



Quality Characteristics of Marshmallow Candy Made with Beef Bone Gelatin and Powdered Cream Milk: Texture, Water Content, Aw, and pH

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Abstract. The addition of powdered cream milk to gelatin containing fat is used to improve the quality of the marshmallows. The aim of this research was to determine the effect of adding powdered cream milk on marshmallow. The material used in this research was gelatin marshmallow added with powdered cream milk at levels of 0%; 25% and 50%. The research method used was experimental research with a completely randomized design using 3 treatments and 4 replications. The variables of this research are texture, water content, Aw and pH. The results showed that the average texture at each level was 2.325 N; 2.275 N and 4.125 N; water content: 21.50%; 22.25%; 23.75%; Aw: 0.811; 0.800; 0.791; and pH 6.55; 6.5; 6.28. The conclusion from this research is the quality of marshmallow candy with the addition of 25% powdered cream milk produces the best candy quality in terms of texture, water content, Aw and pH by producing values of 2.275 N, 22.25%, 0.80 and 6.5 respectively.

Keywords: Full Cream, Gelatin, Marshmallow, Soft Candy, Quality.

1 Introduction

The development of technology today is so rapid, resulting in a variety of processed gelatin products. The processed gelatin products that are widely available on the market include pudding, ice cream, soy sauce, vinegar, and marshmallows. Marshmallow is a candy made from sugar syrup that has a fluffy texture. Marshmallow has a sweet taste and soft texture so it is very popular with children.

Marshmallows achieve their signature melt-in-the-mouth texture through a combination of gelatin, corn syrup or sugar, and flavoring agents, whipped together until they become light and airy [1]. The primary ingredient, sucrose (sugar), not only imparts sweetness but also plays a crucial role in defining the soft texture of marshmallows. Additionally, sucrose reduces water activity (Aw), contributing to a longer shelf life and preventing microbial growth through cell plasmolysis [2].

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Marshmallows sold on the market generally have a sweet taste and contain little nutrition. Marshmallow candy has characteristics, namely a maximum water content of 20%, a maximum reducing sugar of 25%, and a maximum ash content of 3% [3]. Marshmallows sold generally only contain a few components such as vitamins, fiber and minerals [4]. Efforts to increase the nutritional content of marshmallows by adding milk.

Milk is a food ingredient needed by the human body because it is rich in nutrients such as phosphorus, calcium, and vitamin A which are very good and rich in lysine which is an amino acid that is very good for the body [5]. The addition of cream milk in making marshmallows is a form of product development effort to improve the quality of marshmallow products as expected. Therefore, further research is needed to determine the effect of adding cream milk concentration on the physical quality characteristics of the marshmallow candy produced. The basis for this study refers to research [6] the use of 8% gelatin in red dragon fruit marshmallow candy products produces the best marshmallow products in terms of water content of 19.81%, sucrose content of 59.70%, ash content of 0.29%, vitamin C content of 1.98 mg, and density of 0.80 g/ml and with an overall assessment preferred by the panelists.

2 Materials and Methods

The research was conducted at the Animal Product Technology Laboratory, Faculty of Animal Science, Universitas Brawijaya for marshmallow making and testing of texture, water content, Aw and pH. The ingredients are powdered cream milk with different concentrations, gelatin, granulated sugar, mineral water and cornstarch.

The research method used was experiment and calculation with a Completely Randomized Design (CRD) with three treatments and four replications, as follows :

- T0: 100% water + 0% powdered cream milk (control group).
- T1: 75% water + 25% powdered cream milk.
- T2: 50% water + 50% powdered cream milk.

The variables consisted of texture, water content, Aw and pH. How to make marshmallows [6], texture using texture analyzer [7], water content using oven [8], Aw using Aw meter [9] and pH test using pH meter [10]

The melted texture in marshmallows when eaten is obtained by mixing gelatin, corn syrup or sugar, and flavoring ingredients that are whipped until fluffy [1]. In general, the basic ingredient for making marshmallows is sugar (sucrose). Sucrose in making marshmallows is to provide a sweet taste and determine the texture in soft candy. The use of sucrose functions to reduce water activity (Aw) so that the product has a long shelf life and causes cell plasmolysis in bacteria [2].

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3 Results and Discussion

The results of the study of marshmallow with the addition of cream milk can be seen in Table 1:

Table 1. The average value of marshmallow with the addition of cream milk.

Treatment	Texture (N) ± SD	Moisture content (%) ± SD	Water activity ± SD	pH ± SD
T0	2.325 ^{ab} ± 0.38	21.50 ± 3.70	0.81 ± 0.02	6.55 ^b ± 0.06
T1	2.275 ^a ± 0.15	22.25 ± 3.66	0.80 ± 0.02	6.5 ^{ab} ± 0.16
T2	4.125 ^b ± 0.15	23.75 ± 0.96	0.79 ± 0.02	6.28 ^a ± 0.10

Description:

- The addition of cream milk has a highly significant effect ($P > 0.01$) on the texture of marshmallow.
- The addition of cream milk has a significant effect ($P > 0.05$) on the pH of marshmallow.

3.1 Texture

The addition of powdered cream milk had a highly significant effect ($P < 0.01$) on the texture of marshmallows. In Table 1, the results for each treatment T0, T1, and T2 are 2.325 N, 2.275 N, and 4.125 N. The research results show a very significant difference because the addition of 5% powdered cream milk produces a decreasing texture test value. Adding 10% cream milk gives the highest marshmallow texture test results (hard) compared to other treatments.

Marshmallows with the addition of sorbitol and potatoes stated that the value of the texture test was in the range of 1.980 - 4.127 N [11]. Based on the study, all marshmallow treatments with powdered cream milk have met the standards. The cream milk used in marshmallows has a very real effect. The fat content in cream milk can affect the texture. This is in line with the statement that the amount of water content, fat content, protein, and carbohydrate content in food ingredients can affect the tex-

ture [12]. In treatment T1, the addition of 25% cream milk gave a chewy texture, while in treatment T2 the addition of 50% cream milk produced the highest texture value of 4.125 N. This is because the low pH content (6.28) in treatment T2 resulted in a harder texture. The lower the pH in marshmallows, the greater the gelatin strength will be so that the texture is denser.

Texture value plays an important role because it will provide a sensation when consumed. The expected marshmallow texture is soft, chewy and light like foam. The texture value in the research that has been done can be caused by other factors such as the use of gelatin, the amount of water, the amount of trapped air and pH during the manufacturing process. Gelatin is one of the factors in marshmallow texture. Gelatin functions as a gelling agent to stabilize and provide texture to food ingredients through gel formation [2]. The quality of gelatin gel strength can affect the elasticity of the final product. Gelatin contains amino acids that can affect the strength of gelatin gel. The manufacture of jelly candy which states that gelatin strength will increase if the length of the amino acid chain is because it will make micelles to form strong gelatin [20].

3.2 Moisture Content

The results of the analysis of variance calculations in the research that has been conducted show that the concentration of added powdered cream milk has no effect ($P > 0.05$) on the water content of marshmallows. Based on Table 1, shows that the results of the T0, T1, and T2 treatments were 21.50%, 22.25%, and 23.75% respectively. The treatment results are greater than the SNI standard which has a standard for soft jelly confectionery with a maximum water content of 20%. The results show that all water content values from the research that has been conducted have values above the SNI requirements that have been set.

One of the factors of high water content is the use of gelatin in a product. Marshmallow with the addition of broccoli states that the amount of gel-forming small consistency can cause syneresis because the tissue is not strong enough to hold the liquid [13]. In this study, most of the gelatin did not dissolve in water because of the addition of powdered cream milk. The use of water in different amounts in dissolving water.

One of the factors of high water content is the use of gelatin in a product. Marshmallow with the addition of broccoli states that the amount of gel-forming consistency that is small can cause syneresis because the network is not strong enough to hold the liquid. In this study, most of the gelatin did not dissolve in water because of the addition of powdered cream milk. The use of water in different amounts in dissolving water and the use of gelatin in the same concentration resulted in gelatin not being completely dissolved which affected the amount of water content in marshmallow [15].

3.3 Water Activity (A_w)

The results of the analysis of variance calculation in the research that has been conducted show that the concentration of the addition of powdered cream milk has no significant effect. The results of the analysis of variance calculation in the research that has been conducted show that the concentration of the addition of powdered cream milk has no significant effect ($P > 0.05$) on the A_w of marshmallow. Based on Table 1 shows that the results of the T0, T1, and T2 treatments were 0.811, 0.800, and 0.791 respectively. Marshmallows generally have a water activity value (A_w) between 0.60 and 0.75 [14]. The results show that all research results do not comply with the requirements that have been set.

The A_w value in each treatment did not have a significant effect. The final result of the marshmallow with the addition of powdered cream milk had an effect on the low A_w value compared to the marshmallow without the addition of powdered cream milk. The addition of 10% powdered cream milk produced the lowest A_w value of 0.791. This is because fat is hydrophobic which can delay water absorption so that it will affect the free water content available in the product [15]. The more powdered cream milk is used, the more fat content in the product, thus reducing the A_w value. The A_w value of marshmallow can also be affected by other ingredients such as glucose, sugar, and other ingredients that can affect the water activity value of the product.

The water activity value (A_w) in a product can be influenced by other factors, namely the use of sucrose and gelatin. This is because gelatin in marshmallows functions to bind water [16]. The sugar content in marshmallows can prevent moisture loss and control humidity. Water activity is also influenced by air humidity, pH, and packaging materials to preserve the product. A pH value of 6-7 in a product can affect water activity because at that pH the invertase enzyme is at its maximum in carrying out the sucrose hydrolysis reaction which can reduce water activity [14]. Another factor that affects the A_w value in marshmallows is the sugar cooking process which can cause water evaporation in marshmallow candy [17].

3.4 pH

The results of the analysis of variance calculations in the research that has been conducted show that the concentration of the addition of powdered cream milk has a significant effect ($P < 0.05$) on the pH of marshmallows. Based on Table 1, the results of the T0, T1, and T2 treatments are 6.55; 6.5, and 6.28 respectively. The real difference in the results of this study is that the addition of more powdered cream milk results in a decreasing pH value in each treatment.

The addition of cream milk results in a decrease in the pH value of marshmallows. Milk is acidic and basic at the same time because it has amphoteric properties. Milk contains acids that mostly come from lactic acid. The acidity of milk is caused by various compounds that are acidic, for example, amino acid compounds, complex phosphoric acid, citric acid, and carbon dioxide that dissolve in milk [18]. The pH value contained in NZPM brand powdered cream milk is 5.5 so it affects the pH value

of marshmallows. The use of more cream milk will result in a decreasing pH value. The pH value of a product is due to the additional ingredients used. Marshmallows with added cinnamon produce a pH value of 8.5 [19]. Cinnamon has alkaline properties, so adding cinnamon to a product will result in a high pH value.

Another factor that can affect the decrease in pH in marshmallow products is due to the sugar caramelization process [19]. The sugar caramelization process uses high temperatures to produce water molecules. When the process of breaking and dehydration will be accompanied by polymerization which produces various types of acids in the process. In marshmallow production, attention must be paid to the pH value because it will affect the success of the product. pH can affect the texture and color of the final product. Low pH values can cause syneresis but in alkaline pH conditions can result in the product being yellowish [23].

4 Conclusion

The quality of marshmallow candy with the addition of 25% powdered cream milk produced the best candy quality in terms of texture, water content, Aw, and pH with values of 2.275 N, 22.25%, 0.80, and 6.5 respectively.

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