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Evaluation of Proximate, Organoleptic and Vitamin C Changes of Seaweed Jelly Candy (*Gracillaria* Sp.) after the Addition of Honey Mango Juice

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Aims: to determine the effect of the addition of honey mango juice on the characteristics of jelly candy
Study Design: This research was designed using a completely randomized design (CRD) with four treatments namely A (addition of 0% mango juice), B (addition of 9.93%% mango juice), C (addition of 12.5% mango juice) and D (addition of 16.07% mango juice) with 2 replications. Proximate and

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sensory data of jelly candy were analyzed by analysis of variance (ANOVA) and followed by honest real difference test at α5% level

Place and Duration of Study: This research was conducted at the Makassar Health Laboratory Center (Chemical Testing) and Departemen of Aquatic Product Processing and Storage Workshop (Organoleptic Test) of Pangkep State Polytechnic of Agriculture from April to July 2024.

Methodology: The analysis conducted in this study included chemical and organoleptic analysis. Chemical analysis included: analysis of water content by distillation method, total sugar content. Vitamin C levels through iodometric titration. Organoleptic (sensory) analysis included Odor, taste, texture and color.

Results: The results showed that the addition of mango juice to the characteristics of jelly candy was significantly different to water content, total sugar content and vitamin C. The best product based on chemical analysis is jelly candy in treatment D with the highest vitamin C content (5520.1 µg/g) and the highest total sugar content (38.92%) while the lowest water content (11.21%) was found in treatment A. Tests on organoleptic assessment of the highest panelists in treatment D, namely Odor 3.8 (like), taste 4.2 (like), texture 3.2 (normal), and color 3.7 (like).

Keywords: Gracillaria; jelly candy; mango juice; vitamin C.

1. INTRODUCTION

Agar is a mixture of polysaccharides extracted from the cell walls of red algae (Rhodophyta), particularly the genus Glacillaria and Geledium. Agar is a complex polysaccharide consisting of agarose and agaropectin that is used in the preparation of microbial growth media, candy and agar jelly. Agarose has potential utilization as a pharmaceutical food ingredient and cosmetic industry such as a potential biomass provider, a source of antibacterial, anticancer and antioxidant oligosaccharides, and can affect melanoma cells so as to moisturize and whiten the skin.

The amount of water used in agar extraction also affects the yield and quality of agar produced. The amount of water used in agar extraction varies depending on the type of seaweed used because if the amount of water is not correct, it will make it difficult to seal and filter the fistrate. The amount of water usually used in agar extraction varies considerably from 7 to 30 times the dry weight of the seaweed. Too much water will cause the filtrate to not settle and too little water will cause the filtrate to be difficult to filter.

Processing seaweed into raw materials has been done by many farmers but only limited to seaweed. Processing agar-agar from seaweed is an alternative for business development of farmers. Agar is a compound of sulfuric acid esters of galactan compounds that are insoluble in cold water, but dissolve in hot water by forming a gel. Further processing of agar is jelly candy. Various flavors of jelly candy can be made from agar.

Jelly candy is one type of candy that is favored because it has distinctive properties. Jelly candy made from fruits or vegetables has the advantage of nutritional value compared to those on the market that only come from the addition of essence from chemicals [1]. Jelly candy from the addition of fruit juice is favored because of the vitamin C contained in it. The purpose of this study was to determine the level of vitamin C in mango fruit juice jelly candy and to determine the proximate quality (water and sugar) and sensory quality (taste, smell, color and texture) of mango fruit jelly candy.

2. MATERIALS AND METHODS

2.1 Material

The raw materials used were *Glacillaria* sp seaweed powder, technical agar powder, food coloring, water, mango fruit. The materials used in chemical analysis included H2SO4 0.1 N, HCl 32% NaOH 3%, borax acid, Methyl red indicator, pp indicator, 70% alcohol, CaCO3, K2SO4 and ascorbic acid.

2.2 Methods

Making seaweed jelly candy with the addition of mango juice:

1. Fruit is blended (juice volume according to treatment) then set aside.
2. 250 ml of water, 240 g of sugar, 10 g of technical agar powder and 10 g of glacillaria sp seaweed agar flour were put in a pot and stirred. Mango juice

(according to the treatment percentage) was added to this agar mixture.
3. Added 1 ml of food coloring according to the treatment of adding mango juice, namely 50 grams of mango (green), 70 grams of mango (orange) and 90 grams of mango (red).
4. The pot containing the above ingredients is heated on the stove over medium heat while stirring to prevent clumping.
5. Once thick, put it in the mold.
6. After hardening, the agar is cut into pieces with a thickness of 1.5 cm, a length of 4 cm and a width of 2 cm.
7. The agar is then dried in the sun for 2 to 3 days or dried in a conventional oven over a very low flame for 1.5 hours.
8. After drying, the jelly candy is ready for organoleptic and proximate analysis (water and sugar content).
9. Jelly candy that has been made is analyzed for Vitamin C (control without the addition of mango juice and jelly candy added with mango juice according to the percentage of treatment).

2.3 Research Parameters

The analysis conducted in this study included chemical and organoleptic analysis. Chemical analysis includes: analysis of water content by distillation method (AOAV, 2005), total sugar content (AOAC, 2005). Vitamin C levels iodometric titration [2]. Organoleptic (sensory) analysis includes Odor, taste, texture and color [3].

2.4 Data Analysis

This study used a factorial complete randomized design. Proximate and sensory data of jelly candy were analyzed by analysis of variance (anova) and followed by honest real difference test at 5% level (Steel and Torrie, 1989).

Table 1. Research treatment of mango fruit juice jelly candy

	A	B	C	D
Mango Fruit Juice	**Without mango**	**Mango (8.93%)**	**Mango (12.5 %)**	**Mango (16.07%)**
Replicate 1	0%	A11: 50 g	A21:70 g	A31: 90 g
Replicate 2	0%	A12 :50 g	A22: 70 g	A31: 90 g
Water	250ml	250 ml	250 ml	250 ml
Granulated sugar	240 g	240 g	240 g	240 g
Technical agar + seaweed (*Glacillaria sp*)	10 g+10 g	10 g+10 g	10 g+10 g	10 g+10 g

3. RESULTS AND DISCUSSION

3.1 Chemical Analysis of Jelly Candy

3.1.1 Water content

The results of the analysis of the water content of jelly candy for each treatment are presented in Table 2.

Table 2. Water content value of honey mango fruit juice jelly candy for each treatment

Treatments	Water Content (%)
A (Without the addition of mango juice (0	11,49[a]
B (Addition of mango juice (8.93%)	11,21[a]
C (Addition of mango juice (12.5%)	12,22[b]
D (Addition of mango juice (16.07%)	12,32[b]

Based on Table 2. It can could be seen that the results of variance showed the addition of manga juice had a significant effect at the 5% level. The average value of water content obtained ranged from 11.49-12.32%. The highest water content value was found in jelly candy treatment D (12.32%) and the lowest water content value was jelly candy treatment A without the addition of mango juice (11.49%).

Based on the value of water content obtained, it is was observed also known that the more the addition of mango juice, the higher the water content of jelly candy treatment D (addition of mango juice 16.07%).

Based on the moisture content values obtained, it is also known that the more the addition of mango juice, the higher the moisture content of the jelly candy. The high water content was due to the addition of mango juice. This is in line with the opinion of Pracaya (2008) which stated that mango fruit has a high water content of 12.32% in the treatment of adding 16.07% mango juice. The moisture content obtained in this study is known to be below the quality standard limit of jelly candy in SNI 3547-02-2008, which is a maximum of 20%. Based on the results of the analysis, it is known that jelly candy without treatment (A) and with the addition of mango juice 8.93% (treatment B), 12.5% (treatment C) and 16.07% (treatment D) all treatments meet SNI.

Daud et al. [4] stated in the research that moisture content is one of the most important parameters in the chemical test of the food industry which is useful for determining the quality and resistance of food to damage that may occur. The higher the moisture content of a food ingredient, the greater the possibility of damage both as internal biological activity (metabolism) and the entry of pathogenic microorganisms.

3.1.2 Sugar levels

Based on the results of the analysis of variance, it shows that the addition of mango juice in making jelly candy has a significant effect at the α = 5% level on the total sugar content of the jelly candy produced. The total sugar content of jelly candy for each treatment is presented in Table 3.

Based on Table 3, it can be seen that the average value of total sugar content of jelly candy with the addition of honey manga juice ranges from 36.96-38.92%. The highest average value was obtained in treatment D (addition of 16.07% manga juice) with a value of 38.92%. While the lowest average value is without treatment (treatment A) with a value of 36.96%. The results showed that the higher the percentage of mango juice added, the higher the sugar content of the jelly candy produced. This increase is due to the sugar content in mango juice. This is in line with the opinion of Pracaya (2005) which states that in mango fruit there are simple sugars, namely sucrose, glucose, and fructose. These sugars provide sweetness and energy that can be used immediately by the body.

Purwaningsih et. al. (2017) stated that total sugar is a combination of non-reducing sugar and reducing sugar. According to the Indonesian National Standard (SNI) in 2008 regarding the quality requirements of jelly candy, the total sugar content is at least 20%. This shows that jelly candy with the addition of mango juice 8.93%, 12.5% and 16.07% produces total sugar content above 20% so that it meets the quality requirements for total sugar content set by SNI.

3.1.3 Vitamin C

Vitamin C content in jelly candy is between 97.845 µg/g - 5520.1 µg/g. The results of variance showed that the percentage of added manga fruit sati had a significant effect at the 5% level (even very real at the α1% level) on the vitamin C content of the jelly candy produced.The value of vitamin C content of jelly candy for each treatment can be seen in Table 4.

Based on Table 4, it can be seen that the highest vitamin C content was found in jelly candy treatment D (addition of 16.07% mango juice), namely 5520.10 µg/g. The lowest vitamin C content was found in jelly candy treatment A (without the addition of 0% mango juice), namely 97.845 µg/g. The results of the analysis of vitamin C content showed that the higher the percentage of mango juice addition, the higher the vitamin C content in the jelly candy product produced. Meanwhile, when compared between the vitamin C content of fresh mango juice and vitamin C contained in jelly candy that has been added to mango juice, there is a decrease.

Table 3. Total sugar content value of mango fruit juice jelly candy for each treatment

Treatments	Sugar Levels (%)
A (Addition of mango juice (0%)	36,96[a]
B (Addition of mango juice (8.93%)	37,21[a]
C (Addition of mango juice (12.5%)	38,23[b]
D (Addition of mango juice (16.07%)	38,92[b]

Table 4. Value of Vitamin C content of honey mango juice jelly candy for each treatment

Treatments	Vitamin C levels (µg/g)
A (Addition of mango juice (0%)	97,845[a]
B (Addition of mango juice (8.93%)	5315,25[b]
C (Addition of mango juice (12.5%)	5412,20[c]
D (Addition of mango juice (16.07%)	5520,1[d]

Vitamin C content of fresh ripe mango fruit is quite high, namely 19.69 mg/100 g or 19690 µg/g [5] after being processed into mango juice jelly candy to 5315.25 µg/g or 5.315 mg/100 g vitamin C jelly candy (treatment of adding mango juice 8.93%). Neswati (2013) stated that the heating process in jelly candy processing can cause the oxidation process of Vitamin C in jelly candy. According to Nianti et al., 2018, to minimize the excessive decrease in Vitamin C can be done by reducing the heating temperature and peeling the fruit skin not too long.

3.1.4 Organoleptic test

Organoleptic test is one of the tests that is a factor in determining the quality and acceptance of the product. Organoleptic test can determine the level of panelists' liking for jelly candy with the addition of honey mango juice. Organoleptic tests in this study include liking for Odor, taste, texture and color. Panelists used in this study amounted to 15 people. Organoleptic tests were carried out using the hedonic test with a scale of 1 - 5, namely 1 (very dislike), 2 (dislike), 3 (ordinary), 4 (like), 5 (very like). The test results are attached in the form of a table with panelist assessments that have been averaged.

3.1.4.1 Odor

Odor can be recognized by the sense of smell when it is in the form of vapor. This Odor is one of the important factors for consumers to choose their preferred food products. In many ways the delicacy of food is determined by the Odor of the food [6]. The value of organoleptic analysis of jelly candy Odor can be seen in Table 5.

Based on Table 5, the average value of Odor analysis of jelly candy ranges from 3.0 -3.8 The highest average value is found in the vitamin C treatment (addition of 16.07% mango juice) with a value of 3.8 on the scale of like. While the lowest average value was found in treatment B (addition of 8.93% mango juice) with a value of 3.0 on an ordinary scale. The percentage of mango juice addition to jelly candy has a significant effect at the α = 5% level on organoleptic Odor.

Jelly candy from mango juice has a distinctive Odor. The distinctive Odor of this jelly candy is thought to be due to the influence of volatile compounds contained in mango juice. This is in line with the opinion of Zeka et al. [7] which states that the distinctive Odor of mango juice in jelly candy has no significant effect at the α = 5% level on organoleptic Odor.

Jelly candy from mango juice has a distinctive Odor. The distinctive Odor of this jelly candy is thought to be due to the influence of volatile compounds found in mango juice. This is in line with the research of Utami, M et al. [8] that the volatile components in mango gedong are dominated by volatile components that have a sweet Odor, namely ethyl 2,4 hexadienoate, 4-ethyl-o-silene. The intensity of sensory attributes of fruity Odor, caramel Odor, cooked Odor, green Odor, fermented Odor, floral Odor. The volatile components of green Odor include 1-hexanol, trans-22-hexanol, β-cyclocitral, 3 hexen-1-ol, acetate, cis-3-hexenyl butyrate, and 2-butenoic acid, 3-hexenyl ester.

3.1.4.2 Flavor

Flavor is one of the components assessed in the organoleptic test of jelly candy. Flavor determines consumer acceptance of food products. Food flavors can be recognized and differentiated by the taste buds can distinguish four kinds of flavors, namely salty, sour, sweet and bitter [6]. The organoleptic analysis value of jelly candy flavor of each treatment can be seen in Table 6.

Based on Table 6. The addition of mango juice to jelly candy has a significant effect on the analysis of the taste produced. The average value of flavor analysis of jelly candy ranged from 3.2 - 4.2. The highest average value was found in treatment D (addition of 16.07% mango juice) with a value of 4.2 on the scale of like. While the lowest average value was found in treatment A (without the addition of 0% mango juice) with a value of 3.20 on an ordinary scale. The percentage of mango juice added to jelly candy has no significant effect on organoleptic taste.

The jelly candy produced is acceptable to panelists on a regular and like scale, for treatment A is on a regular scale and like in treatment D. Kiyai [9,10,11] panelists' assessment of taste is influenced by several factors, including chemical compounds, concentration temperature, and the interaction of other flavor components.

3.1.4.3 Texture

Texture is one of the important factors that need to be considered in food products, especially in semi-wet food products such as jelly candy. The results of the texture analysis of jelly candy for each treatment can be seen in Table 7.

Based on Table 7, it can be seen that the percentage of mango juice addition has a significant effect on jelly candy on organoleptic texture. The average value of texture analysis of jelly candy ranged from 3.2 - 3.7. The highest average value was found in treatment A (addition of 0% mango juice) with a value of 3.7 on the scale of like.

While the lowest average value was found in treatment D (addition of 16.07% mango juice) with a value of 3.2 on an ordinary scale. In general, jelly candy treatments A, B, C, and D on organoleptic texture can be accepted by panelists on a scale of ordinary to like. This is evidenced by the difference in average values that are not too significant for each treatment.

3.1.4.4 Color

Color is the first organoleptic (sensory) attribute seen by consumers in buying or consuming a product. Unique product colors will attract consumer attention more than the usual product colors [6,12,13]. Color in food products has an important role in food presentation, even though the food is delicious, but if the appearance is not attractive when served, it will cause appetite to be lost [9,14,15,16]. The organoleptic analysis value of jelly candy color for each treatment can be seen in Table 8.

Based on Table 8, it can be seen that the average value of color analysis on jelly candy ranges from 3.3 - 3.7. Where the highest average value is found in treatments C and D (addition of mango juice 12.5% and 16.07%) with a value of 3.7 on the scale of likes. While the lowest average value is found in treatment B (addition of 8.9% mango juice) with a value of 3.3 on an ordinary scale. Based on Table 7, it is also known that the percentage of mango juice addition to jelly candy has a significant effect on organoleptic color.

Table 5. Organoleptic test value of odor of Bu Mango Sari Jelly Candy for each treatment

Treatments	Odor
A (Addition of manga juice 0%)	$3,2^{ab}$
B (Addition of manga juice 8.93%)	$3,0^{a}$
C (Addition of manga juice 12.5%)	$3,3^{ab}$
D (Addition of manga juice 16.07%)	$3,8^{b}$

Note: 1 (strongly dislike), 2 (dislike), 3 (normal), 4 (like), 5 (strongly like)

Table 6. Organoleptic test value of mango fruit juice jelly candy taste for each treatment

Treatments	Flavor
A (Addition of manga juice 0%)	$3,2^{a}$
B (Addition of manga juice 8.93%)	$3,4^{ab}$
C (Addition of manga juice 12.5%)	$3,3^{ab}$
D (Addition of manga juice 16.07%)	$4,2^{b}$

Note: 1 (strongly dislike), 2 (dislike), 3 (normal), 4 (like), 5 (strongly like)

Table 7. Organoleptic test value of texture of mango fruit juice jelly candy for each treatment

Treatments	Texture
A (Addition of manga juice 0%)	$3,7^{b}$
B (Addition of manga juice 8.93%)	$3,4^{ab}$
C (Addition of manga juice 12.5%)	$3,6^{b}$
D (Addition of manga juice 16.07%)	$3,2^{a}$

Note: 1 (strongly dislike), 2 (dislike), 3 (normal), 4 (like), 5 (strongly like)

Table 8. Color organoleptic test value of mango fruit juice jelly candy for each treatment

Treatments	Color
A (Addition of manga juice 0%)	3,5b
B (Addition of manga juice 8.93%)	3,3[a]
C (Addition of manga juice 12.5%)	3,7[c]
D (Addition of manga juice 16.07%)	3,7[c]

Note: 1 (strongly dislike), 2 (dislike), 3 (normal), 4 (like), 5 (strongly like)

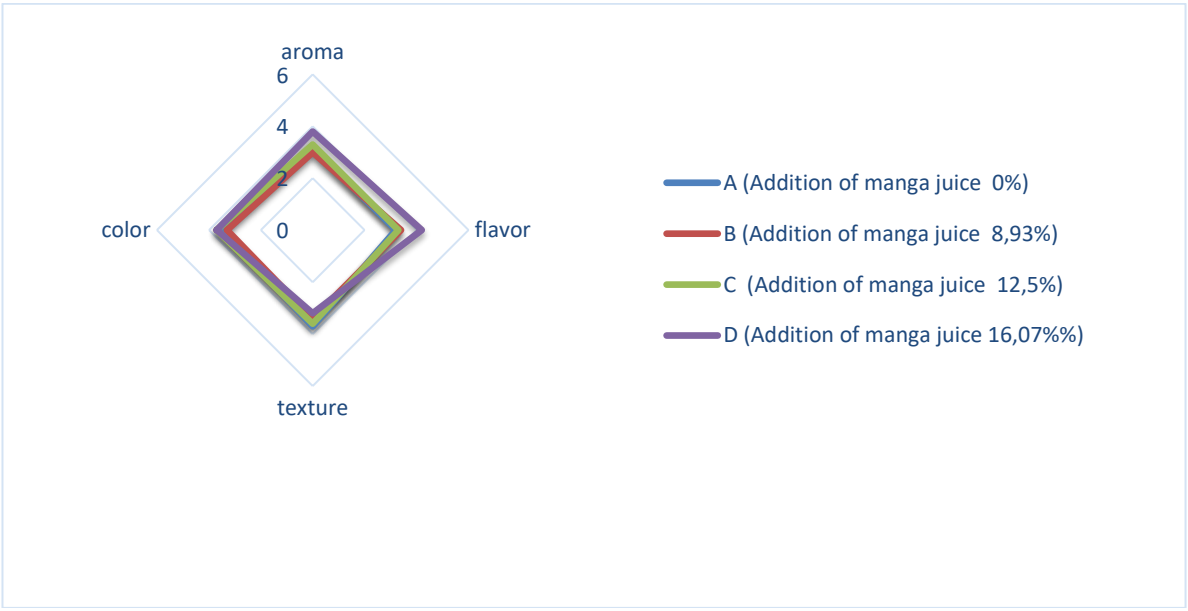

Fig. 1. Radar graph of organoleptic test of mango juice jelly candy

Based on the results of organoleptic analysis (Fig. 1), it can be concluded that the best treatment is jelly candy treatment D (addition of mango juice 16.07%) with an average organoleptic value of Odor 3.8 (like), taste 4.2 (like) texture 3.2 (normal) and color 3.7 (like).

4. CONCLUSION

The results showed that the addition of mango juice to the characteristics of jelly candy was significantly different from water content, total sugar content and vitamin C. The best product based on chemical analysis was jelly candy in treatment D (honey mango juice). The best product based on chemical analysis is jelly candy in treatment D (addition of 16.07% mango juice) with the highest vitamin C content (5520.1 µg/g) and the highest total sugar content (38.92%) and the lowest water content (11.21%) in treatment A without the addition of mango juice (0%) Testing of organoleptic assessment of the highest panelists in treatment D, namely aroma 3.8 (like), taste 4.2 (like), texture 3.2 (normal) and color 3.7 (like).

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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