AJARCDE
ASIAN JOURNAL OF APPLIED RESEARCH FOR COMMUNITY DEVELOPMENT AND EMPOWERMENT

Journal home page: http://ajarcde-safe-network.org ISSN 2581-0405

Study of Addition Gelatin and Egg White on The Physicochemical and Organoleptic Characteristics of Sawo Kecik Marshmallows and Telang Flower and Determining The Storage Period Using The ESS Method (Extended Storage Studies)

Romi Angga Alfiansyah[1], *Rosida*[2]

[1] *Food Science and Technology Department, Faculty of Engineering, Universitas Pembangunan Nasional "Veteran" Jawa Timur. Surabaya, Indonesia.*

ARTICLE INFO

Article History:
Received: 2 June 2024
Final Revision: 7 July 2024
Accepted: 10 July 2024
Online Publication: 11 July 2024

KEYWORDS

butterfly pea flower, gelatine, egg white, sapodilla.

CORRESPONDING AUTHOR

*E-mail: *rosida.tp@upnjatim.ac.id*

A B S T R A C T

Marshmallow is a confectionery product that has a soft, chewy texture and is white. Problems with a texture that is less soft, less chewy, and less attractive color often arise when processing marshmallows. The addition of butterfly pea flowers can help improve the color, while the use of gelatin and egg whites can be an alternative to improve the texture of marshmallows. This research aimed to determine the best treatment combination between adding gelatin and egg whites to obtain sapodilla marshmallows and butterfly pea flowers with good treatment. This research used a Completely Randomized Design (CRD) with a factorial pattern, two factors, and two replications. Factor 1 is the addition of gelatin (8%; 10%; 12% w/w) and factor 2 is the addition of egg white (4%; 6%; 8% w/w). Data were analyzed using ANOVA and further DMRT tests at the 5% level. The treatment with the addition of 12% gelatin and the addition of 6% egg white was the best treatment which produced sapodilla marshmallows and butterfly pea flowers with characteristic water content values of 47.962% ± 0.2942, ash content of 1.355% ± 0.1972, vitamin content of 16.340 mg/100 g ± 0.1556, reducing sugar content 9.595% ± 0.1768, Aw value 0.468% ± 0.0092, texture 3.975 N ± 0.0495 and organoleptic test color 3.60 (rather dislike), taste 4.04 (normal), aroma 3.12 (somewhat dislike) and texture 6.12 (like) and antioxidant activity IC50 of 35.52 ppm and has a shelf life of 7 days.

1. INTRODUCTION

1.1. Research Background

Sawo is one of the fruits that have a level of diversity in type, shape, size, skin color, pulp, aroma, and taste. Sawo fruit also has various types of sweetness levels that vary. But in general, sawo fruit has a glucose content of 4.2 grams/100 grams so it has a very sweet taste so that in its utilization, sawo fruit is consumed directly by the community. According to [1], sawo fruit has been processed into food products such as nastar jam, hotteok, and dadar gulung. In addition, it is also developed to be processed such as sawo dodol, sawo chips, and sawo jam [2]. The purpose of developing sawo-based processed products is to produce quality and high-value food products. One type of sawo that can be processed into food products with high nutritional value is sawo kecik fruit. Sawo kecik is one type of sawo that has a fruit a smaller size than manila sawo, is red when ripe, and has a slightly sour taste. Sawo kecik contains 0.10 g protein, 22.4 g fat, 25 g calcium, 1 g iron, 21 mg vitamin C, 0.01 mg riboflavin, and 0.02 mg niacin [3].

Vitamin C in sapodilla acts as antioxidant activity in the body and effectively counteracts free radicals that can damage cells or tissues, including protecting the lens from oxidative damage, caused by radiation, and increasing endurance absorbed by calcium in the body [4]. However, this sapodilla fruit is one of the climatic fruits that still ripens during storage so it is easily damaged and has a short shelf life.

One source of natural coloring that can be added to make marshmallows more attractive is telang flower (Clitoria ternatea).

The main component in telang flowers that acts as a colorant is anthocyanin. According to [5], anthocyanins in telang flowers range from 5.40 ± 0.23 mmol / mg which is also a flavonoid group that acts as an antioxidant to ward off free radicals in the body. Anthocyanin pigments will turn red in acidic media, while in alkaline media they turn purple and blue [6]. The process of fruit ripening causes physical changes which include color, aroma, and texture as well as a decrease in chemical content, so it is necessary to process the little sawo fruit into a food product that has high nutritional value and has a long shelf life. One of the right alternatives to process small sapodilla fruit is to make a product, namely marshmallows.

1.2. Literature Review

Marshmallow is one of the processed food products that people like because it has an attractive color and chewy texture. Marshmallow is a confectionery product made by mixing sugar, glucose syrup, gelling agent, and foaming agent until fluffy and chewy. Marshmallow has a chewy, soft, foam-like texture and comes in various shapes, aromas, and colors. In principle, marshmallows are formed due to the presence of air bubbles that can form stable foam [7]. This happens because of the presence of gelling agents and foaming agents that play a role in the formation of marshmallow texture. Gelatin as a gelling agent can bind water and form a gel in the product, while egg white as a foaming agent can form foam and expand the volume of marshmallows. This is supported by [8], the use of egg white serves to cause froth (foaming agent) and form a soft marshmallow texture.

The texture of the marshmallow will be chewy along with the addition of gelatin and egg white. The addition of gelatin will reduce the surface tension between air-liquid encounters resulting in the formation of a soft foam and causing the texture of the product to become chewier. According to [9], the amount of gelatin needed in making marshmallows to produce gel ranges from 5-12%, depending on the desired level of hardness of the final product, and the water content according to SNI reaches a maximum of 20%. If the moisture content exceeds the required limit, it causes the marshmallow to have a short shelf life. Shelf life is the period that a product has until it deteriorates and is not suitable for consumption [10]. Longer storage can increase the free water activity (Aw) value and microorganisms can grow quickly.

The length of storage can be determined by the ESS (Extended Storage Studies) method. According to [11], the ESS method is a method to determine the length of storage by storing the product at room temperature until it is damaged for a certain time and measuring the quality change parameters. Therefore, the addition of gelatin and egg white greatly affects the quality and quality of the final marshmallow product. The results of [12], showed the addition of 25% plantain fruit concentration, 12% gelatin concentration, and 3% egg white gave the best results with a vitamin C value of 9.76 mg/100 g and 18.3% water content. [13], shows the addition of 8% gelatin shows the best results in red dragon fruit marshmallows with a vitamin C content of 1.98 mg/100 g and water content of 19.81%. [14] shows that the addition of 8% egg white provides the best treatment for watermelon juice marshmallows with a moisture content of 28.06% and antioxidant activity of 28.42%. The amount of gelatin and egg white added will greatly affect the characteristics of the marshmallow [15]. Based on this, it is necessary to research the study of the addition of gelatin and egg white to the physicochemical and organoleptic characteristics of sawo kecik and bunga telang marshmallows and the length of storage.

1.3. Research Objective

This study aims to determine the effect of gelatin and egg white addition on the physicochemical and organoleptic characteristics of sawo kecik and bunga telang marshmallows and Determine the best treatment between the addition of gelatin and egg white that produces marshmallows with the best physicochemical properties and favored by the panelists.

2. MATERIALS AND METHODS

2.1. Materials and Tools

The materials used in this study include sapodilla fruit and telang flowers obtained at the Sidoarjo Larangan Market, green Valley brand bovine gelatin with MUI halal label, water (aqua), sucrose, fructose syrup, cornstarch (cornstarch), and citric acid obtained at Arvian Margerjo Surabaya shop. Materials used for analysis included 0.01N methanol solution, 1% amylum solution, distilled water, Diphenyl picrylhydrazy reagent, Nelson A, Nelson B reagents, Potato Dextrose Agar (PDA) Arsenomolybdat, and Glucose.

Tools for processing include mixers, stoves, mortars, measuring cups, digital scales, containers/basins, molds, baking sheets, spoons, and stirrers. Tools for the analysis process include equipment for chemical analysis, namely spectrophotometer, desiccator, oven, water bath, texture analyzer, color reader 50 ml burette, static, volumetric flask, 250 ml Erlenmeyer, 250 ml beaker glass, digital scale, analytical balance, drop pipette, micron pipette, volumetric pipette, test tube, stirring rod, measuring cup, test tube, filter paper, watch glass, weighing bottle, porcelain chair, funnel and knife.

2.2. Design Experiment and Analysis

This study used a completely randomized design (CRD) factorial pattern with two factors and two replicates. The first factor is gelatin concentration which consists of three levels: 6%, 8%, and 10% (*b*/v). The second factor is egg white concentration consisting of three levels of 4%, 6%, and 8% (*b*/v). The data obtained were analyzed using Analysis of Variance (ANOVA), to determine the differences in each treatment, further tests were carried out using the DMRT (Duncan Multiple Range Test) method at the 5% level. Organoleptic test using the hedonic method with 25 semi-trained panelists on color, taste, aroma, and texture.

2.3. Implementation of Research

2.3.1. Preparation of Sawo Kecik Extract

Sawo fruit weighing 2 kg is prepared for sorting and the peeling of sawo skin is washed for further separation of the flesh from the seeds. c. Sawo fruit that has been clean, crushed using a blender with the addition of water (sawo : water = 10: 1 (*b*/v)) for ± 3 minutes to obtain sawo kecik pulp Filtering of sawo kecik pulp with a 40 mesh sieve to obtain sawo kecik extract and further analysis of water content, ash content, vitamin C and reduced sugar content.

 https://doi.org/10.29165/ajarcde.v8i2.455

2.3.3. Preparation of Bunga Telang

Extract 50 grams of bayang flowers were prepared for sorting. Telang flowers were then washed for further separation from the stamens so that only the petals were taken. The size of the telang flower was reduced and water was added (telang flower: water = 1:6 (*b*⁄v)) at a temperature of 50oC and soaked for ± 15 minutes. Filtering was carried out until the extract was obtained.

2.3.4. Marshmallow Sawo Kecik and Bunga Telang

Weighed the ingredients including egg white (4%, 6%, 8% (*b*/v)), gelatin (8%, 10%, 12% (*b*/v)), 25ml sawo kecik extract, 100 grams sucrose, and 15 ml fructose syrup. The sugar solution was made by mixing sucrose and fructose syrup according to the amount and heating at ±75˚C for 8 minutes until evenly mixed. Preparation of gelatin solution was done by adding hot water with a temperature of 75˚C as much as 15 ml, then allowed to stand for 5 minutes. Sawo kecik extract, gelatin solution, and sugar solution that has been prepared, and homogenized using a mixer for ± 3 minutes until evenly mixed. The dough was placed into a 5 x 6 cm baking pan, then sprinkled with maezena flour as a coating and aging process for 12 hours at 20 oC. Cutting with a size of 2x2x2 cm until get a small sawo marshmallow.

3. RESULT AND DISCUSSION

3.1. Raw Materials Analysis Result

The results of statistical analysis (Table 1) showed that the water content of the extract was 57.84%, while according to [16] the water content of the sawo fruit was 69.8%. The difference in the results of the preliminary analysis of the water content of small sapodilla with the literature is due to differences in varieties and fruit maturity levels. The level of fruit maturity will affect the moisture content of a material, the higher the level of fruit maturity causes the moisture content to increase. This is following Ref. [17], that the water content will increase along with the increasing level of fruit maturity due to the fruit respiration reaction where the final result of this reaction is water.

Table 1, The results of statistical analysis

Parameters	Analysis Result
	Analysis
Water Content (%)	57.84 ± 0.2935
Ash Content (%)	3.06 ± 0.4139
Vitamin C (mg/100 g)	6.10 ± 0.0283
Reducing Sugar (%)	7.57 ± 0.1981

The ash content of sawo kecik extract in (Table 1) amounted to 3.06%. Ash content is influenced by the maturity level of the fruit because basically, ash content describes the amount of minerals present in a material. Fruit with a high maturity level has a low ash content. The increase in ash content is also influenced by water content. According to [18], the increase in ash content is related to the amount of water that comes out of the material, The higher the moisture content, the lower the ash content. Ash content is also influenced by the type of material, method of ignition, time, and temperature.

Vitamin C value of chicory extract in (Table 1) is 6.10 mg/100 g, while according to [19], vitamin C content in chicory fruit is 21, 11 g/100g. The difference in the results of the initial analysis of sawo kecik vitamin C with the literature is due to storage temperature, length of fruit storage, and the level of fruit maturity. In general, fruits containing vitamin C will be easily oxidized at high-temperature storage, but at low-temperature storage vitamin C fruit will also experience tissue damage which causes vitamin C stability to decrease.

Table 1. Shows the value of reducing sugar in the extract of sawo kecik is 7.75%. The difference in the results of the initial analysis of sawo kecik extract with the literature is due to differences in the level of fruit maturity. The high level of fruit maturity causes enzymes to convert organic acids into simple sugars, especially changing the vitamin C component. This is supported by [20], that sugar content will increase when ripe so that it tastes sweet.

Preliminary analysis of telang flower extract in (Table 2) can be seen in the results of color analysis of telang flower extract L* value of 28.10. L* value is a brightness parameter with a scale value of 0 means black and a value of 100 means white. The L* value states the reflected light that produces white, gray, and black achromatic colors [21]. The difference in the L* value of telang flower extract with the literature is influenced by anthocyanins which are purple color-producing pigments

Table 2. Preliminary Analysis Result of Color and Antioxidant Activity

Parameters	Telang Flower Extract					
	Analysis Result			Literature		
Color	L	a*	b*	L	a*	b*
	28,10	10,30	-4,10	31,99[a]	13,94[a]	-2,87[a]
Antioxidant Activity (IC50)	40,21				41,36[b]	

. The a* value is a chromatic value parameter that states the red-green mixture with +a* (positive) values from 0 to 100 for red colors and -a* values from 0 to -80 for green colors. The results of the color analysis a* value of 10.30. Telang flowers tend to have a blue or purple color so they have a low a* value. However, in some conditions the a* value of telang flowers is large, the greater the a* value the more it shows the red color.

The b* value indicates the intensity of yellow (+ value) and blue (- value) colors. The results of the color analysis of the b* value of -4.10 indicate that the telang flower is blue. Anthocyanins will change color to red to orange at acidic pH so that the anthocyanins measured are monomeric anthocyanin levels [22]. The antioxidant value of telang flower was determined based on its IC50 value. Based on (Table 2) the IC50 value of telang flower is 40.21 ppm. The difference in results with the literature is caused by several factors, including long storage, high temperature, air (oxidation), washing, and immersion in water [23].

3.2. Analysis Result of Sawo Kecik and Telang Flower Marshmallow

3.2.1. Water Content

The average moisture content of sawo kecik and bunga telang marshmallows (Table 3) ranged from 41.362-48.292%. The treatment of 8% gelatin addition and 4% egg white addition produced the lowest moisture content (41.362%) and the treatment of 12% gelatin addition and 8% egg white addition produced the highest moisture content (48.292%). The higher the addition of gelatin and the addition of egg white causes the water content of sawo kecik and bunga telang marshmallows to increase. This is because gelatin and protein in egg white can bind water. According to [24], the addition of gelatin will result in increased water content. This is supported by [25], where gelatin can bind large amounts of water because it has a hydroxyl group that can form hydrogen bonds with water, thereby increasing the water content of the product.

Table 3. The average moisture content of sawo kecik and bunga telang marshmallows

Marshmallow		Water Content (%)	DDMRT 5%
Addition of Gelatin (%)	Addition of Egg white (%)	Average ± $\overline{SD}$	
8	4	41,362 ± 0,5486[a]	0,8593
	6	41,742 ± 0,1748[b]	0,8574
	8	42,700 + 0,5518[c]	0,8542
10	4	44,459 ± 0,0731[d]	0,8491
	6	44,827 ± 0,4264[e]	0,8413
	8	45,626 ± 0,1485[f]	0,8292
12	4	45,971 ± 0,2046[g]	0,8096
	6	47,962 ± 0,2942[h]	0,7756
	8	48,292 ± 0,2910[i]	-

3.2.2. Ash Content

The average ash content of sawo kecik and bunga telang marshmallows (Table 4) ranged from 0.422-2.038%. The treatment of 8% gelatin addition and 4% egg white addition produced the lowest ash content (0.422%) and the treatment of 12% gelatin addition and 8% egg white addition produced the highest ash content (2.038%). The higher addition of gelatin and the addition of egg white causes the ash content of sawo kecik and bunga telang marshmallows to increase. This is because gelatin and egg whites have several types of minerals. Ash content describes the amount of minerals present in the product. According to [26], gelatin contains minerals such as copper (Cu) 0.2 mg, selenium (Se) 2.8 mg, sodium (Na) 14 mg, iron (Fe) 1 mg, and phosphorus (P) 20 mg.

Table 4. The average ash content of sawo kecik and bunga telang marshmallows

Marshmallow		Ash Content (%)	DDMRT 5%
Addition of Gelatin (%)	Addition of Egg White (%)	Average ± $\overline{SD}$	
8	4	0,422 ± 0,0471[a]	-
	6	0,459 ± 0,0888[b]	0,4983
	8	0,536 + 0,5484[c]	0,5201
10	4	0,740 ± 0,2254[d]	0,5327
	6	0,773 ± 0,0597[e]	0,5405
	8	0,803 ± 0,0172[f]	0,5455
12	4	0,840 ± 0,1764[g]	0,5488
	6	1,355 ± 0,1972[h]	0,5508
	8	2,038 ± 0,0348[i]	0,5520

3.2.3. Vitamin C Content

The average vitamin C content (Table 5) ranged from 16.075-16.297 mg/100g. The results showed that the higher the addition of gelatin caused the vitamin C content of sawo kecik and bunga telang marshmallows to increase significantly. This is because gelatin can form a matrix layer so that it can protect vitamin C from damage. According to [27], vitamin C is very susceptible to damage to air, sunlight and heat exposure so it is necessary to add ingredients that function to coat the vitamin C component so that it is not damaged. This is supported by [28], which states that carrageenan can maintain vitamin C contained in food ingredients.

Table 5. The average vitamin C content

Addition of gelatin (%)	Vitamin C (mg/100 g)	DMRT 5%
	Average ± $\overline{SD}$	
8	16,075 ± 0,0173[a]	
10	16,203 ± 0,1011[b]	0,1151
12	16,297 ± 0,2419[c]	0,1202

The average levels of vitamin C in the marshmallow of sawo kecik and bunga telang (Table 6) ranged from 16.153-16.232 mg/100 g. The results showed that the higher the addition of egg white did not have a significant effect on reducing the levels of vitamin C in the marshmallow. The results showed that the higher the addition of egg white did not have a significant effect on the decrease in vitamin C content of sawo kecik and bunga telang marshmallows. This is because the main component of egg white is protein and does not contain vitamin C. According to [29], egg white is a source of protein

https://doi.org/10.29165/ajarcde.v8i2.455

Table 6. The average levels of vitamin C in the marshmallows of sawo kecik and bunga telang

Addition of Egg White	**Vitamin C (mg/100 g)**	DMRT 5%
	Rata-Rata ± $\overline{SD}$	
4 %	16.232 ± 0.3200[a]	0.1151
6%	16.190 ± 0.2666[a]	0.1202
8%	16.153 ± 0.1604[a]	-

.

3.2.4. Reducing Sugar Content

The average reducing sugar content (Table 7) ranged from 9.583-11.505%. The results showed that the higher the addition of gelatin caused the reduction sugar content of sawo kecik and bunga telang marshmallows to decrease significantly. This is because gelatin is a class of amino acids and does not include polysaccharides. According to [30], gelatin is a protein biopolymer. This is supported by [31], gelatin is a hydrocolloid that can be used as a gelling agent, in contrast to other hydrocolloids which are polysaccharides, while gelatin is a protein that contains all essential amino acids except tryptophan.

Table 7. The average reduced sugar content

Addition of gelatin (%)	**Reducing Sugar Content (%)**	DMRT 5%
	Average ± $\overline{SD}$	
8	11.505 ± 0.4714[a]	0.3383
10	10.420 ± 0.4850[b]	0.3241
12	9.583 ± 0.1464[c]	-

Table 8. The average reduction sugar content of marshmallows of sapodilla and telang flower

Addition of Egg White	**Reducing Sugar Content (%)**	DMRT 5%
	Rata-Rata ± $\overline{SD}$	
4 %	10,628 ± 2,0229[a]	0,3383
6%	10,587 ± 2,0157[a]	0,3241
8%	10,293 ± 1,7502[a]	-

The average reduction sugar content of marshmallows of sapodilla and telang flower (Table 8) ranged from 10.293-10.628%. The results showed that the higher addition of egg white did not have a significant effect on reducing the reduction sugar content of sawo kecik and bunga telang marshmallows. This is because the main component of egg white is protein and does not contain carbohydrates.). Egg white is a source of protein (10.8%) [32].

3.2.5. Water Activity

The average Aw content of sawo kecik and bunga telang marshmallows (Table 9) ranged from 0.390-0.987%. The treatment of 8% gelatin addition and 4% egg white addition resulted in the lowest Aw content (0.390%) and the treatment of 12% gelatin addition and 8% egg white addition resulted in the highest Aw content (0.987%). The higher addition of gelatin and the addition of egg white causes the Aw content of sawo kecik and bunga telang marshmallows to decrease. This is because gelatin can form hydrogen bonds that can bind water so that the more water in the bound material can cause the availability of free water in the material to decrease.

Table 9. The average Aw content of sawo kecik and telang marshmallows

Marshmallow		**Water Activity (%)**	
Addition of Gelatin (%)	Addition of Egg White (%)	Average ± $\overline{SD}$	DDMRT 5%
8	4	0,987 ± 0,0085[a]	0,0256
	6	0,921 ± 0,0092[b]	0,0256
	8	0,851 + 0,0057[c]	0,0255
10	4	0,792 ± 0,0035[d]	0,0253
	6	0,704 ± 0,0134[e]	0,0251
	8	0,627 ± 0,0071[f]	0,0247
12	4	0,505 ± 0,0177[g]	0,0241
	6	0,468 ± 0,0092[h]	0,0231
	8	0,390 ± 0,0106[i]	-

Thus the relationship between the addition of egg whites to marshmallows can form froth, trap and bind water so that the water content in the material increases and less free water. According to [33], gelatin has an OH group that binds water so that the more gelatin is added, the more water in the material will be bound in the form of weakly bound water so that the free water content in the material is less. This is supported by the higher concentration of gelatin used which causes a decrease in free water and decreases the Aw value [34].

3.2.6. Texture

Table 10 shows that the higher addition of gelatin and the addition of egg white causes the texture of sapodilla marshmallows and butterfly pea flowers to increase. This is because gelatin can bind water and form a gel matrix and the presence of egg white as a foaming agent can form foam and trap water in the gel and air so that the texture is more fluffy, supple, and dense.

Table 10. The average Texture of marshmallows of sapodilla and telang flower

Treatment		**Texture (N)**	
Addition of gelatin (%)	**Addition of Egg White** (%)	Average ± $\overline{SD}$	DMRT 5%
8	4	1.745 ± 0.0636[a]	-
	6	1.850 ± 0.0424[b]	0.2622
	8	2.030 + 0.0990[c]	0.2736
10	4	2.140 ± 0.0990[d]	0.2803
	6	2.465 ± 0.1626[e]	0.2844
	8	3.165 ± 0.1485[f]	0.2870
12	4	3.505 ± 0.1626[g]	0.2887
	6	3.975 ± 0.0495[h]	0.2898
	8	4.195 ± 0.1344[i]	0.2904

According to Ref. [35], the addition of gelatin can trap water in the gelatin matrix and the gel matrix is formed very compactly so that marshmallows with a dense and chewy texture are obtained, while according to [36], egg whites produce foam and can be used as a foaming agent, the more air bubbles that are trapped, the more fluffy the resulting marshmallow will be. The marshmallow texture value in this study was 1.745-4.195 N, greater than the study by [37], where the marshmallow texture value ranged between 0.17813- 1.58817 N.

4. CONCLUSION

There is a real interaction between the treatment of adding gelatin and egg white to water content, ash content, Aw value, and texture, as well as organoleptic tests of color, aroma, taste, and texture, but there is no real interaction to vitamin C content and sugar content marshmallow reduction. The treatment with the addition of 12% gelatin and 6% egg white is the best treatment which produces sapodilla marshmallows and butterfly pea flowers with a water content of 47.962%, ash content of 1.355%, a vitamin content of 16.340 mg/100 g, reducing sugar content of 9.595%, Aw value 0.468%, texture 3.975 N and organoleptic test color 3.60 (somewhat dislike), taste 4.04 (normal), aroma 3.12 (somewhat dislike) and texture 6.12 (like) and antioxidant activity of 35, 52% and has a shelf life of 7 days..

ACKNOWLEDGMENT

The authors would like to thank the Food Technology lecturers of Universitas Pembangunan Nasional "Veteran" Jawa Timur who have provided direction and support in writing this manuscript.

REFERENCE

[1] Manoppo, J.T., dan Priyanti, E. 2020. Diversifikasi Produk berbahan Dasar Buah Sawo menjadi Nastar, Hotteok, dan Dadar Gulung. SENASTER "Seminar Nasional Riset Teknologi Terapan. 1(1).

[2] Santoso, F. 2012. Produksi Pembuatan Selai Sawo Kaya Akan Vitamin C. Solo: Universitas Sebelas Maret.

[3] Sutarya, R. I. 2016. Perbandingan antara Sawo Manila (Manilkara zapota) dengan Konsentari Gula Kelapa dan Lama Pemanasan terhadap Karakteristik Dodol Sawo. Skripsi. Program Studi Teknologi Pangan Universitas Pasundan. Bandung.

[4] Rosmainar, L., Ningsih, W., Ayu, N. P., dan Nanda, H. 2018. Pengukuran Kadar Vitamin C beberapa Jenis Cabai (Capsicum sp.) dengan Spektrofotometri UV-VIS. Jurnal Kimia Riset. 3 (1): 1-5.

[5] Mastuti, E., Fristianingrum, G., dan Andika, Y. 2013. Ekstraksi dan Uji Stabilitas Warna Pigmen Antosianin dari Bunga Telang (Clitoria ternatea L.) sebagai Bahan Pewarna Makanan. Simposium Nasional RAPI XII - 2013 FT UMS. 44-51.

[6] Palimbong, S., dan Pariama, A. S. 2020. Potensi Ekstrak Bunga Telang (Clitoria ternatea Linn) sebagai Pewarna pada Produk Tape Ketan. Jurnal Sains dan Kesehatan (J. Sains Kes.). 2(3): 228-235.

[7] Tertia, R. 2016. Pengaruh Konsentrasi Ekstrak Kopi dan Gelatin terhadap Karakteristik Marshmallow Kopi Robusta (Coffea robusta). Skripsi. Program Studi Teknologi Pangan. Universitas Pasundan. Bandung.

[8] Sarofa, U., Rosida., dan Putri, L. D. W. 2019. Karakteristik Marshmallow dari Kulit Pisang Raja (Musa textilia): Kajian Konsentrasi Gelatin dan Putih Telur. *Jurnal Teknologi Pangan*. 13(1): 20- 27

[9] Sartika, D. 2009. Pengembangan Produk Marshmallow dari Gelatin Ikan. Kakap Merah (Lutjanus sp.). Skripsi. Fakultas Perikanan dan Ilmu Kelautan Institut Pertanian Bogor. (Bachelor's thesis, Fakultas Sains dan Teknologi UIN Syarif Hidayatullah Jakarta).

[10] Asiah, N., Cempaka, L., dan David, W. 2018. Metode Penentuan Umur Simpan. dalam: Panduan Praktis Pendugaan Umur Simpan Produk Pangan. Jakarta: Universitas Bakrie. 39–52.

[11] Asriani, A., Dharmayanti, N., Purnamasari, H. B., Handoko, Y.P., Rini, N.S., dan Abdulloh, I. M. 2021. Penentuan Umur Simpan Otak-Otak Ikan UMKM Bunga Mawar dengan Metode Extended Storage Studies (ESS). Buletin Jalanidhitah Sarva Jivitam. 2 (2): 101-112.

[12] Sarofa, U., Rosida., dan Putri, L. D. W. 2019. Karakteristik Marshmallow dari Kulit Pisang Raja (Musa textilia): Kajian Konsentrasi Gelatin dan Putih Telur. *Jurnal Teknologi Pangan*. 13(1): 20- 27

[13] Zulfajri, Z., Harun, N., dan Johan, V. S. 2018. Perbedaan Konsentrasi Gelatin terhadap Kualitas Permen Marshmallow Buah Naga Merah (Hylocereus polyrhizus). Sagu. 17 (1): 10-18.

[14] Maisa, N. D. 2020. Pengaruh Penambahan Putih Telur terhadap Karakteristik Marshmallow Sari Buah Semangka (Citrullus lanatus). Disertasi Doktor. Universitas Andalas.

[15] Aziza, I. N., Darmanto, Y. S., dan Kurniasih, R. A. 2019. Pengaruh Gelatin dari Kulit Ikan yang Berbeda terhadap Karakteristik Fisik dan Sensori Produk Marshmallow. Jurnal Perikanan. 21(1): 17–23.

[16] Kusumiyati, K., Farida, F., Sutari, W., dan Mubarok, S. 2017. Mutu Buah Sawo selama Periode Simpan Berbeda. Mencerminkan. 16 (3).

[17] Sutrisno, E.T., Arief, D.Z., dan Oktapiani, T. 2018. Karakteristik Tepung Campolay (Pouteria campechiana) untuk Biskuit dengan Variasi Tingkat Kematangan dan Suhu Blansing. Jurnal Teknologi Pangan Pasundan. 5 (2): 111-121.

[18] Sudarmadji. 2010. Analisa Bahan Makanan dan Pertanian. Penerbit : Liberty Yogyakarta.

[19] Ahligizi. 2018. Informasi Nilai Gizi Sawo Kecik. https://nilaigizi.com/gizi/detailproduk/712/sawo-kecik [3November 2023].

[20] Tampubolon, T. R. dan Yunianta. 2017. Pengaruh formulasi terhadap sifat fisik, kimia, dan organoleptik effervescent jambu biji merah (Psidium guajava var. Pomifera). J. Pangan dan Agroindustri. 5 (3): 27-37.

[21] Andarwulan, N., Kusnandar F., dan Herawati D. 2011. Analisis Pangan. Dian Rakyat: Jakarta.

[22] Tonutare, T., Moor, U., dan Szajdak, L., 2014. Strawberry Anthocyanin Determination by pH Differential Spectroscopic Method – how to get result?. 13(3):35-47.

[23] Almatsier. S. 2001. Prinsip Dasar Ilmu Gizi. Gramedia Pustaka Utama: Jakarta.

[24] Nisa, D. C. 2019. Karakteristik Marshmallow dari Perlakuan Proporsi Ciplukan (*Physalis peruviana* L) dan Jeruk Manis (*Citrus sinensis*) serta Penambahan Gelatin. *Jurnal Teknologi Pangan*.13 (1), 28-38.

[25] Ntau, E., Djarkasi, G.S., dan Lalujan, L.E. 2021. Pengaruh Penambahan Gelatin Terhadap Kualitas Fisik Es Krim Sari Jagung Manis. Jurnal Penelitian Pangan Sam Ratulangi.1 (1): 10-19.

[26] Sarofa, U., Rosida., dan Putri, L. D. W. 2019. Karakteristik Marshmallow dari Kulit Pisang Raja (Musa textilia): Kajian Konsentrasi Gelatin dan Putih Telur. *Jurnal Teknologi Pangan*. 13(1): 20- 27

[27] Aina, M. dan Dawan, S. 2011. Uji Kualitatif Vitamin C pada berbagai Makanan dan Pengaruhnya terhadap Pemanasan. Jurnal Sains dan Matematika. 61-67.

 https://doi.org/10.29165/ajarcde.v8i2.455

[28] Bahri, M. A., Dwiloka, B., dan 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.

[29] Saputra, D.H. 2021. Suplemen Putih Telur dalam Tatalaksana Hipoalbuminemia. Cermin Dunia Kedokteran. 48 (10): 410-413.

[30] Zilhadia, Z., Kusumaningrum, F., Betha, O.S, dan Supandi, S. 2018. Diferensiasi Gelatin Sapi dan Gelatin Babi pada Gummy Vitamin C menggunakan Metode Kombinasi Spektroskopi Fourier Transform Inframerah (FTIR) dan *Principal Component Analysis* (PCA). *Ilmu dan Penelitian Farmasi*. 5 (2): 6.

[31] Purwati, H., Istiawaty, H., dan Soetaredjo, F.E. 2017. Pengaruh Waktu Penyimpanan terhadap Kualitas Soyghurt dengan Penambahan Susu Bubuk. *Widya Teknik*. *7* (2): 134-143.

[32] Ekafitri, R., Surahman, D. D., dan Afifah, N. 2016. Pengaruh Penambahan Dekstrin dan Albumen Telur (Putih Telur) terhadap Mutu Tepung Pisang Matang. *Jurnal Litbag Industri*. 6(1): 13.

[33] Hendra, A.A., Utomo, A.R., dan Setijawati, E. 2015. Kajian karakteristik Edible Film dari Tapioka dan Gelatin dengan Perlakuan Penambahan Gliserol. *Jurnal Teknologi Pangan dan Gizi.* 14 (2): 95-100.

[34] Novitasari, M., Mapiratu., dan Dwi, S. 2016. Mutu Kimia dan Organoleptik PermenJelly Rumput Laut Gelatin Sapi. *E-Jurnal Mitra Sains*. 4 (3).

[35] Hendra, A.A., Utomo, A.R., dan Setijawati, E. 2015. Kajian karakteristik Edible Film dari Tapioka dan Gelatin dengan Perlakuan Penambahan Gliserol. *Jurnal Teknologi Pangan dan Gizi.* 14 (2): 95-100.

[36] Ekafitri, R., Surahman, D. D., dan Afifah, N. 2016. Pengaruh Penambahan Dekstrin dan Albumen Telur (Putih Telur) terhadap Mutu Tepung Pisang Matang. *Jurnal Litbag Industri*. 6(1): 13.

[37] Arizona, K., Laswati, D. T., dan Rukmi, K. S. A. 2021. Studi Pembuatan Marshmallow dengan Variasi Konsentrasi Gelatin dan Sukrosa. *Agrotech: Jurnal Ilmiah Teknologi Pertanian*. 3 (2): 11-17.