



## The Effect of Multifloral Honey Addition on The Physico-chemical and Sensory Evaluation of Marshmallow

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### ABSTRACT

This study aimed to determine the effect of multifloral honey addition on the physicochemical and sensory evaluation of marshmallows. The research was conducted using a laboratory experiment with a Completely Randomized Design (CRD), if there are differences, the Duncan Multiple Range Test (DMRT) will be used. This study consisted of 4 treatments with 5 replications: without multifloral honey addition (M0), 15% multifloral honey concentration (M1), 30% multifloral honey concentration (M2), and 45% multifloral honey concentration (M3), calculated on a volume-to-volume basis (v/v) relative to the total gelatin used in the marshmallow formulation. The variables in this study included moisture content, water activity, chewiness, Lab\* color, reducing sugar, ash content, antioxidant activity, and sensory evaluation. The result showed that multifloral honey addition had a highly significant effect ( $P < 0.01$ ) on moisture content, reducing sugar content, ash content, and antioxidant activity ( $IC_{50}$ ) of marshmallow, and had a significant effect ( $P < 0.05$ ) on the decrease of color sensory evaluation. Multifloral honey addition showed no significant effect ( $P > 0.05$ ) on water activity (Aw), chewiness (N), color Lab\*, as well as sensory evaluation parameters (taste, aroma, texture, and overall acceptance). The average values of the moisture content of marshmallows ranged from 26.22–27.98%; Aw 0.703–0.733; chewiness 2.94–3.30 N; brightness level ( $L^*$ ) 92.81–93.65; redness ( $a^*$ ) -0.376–(-0.568); yellowness ( $b^*$ ) 7.062–8.016; reducing sugar content 8.99–20.95%; ash content 0.61–2.65%; antioxidant activity ( $IC_{50}$ ) 110.63–462.83  $\mu\text{g/ml}$ ; sensory evaluation including taste 3.8–4.09; color 4.45–4.74; aroma 3.74–3.91; texture 3.54–3.91; and overall acceptance 3.83–4.09. The formulation with 15% multifloral honey addition (M1) was indicated as the optimal treatment based on physicochemical and sensory evaluation.



### ABSTRAK

Penelitian ini bertujuan untuk mengevaluasi pengaruh penambahan madu multiflora terhadap karakteristik fisikokimia dan mutu sensori marshmallow. Penelitian dilaksanakan melalui percobaan laboratorium dengan Rancangan Acak Lengkap (RAL), apabila terdapat perbedaan akan dilanjutkan menggunakan Uji Jarak Berganda Duncan (UJBD). Penelitian ini terdiri dari empat perlakuan dan lima ulangan, yaitu: tanpa madu multiflora (M0), penambahan 15% (M1), 30% (M2), dan 45% (M3) (v/v) dari jumlah total penggunaan gelatin yang digunakan dalam pembuatan marshmallow. Variabel pada penelitian ini antara lain kadar air, aktivitas air, kekenyalan, warna Lab\*, gula reduksi, kadar abu, aktivitas antioksidan, dan uji organoleptik. Hasil penelitian menunjukkan bahwa penambahan madu multiflora berpengaruh sangat nyata ( $P < 0,01$ ) terhadap kadar air, gula reduksi, kadar abu, serta aktivitas antioksidan (IC50), dan

berpengaruh nyata ( $P < 0,05$ ) terhadap penilaian sensori warna. Sebaliknya, tidak terdapat pengaruh nyata ( $P > 0,05$ ) terhadap aktivitas air (Aw), kekenyalan, nilai warna Lab\*, maupun atribut sensori rasa, aroma, tekstur, serta penerimaan keseluruhan. Rata-rata nilai karakteristik marshmallow meliputi kadar air 26,22–27,98%; Aw 0,703–0,733; kekenyalan 2,94–3,30 N; L\* 92,81–93,65; a\* -0,376–(-0,568); b\* 7,062–8,016; gula reduksi 8,99–20,95%; kadar abu 0,61–2,65%; aktivitas antioksidan (IC50) 110,63–462,83  $\mu\text{g/ml}$ ; serta skor sensori untuk rasa 3,8–4,09; warna 4,45–4,74; aroma 3,74–3,91; tekstur 3,54–3,91; dan penerimaan keseluruhan 3,83–4,09. Berdasarkan hasil tersebut, formulasi marshmallow dengan penambahan madu multiflora 15% (M1) dinilai sebagai perlakuan optimal karena menghasilkan keseimbangan terbaik antara karakteristik fisikokimia dan mutu sensori.

### INTRODUCTION

The demand for gelatin-based products in Indonesia continues to rise each year. However, the country still relies heavily on imports from major producers such as Brazil, India, China, Thailand, and the United States (Direktorat Peternakan dan Kesehatan Hewan, 2023). One strategic solution to reduce this dependence is by developing the domestic food industry using local agricultural resources, such as fruits and vegetables, which have been shown to improve product taste, color, texture, nutrition content, and antioxidant.

Marshmallow is a gelatin-based confectionery product with a soft, chewy, and foamy texture, classified as a non-crystalline candy with high sugar content (Arizona *et al.*, 2021). Marshmallows are soft jelly candies primarily made with gelatin (BSN, 2008). Gelatin functions both as a foaming agent to create a stable structure and as a gelling agent to

develop the product's characteristic chewy texture (Cahyaningrum, 2019).

Sucrose and glucose syrup are key ingredients in marshmallow formulation, contributing to sweetness and texture. However, commercial glucose syrup lacks added functional properties like antioxidants (Rahmawati & Sutrisno, 2015). This limitation has driven interest in functional food development that offers both nutritional and health benefits. Honey, as a natural sweetener, is a promising alternative that can improve product quality, especially in jelly-based confectioneries (Yanti *et al.*, 2022; Erwan *et al.*, 2022).

Honey, produced by honey bees (*Apis sp.*) from floral nectar or plant secretions, is widely used as a sugar substitute in confectionery products (Gok *et al.*, 2020). It contains bioactive compounds such as vitamins, organic acids, amino acids, minerals, phenolic compounds, and flavonoids, which contribute to strong

antioxidant activity and disease prevention (Gayosso-Sánchez *et al.*, 2022). Among various honey types, multifloral honey shows the highest antioxidant activity (Akgün *et al.*, 2021).

Honey can also be added to some food products such as marshmallow. Marshmallows fortified with honey show improved nutritional value, increased phenolic and flavonoid content, and enhanced antioxidant activity compared to conventional products. Fructose in honey not only enhances sweetness but also helps prevent sugar crystallization and microbial growth due to its high osmotic pressure and low water activity (Apriyanto *et al.*, 2020).

Unlike conventional marshmallow production, which typically relies on refined sugar, this study introduces honey as a functional ingredient that may enhance nutritional value and consumer acceptability. There has been research on marshmallows with the addition of *Apis mellifera* honey, and the results show that the use of up to 75% honey still produces good physicochemical properties, increases antioxidant activity and phenolic content, although it does not significantly affect probiotic viability (Colmenares-Cuevas *et al.*, 2024). Based on these considerations, this study aims to examine the effect of multifloral honey addition on the physicochemical and sensory evaluation of marshmallow.

## METHODS

This study was conducted from August to October 2024, at the Animal Products Technology Laboratory, Faculty of Animal Science, Universitas Brawijaya. The primary materials used in marshmallow production were multifloral honey

obtained from Kembang Joyo Honey Bee Farm, located at Karang Bonowarong street, Karangploso District, Malang Regency, East Java, Indonesia. Beef bone gelatin and sugar were utilized, along with corn starch as an additional ingredient for dusting the surface of the base (parchment paper) to prevent the marshmallow mixture from sticking or adhering.

The equipment used in the marshmallow production process included a mixer, 750 ml thin wall container, mixing bowls, spatula, wooden stirrer, teflon pan, stove, measuring cup, thermometer, parchment paper, digital scale, and knife. The equipment used for physicochemical characteristic analysis comprised petri dishes, oven (Wtc Binder), desiccator, analytical balance (Mettler Toledo), Aw meter (Rotronic HygroPalm-HM21), texture analyzer, color reader (Konica Minolta CR-10), porcelain crucible, furnace (Naber), micropipette (HumaPette), Erlenmeyer flask, beaker glass, measuring cylinder, burette, stirring rod, electric stove, filter paper, aluminum foil, centrifuge tube, cuvette, and spectrophotometer (Visible 721 Spectrophotometer).

This study employed a laboratory experimental method using a Completely Randomized Design (CRD) consisting of 4 treatments with 5 replications. The treatments applied were as follows:

- M0 = Marshmallow without the addition of multifloral honey 0% (control)
- M1 = Marshmallow with 15% multifloral honey concentration
- M2 = Marshmallow with 30% multifloral honey concentration

M3 = Marshmallow with 45% multifloral honey concentration

Note: The concentration of multifloral honey was calculated on a volume-to-volume basis (v/v) relative to the total amount of gelatin used in the marshmallow formulation

The production method of marshmallow with multifloral honey followed the procedure of (Zulfajri *et al.*, 2018), with modifications based on preliminary research. The ingredients used included gelatin, sugar, and corn starch, measured according to the set formulation. Corn starch was first roasted, drained, and sprinkled into a thin-walled container lined with parchment paper. Separately, 125 g of sugar and 60 ml of water were boiled at 80°C for 5 minutes. In another container, 10 g of gelatin was dissolved in 40 ml of water preheated to 70°C and stirred until it formed a gel-like texture.

The gelatin and sugar solutions were then combined and whipped using a high-speed mixer for 5 minutes until the mixture expanded. In the last minute of mixing, multifloral honey was added according to the designated treatment concentration. The final mixture was poured into the prepared containers and allowed to set at room temperature for 24 hours.

The physicochemical and sensory quality of marshmallows was evaluated through various parameters. Moisture content was measured gravimetrically by calculating the weight loss after drying at 150°C, representing the evaporation of free water (AOAC, 2005). Water activity ( $A_w$ ) was determined using an  $A_w$  meter following the procedure by (Ariani *et al.*, 2016). Chewiness was assessed using a texture analyzer, with results expressed in Newton (Delgado &

Bañón, 2015). Color intensity (Lab\*) was measured with a chromameter (Minolta CR-310), where  $L^*$  indicates brightness (0 = black, 100 = white),  $a^*$  indicates redness to greenness, and  $b^*$  represents yellowness to blueness (Bahri *et al.*, 2020).

Reducing sugar content was analyzed by the Lane-Eynon titration method using methylene blue as an indicator (BSN, 1992). Ash content was determined using the gravimetric furnace method (BSN, 2008). Antioxidant activity was evaluated using the DPPH method and expressed as IC50, the concentration required to inhibit 50% of free radicals (Gumansalangi *et al.*, 2019). Sensory evaluation with 30 untrained panelist who understood the product and understood the assessment criteria including taste, color, aroma, texture, and overall acceptance, were tested using a 5-point hedonic scale ranging from "dislike very much" (1) to "like very much" (5) (Arizona *et al.*, 2021).

The data obtained from the testing results were analyzed using analysis of variance (ANOVA) based on Completely Randomized Design (CRD). If significant ( $P < 0.05$ ) or highly significant ( $P < 0.01$ ) differences were found between treatments, further analysis was conducted using Duncan's Multiple Range Test (DMRT) (Sudarwati *et al.*, 2019).

## RESULT AND DISCUSSION

### Moisture Content

Marshmallow is classified as a soft confectionery with a maximum moisture content of 20% according to BSN (2008). Moisture content includes both free and physically bound water, such as that contributed by multifloral

honey (Ningsih & Marlina, 2024). The addition of multifloral honey significantly influenced the moisture content of marshmallow, with

increasing concentrations resulting in progressively higher moisture values.

Table 1. Average Values of Physico-Chemical of Marshmallows with The Addition of Multifloral Honey

Treatment	Moisture Content (%) ± SD	Water Activity (Aw) ± SD	Chewiness (N) ± SD
M0	26.22 ± 0.50 <sup>a</sup>	0.703 ± 0.04	3.17 ± 0.35
M1	26.55 ± 0.70 <sup>a</sup>	0.722 ± 0.01	3.23 ± 0.56
M2	27.55 ± 0.66 <sup>b</sup>	0.729 ± 0.02	2.94 ± 0.36
M3	27.98 ± 0.37 <sup>c</sup>	0.733 ± 0.04	3.30 ± 0.35

Description: Different superscripts indicate highly significant differences (P<0.01) among treatments and absence of superscripts indicate no differences (P>0.05) among treatments

Moisture content increased linearly from 26.22% in M0 to 27.98% in M3, with statistical analysis showing a highly significant difference (P<0.01) among treatments. This aligns with prior studies reporting increased moisture in jelly candies with rising honey levels (Ningtyas *et al.*, 2024). All treatments exceeded the SNI standard, indicating honey’s notable effect on water retention. Honey's high moisture and hygroscopic sugar content especially fructose enhance water-binding capacity (Rosida *et al.*, 2022; Sasmita *et al.*, 2023), while similar trends were also observed in marshmallows enriched with royal jelly, which showed moisture contents between 28.73% and 33.01% (Kristantri *et al.*, 2024). Therefore, the moisture content in treatment M3 is still considered appropriate and acceptable based on SNI, but it still needs to be considered in relation to product stability, especially when compared to previous research result that showed higher moisture content values.

### Water Activity (Aw)

Water activity (Aw) is a parameter that indicates the availability of free water in food, which can be utilized by microorganisms for growth. It plays a significant role in determining product shelf life, safety, and sensory attributes such as texture, taste, and aroma (Alharanu & Eviana, 2019). The water activity values of marshmallows with different concentrations of multifloral honey are presented in Table 1. Based on the analysis of variance, the addition of multifloral honey had no significant effect (P>0.05) on the Aw of marshmallow. However, higher honey concentrations tended to increase Aw, in line with the elevated moisture content that surpassed 50%, exceeding the SNI (2008) standard. Marshmallows, categorized as intermediate moisture foods (IMFs) with Aw values between 0.6–0.9 (Nepovinnykh *et al.*, 2018), showed a strong positive correlation between Aw and moisture content, indicating a linear relationship. The moisture content was significantly different because it measured the total water in the product, while the water activity

was not significantly different because the additional water tended to be bound by formulation components (such as sugar and protein), so it did not significantly increase the free water.

This increase is attributed to honey's composition of ~80% sugar and 20% water (Afshari *et al.*, 2022). Rising moisture content in jelly candy with 5–20% honey addition (Mutisari *et al.*, 2019). The  $A_w$  values in this study ranged from 0.703 to 0.733—within the acceptable range for jelly confectionery (0.7–0.8). Semi-moist foods have  $A_w$  values of 0.6–0.9 (Putri *et al.*, 2024), while that soft confectioneries typically range from 0.45–0.75, still below the microbial growth threshold (Gunes *et al.*, 2022). Compared to previous studies, the results of this study are still within a good range.

### **Chewiness**

Chewiness refers to the resistance experienced by food during mastication until swallowing, making it a key parameter in the texture analysis of jelly-based confections. The chewiness values of marshmallows with various concentrations of multifloral honey are used to assess the effect of honey on the product's texture. Based on the Table 1 the addition of multifloral honey had no significant effect ( $P > 0.05$ ) on marshmallow chewiness. Chewiness values varied, with M3 (45% honey) showing the highest at 3.30 N. Marshmallow texture is

influenced by moisture, sugar, and gelatin content. Increased honey raised moisture levels, which correlated with higher chewiness (Gunes *et al.*, 2022).

Honey's sugar content glucose, fructose, and sucrose supports elastic structure formation, enhancing chewiness (Kurniawan *et al.*, 2016). Additionally, honey's interaction with gelatin influences the gel matrix and final product stability (Teixeira-Lemos *et al.*, 2021). Although not statistically significant, the trend suggests honey contributes positively to marshmallow texture.

### **Color Intensity (Lab\*)**

Color is an important sensory parameter in marshmallows, influencing consumer appeal and perception of product quality (Timisela *et al.*, 2023). The color evaluation in this study used the CIE Lab system, where  $L^*$  represents lightness,  $a^*$  indicates redness–greenness, and  $b^*$  indicates yellowness–blueness (Murib & Kartikawati, 2022). These three coordinates provide a standardized color measurement to assess the visual impact of honey addition in the formulation. Multifloral honey contains natural pigments and browning reaction products that can alter the color of the final product. Variations in honey concentration may affect each color component differently due to caramelization and Maillard reactions during the heating process (Alharanu & Eviana, 2019).

Table 2. Average Values of (L\*, a\*, and b\*) Color Parameters in Marshmallows with The Addition of Multifloral Honey

Treatment	Lightness (L*) ± SD	Redness (a*) ± SD	Yellowness (b*) ± SD
M0	92.99 ± 1.23	-0.568 ± 0.13	7.062 ± 0.76
M1	93.65 ± 0.81	-0.534 ± 0.04	7.198 ± 0.72
M2	93.29 ± 0.52	-0.442 ± 0.16	7.702 ± 0.63
M3	92.81 ± 1.10	-0.376 ± 0.12	8.016 ± 1.03

Description: Absence of superscripts indicate no differences (P>0.05) among treatment

The average L\* value increased from treatment M0 (control) to M1, then decreased from M1 to M3. The highest L\* value was found in treatment M1 at 93.65, with the addition of 15% multifloral honey. This was statistically significant (P<0.05), indicating that honey's color and sugar content affect brightness through non-enzymatic browning during heating (Murib & Kartikawati, 2022; Alharanu & Eviana, 2019). The results are not much different when compared to previous studies, where marshmallows with added skim milk produced L\* colors ranging from 83.78 to 86.78 (Amertaningtyas *et al.*, 2024). These results are also comparable to previous studies that produced L\* color values ranging from 92.9 to 93.5 in marshmallow products with added propolis (Kurniati & Amertaningtyas, 2025).

Redness (a\*) values increased slightly with higher honey levels, though not significantly (P>0.05). Treatment M3 produced the highest a\* value of -0.376, while M0 yielded the lowest value of -0.568. This is not comparable to previous studies that produced a\* color values in the range of 2.07-2.40 (Amertaningtyas *et al.*, 2024). This trend may result from anthocyanins and flavonoids in honey, contributing to reddish tones, along with caramelization during heating

(Putri *et al.*, 2024). Meanwhile, previous studies produced a more greenish color because the skim milk used as an additive had a weak red color (Amertaningtyas *et al.*, 2024).

Yellowness (b\*) values significantly increased (P<0.05) with honey addition, as seen in M3. The highest b\* color value was produced by treatment M3, which was 8.016, and the lowest was produced by treatment M0, which was 7.062. This is comparable to previous studies where marshmallows with added skim milk produced b\* colors ranging from 10.6 to 12.1 (Amertaningtyas *et al.*, 2024). Although the effect was not statistically significant, increasing the concentration of multifloral honey in the marshmallow formulation correlated with an increase in the b\* value. This increase in b\* suggests a reaction that contribute to color changes in marshmallows. The rise is due to carotenoids and flavonoids in honey, making b\* a more sensitive indicator of honey presence than a\*. This is consistent with findings by (Alharanu & Eviana, 2019; Timisela *et al.*, 2023).

**Reducing Sugar Content**

The results of the reducing sugar content analysis of marshmallows with varying concentrations of multifloral honey are presented in Table 3.

Table 3. Average Values of Physical Properties of Marshmallows with The Addition of Multifloral Honey

Treatment	Reducing Sugar Content (%) $\pm$ SD	Ash Content (%) $\pm$ SD	IC <sub>50</sub> Values ( $\mu$ g/mL) $\pm$ SD
M0	8.99 $\pm$ 0.30 <sup>a</sup>	0.61 $\pm$ 0.26 <sup>a</sup>	462.83 $\pm$ 16.92 <sup>a</sup>
M1	12.46 $\pm$ 0.98 <sup>b</sup>	1.21 $\pm$ 0.38 <sup>ab</sup>	298.53 $\pm$ 86.61 <sup>ab</sup>
M2	16.33 $\pm$ 0.41 <sup>c</sup>	1.58 $\pm$ 0.43 <sup>b</sup>	197.67 $\pm$ 92.81 <sup>b</sup>
M3	20.95 $\pm$ 0.62 <sup>d</sup>	2.65 $\pm$ 0.62 <sup>c</sup>	110.63 $\pm$ 31.93 <sup>c</sup>

Description: Different superscripts indicate highly significant differences ( $P < 0.01$ ) among treatments

The analysis of varinace results indicated that the addition of multifloral honey had a highly significant effect ( $P < 0.01$ ) on the increase in reducing sugar content of marshmallow. The lowest value was found in the M0 (8.99%) and the highest value was found in the M3 (20.95%). These results are comparable to previous studies, such as marshmallow with the addition of watermelon albedo juice and rosella flower extract, which resulted in 22.7-24.57% (Sarofa *et al.*, 2021). As the concentration of honey increased, the reducing sugar content in the marshmallows also increased. This is attributed to the high level of reducing sugar content in honey (Silaen & Ginting, 2019).

Honey contains glucose and fructose as the main carbohydrate components, where the mixture of both constitutes invert sugar. Invert sugar is produced through the hydrolysis of sucrose by acids or the enzymes invertase, naturally found in honey, which converts sucrose into glucose and fructose (Wulandari *et al.*, 2017). According to Pontoh (2019), the reducing sugars in sweeteners is generated from the enzymatic hydrolysis process of sucrose by invertase. Thus, the higher the reducing sugar content, the lower the remaining sucrose content. This explains the notable difference in reducing sugar content observed in the marshmallow.

### Ash Content

The results of the ash content analysis of marshmallows with varying concentrations of multifloral honey are presented in Table 3. Ash content analysis resulted in the lowest value in treatment M0 and the highest value in treatment M3 with a range of 0.61-2.65%. This is comparable to previous studies which stated that the ash content in marshmallows with the addition of watermelon albedo juice and rosella flower extract produced ash content values ranging from 0.14-1.11% (Sarofa *et al.*, 2021).

These results are higher than previous studies stating that marshmallows enriched with *Apis mellifera* honey produced ash content values ranging from 0.43 to 0.57% (Colmenares-Cuevas *et al.*, 2024). The addition of multifloral honey significantly increased ( $P < 0.01$ ) the ash content of marshmallow in proportion to the honey concentration, due to honey's naturally high mineral content including chlorine, potassium, and sulfur (Sasmita *et al.*, 2023). This contributed to elevated mineral levels in the product, supported by the SNI honey standard which allows up to 0.5% ash (BSN, 2018). Additionally, ash also originated from gelatin, as residual minerals like calcium and phosphorus may remain after processing (Wandita & Rosida, 2023), explaining why even the control treatment (M0) showed a baseline ash content of 0.61%,

consistent with previous reports of 0.51% in gelatin-based confections (Yudhistira *et al.*, 2021).

**Antioxidant Activity**

The results of the antioxidant activity analysis of marshmallows with varying concentrations of multifloral honey are presented in Table 3. The IC50 value indicates the concentration of antioxidant compounds needed to neutralize 50% of free radicals, with antioxidant activity calculated through linear regression of the inhibition percentage (Rosyidi *et al.*, 2018). In this study, marshmallow M3 required 110.63 µg/mL to reach 50% inhibition, categorizing it as having moderate antioxidant strength based on the classification (Pangisian *et al.*, 2022), where IC50 values between 100–150 µg/mL are considered moderate.

The addition of multifloral honey significantly (P<0.01) decreased the IC50 values

in marshmallow, showing increased antioxidant activity with higher honey concentrations. This improvement is linked to the natural antioxidant components in honey, such as flavonoids, enzymes, and organic acids that contribute to free radical scavenging (Intar *et al.*, 2016). Higher IC50 value of 277 µg/mL in gummy candies with 2% pistachio extract, the lower IC50 in this study suggests better antioxidant potency due to differences in raw materials and functional ingredients used (Roudbari *et al.*, 2024). These results are much higher than those obtained with marshmallows containing watermelon albedo juice and rosella flower extract, which ranged from 10.69 to 36.09% (Sarofa *et al.*, 2021).

**Sensory Evaluation**

**Taste.** The results of the sensory evaluation taste analysis of marshmallows with varying concentrations of multifloral honey are presented in Table 4.

Table 4. Average Sensory Evaluation Scores of Marshmallows with The Addition of Multifloral Honey

Treatment	Taste Score	Color Score	Aroma Score	Texture Score	Acceptance Score
M0	4.00 ± 0.35	4.74 ± 0.06 <sup>d</sup>	3.86 ± 0.14	3.54 ± 0.46	3.83 ± 0.36
M1	4.09 ± 0.26	4.63 ± 0.26 <sup>c</sup>	3.80 ± 0.16	3.91 ± 0.22	3.94 ± 0.13
M2	3.80 ± 0.52	4.54 ± 0.34 <sup>b</sup>	3.74 ± 0.21	3.54 ± 0.41	3.77 ± 0.55
M3	3.91 ± 0.31	4.45 ± 0.06 <sup>a</sup>	3.91 ± 0.16	3.86 ± 0.36	4.09 ± 0.24

Description: Different superscripts indicate highly significant differences (P<0.01) among treatments and absence of superscripts indicate no differences (P>0.05) among treatments

The addition of multifloral honey had a highly significant effect (P<0.01) on marshmallow taste preference. Marshmallows generally derive their sweetness from sucrose and a mild flavor from gelatin (Adi *et al.*, 2022), while honey imparts a more distinct flavor, especially at higher concentrations (Juliani *et al.*,

2022). Although no statistically significant differences were observed among treatments, panelists most preferred the 15% honey addition (M1) due to its balanced sweetness. Lower scores for M2 and M3 were likely due to excessive sweetness and a strong honey aftertaste, as honey’s higher fructose content makes it sweeter

than sucrose, resulting in a more dominant flavor at higher concentrations (Evahelda *et al.*, 2018).

**Color.** The results of the sensory evaluation color analysis of marshmallows with varying concentrations of multifloral honey are presented in Table 4. The addition of multifloral honey significantly ( $P < 0.05$ ) decreased the color preference scores of marshmallows, as higher concentrations caused visible darkening. The highest panelist acceptance score for sensory evaluation color was obtained in treatment M0 with a score of 4.75 (very like). Meanwhile, the lowest panelist acceptance score for sensory evaluation color was obtained in treatment M3 with a score of 4.45 (like).

Gelatin typically contributes to a bright white color by stabilizing foam and scattering light (Hardiyanti *et al.*, 2018), but honey introduces yellow-brown pigments like xanthophyll, carotene, and phenolic compounds from floral nectar (Jaya *et al.*, 2017), which intensify browning through Maillard reactions during heating (Yuwana *et al.*, 2022). This color shift likely led to lower acceptance, as panelists preferred the original bright white appearance common in commercial marshmallows (Adi *et al.*, 2022).

**Aroma.** The results of the sensory evaluation aroma analysis of marshmallows with varying concentrations of multifloral honey are presented in Table 4. The addition of multifloral honey did not significantly affect ( $P > 0.05$ ) aroma preference in marshmallows, although the highest score was observed at 45% concentration (M3), where the pleasant, balanced honey aroma complemented the base scent (Qomaruddin & Afandi, 2017). Honey's natural volatile

compounds from fermentation contribute to its distinctive sweet smell, but lower concentrations in M1 and M2 may have failed to produce a strong enough aroma, leading to reduced preference compared to M3 and the control (M0), despite honey's appealing profile (Jaya *et al.*, 2017).

**Texture.** The results of the sensory evaluation texture analysis of marshmallows with varying concentrations of multifloral honey are presented in Table 4. The addition of multifloral honey had no significant effect ( $P > 0.05$ ) on marshmallow texture preference. Texture, influenced by factors like size, shape, and structure, is critical to sensory quality. Marshmallow's chewy, foam-like texture forms from aerated sugar-gelatin mixtures, with gelatin stabilizing foam and sugar reducing surface tension to aid softness. Gelatin viscosity and sugar types like glucose and fructose contribute to chewiness and prevent hardening (Arizona *et al.*, 2021).

Honey's glucose and fructose affect hygroscopicity and crystallization (Qomaruddin & Afandi, 2017). Its low moisture content helps retain softness and enhance chewiness, as seen in jelly candies with higher honey levels (Silaen & Ginting, 2019). Although not statistically different, marshmallows with 15% honey (M1) were most preferred, likely due to their optimal balance of softness and chewiness—indicating that moderate honey addition improves texture appeal.

**Overall acceptance.** The results of the sensory evaluation acceptance analysis of marshmallows with varying concentrations of multifloral honey are presented in Table 4. The

analysis of variance showed that multifloral honey addition significantly affected ( $P>0.05$ ) marshmallow's overall preference. Overall acceptance reflects the panelists' comprehensive judgment of sensory attributes taste, color, aroma, and texture (Arizona *et al.*, 2021).

Marshmallows are typically known for their chewy, foam-like, and slightly sticky texture, and these characteristics influence how the product is perceived holistically (Arizona *et al.*, 2021). These results align with (Sarofa *et al.*, 2019), who found that incorporating natural ingredients like honey can improve key sensory traits, particularly taste and aroma, thus enhancing consumer acceptance. The enhancement of multiple sensory aspects through honey addition likely contributed to the increased overall preference observed in the study.

## CONCLUSIONS AND RECOMMENDATION

The formulation with 15% multifloral honey addition (M1) was indicated as the optimal treatment based on physicochemical and sensory evaluation. The results of treatment M1 included moisture content of 26.55%, water activity of 0.722, chewiness of 3.23 N, color  $L^*$  93.65, color  $a^*$  (-0.534), color  $b^*$  7.198, reducing sugar 12.46%, ash content 1.21%, and antioxidant activity (IC<sub>50</sub>) 298.53  $\mu\text{g/mL}$ . Sensory evaluation results included taste 4.09 (like), color 4.63 (very like), aroma 3.80 (like), texture 3.91 (like), and overall acceptance 3.94 (like). Further research is recommended to evaluate product stability during storage and to develop functional marshmallow formulations with other natural ingredients.

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## CONTRIBUTIONS STATEMENTS

DA: acted as the supervising lecturer, providing guidance, scientific direction, and oversight throughout the research process; SNA and ZDIDR: carried out the experimental work, including material preparation, data collection, and result analysis; CWD & AA: contribute to the preparation, editing, and refinement of the manuscript for publication.

## REFERENCES

- Adi, C. P., Prasetyati, S. B., Sebayang, E. A. B., & Aripudin, A. (2022). Utilization Of Catfish Bone Gelatin (*Pangasius Sp.*) In Marshmallow Products. *Barakuda 45: Jurnal Ilmu Perikanan Dan Kelautan*, 4(2), 141–150. <https://doi.org/10.47685/barakuda45.v4i2.266>
- Afshari, A., Ram, M., & Mohamadi, S. (2022). Quality Evaluation of Iranian Honey Collected from Khorasan Province, Iran. *International Journal of Food Science*, 1(1), 1–6. <https://doi.org/10.1155/2022/3827742>
- Akgün, N., Çelik, Ö. F., & Kelebekli, L. (2021). Physicochemical properties, total phenolic content, and antioxidant activity of chestnut, rhododendron, acacia and multifloral honey. *Journal of Food*

- Measurement and Characterization*, 15(4), 3501–3508.  
<https://doi.org/10.1007/s11694-021-00937-3>
- Alharanu, P. R., & Eviana, N. (2019). Pemanfaatan Buah Pedada (*Sonneratia caseolaris*) pada Pembuatan Permen Jelly. *Jurnal EDUTURISMA*, 4(2), 53–64.  
<http://ppid.menlhk.go.id>
- Amertaningtyas, D., Kurniawan, W., Al Awwaly, K. U., Evanuarini, H., Widyastuti, E. S., & Masyithoh, D. (2024). Quality of Color, Moisture Content, Water Activity and pH Marshmallow Gelatin Candy with Addition of Skim Milk. *Jurnal Ilmu Dan Teknologi Hasil Ternak*, 19(3), 179–188.  
<https://doi.org/10.21776/ub.jitek.2024.019.03.4>
- Amertaningtyas, D., Risti, F. B., Widyastuti, E. S., Evanuarini, H., Al Awwaly, K. U., Masyithoh, D., & Saleha, R. A. (2025). Quality Characteristics of Marshmallow Candy Made with Beef Bone Gelatin and Powdered Cream Milk: Texture, WaterContent, Aw, and pH. *Proceedings of the 5th International Conference on Environmentally Sustainable Animal Industry (ICESAI 2024)*, 47–54.  
[https://doi.org/10.2991/978-94-6463-670-3\\_5](https://doi.org/10.2991/978-94-6463-670-3_5)
- AOAC. (2005). *Official methods of analysis of AOAC International*. AOAC International.  
<https://www.researchgate.net/publication/292783651>
- Apriyanto, B., Karyantina, M., & Widanti, Y. A. (2020). Aktivitas Antioksidan Permen Jelly dengan Kombinasi Daun Kersen (*Muntingia calabura L.*) – Daun Pandan (*Pandanus amaryllifolius Roxb.*) dan Variasi Jenis Gula. *JITIPARI*, 5(2), 59–70.  
<https://doi.org/10.33061/jitipari.v5i2.4397>
- Ariani, N. L. S. N., I.N.S. Miwada, & S.A. Lindawati. (2016). Karakteristik Kimia Produk Susu Fermentasi “Kefir” Berantioksidan Selama Penyimpanan. *Jurnal Peternakan Tropika*, 4(2), 321–336.  
[https://scholar.google.com/scholar?hl=en&as\\_sdt=0%2C5&q=Ariani%2C+N.+L.+S.+N.%2C+I.N.S.+Miwada%2C+%26+S.A.+Lindawati.+%282016%29.+Karakteristik+Kimia+Produk+Susu+Fermentasi+%E2%80%9CKefir%E2%80%9D+Berantioksidan+Selama+Penyimpanan&btnG=](https://scholar.google.com/scholar?hl=en&as_sdt=0%2C5&q=Ariani%2C+N.+L.+S.+N.%2C+I.N.S.+Miwada%2C+%26+S.A.+Lindawati.+%282016%29.+Karakteristik+Kimia+Produk+Susu+Fermentasi+%E2%80%9CKefir%E2%80%9D+Berantioksidan+Selama+Penyimpanan&btnG=)
- Arizona, K., Laswati, D. T., & SAR, K. (2021). Studi Pembuatan Marshmallow dengan Variasi Konsentrasi Gelatin dan Gula. *AGROTECH*, 3(2), 11–17.  
<https://doi.org/10.37631/agrotech.v3i2.279>
- Badan Standarisasi Nasional. (1992). Cara Uji Gula – Bagian 3.2: Metode Lane dan Eynon. (SNI 01-2892-1992). Jakarta.  
<https://id.scribd.com/document/364259190/SNI-01-2892-1992>
- Badan Standarisasi Nasional. (2008). Kembang Gula Lunak – Lampiran B.4: Kadar Abu. (SNI 01-3547-2008). Jakarta.  
<https://id.scribd.com/doc/284102506/sni-kembang-gula>
- Bahri, M. A., Dwiloka, B., & Setiani, B. E. (2020). Perubahan Derajat Kecerahan, Kekenyalan, Vitamin C, Dan Sifat Organoleptik Pada Permen Jelly Sari Jeruk Lemon (*Citrus limon*). *Jurnal Teknologi Pangan*, 4(2), 96–102. [www.ejournal-s1.undip.ac.id/index.php/tekpangan](http://www.ejournal-s1.undip.ac.id/index.php/tekpangan)
- BSN. (2018). Madu (SNI 8664:2018). Jakarta: BSN RI.  
<https://www.scribd.com/document/710643426/13-Policy-Brief-SNI-Madu>
- Cahyaningrum, P. L. (2019). Aktivitas Antioksidan Madu Ternakan dan Madu Kelengkeng Sebagai Pengobatan Alami. *Widya Kesehatan*, 19(1), 1–6.  
<https://doi.org/10.32795/widyakesehatan.v1i1.279>
- Colmenares-Cuevas, S. I., Contreras-Oliva, A., Salinas-Ruiz, J., Hidalgo-Contreras, J. V., Flores-Andrade, E., & García-Ramírez, E. J. (2024). Development and study of the functional properties of marshmallow enriched with bee (*Apis mellifera*) honey and encapsulated probiotics (*Lactobacillus rhamnosus*). *Frontiers in Nutrition*, 11, 1–11.  
<https://doi.org/10.3389/fnut.2024.1353530>

- Delgado, P., & Bañón, S. (2015). Determining the minimum drying time of gummy confections based on their mechanical properties. *CYTA - Journal of Food*, 13(3), 329–335. <https://doi.org/10.1080/19476337.2014.974676>
- Direktorat Peternakan dan Kesehatan Hewan. (2023). *Buku Statistik 2023\_ISSN*. Direktorat Jenderal Peternakan dan Kesehatan Hewan Kementerian Pertanian RI. [https://satudata.pertanian.go.id/assets/docs/publikasi/Buku\\_Statistik\\_2023\\_ISSN.pdf](https://satudata.pertanian.go.id/assets/docs/publikasi/Buku_Statistik_2023_ISSN.pdf)
- Erwan, D. K. P., Resti, R., & Muhsinin, M. (2022). Identification of Honeybee Feeding Plants as Source of Nectar and Pollen. *Jurnal Triton*, 13(2), 206–220. <https://doi.org/10.47687/jt.v13i2.254>
- Evahelda, E., Pratama, F., & Santoso, B. (2018). Sifat Fisik dan Kimia Madu dari Nektar Pohon Karet di Kabupaten Bangka Tengah, Indonesia. *Agritech*, 37(4), 363. <https://doi.org/10.22146/agritech.16424>
- Gayosso-Sánchez, A. P., Colmenares-Cuevas, S. I., García-Ramírez, E. J., Contreras-Oliva, A., Uscanga-Sosa, D. P., Herrera-Corredor, J. A., & Salinas-Ruiz, J. (2022). Phenolic compounds and antioxidant activity of a functional honey-added marshmallow. *Agro Productividad*, 15, 111–119. <https://doi.org/10.32854/agrop.v15i3.2164>
- Gok, S., Toker, O. S., Palabiyik, I., & Konar, N. (2020). Usage possibility of mannitol and soluble wheat fiber in low calorie gummy candies. *LWT*, 128, 1–10. <https://doi.org/10.1016/j.lwt.2020.109531>
- Gumansalangi, F., Tuju, T. D. J., & Djarkasi, G. S. S. (2019). Aktivitas Antioksidan, Sifat Fisik dan Sensoris Marshmallow Melon (*Cucumis melo* L.) dengan Penambahan Ekstrak Bit Merah (*Beta vulgaris* L. var. *Conditiva*). *Jurnal Teknologi Pertanian*, 10(2), 18–28. <https://doi.org/10.35791/jteta.v10i1.25037>
- Gunes, R., Palabiyik, I., Konar, N., & Said Toker, O. (2022). Soft confectionery products: Quality parameters, interactions with processing and ingredients. In *Food Chemistry* (Vol. 385, pp. 82–91). Elsevier Ltd. <https://doi.org/10.1016/j.foodchem.2022.132735>
- Hardiyanti, A., Nugroho, A., & Putri, S. (2018). Kajian Pembuatan Marshmallow Dengan Penambahan Ekstrak Daun Kersen (*Muntingia calabura* L.). *Jurnal Kebidanan*, 4(3), 110–118. <https://doi.org/10.33024/jkm.v4i3.662>
- Intar, E., Widyawati, P. S., Dwi, T., & Budianta, W. (2016). Pengaruh Penambahan Madu Terhadap Aktivitas Antioksidan Minuman Beluntas-The Hitam dengan Perbandingan 25:75% (B/B) (Honey addition effect of antioxidant activity *Pluchea indica* Less-black drink at 25:75% (w/w) proportion). *Jurnal Teknologi Pangan Dan Gizi*, 15(1), 13–18. <https://doi.org/10.33508/jtpg.v15i1.1371>
- Jaya, F., & Widodo, W. N. (2017). Penambahan Madu pada Minumam Whey Kefir ditinjau dari Mutu Organoleptik, Warna, dan Kekekruhan Honey Addition in Kefir Whey Drink in Term of Organoleptic Quality, Colour, and Turbidity. *Jurnal Ilmu Dan Teknologi Hasil Ternak*, 12(1), 16–21. <https://doi.org/10.21776/ub.jitek.2017.012.01.3>
- Juliani, Irmayanti, & Daud, M. A. K. (2022). Antibacterial Activity and Sensory Characteristics of Low Calories Functional Candy Contains Tigona's Honey (*Trigona Itama*) and Patchouli Oil (*Pogostemon Cablin Benth*). *Jurnal Medika Veterinaria*, 16(2), 46–54. <https://doi.org/10.21157/j.med.vet.v14i2.28256>
- Kristantri, R. S., Sari, W. K., & Pebriani, T. H. (2024). Analisis Sifat Fisikokimia Marshmallow dengan Penambahan Royal Jelly Lebah Apis mellifera. *Jurnal Kesehatan Qamarul Huda*, 12(1), 54–61. <https://doi.org/10.37824/jkqh.v12i1.2024.668>
- Kurniawan, A., Agustini, T. W., & Rianingsih, L. (2016). *Prosising Seminar Nasional Tahunan Ke-V Hasil-Hasil Penelitian Perikanan dan Kelautan Pengaruh*

- Penambahan Spirulina platensis Powder terhadap Karakteristik Marshmallow.* [https://eprints.undip.ac.id/51351/1/55.\\_\(D\)\\_Arif\\_Kurniawan\\_-\\_PENGARUH\\_PENAMBAHAN\\_Spirulina\\_platensis\\_POWDER\\_TERHADAP\\_KARAKTERISTIK\\_MARSHMALLOW.pdf](https://eprints.undip.ac.id/51351/1/55._(D)_Arif_Kurniawan_-_PENGARUH_PENAMBAHAN_Spirulina_platensis_POWDER_TERHADAP_KARAKTERISTIK_MARSHMALLOW.pdf)
- Kurniati, F., & Amertaningtyas, D. (2025). The Effect of Propolis Addition on the Quality of Marshmallows in Terms of Texture, Water Content, Water Activity (Aw), and Color. *Jurnal Ilmu Dan Teknologi Hasil Ternak*, 20(1), 85–96. <https://doi.org/10.21776/ub.jitek.2025.020.01.7>
- Murib, P., & Kartikawati, D. (2022). Sifat Fisik dan Organoleptik Kerupuk dengan Pewarna Hijau Alami dari Sari Daun Suji, Sari Daun Katuk dan Sari Daun Sawi. *Agrifoodtech*, 1(1), 72–87. <https://doi.org/10.56444/agrifoodtech.v1i1.105>
- Mutisari, N., Larasati, D., & Fitriana, D. I. (2019). Sifat Fisik Kimia dan Sensori Permen Jelly Albedo Semangka (*Citrullus vulgaris* sp) dengan Penambahan Madu Multiflora Physical, Chemical and Sensory Properties of Watermelon Albedo Jelly Candy (*Citrullus Vulgaris* Sp) with the Addition of Multiflora Honey. *Jurnal Mahasiswa*, 1(1), 1–7. <https://repository.usm.ac.id/files/journalmhs/D.141.15.0015-20200907122510.pdf>
- Nepovinnykh, N. V., Klyukina, O. N., Kodatskiy, Y. A., Ptichkina, N. M., & Yeganehzad, S. (2018). Study of the stability of foam and viscoelastic properties of Marshmallow without Gelatin. *Foods and Raw Materials*, 6(1), 90–98. <https://doi.org/10.21603/2308-4057-2018-1-90-98>
- Ningtyas, I., Fitriana, I., & Larasati, D. (2018). Pengaruh Penambahan Madu terhadap Sifat Fisikokimia dan Organoleptik Permen Jelly Albedo Semangka (*Citrullus vulgaris* sp). *Jurnal Mahasiswa, Food Technology and Agricultural Products*, 1(1), 1–9. [https://repository.usm.ac.id/files/journalmhs/D.131.13.0041-20180906015850-PENGARUH-PENAMBAHAN-MADU-TERHADAP-SIFAT-FISIKOKIMIA-DANORGANOLEPTIK-PERMEN-JELLY-ALBEDO-SEMANGKA--\(Citrullus-vurgaris-sp\).pdf](https://repository.usm.ac.id/files/journalmhs/D.131.13.0041-20180906015850-PENGARUH-PENAMBAHAN-MADU-TERHADAP-SIFAT-FISIKOKIMIA-DANORGANOLEPTIK-PERMEN-JELLY-ALBEDO-SEMANGKA--(Citrullus-vurgaris-sp).pdf)
- Ningsih, A. P., & Marlina, L. (2024). Indonesian Journal of Fundamental and Applied Chemistry The Effect of Purple Sweet Potato Starch Variation on Marshmallow Characteristics. *IJFAC (International Journal of Fundamental and Applied Chemistry)*, 9(3), 130–138. <https://doi.org/10.24845/ijfac.v9.i3.130>
- Pangisian, J., Sangi, M. S., & Kumaunang, M. (2022). Analisis Senyawa Metabolit Sekunder dan Uji Aktivitas Antioksidan serta Antibakteri Biji Buah Pangi (*Pangium edule* Reinw). *Jurnal LPPM Bidang Sains Dan Teknologi*, 7(1), 11–19. <https://doi.org/10.35801/jlppmsains.7.1.2022.43979>
- Pontoh, J. (2019). Pnentuan Kandungan Sukrosa pada Gula Aren dengan Metode Enzimatik. *Chemical Program*, 6(1), 26–33. <https://doi.org/10.35799/cp.6.1.2013.2068>
- Putri, E. M. G., Wahyudi, V. A., Warkoyo, W., Harini, N., & Husna, A. (2024). Formulasi Permen Jeli Vegan Sari Buah Nanas, Lemon, Bunga Kol, dan Umbi Bit Merah dengan Konsentrasi Karagenan. *Food Technology and Halal Science Journal*, 7(2), 107–122. <https://doi.org/10.22219/fths.v7i1.35914>
- Qomaruddin, M., & H. Afandi. 2017. Tingkat Kesukaan Konsumen Terhadap Telur Asin Ayam Ras dan Telur Asin Itik di Kecamatan Kembangbahu, Kabupaten Lamongan. *Jurnal Ternak*. 8(2):1–8. <https://doi.org/10.30736/jy.v8i2.17>
- Rahmawati, A. Y., & Sutrisno, A. (2015). Hidrolisis Tepung Ubi Jalar Ungu (*Ipomea batatas* L.) secara Enzimatis menjadi Sirup Glukosa Fungsional: Kajian Pustaka. *Jurnal Pangan Dan Agroindustri*, 3(3), 1152–1159. [https://www.academia.edu/85628226/HIDROLISIS\\_TEPUNG\\_UBI\\_JALAR\\_ANGU\\_IPOMEA\\_BATATAS\\_L\\_SECARA\\_ENZIMATIS\\_MENJADI\\_SIRUP\\_GLUKOSA\\_FUNGSIONAL\\_KAJIAN\\_PUSTAKA](https://www.academia.edu/85628226/HIDROLISIS_TEPUNG_UBI_JALAR_ANGU_IPOMEA_BATATAS_L_SECARA_ENZIMATIS_MENJADI_SIRUP_GLUKOSA_FUNGSIONAL_KAJIAN_PUSTAKA)

- Enzymatic Hydrolysis of Purple Sweet Potato Ipomea batatas L Flour into Functional Glucose Syrup A Review
- Rosida, D. F., Priyanto, A. D., & Ristanti, D. W. (2022). Kajian Penambahan Madu dan Pati Kimpul (*Xanthosoma sagittifolium*) pada Snack Bar Buah Kering dan Sereal. *Jurnal Keteknik Pertanian Tropis Dan Biosistem*, 10(3), 200–212. <https://doi.org/10.21776/ub.jkptb.2022.010.03.04>
- Rosyidi, D., Eka Radiati, L., Minarti, S., Mustakim, M., Susilo, A., Jaya, F., & Azis, A. (2018). Perbandingan Sifat Antioksidan Propolis pada Dua Jenis Lebah (*Apis mellifera* dan *Trigona* sp.) di Mojokerto dan Batu, Jawa Timur, Indonesia. *Jurnal Ilmu Dan Teknologi Hasil Ternak*, 13(2), 108–117. <https://doi.org/10.21776/ub.jitek.2018.013.02.5>
- Roudbari, M., Barzegar, M., Sahari, M. A., & Gavlighi, H. A. (2024). Formulation of functional gummy candies containing natural antioxidants and stevia. *Heliyon*, 10(11), 1–12. <https://doi.org/10.1016/j.heliyon.2024.e31581>
- Sarofa, U., Rosida, & Wulandari, L. P. D. (2019). Karakteristik Marshmallow dari Kulit Pisang Raja (*MUSA TEXTILIA*): Kajian Konsentrasi Gelatin dan Putih Telur The Characteristics of Banana Peel Marshmallow (*Musa Textilia*): The Study of Gelatin and White Egg Concentration. *Jurnal Teknologi Pangan*, 13(1), 20–27. <https://doi.org/10.33005/jtp.v13i1.1505>
- Sarofa, U., Putra, A. Y. T., & Napitupulu, L. K. I. (2021). Characteristics of Marshmallow from a Mixture of Watermelon Albedo (*Citrullus vulgaris* Schard) and Rosella Flower (*Hibiscus sabdariffa*) Extract with The Addition of Gelatin. *2nd International Conference Eco-Innovation in Science, Engineering, and Technology*, 51–56. <https://doi.org/10.11594/nstp.2021.1409>
- Sasmita, Y., Sukainah, A., & Wijaya, M. (2023). Pengaruh Penambahan Madu sebagai Sumber Karbon terhadap Fermentasi Spontan Biji Kopi Arabika di Kabupaten Banteang. *PATANI*, 6(1), 11-17. <https://doi.org/10.47767/patani.v6i1.456>
- Silaen, N. R., & Ginting, S. (2019). Pengaruh Penambahan Madu terhadap Sifat Fisikokimia dan Organoleptik Permen Jelly Albedo Semangka (*Citrullus vulgaris* sp). *AGRINTECH (Jurnal Teknologi Pangan Dan Hasil Pertanian)*, 2(2), 68–77. [https://repository.usm.ac.id/files/journalmhs/D.131.13.0041-20180906015850-PENGARUH-PENAMBAHAN-MADU-TERHADAP-SIFAT-FISIKOKIMIA-DANORGANOLEPTIK-PERMEN-JELLY-ALBEDO-SEMANGKA--\(Citrullus-vurgaris-sp\).pdf](https://repository.usm.ac.id/files/journalmhs/D.131.13.0041-20180906015850-PENGARUH-PENAMBAHAN-MADU-TERHADAP-SIFAT-FISIKOKIMIA-DANORGANOLEPTIK-PERMEN-JELLY-ALBEDO-SEMANGKA--(Citrullus-vurgaris-sp).pdf)
- Sudarwati, H., Natsir, M. H., & Nurgartiningasih, V. A. (2019). *Statistika dan Rancangan Percobaan: Penerapan dalam Bidang Peternakan*. Malang: Universitas BrawijayaPress. <https://books.google.co.id/books?id=hbePDwAAQBAJ&printsec=frontcover&hl>
- Teixeira-Lemos, E., Almeida, A. R., Vouga, B., Morais, C., Correia, I., Pereira, P., & Guiné, R. P. F. (2021). Development and characterization of healthy gummy jellies containing natural fruits. *Open Agriculture*, 6(1), 466–478. <https://doi.org/10.1515/opag-2021-0029>
- Timisela, N., Breemer, R., & Lawalata, V. N. (2023). Effect of Gelatin Concentration on Physicochemical and Organoleptic Characteristics of Chinese Lemon Jelly Candy (*Citrus microcarpa*). *Jurnal Agrosilvopasture-Tech*, 2(1), 69–77. <https://doi.org/10.30598/j.agrosilvopasture-tech.2023.2.1.69>
- Wandita, H., & Rosida. 2023. Pengaruh Proporsi Sari Labu Siam dan Ekstrak Bunga Telang serta Penambahan Gelatin Terhadap Karakteristik Marshmallow. *Sinta Journal (Science, Technology, and Agriculture Journal)*, 4(1), 35–50. <https://doi.org/10.37638/sinta.4.1.35-50>
- Wulandari, D., Monica, R. E., Surono, A., & Triastuti, W. E. (2017). *Pembuatan Masker Wajah Peel Off Berbasis Gelatin dari Sisik Ikan Kakap Merah dengan Metode Hidrolisis*. Institut Teknologi

Sepuluh November. <https://fileservers-az.core.ac.uk/download/pdf/291464271.pdf>

- Yanti, E. N., Pangesti, M. D., Zulfa, A. F., Rahma, S., & Kustiawan, P. M. (2022). Pelatihan Cara Pembuatan Permen Jelly Dari Tanaman Herbal Sebagai Alternatif Cemilan Peningkat Daya Tahan Tubuh di Masa Pandemi. *Surya Abdimas*, 6(2), 396–405.  
<https://doi.org/10.37729/abdimas.v6i2.1789>
- Yudhistira, B., Putri, A. K., & Prabawa, S. (2021). The effect of sorbitol and white sweet potatoes (*Ipomea batatas* L.) inulin extract application on marshmallow physical, chemical and organoleptic properties. *Food Research*, 5(1), 298–305.  
[https://doi.org/10.26656/fr.2017.5\(1\).405](https://doi.org/10.26656/fr.2017.5(1).405)
- Yuwana, A. M. P., Putri, D. N., & Harini, N. (2022). Hubungan antara atribut sensori dan kualitas gula merah tebu: pengaruh pH dan kondisi karamelisasi. *Teknologi Pangan : Media Informasi Dan Komunikasi Ilmiah Teknologi Pertanian*, 13(1), 54–66.  
<https://doi.org/10.35891/tp.v13i1.2767>
- Zulfajri, Harun, N., & Johan, V. S. (2018). Perbedaan Konsentrasi Gelatin terhadap Kualitas Permen Marshmallow Buah Naga Merah (*Hylocereus polyrhizus*). *SAGU*, 17(1), 10–18.  
<https://garuda.kemdiktisaintek.go.id/documents/detail/2632213>