Jurnal Ilmiah Mandala Education (JIME)
Vol 12 No.3 Agustus 2026
p-ISSN : 2442-9511, e-2656-5862
DOI: *10.58258/jime.v12i3.11170/http://ejournal.mandalanursa.org/index.php/JIME*

The Effect of Garbanzo Bean Aquafaba (Cicer arietinum) Substitution on the Physical and Sensory Quality of Marshmallow

Muhammad Bagir Ellong[1], Mutiara Dahlia[2], Sachriani[3]
[123]Pendidikan Tata Boga, Fakultas Teknik, Universitas Negeri Jakarta

Article Info

Article history:
Accepted: 15 July 2026
Publish: 04 Agustus 2026

Keywords:
Aquafaba, Garbanzzo, Marshmallow, Density, ensory Quality

Abstract

This study aimed to analyze the effect of chickpea aquafaba (Cicer arietinum) substitution on the physical quality and sensory attributes of marshmallow. This research applied an experimental method using three levels of aquafaba substitution, namely 30%, 45%, and 60%. Physical quality testing was conducted by measuring density with three replications, analyzed using ANOVA followed by Duncan's Multiple Range Test. The ANOVA results indicated that chickpea aquafaba substitution significantly affected the density of marshmallow ($F = 30.17$; $p < 0.001$). The mean density values of marshmallow at 30%, 45%, and 60% substitution levels were 0.45 g/cm³, 0.47 g/cm³, and 0.52 g/cm³, respectively. Duncan's test showed that the 30% substitution treatment produced the best density result. Sensory evaluation was carried out by 45 semi-trained panelists assessing color, egg white aroma, chickpea aroma, sweetness, chickpea flavor, chewy texture, and melting speed in the mouth. The Kruskal-Wallis test results showed that aquafaba substitution had no significant effect on all sensory attributes tested ($p > 0.05$ for all attributes). Based on descriptive analysis, the 60% substitution marshmallow obtained the highest mean score for chewiness, while the 45% substitution marshmallow obtained the highest mean score for color and melting speed in the mouth. It can be concluded that chickpea aquafaba substitution affected the physical density of marshmallow but did not influence its sensory quality. The 60% substitution formulation is recommended for further development

Corresponding Author:
Muhammad Bagir Ellong
Universitas Negeri Jakarta
Email Coresspoden: bagirellong@gmail.com

1. INTRODUCTION

Marshmallow is a foam-based confectionery product made from aerated sugar and stabilized by binding agents such as gelatin and egg white. It is widely appreciated for its soft, light, and chewy texture, which is largely attributed to the incorporation and stabilization of air bubbles during whipping (Arizona et al., 2021). During the manufacturing process, air is dispersed into the sugar matrix and retained by surface-active compounds, resulting in a stable foam structure that contributes

to the characteristic texture and appearance of marshmallow. Egg white plays a crucial role as a foaming agent because its proteins, including ovalbumin, ovotransferrin, ovomucin, and lysozyme, contribute to foam formation and stability (Lomakina & Mikova, 2006; Li et al., 2022). These proteins are capable of adsorbing at the air–water interface, reducing surface tension, and forming a viscoelastic film that helps maintain foam integrity throughout processing and storage.

However, the use of egg white may limit product consumption among individuals with egg allergies and those following vegan or plant-based diets (Mustafa et al., 2018). In addition, concerns regarding animal-derived ingredients and the growing preference for sustainable food sources have encouraged the food industry to explore alternative ingredients that can provide similar functional properties while meeting diverse consumer needs.

As consumer demand for plant-based food products continues to increase, aquafaba has emerged as a promising alternative to egg white. Aquafaba is the viscous liquid obtained from cooking legumes, particularly garbanzo beans (Cicer arietinum), and possesses functional properties similar to egg white (The Official Aquafaba Website, 2016). This ingredient has gained considerable attention in recent years because of its ability to generate and stabilize foam, emulsify mixtures, and improve texture in various food applications. Compared with aquafaba derived from other legumes, garbanzo bean aquafaba exhibits color, consistency, and foaming characteristics that more closely resemble egg white (Ridhani & Faulika, 2020). Its functionality is associated with the presence of proteins, carbohydrates, saponins, and other soluble compounds that contribute to foam formation and stabilization (Mustafa & Reaney, 2020). Furthermore, these compounds interact synergistically to create a stable network around air bubbles, allowing aquafaba to perform effectively in products that require aeration. The utilization of aquafaba also supports the valorization of legume-processing byproducts, thereby contributing to more sustainable food production practices.

Previous studies have demonstrated the potential of garbanzo bean aquafaba as an egg white substitute in various food products. Research on royal icing showed that garbanzo bean aquafaba exhibited considerable foaming capacity, although lower than that of egg white, while maintaining acceptable physicochemical properties (Sugiarto, 2019). Similar findings have been reported in bakery and dessert products, where aquafaba successfully replaced egg white without causing substantial reductions in product quality. These findings indicate that aquafaba has potential applications in aerated food systems. Nevertheless, studies investigating the use of garbanzo bean aquafaba in marshmallow production remain limited, particularly regarding its effects on the physical and sensory characteristics of the final product. Information related to texture, volume expansion, foam stability, color, taste, aroma, and overall consumer acceptance is still insufficient. Therefore, further investigation is necessary to better understand the suitability of aquafaba as a functional ingredient in marshmallow formulations and to determine its optimal substitution level.

Therefore, this study offers scientific novelty by evaluating the application of garbanzo bean aquafaba as an egg white substitute in marshmallow and examining its effects on physical quality and sensory attributes. The objective of this research was to determine the effect of garbanzo bean aquafaba substitution on the physical quality and sensory quality of marshmallow and to identify the substitution level that produces the most desirable product characteristics. The results of this study are expected to provide valuable information for the development of plant-based confectionery products and contribute to the growing body of knowledge regarding the functional applications of aquafaba in food systems. Moreover, the findings may serve as a reference for food manufacturers seeking innovative, sustainable, and consumer-friendly alternatives to conventional egg-based ingredients.

2. METHOD

2.1 Research Methods

The research employed an experimental method to determine the effect of garbanzo bean aquafaba (*Cicer arietinum*) substitution on the physical quality and sensory attributes of marshmallow. The population of this study consisted of marshmallow products formulated with different levels of garbanzo bean aquafaba substitution at 30%, 45%, and 60%. The sampling technique was carried out randomly *(random sampling),* where each sample was given a random three-digit code generated prior to testing, and the presentation order of the samples was randomized for each panelist to minimize order and position bias; these codes were known only to the researcher.

2.2 Data Collection And Analysis Tecniques

Data collection in this study was carried out in stages, beginning with product validation by five expert panelists, namely lecturers from the Culinary Arts Education Study Program, Jakarta State University. Next, samples were tested by 45 semi-trained panelists, namely students from the Culinary Arts Education Study Program, Jakarta State University, to assess the sensory quality aspects of color, egg white aroma, garbanzo bean aroma, sweet taste, garbanzo bean flavor, chewiness, and mouth-melting property. The sensory evaluation instrument used was a hedonic scale scoresheet adapted from Adawiyah et al. (2024), a method widely applied in food sensory research. Prior to the main testing, this instrument was reviewed and validated by the five expert panelists to confirm that the attributes, scale, and terminology used were clear, relevant, and easily understood, thereby supporting the content validity of the instrument. The 45 semi-trained panelists also underwent a briefing session to familiarize themselves with the sensory attributes and scoring procedure before the actual assessment, which helped ensure the reliability and consistency of their responses. The samples were then evaluated for their physical quality, including density measurements, using a digital scale.

Data obtained from the physical quality tests were analyzed using one-way ANOVA to determine the effect of each treatment. When a significant effect was observed, Duncan's Multiple Range Test was performed as a post hoc analysis. Physical quality was evaluated based on density measurements. Sensory quality data were analyzed using the Kruskal–Wallis test, followed by Tukey's post hoc test. Sensory quality was assessed based on the attributes of color, egg white aroma, garbanzo bean aroma, sweet taste, garbanzo bean flavor, chewiness, and mouthmelting property.

2.3 Production of Garbanzo Bean Aquafaba

In this study, the manufacture of aquafaba garbanzo bean refers to research conducted by ihsan et al (2023). The process of making aquafaba garbanzo bean can be seen in the following flow diagram:

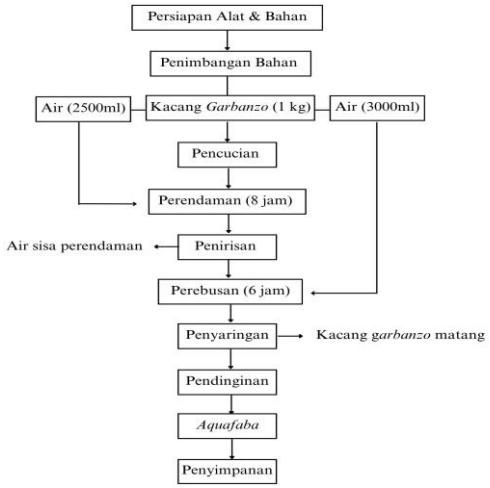

Figure 1 Flowchart of the Aquafaba Garbanzo Bean Making Process

2.4 Production of Marshmallow

Marshmallow production in this study followed the procedure developed by Olson (2016), as shown in the flow diagram below.

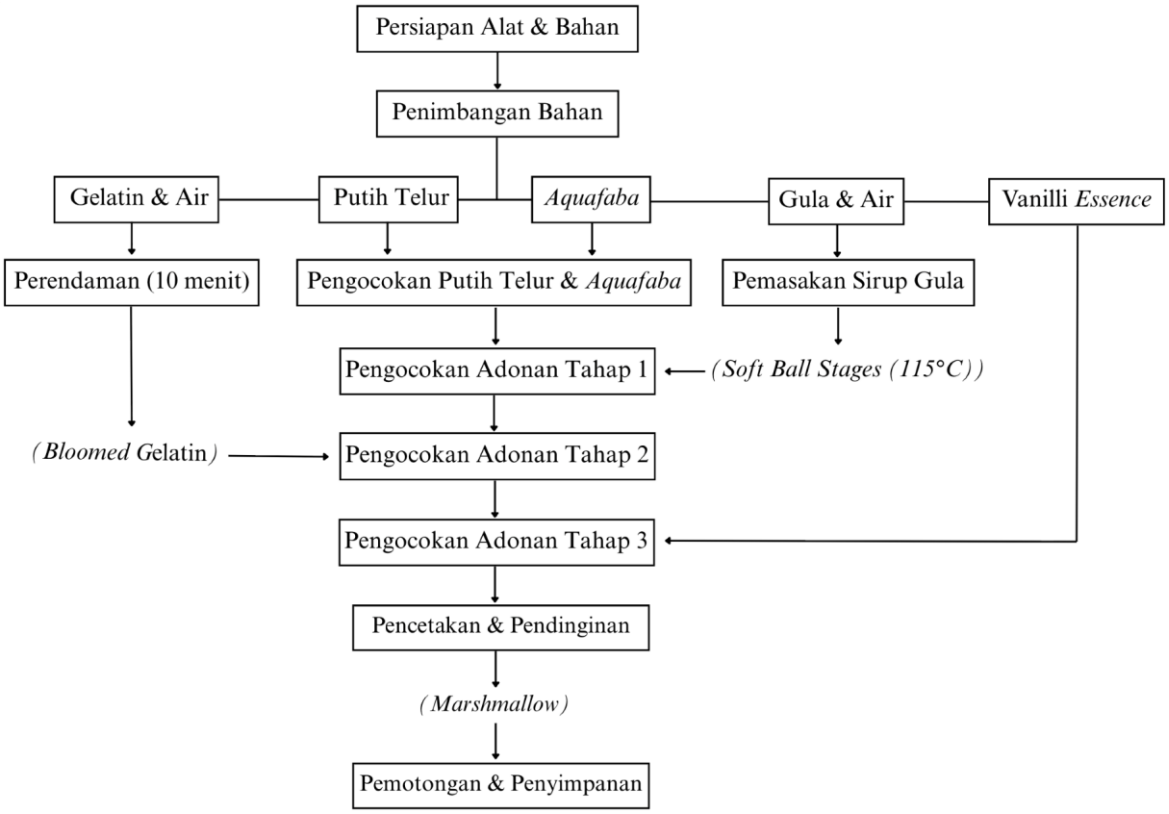

Figure 2 Manufacturing Process of *marshmallow*

The product manufacturing formula can be seen in the following table:

Table 1 formula of marshmallow aquafaba garbanzo bean substitution

Aquafaba garbanzo bean substitution

Material	30%		45%		60%	
	Gram	**%**	**Gram**	**%**	**Gram**	**%**
Egg White	29,4	70	23,1	55	16,8	40
Aquafaba Garbanzo Bean	**12,6**	**30**	**18,9**	**45**	**25,2**	**60**
Sugar	150	357	150	357	150	357
Gelatin *Powder*	11,25	26,7	11,25	26,7	11,25	26,7
Vanili *Essence*	1	2,38	1	2,38	1	2,38
Water	75	178	75	178	75	178

3. RESULTS AND DISCUSSION

1.1 Physical Quality

a. Density

Based on the results of the physical quality test on density, marshmallows with the highest level of garbanzo bean aquafaba substitution exhibited the highest density value. As the percentage of garbanzo bean aquafaba substitution increased, the density of the marshmallow tended to increase.

The results of the ANOVA test showed an F-value of 30.17 ($p < 0.001$). Therefore, it can be concluded that garbanzo bean aquafaba substitution significantly affected the density of the marshmallow. To determine which treatments differed significantly from one another, the analysis was further continued using Duncan's Multiple Range Test.

Table 1: ANOVA Test Of Density Measurement

SK	Db	JK	KT	Fvalue	Ftable
treatment	2	0,00628	0,00314		
error	6	0,00062	0,00010	30,17	5,14
			Total	8	0,00691
0,00325					

Based on the results of the Duncan test, it was found that the 60% treatment was significantly different from the 30% and 45% treatments. Meanwhile, the 30% treatment was not significantly different from the 45% treatment.

Table 2 Duncan Test Result

Treatment	Mean	Mean ± DMRT	Notation
30% (A)	0,45	0,474	a
45% (B)	0,47	0,492	a
60% (C)	0,52		b

According to Buhl et al. (2019), aquafaba foam exhibits lower foam capacity and foam volume, as well as higher liquid drainage, compared to egg white foam. These differences are attributed to the distinct chemical composition of aquafaba, which contains proteins and soluble carbohydrates that influence its foaming properties. Reduced foam capacity and foam volume

result in less air being incorporated into the system, while increased liquid drainage decreases foam stability by promoting bubble collapse. Consequently, fewer air bubbles are retained within the product structure, leading to a denser foam-based product. Therefore, increasing the level of aquafaba substitution may contribute to higher marshmallow density due to reduced air incorporation and a greater proportion of dissolved solids in the system.

1.2 sensory quality

a. Color

Based on the results of the assessment for the color attribute of marshmallows with 30% garbanzo bean aquafaba substitution was 3.87, which was classified as ivory white. Marshmallows with 45% garbanzo bean aquafaba substitution obtained a mean score of 4.07, which was also classified as ivory white. Meanwhile, marshmallows with 60% garbanzo bean aquafaba substitution achieved a mean score of 3.80, which likewise fell into the ivory white category.

Table 3 Result Of The Color Aspect Hypothesis

Testing criteria	X^2 Count	X^2 table
Color	1,15	5,99

Based on the results of the Kruskal–Wallis test, garbanzo bean aquafaba substitution did not significantly affect the color attribute of marshmallow. This was indicated by the calculated χ^2 value, which was lower than the critical χ^2 value (χ^2count < χ^2table; p = 0.563). Therefore, no significant differences were observed among the treatments.

Based on the hypothesis testing results, garbanzo bean aquafaba substitution did not significantly affect the sensory quality of marshmallow in terms of color. This finding is consistent with the study conducted by Caroko and Kristopo (2025) on French meringue production, which reported no significant differences in color ratings among samples prepared using garbanzo bean aquafaba. These results suggest that replacing egg white with garbanzo bean aquafaba does not substantially alter panelists' perception of product color.

b. Egg White Aroma

Based on the results of the assessment for the egg white aroma attribute of marshmallows with 30% garbanzo bean aquafaba substitution was 4.87, which was classified as having no egg white aroma. Marshmallows with 45% garbanzo bean aquafaba substitution obtained a mean score of 4.67, which was also classified as having no egg white aroma. Meanwhile, marshmallows with 60% garbanzo bean aquafaba substitution achieved a mean score of 4.53, which likewise fell into the category of having no egg white aroma.

Table 4 Result Of Egg White Aroma Aspect Hypothesis

Testing criteria	X^2 Count	X^2 table
Egg White Aroma	2,22	5,99

Based on the results of the Kruskal–Wallis test, garbanzo bean aquafaba substitution did not significantly affect the egg white aroma attribute of marshmallow. This was indicated by the calculated χ^2 value, which was lower than the critical χ^2 value (χ^2count < χ^2table; p = 0.330). Therefore, no significant differences were observed among the treatments.

According to Adawiyah et al. (2024), aroma is determined by volatile compounds released from food and perceived by the olfactory system. The hypothesis testing results indicated that

garbanzo bean aquafaba substitution did not significantly affect the sensory quality of marshmallow in terms of egg white aroma. This may be attributed to the presence of other ingredients, such as garbanzo bean aquafaba, sugar, and flavoring agents, which can mask the natural aroma of egg white. Similarly, Aslan and Ertaş (2020) reported that the use of garbanzo bean aquafaba as an egg white substitute in cake formulations did not result in significant changes in sensory acceptability, suggesting that aquafaba substitution can be applied without adversely affecting aroma perception.

c. Garbanzo Bean Aroma

Based on the results of the assessment for the garbanzo bean aroma attribute, marshmallows with 30% garbanzo bean aquafaba substitution obtained a mean score of 4.30, which was classified as moderately exhibiting garbanzo bean aroma. Marshmallows with 45% garbanzo bean aquafaba substitution obtained a mean score of 4.40, which was also classified as moderately exhibiting garbanzo bean aroma. Meanwhile, marshmallows with 60% garbanzo bean aquafaba substitution achieved a mean score of 4.10, which likewise fell into the category of moderately exhibiting garbanzo bean aroma.

Table 5 Result Of Garbanzo Bean Aroma Aspect Hypothesis

Testing criteria	$\mathbf{X^2}$ **Count**	$\mathbf{X^2}$ **table**
Garbanzo Bean Aroma	1,01	5,99

Based on the results of the Kruskal–Wallis test, garbanzo bean aquafaba substitution did not significantly affect the garbanzo bean aroma attribute of marshmallow. This was indicated by the calculated χ^2 value, which was lower than the critical χ^2 value (χ^2count < χ^2table; p = 0.604). Therefore, no significant differences were observed among the treatments.

Based on the hypothesis testing results, garbanzo bean aquafaba substitution did not significantly affect the sensory quality of marshmallow in terms of garbanzo bean aroma. The aroma of garbanzo bean aquafaba originates from volatile compounds naturally present in legumes, which generally contribute to the characteristic beany aroma. According to Mehren et al. (2026), garbanzo bean aquafaba possesses a distinctive legume aroma profile derived from the natural volatile compounds of garbanzo beans, which may still be detectable in processed food products.

d. Sweet Taste

Based on the results of the assessment for the sweetness attribute, marshmallows with 30% garbanzo bean aquafaba substitution obtained a mean score of 4.40, which was classified as moderately sweet. Marshmallows with 45% garbanzo bean aquafaba substitution obtained a mean score of 4.50, which was classified as sweet. Likewise, marshmallows with 60% garbanzo bean aquafaba substitution achieved a mean score of 4.50, which was also classified as sweet.

Table 6 Result Of Sweet Taste Aspect Hypothesis

Testing criteria	$\mathbf{X^2}$ **Count**	$\mathbf{X^2}$ **table**
Sweet Taste	0,44	5,99

Based on the results of the Kruskal–Wallis test, garbanzo bean aquafaba substitution did not significantly affect the sweet taste attribute of marshmallow. This was indicated by the calculated χ^2 value, which was lower than the critical χ^2 value (χ^2count < χ^2table; p = 0.803). Therefore, no significant differences were observed among the treatments.

Taste refers to a sensory characteristic perceived by the gustatory system, particularly the tongue, through compounds dissolved in the oral cavity (Rahayu W.P. et al., 2019). Based on the

hypothesis testing results, garbanzo bean aquafaba substitution did not significantly affect the sensory quality of marshmallow in terms of sweetness. This finding is supported by Nurlela et al. (2025), who stated that sweetness is a primary characteristic of marshmallow derived mainly from the addition of sugar. In addition to providing sweetness, sugar also contributes to the overall flavor balance of the marshmallow product. This consistent perception of sweetness across substitution levels can likely be attributed to the formulation design, in which the amount of sugar was kept constant across all treatments while only the proportion of aquafaba was varied; since sucrose remained the dominant sweetening agent, the panelists' perception of sweetness was largely unaffected by the change in aquafaba level. This result is in line with Buhl et al. (2019), who reported that aquafaba mainly contributes soluble carbohydrates and proteins that influence foaming behavior rather than acting as a primary sweetening agent, so its contribution to sweetness is comparatively minor relative to the added sucrose. These findings suggest that, unlike density, sweetness perception in aquafaba-substituted marshmallow is governed more by the sugar formulation than by the aquafaba substitution level itself, which explains the difference between the significant effect observed for density and the non-significant effect observed for sweetness in this study.

e. Garbanzo Bean Taste

Based on the results of the assessment for the garbanzo bean flavor attribute, marshmallows with 30% garbanzo bean aquafaba substitution obtained a mean score of 4.47, which was classified as moderately exhibiting garbanzo bean flavor. Marshmallows with 45% garbanzo bean aquafaba substitution also obtained a mean score of 4.47, which was classified as moderately exhibiting garbanzo bean flavor. Meanwhile, marshmallows with 60% garbanzo bean aquafaba substitution achieved a mean score of 4.00, which likewise fell into the category of moderately exhibiting garbanzo bean flavor.

Table 7 Result Of Garbanzo Bean Taste Aspect Hypothesis

Testing criteria	X^2 Count	X^2 table
Garbanzo Bean Taste	3,57	5,99

Based on the results of the Kruskal–Wallis test, garbanzo bean aquafaba substitution did not significantly affect the garbanzo bean taste attribute of marshmallow. This was indicated by the calculated χ^2 value, which was lower than the critical χ^2 value (χ^2count < χ^2table; p = 0.168). Therefore, no significant differences were observed among the treatments.

Based on the hypothesis testing results, garbanzo bean aquafaba substitution did not significantly affect the sensory quality of marshmallow in terms of garbanzo bean flavor. According to Mehren et al. (2026), garbanzo bean aquafaba possesses a characteristic beany flavor derived from volatile compounds formed during the cooking and extraction processes. These compounds may remain detectable in the final product and contribute to its flavor profile. However, the intensity of the beany flavor can vary depending on processing conditions, as treatments such as heating or fermentation may reduce the beany character and produce a more neutral flavor.

f. Chewiness

Based on the results of the assessment for the chewiness attribute, marshmallows with 30% garbanzo bean aquafaba substitution obtained a mean score of 4.80, which was classified as chewy. Marshmallows with 45% garbanzo bean aquafaba substitution also obtained a mean score of 4.80, which was classified as chewy. Meanwhile, marshmallows with 60% garbanzo bean aquafaba substitution achieved a mean score of 4.87, which likewise fell into the chewy category.

Table 8 Result Of Chewiness Aspect Hypothesis

Testing criteria	X^2 Count	X^2 table
Chewiness	0,89	5,99

Based on the results of the Kruskal–Wallis test, garbanzo bean aquafaba substitution did not significantly affect the chewiness attribute of marshmallow. This was indicated by the calculated χ^2 value, which was lower than the critical χ^2 value (χ^2count < χ^2table; p = 0.641). Therefore, no significant differences were observed among the treatments.

Based on the hypothesis testing results, garbanzo bean aquafaba substitution did not significantly affect the sensory quality of marshmallow in terms of chewiness. Tufaro and Cappa (2023) reported that garbanzo bean aquafaba possesses functional properties that enable the formation of foam structures similar to those produced by egg white due to the presence of proteins, carbohydrates, and saponins. These components contribute to foam formation and stabilization, which influence the texture of confectionery products. In marshmallow, the chewy texture is generated through the interaction between the foaming properties of aquafaba and the gelatin-based gel system, resulting in a stable product structure with desirable textural characteristics.

g. Mouth Melting

Based on the results of the assessment for the mouth-melting property attribute, marshmallows with 30% garbanzo bean aquafaba substitution obtained a mean score of 4.27, which was classified as moderately fast melting. Marshmallows with 45% garbanzo bean aquafaba substitution obtained a mean score of 4.40, which was also classified as moderately fast melting. Meanwhile, marshmallows with 60% garbanzo bean aquafaba substitution achieved a mean score of 4.13, which likewise fell into the category of moderately fast melting.

Table 9 Result Of Mouth Melting Aspect Hypothesis

Testing criteria	X^2 Count	X^2 table
Mouth Melting	1,15	5,99

Based on the results of the Kruskal–Wallis test, garbanzo bean aquafaba substitution did not significantly affect the chewiness attribute of marshmallow. This was indicated by the calculated χ^2 value, which was lower than the critical χ^2 value (χ^2count < χ^2table; p = 0.563). Therefore, no significant differences were observed among the treatments.

Based on the hypothesis testing results, garbanzo bean aquafaba substitution did not significantly affect the sensory quality of marshmallow in terms of mouth-melting property. The melting behavior of marshmallow is closely related to its structure as a foamed gel. According to Goh et al. (2025), the porous structure of marshmallow influences its disintegration during oral processing. Higher porosity reduces the strength of the gel network, allowing the product to break down more rapidly in the mouth.

Consequently, mouth-melting property is influenced not only by ingredient composition but also by the microstructure of the product, particularly the distribution of air within the foam system. Increased aeration promotes faster structural breakdown through mechanical action and saliva interaction during consumption, resulting in a quicker melting sensation.

4. CONCLUSION

The results of the physical quality analysis using ANOVA showed that garbanzo bean aquafaba substitution significantly affected the density of marshmallow. Duncan's Multiple Range Test indicated that the 60% substitution treatment produced the highest density value and differed significantly from the other treatments.

The results of the sensory quality analysis using the Kruskal–Wallis test showed that garbanzo bean aquafaba substitution had no significant effect on the attributes of color, egg white aroma, garbanzo bean aroma, sweetness, garbanzo bean flavor, chewiness, and mouth-melting property. All treatments were generally accepted by the panelists and exhibited similar sensory characteristics.

Therefore, it can be concluded that garbanzo bean aquafaba substitution affects the physical quality of marshmallow, particularly its density, but does not significantly affect its sensory quality. Based on the overall results, marshmallow with 60% garbanzo bean aquafaba substitution can be recommended for further development as an alternative foam-based confectionery product utilizing plant-based ingredients. Further research is recommended to examine the shelf-life stability of aquafaba-substituted marshmallow, to conduct instrumental texture analysis for a more objective assessment of textural properties, and to carry out consumer acceptance testing on a wider scale in order to strengthen the practical applicability of these findings.

5. ACKNOWLEDGMENTS

The author would like to express sincere gratitude to all individuals and institutions who contributed their support, assistance, and guidance throughout the research process and the preparation of this article. It is hoped that this study will contribute valuable knowledge and provide benefits to both researchers and readers.

6. BIBLIOGRAPHY

Adawiyah, D. R., Hunaefi, D., & Nurtama, B. (2024). *Evaluasi Sensori Produk Pangan*, Bumi Aksara, Jakarta.

Aquafaba history, https://aquafaba.com/history.html diakses pada tanggal 4 Juni 2025.

Arizona, K., Dyah, T., & Laswati, K. S. (2021). Studi Pembuatan Marshmallow Dengan Variasi Konsentrasi Gelatin Dan Sukrosa, *Agrotech* 3(2).

Aslan, M., & Ertaş, N. (2020). Possibility of using "chickpea aquafaba" as egg replacer in traditional cake formulation. *Harran Tarım ve Gıda Bilimleri Dergisi*, *24*(1).

Buhl, T. F., Christensen, C. H., & Hammershøj, M. (2019). Aquafaba as an egg white substitute in food foams and emulsions: Protein composition and functional behavior. *Food Hydrocolloids*, *96*.

Caroko, R.D, Kristopo, H.(2025) The Effect of Using Aquafaba from Various Brands of Chickpeas (Cicer arietinum L.) as an Egg Replacer in French Meringue Production on Physical, Chemical, and Sensory Characteristics [tesis]. Jakarta : Bina Nusantara University.

Goh, S. M., Lee, J. M. W., Tan, S. N., Stoyanov, S., Lim, V. pua cheng, Kwong, S. L., & Nishinari, K. (2025). Marshmallow as a Model Foamed Gel for Dysphagia-Friendly Transitional Food. *Pplied Food Research*, *5*(2).

Ihsan, N., Astiana, R., & Oktavia Puspita Rini, R. (2023). Penggunaan Aquafaba Kacang Arab Sebagai Alternatif Pengganti Putih Telur Dalam Pembuatan Macaron. *Jurnal Manajemen Kuliner*, *2*(1).

Li, Z., Huang, X., Tang, Q., Ma, M., Jin, Y., & Sheng, L. (2022). Functional Properties and Extraction Techniques of Chicken Egg White Proteins. In *Foods*,11(16).

Lomakina, K., & Mikova, K. (2006). kateryna and kamila 2006. *Czech J. Food Sci.*, *24*(3).

Mehren, Lea, Rabea Hondrich, Maretzky, Fabian, Wust, Matthias, Schieber, Andreas, & Schulzekaysers, Nadine. (2026). Mehren, Lea, et al. "Characterization of the aroma profile of fermented chickpea (Cicer arietinum L.) aquafaba by GC-MS and sensory analysis. *Current Research in Food Science*.

Mustafa, R., & Reaney, M. J. T. (2020). Aquafaba, from Food Waste to a Value-Added Product. In *Food Wastes and By-products*, 4.

Mustafa, R., He, Y., Shim, Y. Y., & Reaney, M. J. T. (2018). Aquafaba, wastewater from chickpea canning, functions as an egg replacer in sponge cake. *International Journal of Food Science and Technology*, *53*(10).

Nurlela, R., pertiwi, sri R., & maulidi, M. (2025). *profil sensori marshmallow dengan penambahan sari buah kecombrang (etlingera elatior) menggunakan metode RATA*. *Jurnal Ilmiah Pangan Halal*, *7*(1).

Olson, A. (2016). *Bake with Anna Olson: More than 125 Simple, Scrumptious and Sensational Recipes to Make You a Better Baker: A Baking Book: Vol. 4.1a*. Appetite by Random House. Canada

Ridhani, & Faulika. (2020). Penggunaan Aquafaba Sebagai Pengganti Telur Dalam Pembuatan Japanese Cheesecake[skripsi]. Bandung : Politeknik pariwisata NHI Bandung.

Sugiarto, Y. (2019). *Effect Of Chickpeas (Cicer Arietinum L.) And Soybean (Glycine Max L.) Aquafaba As Egg White Substitues On The Physicochemical And Organoleptic Properties Of Royal Icing During Storage*[tesis], Semarang: Universitas Katolik Soegijapranata.

Tufaro, deborah, & Cappa, carola. (2023). Chickpea cooking water (Aquafaba): Technological properties and application in a model confectionery product. *Food Hydrocoloid*, *136*.