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Physicochemical and sensory properties of suji and pandan gummy candy

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Abstract

The increasing demand for healthier food products, including confectionery, has led to increased research into gummy candy with fewer chemical ingredients and enriched with bioactive components. In this study, four concentrations of suji (*Pleomele angustifolia*) and pandan (*Pandanus amaryllifolius* Roxb.) leaves extract (0%, 5%, 10%, and 15%) were incorporated into the formulation to develop a functional soft candy with natural coloring and flavoring agents. The resulting gummy candies were evaluated for physicochemical and sensory properties. Results showed that the water content of the samples ranged from 37% to 41% (on a wet basis), and the ash content ranged from 0.4% to 0.7% (on a wet basis). There is a decrease in pH and an increase in titratable acidity in the sample with the addition of leaf extracts. The chlorophyll content and antioxidant activity were the highest in the sample with 15% leaf extracts. Color analysis revealed that each sample produced its own unique color, characterized by distinct L*, a*, and b* values. The sample with 15% leaves extract yielded a more intense green color than the others. Texture analysis revealed no significant differences in cohesiveness, adhesiveness, chewiness, gumminess, and springiness among the samples. However, the sample hardness tends to increase with the addition of leaf extract. Sensory analysis revealed that the product with leaf extract addition was more preferable than the control, in terms of taste, aroma, texture, and overall acceptance, with the sample (15% leaf extract addition) achieving the highest total score. In conclusion, the addition of suji and pandan leaves has the potential to be incorporated into gummy candy, offering consumers a healthier alternative to the common gummy candies available on the market.

1. Introduction

Gummy candy is a confectionery product characterized by its soft, chewy texture, attractive shape, and sweet taste (Wulandari *et al*., 2023). It also has numerous colours with different flavours and is one of the most widely consumed varieties of soft confectionery. According to Lam *et al*. (2025), the global market value of this soft candy reached USD 21.40 billion in 2022.

Traditionally, the production of gummy candy involves three main ingredients: sugar, a gelling agent, and water (Cano-Lamadrid *et al*., 2020; Roudbari *et al*., 2024). The high consumption of confectionery products is known to be inadequate in nutritional value, due to their high content of sweeteners and artificial food colorants (Romo-Zamarrón *et al.,* 2019; Teixeira-Lemos *et al*., 2021). Various studies have shown the side effects of synthetic food dyes, including inhibition of nerve cell growth in children (Artamonova *et al*., 2017), allergies, chromosomal damage, hyperactivity, thyroid tumor, and respiratory problems, among others (Teixeira-Lemos *et al*., 2021; Hamzah *et al*., 2023).

These findings have contributed to an increasing demand for healthier, fortified food products, including in confectionery products (Tarahi *et al.,* 2023a; Lam *et al.,* 2025). Consumers prefer healthier products with fewer chemical ingredients (Tarahi *et al.,* 2023a; Jamilatun *et al.,* 2024). These trends have led to the increased availability of gummy candy with fewer chemical ingredients (Jamilatun *et al.,* 2024) and enriched it with bioactive components. Many authors have explored the potential of using jelly and gummies as a vehicle to enhance the intake of functional elements (El Latif *et al.,* 2022; Rashmi and Negi, 2024; Dian and Khonifiah, 2025). For example, research by Dian and Khonifiah (2025) incorporated a traditional herbal drink (jamu) into gummy candy. Other authors have used natural ingredients, such as fruit juice and puree, in the production of gummy candy without added sugar and

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artificial food additives (Teixeira-Lemos *et al.*, 2021). Roudbari *et al.* (2024) incorporated natural antioxidants and zero-calorie sweeteners, such as stevia, into gummy candy. Some authors have shown the beneficial effects of anthocyanin extract in gummy candy, not only as a natural colorant but also as having additional health benefits at moderate consumption (de Moura *et al.*, 2019; Teixeira-Lemos *et al.*, 2021).

Considering the demand for beneficial and nutritional characteristics in gummy candy, this study utilizes suji and pandan leaves to introduce natural colouring and flavouring agents. Suji (*Dracaena angustifolia*) and pandan (*Pandanus amaryllifolius*) are traditional Indonesian plants commonly used as natural colorants and flavouring agents, respectively. Suji leaves are one of the most widely used sources of green colour in conventional foods. They are rich in chlorophyll. However, using too many suji leaves can cause undesirable leaf flavour. Pandan leaves have a light green colour with a favourable aroma. Unfortunately, the green colour is less intense and fades easily (Wijaya and Lewerissa, 2024).

In Indonesia, it is a common practice to combine suji leaves with pandan leaves in food. Both leaves have their own strength; pandan has a light green colour with a favourable aroma, while suji contributes to the intense green colour. Traditionally, the use of suji and pandan leaves is quite simple: they are crushed and boiled to produce the desired colour and aroma. The resulting green liquid is widely used in traditional snacks and cakes (Wijaya and Lewerissa, 2024).

Suji leaves are known to be rich in flavonoids and chlorophyll. Both metabolites are known to act as antioxidants, and therefore have anti-inflammatory, anti-cancer, and anti-obesity properties (Ebrahimi *et al.*, 2023). According to Koja *et al.* (2024), suji leaves may help reduce arthritis and muscle inflammation. This study aimed to develop gummy candy using natural food colorants, which also offer health benefits, including antioxidant activity.

Therefore, the objective of this study was to incorporate suji and pandan leaves into gummy candies and evaluate their impact on the physicochemical and sensory properties of the products.

2. Materials and methods

2.1 Materials

Materials used in this study were suji and pandan leaves collected from the university surrounding area.

2.2 Suji and pandan leaves extraction

Mixtures of suji and pandan leaves in a 10:1 ratio were prepared. The chosen ratio was determined through preliminary research using sensory preference tests. Leaf extracts were prepared by washing the leaves, cutting them into small pieces, and then grinding them with a chopper in 250 mL of water. The filtrate was filtered through the filter cloth. Three different levels of leaf extract were prepared, corresponding to 5%, 10%, and 15% of the water volume in the gummy candy formula. The gummy candy formulation is shown in Table 1.

Table 1. Formulation of gummy candy.

	Leaves extract concentration			
Ingredient	0%	5%	10%	15%
Refine sugar (g)	60.0	60.0	60.0	60.0
Glucose syrup (g)	40.0	40.0	40.0	40.0
Citric acid (g)	0.5	0.5	0.5	0.5
Gelatine (g)	15.0	15.0	15.0	15.0
Water (mL)	150.0	142.5	135.0	127.5
Suji pandan extract (mL)	0	7.5	15.0	22.5

2.3 Gummy candy making

The making of gummy candy was carried out as described by Mutlu *et al.* (2018) with slight modifications. The first stage involved dissolving water and gelatin without the use of heat. Mixing was done until a slightly clear solution was formed. The next stage was to add glucose syrup and refined sugar to the gelatin solution at low heat. Once everything was combined, the heat was gradually increased until the solution boiled at 90°C. After completely dissolving, the solution was cooled to 70°C. Then, suji pandan extract was added until it thickened for 5 minutes at a consistent temperature of 70°C. The gummy candy solution was poured into moulds. After that, the gummy candy was left to reach room temperature and then cooled in the refrigerator for 24 hours.

2.4 Moisture content measurement

Water content measurement was performed by drying a 1-gram sample in a vacuum oven at 105°C until a constant weight was achieved (AOAC, 2005). The difference in weight before and after heating is calculated as the moisture content of the material.

2.5 Ash content measurement

Ash content was determined by placing an empty porcelain crucible in a furnace at 550°C for 24 hours. The crucible was then cooled in a desiccator for 30 minutes and weighed. Two grams of the sample were placed in the porcelain crucible and put in an oven at 100°C for 24 hours. After the process was complete, the porcelain crucible was transferred to the furnace, and the temperature was gradually increased until it reached 550 ± 5°C and maintained for 24 hours until white ash was obtained. The temperature was then lowered to approximately 40°C until white ash was obtained. The crucible was then placed in a desiccator for 30 minutes at room temperature and weighed until a constant weight was achieved. The ash content was calculated as a

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percentage by dividing the ash obtained by the weight of the starting material (Wilmulda, 2021).

2.6 Total soluble solids

Five-gram samples were diluted with 40 mL of demineralized water in a beaker and heated for 20 minutes at 60°C. Water was added to the solution until it reached 100 mL, and then the solution was stirred continuously until it was thoroughly mixed and evenly distributed. The brix level was measured using a refractometer (Elisanti *et al.,* 2023).

2.7 pH determination

The pH value was measured using a pH meter. Before using the pH meter, the indicator cathode tip was washed with distilled water and then cleaned with a tissue. The pH meter was then calibrated by dipping the cathode tip into buffer solutions 4 and 7. The cathode tip was then dipped in 1 gram of gummy candy, which had been heated at 50°C for 30 minutes (until dissolution), dissolved in 9 mL of demineralized water, and vortexed. The dissolved candy was cooled for a short time (15 minutes) at room temperature. The probe was cleaned with distilled water each time the pH of another sample was measured. The reading value was the value when the pH meter had stabilized (Vojvodić *et al.*, 2024).

2.8 Titratable acidity

A ten mL sample was placed in an Erlenmeyer flask, followed by three drops of 1% phenolphthalein indicator. The sample was titrated with a 0.1 N NaOH solution until a pink color appeared, indicating the endpoint of the titration. After obtaining the results, the data were entered into the following calculation formula (Mutlu *et al.,* 2018):

$$\%\,Titratable\ acidity = \frac{V\,NaOH \times N\,NaOH \times 90 \times 100}{V\ sample\ \times 1000}$$

V: volume

N: normality

2.9 Color measurement

The color intensity test of pandan suji jelly candy was carried out using a chromameter (Rismandari *et al.,* 2017). The tool was calibrated first before the test was carried out. After the tool was ready, tests were carried out on three points on the surface of the pandan suji gummy candy. The test results were presented in the form of L*, a*, and b* value data. L* value represents lightness, with zero value meaning black and 100 meaning white, chroma a* with +a meaning red, and -a meaning green, and chroma b* with a positive value b meaning yellow, and a negative value of b meaning blue (Ligarda-Samanez *et al.*, 2025).

2.10 Chlorophyll measurement

Five-gram samples were soaked in 20 mL of 80% acetone and centrifuged at 6200 × *g* for 15 minutes. The aliquot was filtered through Whatman filter paper No. 1 and 42, and then the absorbance was measured at 663 and 645 nm (Khairunnisa *et al.,* 2024). Total chlorophyll was measured with the following formulae:

$$Total\ chlorophyll\ \left(\frac{ug}{g}\right) = (20.2\ x\ A645) + (8.02\ x\ A663)\ x\ dilution\ factor$$

A645: absorbance at 645 nm.

A663: absorbance at 663 nm.

2.11 Antioxidant activity test

Antioxidant activity test was carried out using the DPPH (2,2-diphenyl-1-picrylhydrazyl) method (Almiranti *et al.,* 2024). A 1-gram candy sample was dissolved in 2 mL of 0.25 µM DPPH in 100% methanol, then homogenized using a vortex, and the solution was stored in a dark place at room temperature for 30 minutes. A blank sample was prepared as a control. The absorbance of each sample was measured using a UV-Vis spectrophotometer at a wavelength of 517 nm. The antioxidant activity was analyzed using the following equation:

$$\%\,Inhibition = \frac{blank\ absorbance}{sample\ absorbance} \times 100\%$$

2.12 Texture analysis

The texture of pandan suji extract gummy candy was analyzed using the texture profile analysis (TPA) method. The tool used was a texture analyzer (Lloyd) with parameters of hardness, springiness, chewiness, gumminess, cohesiveness, and adhesiveness. The pandan suji extract gummy candy sample was made in a size of 3 × 3 × 3 cm^3, then pressed with a probe twice. The probe speed was set at 5 mm/s, and the sample was compressed to 30% of its initial height (Mawarno and Putri, 2022).

2.13 Organoleptic test

Organoleptic testing was conducted using a panelist preference test (hedonic) on 30 untrained panelists. During the test, panelists were asked to taste pandan suji jelly gummy candy. After tasting one sample, panelists were required to rinse their mouths with water provided as a taste neutralizer. Then, panelists were asked to rate the pandan suji jelly candy based on their preferences. The assessment was conducted on parameters of color, taste, texture, aroma, and overall using a 5-level hedonic scale (1: immensely dislike, 2: dislike, 3: neutral, 4: like, 5: very like) (Setiawati and Cendana, 2023).

2.14 Data analysis

The experimental design used in this study is a completely randomized design (CRD) with a

Table 2. Chemical properties of suji pandan gummy candy.

	Leaves extract			
Parameter	0%	5%	10%	15%
Water content (%wb)	40.38 ± 0.70[a]	41.18 ± 0.92[a]	37.09 ± 1.15[b]	40.68 ± 0.76[a]
Ash content (%wb)	0.16 ± 0.11	0.20 ± 0.01	0.22 ± 0.04	0.26 ± 0.01
Total soluble solid (Brix)	33.3 ± 0.60[c]	36.7 ± 0.15[b]	43.0 ± 0.26[a]	44.3 ± 0.06[a]
pH	4.96 ± 0.03[a]	4.42 ± 0.02[b]	4.92 ± 0.01[a]	4.26 ± 0.04[c]
Titratable acidity (%)	0.23 ± 0.06[b]	0.60 ± 0.10[a]	0.50 ± 0.10[a]	0.63 ± 0.06[a]

Values followed by different superscript letter within the same row was significantly different ($p<0.05$) according to LSD.

concentration factor of pandan suji extract at different concentrations (0%, 5%, 10%, 15%) and three repetitions. The data obtained were analyzed using one-way ANOVA. If the results are significantly different, a further test of the least significant difference (LSD) was conducted. A 95% confidence level was used.

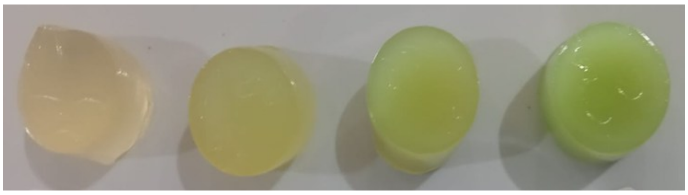
3. Results and discussion

The water content of suji pandan gummy candy and the control is in the range of 37-41% (wet basis) (Table 2). The result exceeded the standard set by Indonesian regulation, which stipulates a maximum water content of 20% for gummy candy (SNI No 3547.2-2008, 2008). The water content of the samples in this study is significantly higher than in other studies (Wulandari *et al.,* 2023; Jamilatun *et al.,* 2024; Soraya *et al.,* 2024), but lower than that of the study by Ligarda-Samanez *et al.* (2025), with a water content range of 43-52%. Certain factors can contribute to high water content in the products. The temperature used for the candy hardening process, which is room temperature, could cause inadequate evaporation (Jamilatun *et al.,* 2024). Cooking durations and boiling temperatures affect the final water content of the product (Miranti, 2020; Lesmayati *et al.,* 2022; Vojvodić *et al.,* 2024). According to Koswara (2009), the recommended heating temperature for a gelatin and sucrose solution was higher than 82°C. In this study, a temperature of 70°C was used to preserve the green color of the leaf extract, 90°C was used for a short time. The low total soluble solids and high-water content of the ingredient also influence the final water content (Rismandari *et al.,* 2017). Analysis of variance shows that the sample with 10% leaf extract has a lower moisture content compared to the others. All ingredients used in this study are the same, except for the leaf extract concentration, which is expected not to affect the moisture content of the product. Therefore, it is suspected that there are slight differences in cooking duration and boiling temperature between samples during the candy-making process. A high moisture content can negatively affect the textural properties and microbial susceptibility of the product. Therefore, formulation adjustments and improvements to the drying process are recommended to meet the standard quality, ensuring product appeal and market success (Ligarda-Samanez *et al.*, 2025).

Ash content, which represents the mineral content, and total dissolved solids of the sample increase with the increase in leaf extract addition. It is understandable since suji and pandan leaves contain some minerals, and the total dissolved solids increase due to the presence of soluble fibers in the leaf extract. The ash content of these samples is lower than that of gummy candy from seaweed, which ranges from 0.4 to 0.7% (wet basis) (Novitasari *et al.,* 2016). However, the studies on seaweed and gelatin used in those studies are much higher than those in this study. In this study, the total ash content ranges from 0.16% to 0.26% (wet basis), with no significant difference among the samples. The ash content of all samples meets the Indonesian Standard requirement for gummy candy (Kurniawan *et al.,* 2022), with a maximum ash content of 3%.

The total soluble solids in the samples range from 33.3 to 44.3 Brix. The values represent the sugar content and some soluble solids in gummy candies. The addition of sugar and glucose to all samples in the formulation is 37.7%, and therefore, the increase in total soluble solids correlates with the increase in leaf extract. This trend is also observed in the study by Ligarda-Samanez *et al.* (2025), where total soluble solids increase with the addition of microencapsulated erythrocytes and tumbo juice. In general, the total soluble solid content of standard gelatin products exceeds 70 Brix to ensure microbial safety and maintain texture stability (Cano-Lamadrid *et al.*, 2020; Gunes *et al.*, 2022). As mentioned earlier, the low soluble solid content in this study is attributed to the lack of concentration and drying stages during processing, which can impact the final quality of the product.

The pH tends to decrease with the addition of leaf extract. The pH values of the sample range from 4.26 to 4.92. Those values fall within the range of the isoelectric point of gelatin. According to Goudie *et al.* (2023), the isoelectric point of gelatin is at a pH of 4.4. Other authors stated that the isoelectric point of bovine type B gelatine is in the range of pH 4.8-5.0 (Cano-Lamadrid *et al.*, 2020). At pH values close to the isoelectric point, a close and compact structure was formed due to balanced interactions between the gelatin network. More acidic or alkaline pH values resulted in softer gels and higher degrees of swelling. Maintaining a stable pH value is essential to prevent gel instability (Roudbari *et al.*, 2024). The decrease in pH values in samples with leaf extract addition corresponds well with the increase in titratable acidity of those samples. Leaf extract may contain organic acids, which could originate from the degradation of chlorophyll, leading to a decrease in pH value (Rahmawati *et al.*, 2023). Chlorophyll is sensitive to light, heat, and oxidation. Heat used in candy making can cause some degradation of chlorophyll.



0% 5% 10% 15%

Figure 1. Suji pandan gummy candy with different leaves extract concentration.

Table 3. Color parameters of suji pandan gummy candy with different leaves extract concentration.

Sample	L*	a*	b*
0%	29.50 ± 1.11^{c}	0.33 ± 0.31^{b}	4.81 ± 0.1^{b}
5%	33.94 ± 000^{b}	1.90 ± 0.07^{a}	2.92 ± 1.51^{c}
10%	42.06 ± 0.27^{a}	-0.44 ± 0.42^{c}	2.76 ± 0.03^{c}
15%	33.73 ± 0.17^{b}	-3.07 ± 0.32^{d}	9.72 ± 0.44^{a}

Values followed by different letter within the same column was significantly different ($p<0.05$) according to LSD.

The visual observation reveals that the control is slightly white, while the sample with suji pandan addition exhibits a slight yellow tint (5%), a slightly green tint (10%), and a green tint (15%) (Figure 1). The average L* parameter of samples is in the range of 29.50 -42.06 (Table 3). The addition of suji pandan causes an increase in L* value compared to the control, but the incorporation of suji pandan at each concentration results in random trends. The results of this study align with those of Dhal *et al.* (2023). The addition of leaf extract to the formulation affects the color parameter of the candy. Samples with 5% and 15% have similar L*, and the 10% addition has a higher L* value. The red parameter (a*) indicates a decrease in value upon the addition of leaf extract, with the lowest number observed at a 15% addition, suggesting a shift towards the green color. The yellow component (b*) of control is higher than 5% and 10% suji pandan gummy candy, and lower than 15% suji pandan gummy candy. Increase b* shows that gummy candy tends to a yellowish color. The highest b value is found in the 15% leaves extract; fortunately, this sample also has the lowest a* value, giving it a visually green color. The L*, a*, and b* parameter reflects the visual impact on gummies' hue. Interestingly, each concentration results in a different color, with 15% leaves extract yielding a stable green color.

Table 4 shows that the highest total chlorophyll content is in the sample with the highest leaf extract addition. Increasing the amount of leaf extract leads to an increase in chlorophyll content. This natural green pigment is highly susceptible to heat degradation. The candy-making process was performed at 70°C and then raised to 90°C for a few minutes to preserve the chlorophyll as much as possible. The resulting color in suji pandan addition was still favorable for the sample with 10% and 15% leaves extract addition. A sample with 5% sample addition exhibited chlorophyll degradation, resulting in a product with a yellowish color (Figure 1). The control sample, with no leaf extract addition, has a slightly yellow color due to the background color of the gelatin.

Table 4. Total chlorophyl content of suji pandan gummy candy with different leaves extract concentration.

Sample	Total chlorophyl (ug/g)
0%	0^{d}
5%	0.91 ± 0.05^{c}
10%	1.36 ± 0.07^{b}
15%	2.40 ± 0.13^{a}

Values followed by different superscript letter within the same column was significantly different ($p<0.05$) according to LSD.

Table 5 shows that the antioxidant activity of the leaf extract increases with higher concentrations, indicating that chlorophyll contributes to its antioxidant properties (Kumar *et al.,* 2023). Additionally, leaf extract contains flavonoids that act as antioxidants (Kumar *et al.*, 2023; Tarahi, *et al.*, 2023b). The control sample also exhibits some antioxidant activity, i.e., 2.261%. A study reveals that gelatin exhibits antioxidant activity due to its amino acid composition, specifically lysine, histidine, and tyrosine (Nuñez *et al.*, 2023). The natural antioxidant content in gummy candy can enhance the nutraceutical and functional benefits of gummy candy, while also attracting health-conscious consumers (Tarahi *et al.*, 2023b).

Table 5. Antioxidant activity of suji pandan gummy candy with different leaves extract concentration.

Sample	Antioxidant activity* (%)
0%	2.261 ± 0.495
5%	2.936 ± 0.166
10%	4.014 ± 0.373
15%	4.424 ± 0.267

*Sample was measured at 1% concentration

Table 6 shows the data on texture parameters. Regarding hardness, the addition of leaf extract had a significant effect on hardness. Overall, the hardness tends to increase with an increase in leaf extract, except for sample 10%, which has the lowest moisture content among the samples. A lower moisture content contributes to a denser and harder structure in gummy candy (Teixeira-Lemos *et al.*, 2021). The hardness result for the 10% leave extract addition shows the contrary. Several factors, including gelatin dose (Mutlu *et al.,* 2018), setting pH (Goudie *et al.,* 2023), and water content (Rismandari *et al.,* 2017), appear to influence the hardness of the gel. According to Mutlu *et al.* (2018), the

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Table 6. Mechanical properties of suji pandan gummy candy with different leaves extract concentration.

	Hardness (gf)	Cohesiveness (kgf.mm)	Springiness (mm)	Gumminess (gf)	Chewiness (N.mm)	Adhesiveness (kgf.mm)	Stiffness (kgf/mm)
0%	697.52 ± 40.28[c]	0.13 ± 0.08	0.60 ± 0.20	94,899.67 ± 61,353.13	8,797.33 ± 8,754.89	0.29 ± 0.31	0.09 ± 0.03
5%	779.30 ± 34.44[b]	0.22 ± 0.01	0.78 ± 0.09	174,067.67 ± 8,402.64	19,234.67 ± 2,053.37	0.36 ± 0.13	0.08 ± 0.04
10%	645.12 ± 49.43[c]	0.25 ± 0.06	0.79 ± 0.08	158,369.00 ± 24,245.16	18,753.67 ± 4,366.92	0.38 ± 0.20	0.07 ± 0.00
15%	962.05 ± 23.47[a]	0.17 ± 0.05	0.61 ± 0.13	178,583.00 ± 41,614.57	15,365.00 ± 8,051.48	0.67 + 0.41	0.09 ± 0.00

Values followed by different superscript letter within the same column was significantly different ($p<0.05$) according to LSD.

gelatine dose affects texture parameters, which increase with increasing gelatine dosage. This study uses a 5% gelatin concentration, which is significantly lower than the concentration used in studies by Roudbari *et al.* (2024). Therefore, the texture parameter of this study is also much softer than those of candies investigated by Roudbary *et al.* (2024). Adhesiveness is influenced by the molecular structure, which determines the stickiness between a product and a surface (Mutlu *et al.,* 2018). Adhesiveness increases with the increase of titratable acidity. Data in this study show a tendency among samples with leaf extract inclusion to have higher adhesiveness with increasing titratable acidity. The control with the lowest titratable acidity has the lowest adhesiveness.

There are no significant differences in cohesiveness, springiness, gumminess, chewiness, adhesiveness, and stiffness among the samples (Table 6). The results are similar to those of the study by Nurhasanah *et al.* (2025), which found no significant differences in texture profile in gummy candies incorporated with sungkai leaf extract. Cizauskaite *et al.* (2019) found the same results when incorporating gummy candy with acai berry extract. Other studies by Charoen *et al.* (2015) show the contrary. Supplementation of *Psidium guajava* leaf extract affects the texture properties of gummy candy. The extract causes a decrease in gumminess and chewiness of the products, although it does not affect cohesiveness and springiness. The addition of leaf extract can increase the total acidity of the gummy candy, which affects the gumminess and chewiness of the product (Charoen *et al.,* 2015). In this study, the addition of leaf extract does not affect the total acidity of the product; therefore, it explains why there is no effect of leaf extract on gumminess and chewiness in suji pandan gummy candies.

Table 7 presents the organoleptic test results for gummy candy, including taste, aroma, color, texture, and general acceptance parameters. Results show that there is no significant difference among the samples for all parameters. Color influences the attractiveness of the product. The average preference for color is 3.48 to 3.76. The taste parameter for all samples with extract leaf inclusion in the formulation has the same average preference, i.e, 3.64, which is 3% higher than the control. It suggested that the addition of leaf extract affects the taste of the gummy candy. In the case of the aroma parameter, it is evident that the addition of leaf extract leads to an increase in aroma preference, which may be attributed to the pleasant aroma of the pandan leaves. Texture parameters are in the range of 3.56 to 3.68. Texture is a crucial parameter in enhancing the taste of a product (Ahmad and Mujdalipah, 2017). An increase in leaf extract resulted in a higher score for the panelists' preferences. In the case of the general acceptance parameter, panelists' preference falls to candy with 5% and 15% leaf extract addition. In general, the formulation with 15% achieved the highest scores for aroma, texture, and overall acceptance. All samples with leaf extract inclusion in the formulation achieved higher scores in all sensory parameters compared to the control, suggesting that the gummy candy with suji pandan inclusion is acceptable to the panelists.

Conclusion

The moisture content of all samples exceeds the value set by Indonesian regulations, which can be attributed to the cooking duration and setting temperature during candy making. The ash content and total dissolved solids of the sample increase with the increase in leaf extract addition. The total soluble solids in the samples range from 33.3 to 44.3 Brix, which represent the sugar content and some soluble solids in gummy candies. The pH tends to decrease with the addition of leaf extract. The visual observation reveals that the control is slightly white, while the sample with suji pandan addition exhibits a slight yellow tint (5%), a slightly green tint (10%), and a green tint (15%). The antioxidant activity of the leaf extract increases with higher concentrations, suggesting that chlorophyll contributes significantly to its antioxidant properties. The chlorophyll content and antioxidant activity were the highest in the sample with 15% leaf extraction. Color

Table 7. Sensory parameters of suji pandan gummy candy with different leaves extract concentration.

Sample	Color	Taste	Aroma	Texture	General acceptance
0%	3.48 ± 0.71	3.52 ± 0.71	3.56 ± 0.58	3.56 ± 0.77	3.48 ± 0.71
5%	3.76 ± 0.52	3.64 ± 0.70	3.40 ± 0.87	3.57 ± 0.71	3.76 ± 0.52
10%	3.60 ± 0.91	3.64 ± 0.57	3.64 ± 0.70	3.64 ± 0.81	3.60 ± 0.91
15%	3.76 ± 0.72	3.64 ± 0.70	3.68 ± 0.69	3.68 ± 0.63	3.76 ± 0.72

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analysis revealed that each sample produced its own unique color, characterized by distinct L*, a*, and b* values. The hardness tends to increase with an increase in leaf extract, except for 10% leaf extract. Statistical analysis of the organoleptic test reveals no significant differences among the samples for all parameters. All samples with leaf extract inclusion in the formulation achieved higher scores in all sensory parameters compared to the control, suggesting that the product with leaf extract addition is more acceptable to the panelists. The study demonstrated that suji and pandan leaves have the potential to be incorporated into gummy candy, offering a healthier alternative to traditional gummy candy.

Conflict of interest

The authors declare no conflict of interest.

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Declaration of generative AI in scientific writing process

During the preparation of this work, the authors used GRAMMARLY TOOL in order to [make clear sentences and avoid spelling errors] in the manuscript. The authors have reviewed and edited the content as needed. The authors will take full responsibility for the content of the published article.

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