptance at higher concentrations may be associated with the stronger pandan flavor and the resulting change in the overall flavor balance.

Texture

Chewiness is an important sensory parameter in evaluating the texture of an elastic product. The analysis of variance (ANOVA) results indicate that the addition of different concentrations of pandan leaf powder had a significant effect ($P < 0.05$) on the chewiness of the pandan leaf powder marshmallows, both descriptively and hedonically.

Table 7 shows that the average descriptive texture scores for the marshmallows ranged from 3.40 to 4.37, indicating a texture ranging from somewhat chewy to chewy. The results obtained for treatment P4 were not significantly different from those of all other treatments. The more fragrant pandan leaf powder added, the chewier the resulting marshmallows became. This is because fragrant pandan leaves contain several types of fiber, namely lignin (48.79%), cellulose (19.95%), and hemicellulose (18.64%). This is due to the ability of the fibers in the pandan leaf powder to absorb and bind water. The higher the concentration of pandan leaf powder added, the more water is retained in the product matrix, resulting in a chewier texture.

Table 7. Average texture assessment of marshmallows

Treatment	Texture Scores $\pm$ SD	
	Descriptive	Hedonic
P0 = Without addition of pandan leaf powder	3.40 ^a $\pm$ 0.50	4.27 ^c $\pm$ 0.75
P1 = Addition of pandan leaf powder 2%	3.57 ^a $\pm$ 0.57	3.96 ^b $\pm$ 0.77
P2 = Addition of pandan leaf powder 4%	3.70 ^a $\pm$ 0.47	3.80 ^b $\pm$ 0.82
P3 = Addition of pandan leaf powder 6%	4.07 ^b $\pm$ 0.83	3.41 ^a $\pm$ 0.87
P4 = Addition of pandan leaf powder 8%	4.37 ^c $\pm$ 0.49	3.24 ^a $\pm$ 0.92

Numbers followed by different letters in the same column indicate a statistically significant difference ($P < 0.05$), $n=80$. **Descriptive scores:** 1. Crispy, 2. Not chewy, 3. Slightly chewy, 4. Chewy, 5. Very chewy. **Hedonic scores:** 1. Dislike very much, 2. Dislike, 3. Like somewhat, 4. Like, 5. Like very much.

Table 7 shows that the average hedonic chewy texture scores for the marshmallows ranged from 3.24 to 4.28, corresponding to “somewhat like” to “like.” The lowest hedonic chewy texture score was obtained for treatment P4, which was not significantly different from treatment P3 but was significantly different from treatments P0, P1, and P2. The testers’ preference for the marshmallows decreased as the amount of fragrant pandan leaf powder increased because the resulting marshmallows had an increasingly chewy texture. The increase in chewiness occurred because the fiber and solid particles in the fragrant pandan leaf powder increased the solid content in the marshmallows, causing the resulting gel structure to become denser and chewier.

Overall Evaluation

The overall rating is a parameter used to determine the panelists’ level of preference for the color, aroma, taste, and chewiness of the marshmallows as a whole. The analysis of variance (ANOVA) results indicate that the addition of different amounts of fragrant pandan leaf powder had a significant effect ($P < 0.05$) on the overall rating of the resulting marshmallows. Table 8 shows the average hedonic overall ratings of pandan leaf powder ranged from 2.46 to 4.26, indicating a range from “like” to “dislike.”

Table 8. Average overall assessment of marshmallow

Treatment	Overall $\pm$ SD
P0 = Without addition of pandan leaf powder	3.91 ^d $\pm$ 0.68
P1 = Addition of pandan leaf powder 2%	4.26 ^c $\pm$ 0.63
P2 = Addition of pandan leaf powder 4%	3.54 ^c $\pm$ 0.57
P3 = Addition of pandan leaf powder 6%	2.79 ^b $\pm$ 0.67
P4 = Addition of pandan leaf powder 8%	2.46 ^a $\pm$ 0.76

Numbers followed by different letters in the same column indicate a statistically significant difference ($P < 0.05$), $n=80$. 1. Dislike very much, 2. Dislike, 3. Like somewhat, 4. Like, 5. Like very much.

CONCLUSION

Based on the results of the study, different levels of pandan leaf (*Pandanus amaryllifolius*) powder addition had a significant effect on moisture content, ash content, reducing sugar content, as well as descriptive and hedonic sensory attributes, including color, aroma, taste, chewiness, and overall acceptability. P1, with the addition of 2% pandan leaf powder, showed the most favorable sensory acceptance among the treatments, although its moisture content of 25.44% exceeded the maximum moisture requirement of 20% specified in SNI 3547.02-2008 for soft confectionery. P1 had an ash content of 0.34% and reducing sugar content of 3.93%, and its descriptive sensory profile was light green,

characteristic pandan aroma, sweet taste, and chewy texture. The hedonic scores for color, aroma, taste, chewiness, and overall acceptability were 4.18, 4.00, 3.70, 3.96, and 4.26, respectively. Therefore, P1 can be considered the selected treatment based on sensory acceptance, while further formulation and processing optimization is needed to meet the moisture requirement.

REFERENCES

- Adhamatika, A., Murtini, E. S., & Sunarharum, W. B. (2023). The application of pandan leaves powder (*Pandanus amaryllifolius* Roxb.) as a natural coloring on the pandan steamed bun production. *Food Science and Technology*, 11(1), 44–53.
- Arimawan, J., & Santoso, A. (2023). Pengaruh suhu pengeringan dan konsentrasi penambahan bubuk pandan wangi (*Pandanus amaryllifolius*) terhadap karakteristik fisik dan organoleptik klepon. *JOFE: Journal of Food Engineering*, 2(4), 183–195.
- Badan Pusat Statistik. (2026). *Provinsi Riau dalam Angka 2026*. Jakarta: Badan Pusat Statistik Indonesia.
- Badan Standardisasi Nasional. (2008). *SNI 3547.2-2008: Kembang Gula – Bagian 2: Lunak*. Jakarta.
- Faras, A. F., Wadkar, S. S., & Ghosh, J. S. (2014). Short communication effect of leaf extract of *Pandanus amaryllifolius* (roxb.) on growth of *Escherichia coli* and *Micrococcus* (*Staphylococcus aureus*). *International Food Research Journal*, 21(1), 421–423.
- Jariyah, Nurismanto, R., & Pratiwi, N. F. D. (2019). Pengaruh penambahan cmc terhadap karakteristik es krim jus buah pedada dan kelapa muda. *Jurnal Teknologi & Industri Hasil Pertanian*, 24(1), 51–58.
- Isma, K., & Fitriani, S. (2021). Karakteristik selai lembaran dari daging kelapa muda dan ubi jalar ungu. *Jurnal Sagu*, 19(2), 39–47.
- Mahmud, M. K., Hermana, H., Nazarina, N., Marudut, S., Zulfianto, Muhayatun, N. A., Jahari, A. B., Dewi, P., Ernawati, F., Rugayah, R., Haryono, H., Prihatini, S., Raswanti, Rahmawati, I., Santi, D., Permanasari, Y.F.U., Sulaeman, Ahmad, Andarwulan, N., Atmarita, A., Almasyhuri, A., Nurjanah, N., Ikka, N., & Marlina, L. (2018). *Tabel Komposisi Pangan Indonesia (TKPI)*. Jakarta Selatan: Kementerian Kesehatan Republik Indonesia.
- Nida, E. H., Nilda, C., & Manik, S. (2018). Kajian pembuatan permen jelly dari buah tanjung (*Mimusops Elengi* L.). *Jurnal Teknologi Pangan dan Industri Pertanian Indonesia*, 10(1).
- Nurwanto, & Suswantinah, A. (2021). Metode pengeringan sari pandan (*Pandanus amaryllifolius*) untuk meningkatkan kualitas bubuk sari pandan. *Indonesian Journal of Laboratory*, 4(3), 116–123.
- Sugita, P., Rifai, M., Ambarsari, L., Rahayu, D. U. C., & Dianhar, H. (2021). Gelatin extraction and characterization from femur bones of bovine and porcine with acid process. *Jurnal Jamu Indonesia*, 6(1):32–41.
- Sukmawati, D. L., Dwijaya, D. P., Saksono, D. A., Riftina, D., & Desi, S. (2024). Penetapan parameter spesifik, non-spesifik, penetapan kadar flavonoid total, fenolik total ekstrak aseton daun pandan wangi (*Pandanus amaryllifolius* Roxb.). *Indonesian Pharmacy and Natural Medicine Journal*, 8(2), 112–125.
- Suryani, C. L., Tamaroh, S., Ardiyan, A., & Setyowati, A. (2017). Aktivitas antioksidan ekstrak etanol daun pandan (*Pandanus amaryllifolius* Roxb.) dan fraksi-fraksinya. *agriTECH*, 37(3), 271–279.
- Yunanto, C., Ekawati, G. A., & Permana, D. G. M. (2023). Pengaruh penambahan bubuk daun murbei (*Morus alba* l.) terhadap karakteristik marshmallow. *Jurnal Ilmu dan Teknologi Pangan*, 12(2), 224–235.