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The Effect of Use of Gelatin in Milk Candy Making on Organoleptic and Physicochemical Properties

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Authors' contributions

This work was carried out in collaboration among all authors. Authors DA and AMW designed the study, wrote the protocol and managed the analyses of the study. Authors ADS and GWHE wrote the first draft of the manuscript and performed the statistical analysis. Author RAS managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

The making process of milk candy used many other additional ingredients, one of which is gelatin. Gelatin is a livestock product obtained from processing livestock bones and skin. This research uses gelatin as an additional ingredient for making milk candy. The purpose of this research was to

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affect addition gelatin on organoleptic and physicochemical in milk candy. The objective using gelatin as binding agent in confectionary candy. The research material used milk, gelatin, and sugar. The 4 treatments with five replications used 0%, 10%, 20%, and 30% of gelatin. Variables were organoleptic, water content, pH, water activity, texture (toughness), protein content, and reducing sugar. The result of the study showed addition gelatin had a highly significant different ($P<0.01$) in organoleptic (color) and had a significant different ($P < 0.05$) in organoleptic (aroma). The result of the study shows addition gelatin had a significant different in organoleptic and physicochemi call milk candy. Average texture value milk candy was 2.75±0.17-2.22±0.14, taste value was 3.67±0.08-2.27±0.14, aromatic value was 2.80±1.02-2.53±0.96, color value was 3.33±0.83- 2.45±0.82, water content value was 7.56%±0.44-37.34%±0.54, average pH value was 6.00±0.08-6.06±0.01, water activity value was 0.79±0.004-0.90±0.016, texture (elasticity) value with newton (N) test units was 25.62±3.38-25.38±3.87, average proteins value was 3.12±0.17%-17.34±0.57%, average reducing sugar value was 3.38±0.24%-2.12±0.15. Milk candy used 10% of gelatin produced with a clear color and milky aroma. As the result, using 10% of gelatin influenced the physicochemical characteristic by increasing protein content and reducing sugar. The conclusion showed that the addition of gelatin to milk candy had a significant effect on organoleptic and physicochemical so the best value of milk candy can use the additional as much as 10% of gelatin.

Keywords: Caramel; concentration; gelatin; milk candy; taste.

1. INTRODUCTION

Livestock farming is a sector that has an important role in meeting people's food needs. Many products from the livestock sector have high utility value for direct consumption or through further processing into other products. Milk is one of the livestock products that are widely known to the public. In general, milk is a white liquid produced from the secretions of the animal's udder glands. Milk is a liquid obtained from healthy and clean udders of dairy cattle and obtained by correct milking methods in accordance with applicable regulations [1]. Milk can be milked from mammals such as cows, goats, horses and buffalo. The chemical characteristics of good quality cow's milk consist of a minimum protein content of 2.8%, a minimum fat content of 3 %, and a non-fat dry matter content of 7.8% [2,3,4,5].

The high value of the benefits of milk apparently does not mean that milk consumption figures in Indonesia are higher compared to other countries. In Indonesia the milk consumption figure has been recorded at 16.23 liters/capita/year [6]. This figure is lower compared to other countries in the Southeast Asia region such as Malaysia whose milk consumption is 50.9 liters/capita/year, Brunei 129.1 liters/capita/year, Vietnam 20.1 liters/capita/year, and Singapore at 46.1 liters/capita/year, so that under these condition's efforts should be made to increase the interest in milk consumption of Indonesian people.

There are many efforts that can be made to increase interest in milk consumption in Indonesia, one of which is by making innovations in processing milk into other processed products that can attract public interest. Many innovations in processed products derived from milk have been carried out to date, one of which is milk candy products. The process of making milk candy can be an alternative answer to the problem of using milk other than processing it into yogurt and cheese. Processing milk into candy can extend the shelf life of milk, and can also increase the selling value of milk. The process of making milk candy mostly uses cow's milk as an ingredient. Cow's milk is easier to obtain, better known to the public and more accepted among consumers. Milk can use to make it a long-lasting product can be done by processing milk into candy [7]. Candy is also a product that many people like, so making candy made from milk can indirectly increase the fulfillment of people's animal nutritional needs.

In the process of making milk candy, many ingredients are added to improve the quality of milk candy, one of which is gelatin that can be used in making milk candy. Gelatin is a livestock product. Gelatin is made from livestock by-products, usually from livestock bones and skin. This by-product is usually rarely used further as a food ingredient, even though it can still be processed into gelatin. Gelatin is a protein obtained from the partial hydrolysis process of animal skin and bone collagen [8]. Gelatin is generally used as a raw material in making jelly

candy. Gelatin has the characteristics of being clear, translucent, colorless, and brittle when dry, and tasteless. Gelatin has been widely used and spread in the food and beverage industry, becoming an ingredient in making candy, ice cream, jelly, marshmallows and panna cotta [9]. In making jelly candy the use of gelatin aims to inhibit crystallization, change the liquid into an elastic solid, and improves the shape and texture of the resulting jelly candy [10]. Milk contains many nutrients and benefits, then the use of gelatin which has potential and prospects in the future will be the main supporting factor for this research to be carried out by using different types of gelatins as a variation of addition to making milk candy. The parameters observed in this research are the organoleptic and physicochemical properties of milk candy with the addition of gelatin in the process of making a product.

2. MATERIALS AND METHODS

2.1 Materials

The process of making milk candy samples was carried out at the Laboratory of PSDKU Universitas Brawijaya Kediri. The analysis process for milk candy samples was carried out at the Laboratory of the Faculty of Agricultural Technology and the Animal Products Technology Laboratory, Universitas Brawijaya, Malang. The organoleptic test process was carried out in two cities consisting of Kediri and Malang. The process of making and analyzing milk candy samples was carried out on March 1-August 30 2023.

The raw materials used in making milk candy are full cream UHT milk (Ultramilk), sugar, and gelatin from cattle bone (Hakiki). Equipment used for making milk candy includes Teflon, wooden spatula, stove, stopwatch, refrigerator, candy molds made from Food grade silicon, measuring cup and plastic clip. Other equipment used is a pH meter (Eddo PL- 600), Aw meter (Paw kit Pullman 99163), oven, analytical balance (Aces), desiccator, porcelain cup, thermometer, elasticity test equipment using a warner-brazier (shear), Kjeldahl distillation apparatus, digestion apparatus, burette, Erlenmeyer, volumetric pipette, volumetric flask, electric heater, upright cooler, thermometer, and boiling stone.

2.2 Methods

The research method used was an experimental method. Organoleptic test data was collected by administering an assessment questionnaire to the panelists using a liking or hedonic test for milk candy samples. This research consisted of 4 treatments with the addition of gelatin at 0% (P0), 10% (P1), 20% (P2), and 30% (P3) with 5 repetitions of each treatment. Each research sample was observed according to the research variables. Research variables consist of organoleptic tests uses the help of a hedonic scale [11], the hedonic scale is presented in Table 1, water content, pH, Aw, texture (toughness), protein content, and reducing sugar. Milk candy formula with the addition of gelatin [11], which was modified as follows:

1. P0: 100 ml UHT milk, 0 grams of gelatin, 50 grams of sugar.
2. P1: 100 ml UHT milk, 10 grams of gelatin, 50 grams of sugar.
3. P2: 100 ml UHT milk, 20 grams of gelatin, 50 grams of sugar.
4. P3: 100 ml UHT milk, 30 grams of gelatin, 50 grams of sugar.

2.3 Research Procedure

The research implementation procedure is divided into several stages, including the following preparing the tools, and materials to be used. The ingredients used include UHT milk, gelatin and sugar. UHT milk was added as much as 100 ml of UHT milk to teflon, 50 grams of sugar was added, gelatin was dissolved in treatments as much as 0, 10, 20 or 30 grams with cow's milk UHT as much as 50 ml. Gelatin is added to the mixed solution according to the treatment. The ingredients are stirred at a temperature of ± 99 ºC, cooking for 8 minutes, the cooked mixture is cooled and placed in candy place. Milk candy products are stored in the refrigerator, packaged using plastic cups continue with analyzing process with organoleptic and physicochemical tests.

2.4 Variables

Research variables include organoleptic and physicochemical properties. The following is the test method used to test milk candy with the addition of gelatin. The variables were organoleptic testing [12], water content testing [13], pH testing [14], testing water activity levels [15], texture testing (toughness) [16], protein content testing according to the Kjeldahl method [17], and testing of reducing sugar [18].

Table 1. Research hedonic scale

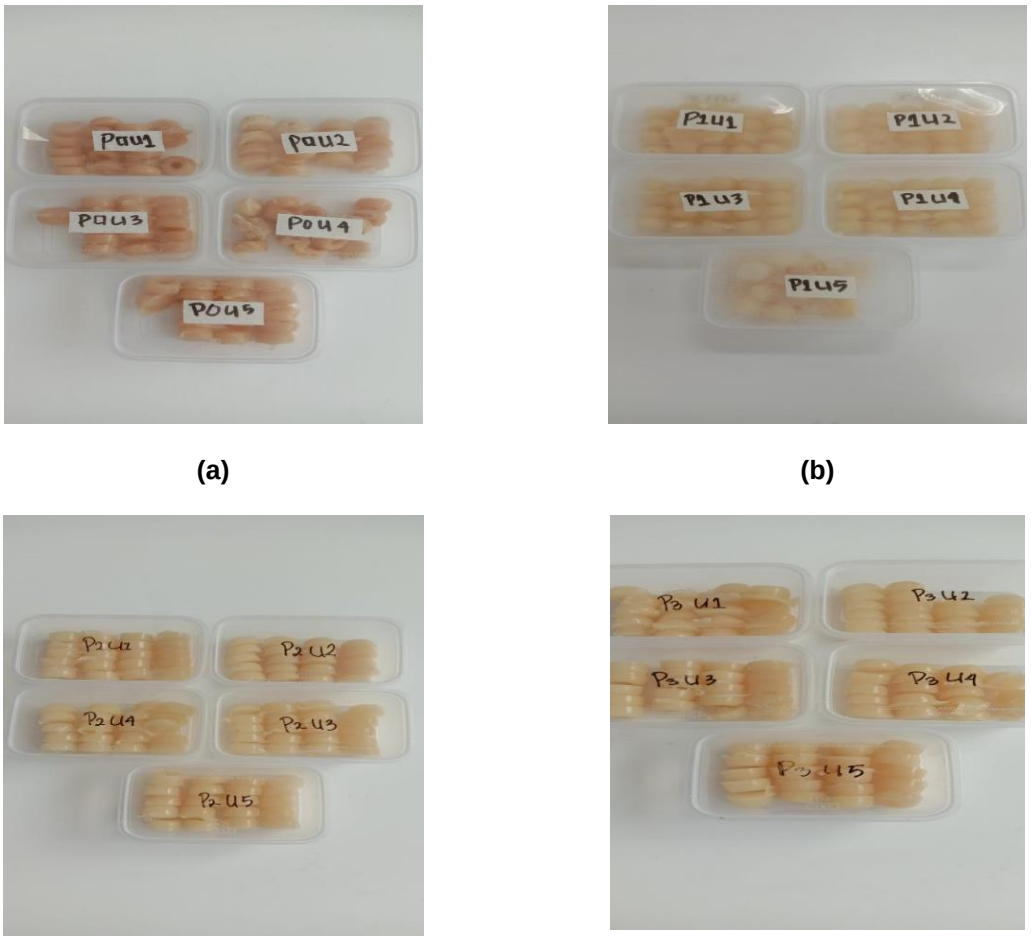
Hedonic Scale							
Scale	**Color**	**Scale**	**Aroma**	**Scale**	**Taste**	**Scale**	**Texture**
1	Very bright	1	Very dislike	1	Very dislike	1	Very dislike
2	Bright	2	Do not like	2	Do not like	2	Do not like
3	A little dark	3	Like	3	Like	3	Like
4	Very dark	4	Really like	4	Really like	4	Really like

2.5 Statistical Analysis

The experimental design used in this research used a completely randomized design using four treatments and five repetitions. Based on the data obtained from tests that have been carried out on milk candy, the data analysis method used is the data analysis method of variance (ANOVA) using the help of Microsoft Excel in the calculations, then if there are significant differences then it will be continued using the Duncan's Multiple Range Test method (DMRT).

3. RESULTS AND DISCUSSION

The milk candy that has been produced with the addition 0% of gelatin, 10% of gelatin, 20% of gelatin, and 30% of gelatin with 5 replications. The results of milk candy products can be seen in Fig. 1.



(a) **(b)**

(c) **(d)**

Fig. 1. Results of milk candy with various treatments

Remarks: (a) Photo of milk candy sample treated P0 (0% gelatin), (b) Photo of milk candy sample treated P1 (10% gelatin), (c) Photo of milk candy sample treated P2 (20% gelatin), (d) Photo of sample P3 treated milk candy (30% gelatin)

Table 2. Average organoleptic test results for milk candy with the addition of gelatin

Treatment	Organoleptic Test			
	Taste	Texture	Aroma	Color
P0	$3.67^{b} \pm 0.08$	$2.75^{b} \pm 0.17$	$3.33^{c} \pm 0.83$	$2.80^{bc} \pm 1.02$
P1	$2.67^{b} \pm 0.15$	$2.62^{b} \pm 0.16$	$2.50^{b} \pm 1.01$	$2.88^{c} \pm 0.72$
P2	$2.42^{ab} \pm 0.15$	$2.55^{ab} \pm 0.15$	$2.48^{ab} \pm 0.88$	$2.75^{b} \pm 0.74$
P3	$2.27^{a} \pm 0.14$	$2.22^{a} \pm 0.14$	$2.45^{a} \pm 0.82$	$2.53^{a} \pm 0.96$

Explanation: Different notations in the same column indicate highly significant differences (P<0.01) between one treatment and another

Milk is a white liquid obtained from mammals and can be utilized or used as a healthy food ingredient, without adding or subtracting other ingredients [19]. The types of milk commonly consumed by humans come from cows, goats and buffalo. Milk can be processed into various products, one of which is candy. The processing fresh milk into candy is an effort that can be made to utilize milk into long-lasting products [7]. Candy is a product that is liked by people of various age groups. The development of making milk candy has given rise to the latest innovations in making milk candy products, including adding certain ingredients or mixtures during the process of making milk candy, one of which is gelatin. Gelatin is a protein resulting from the hydrolysis of bone and skin collagen. Specifically, in the food and non-food industries, the use of gelatin is very widespread [20]. This research carried out the addition of various concentrations of gelatin, such as the addition of 0% gelatin (control), the addition of 10% gelatin, the addition of 20% gelatin, and the addition of 30% gelatin in making milk candy, which would then be tested on milk candy products. Testing of milk candy includes organoleptic testing (texture, taste, aroma and color), water content, pH level, Aw level, texture (toughness), protein content and reducing sugar content. Data on test results from milk candy with the addition of gelatin are shown in Tab. 2. for organoleptic tests and Tab. 3. for physicochemical tests.

3.1 Organoleptic

Organoleptic testing is an effective test carried out to measure consumers subjective attitudes towards a product based on the properties of the product including color, texture, aroma, taste, acidity level and viscosity level. The level of liking for the product is the result that will be obtained [21]. Organoleptic testing is an evaluation that relies on human sensory abilities, and sometimes this research can produce very accurate assessments, even exceeding the sensitivity level of the most sensitive devices [22]. The average organoleptic test results for milk candy with the addition of gelatin can be seen in Table 2.

3.1.1 Taste

Taste is an organoleptic test that mostly involves the five senses of the tongue. Human tastes are very diverse, making taste more difficult to understand completely. Food generally consists of a combination of various integrated flavors and does not only consist of one group of flavors, so that it can give rise to a delicious food taste. One way a person's acceptance of food is influenced by taste [23]. Based on the results of the ANOVA test that has been carried out, it is known that the addition of gelatin has a highly significant effect (P<0.01) on the taste of milk candy. The control treatment (P0) had the highest mean value (3.67 ± 0.08) when compared with the gelatin addition treatment P1 (2.67 ± 0.15), P2 (2.42 ± 0.15), and P3 (2.27±0.14). The average value of the milk candy taste test was 2.27-3.67 (a little like it). This is different from research on jelly candy made from shark skin gelatin (*Chiloscyllium punctatum*) with the addition of carrageenan and seaweed used 4 treatments including treatment G101 (1.75% gelatin and 1.75% carrageenan), L102 (1.75% gelatin and 3.50% carrageenan), P103 (1.75% gelatin and 1.75% seaweed), and J104 (1.75% gelatin and 3.50% seaweed) [24]. The results of the preference test for jelly candy showed that the most preferred jelly candy sample was L102 treated jelly candy with the addition of 1.75% shark skin gelatin (*Chiloscyllium punctate*) and 3.50 % carrageenan. The average taste value of L102 jelly candy is 7.50 (like). The panelists like L102 jelly candy because the taste of the jelly candy is not too sweet. The concentration of added gelatin also influences the level of panelist assessment of milk candy. The research which used beef bone gelatin and red dragon fruit juice (*Hylocereus polyrhizus* L.) as additions to making jelly candy which obtained a research average of 3.64-4.29 (a little like it) with the dragon fruit juice

mixture formula. red 45% and gelatin 18% got the highest score, while the mixture of red dragon fruit juice 40% and gelatin 18% got the lowest score [25]. Based on this data, it is known that the higher the gelatin concentration makes the panelists dislike the taste of the resulting product.

3.1.2 Texture

Texture is the sensation of pressure that can be observed using the mouth (when biting, chewing, and swallowing). One of the important physical properties of food ingredients is the texture [26]. Based on the results of the ANOVA tests that have been carried out, it is known that the addition of gelatin to the manufacture of milk candy has a highly significant effect (P>0.01) on the texture of the milk candy. P0 (control) had the highest mean value (2.75 ± 0.17), while other treatments had lower mean values including P1 (2.62 ± 0.16), P2(2.55 ± 0.15), and P3 (2.22 ± 0.14). The average value in this study is lower than the average value in research made marshmallow products using basic ingredients from chicken claw gelatin (P1) and beef bone gelatin (P2) [27]. The dosage for adding gelatin to both treatments was the same with 30 grams each. The results of research on the elasticity of the texture of marshmallows show that the addition of two types of gelatins did not have a significant effect (P>0.01) on the elasticity of the texture of marshmallow products. For P1, the average value was 3.12 and for P2, the average value was obtained of 3.27. The chewy texture of milk candy is caused by the use of gelatin, which is one of the gelling ingredients in food. The process of making gelatin from camel skin stated that gelatin is used as an ingredient in the food industry and non-food industry as a gelling, stabilizer, thickener, emulsifier and film-forming agent [28].

3.1.3 Aroma

Gelatin concentration based on the results of analysis of variance showed that the concentration of gelatin had a highly significant effect (P<0.01) on the organoleptic properties of the aroma of milk candy. The mean score for aroma organoleptic parameters ranged between 2.40-3.33. The highest aroma organoleptic properties score was produced by P0 with a mean score of 3.33 and the lowest aroma organoleptic properties score was produced by P3 with an average score of 2.45. The very real influence of gelatin on the aroma of milk candy is shown by the decrease in individual respondents scores in assessing the aroma parameters of milk candy, shown in Tab. 1. The effect of gelatin shows that the greater the percentage of gelatin (the largest percentage is 30%) added to milk candy is directly proportional to the decrease panelist's average score in organoleptic aroma test parameters.

If the gelatin concentration continues to increase (high gelatin concentration), the impact on the distinctive aroma of goat's milk will become fainter due to more amino acids reacting with the reducing sugar components [11]. The distinctive aroma of goat's milk, which becomes faint or diminishes, is further strengthened by the Maillard reaction, in the form of a reaction between reducing sugars and amino acids with heating [29]. The stages in the Maillard reaction consist of 3 parts; the first part is the formation of glycosylating. The second part is that the glycosylamine compound undergoes a dehydration process which produces furan derivatives, reductions, and various other carbonyl compounds. The final stage involves the transformation of furans and carbonyls into compounds that give the substance its taste and color [29].

3.1.4 Color

Gelatin concentration based on the results of analysis of variance showed that the concentration of beef bone gelatin had a significant effect (P<0.05) on the organoleptic properties of the color of cow's milk candy. The average score for color organoleptic parameters ranged between 2.50-2.80. The highest color organoleptic property score was produced by P1 with a mean score of 2.88 and the lowest color organoleptic property score was produced by P3 with a mean score of 2.53. The real influence of gelatin on the color of cow's milk candy is shown by the addition of gelatin to cow's milk candy which can cause the candy to become clear because of the physicochemical properties of gelatin which play a role in gel formation and dominate the color of the final product of cow's milk candy.

Organoleptic color test on goat's milk candy with the addition of the highest concentration of gelatin (25%) caused the color of the goat's milk candy product to become clear yellowish, in accordance with the results of the research in the form of cow's milk candy fortified with the highest concentration of beef bone gelatin (30%) having

a color clear brownish yellow, it can be seen that the higher the gelatin concentration (30%) causes the color of the cow's milk candy to become clearer and the original color of the cow's milk fades. Gelatin in milk acts as a gel forming agent, while sugar can affect the properties of the gelatin gel, so that when the heating process is carried out there is an interaction between sugar and gelatin which can affect the physicochemical properties of milk, including color and texture [11]. Heating can also affect the color change in milk. Research on buffalo milk candy, it was found that temperature and cooking time had significantly different effects on the color of the candy, this shows that the heating process can also influence color changes in milk products containing sugar and gelatin [30].

3.2 Physicochemical

Data on test results from milk candy with the addition of gelatin are shown in Table 2.

3.2.1 Water content

Water is an important component of food. Animal foods and plant foods contain water in varying amounts [31]. Based on the test results, it is known that the average water content value of milk candy is 7.56%-37.34%. Testing the water content of milk candy with the addition of gelatin using ANOVA showed highly significant different results (P<0.01). So, it can be seen that the addition of gelatin to the manufacture of milk candy has a highly significant effect on the water content of milk candy. Based on testing, it is known that the highest water content is found at P3 (37.34 ± 0.54%) and the lowest water content is at P0 (7.56 ± 0.4. The average water content of milk candy in this study is higher if compared with SNI 3547.2-2008; it is known that the SNI for soft candy without jelly has a maximum water content of 7.5%. The lowest water content in this study was 7.56%, which is still not in accordance with SNI because the value is slightly higher compared to the standard. Maximum with SNI soft sugar flowers [18]. The high water content is due to the higher concentration of added gelatin. The process of making red dragon fruit (*Hylocereus polyrhizus*) marshmallow candy, the more beef bone gelatin added will increases the water content, this is because gelatin has the ability to bind water so that the more gelatin added, the more water will be bound and cause the water content in the candy to increase [32]. The water content of marshmallow candy products in this study ranged from 18.09-22.97 %, treatment G1 (added 6% gelatin) got an average of 18.09%, treatment G2 (added gelatin 8%) got an average of 19.81%, treatment G3 (addition of 10% gelatin) got an average of 21.56%, and treatment G4 (addition of12% gelatin) got an average of 22.97%. The water content in a product can influence the freshness, durability of the product and quality. The factor that determines the shelf life of a product is water content. Food products that have higher water content will result in the product becoming more fragile and having a relatively short shelf life [33].

3.2.2 pH

pH measurements need to be carried out to determine the level of acidity or alkalinity of the product and its relationship to the shelf life and safety of the product. If it is related to product quality, the pH value is an important factor in it. Based on the test results, it is known that the average pH level of milk candy is 6.00 ± 0.08 - 6.41 ± 0.03 (acid). The lowest mean value was obtained by the P0 treatment 6.00 and the highest average value was obtained by the P1 treatment 6.41. The addition of various concentrations of gelatin to the manufacture of cow's milk candy had a very significant effect (P<0.01) in the ANOVA test. The process of making jelly candy with the addition of fish scale gelatin using 4 treatments, consist of A (without adding gelatin), B (adding tawes (*Barbonymus gonionotus*) fish scale gelatin), C (adding milkfish (*Chanos chanos*) fish scale gelatin), and D (addition of kurisi (*Nemipterus nematophorus*) fish scale gelatin), it is known that the average pH value is 4.40-5.53 [34]. The highest average value was obtained from jelly candy D and the lowest was obtained from jelly candy A. The addition of gelatin to jelly candy can increase the pH value. This can be seen from the value of the control jelly candy with the jelly candy containing fish scale gelatin. The pH value resulting from the entire treatment is included in acidic conditions because the pH value is below 7 (neutral). The normal pH value is 7, if the pH value is >7 it indicates that the substance has alkaline properties, whereas if the pH value is <7 it has acidic properties [35]. This condition allows microorganisms to grow so this also affects the pH value of milk candy. The activity of microorganisms causes the pH value to change [35]. This condition is because several types of organisms can grow at various levels of acidity, including yeast (pH 2.5-8.5) and mold (pH 5-7).

Table 3. Average results of physicochemical testing of milk candy with the addition of gelatin

Treatment	Physicochemical Test					
	Water Content (%)	**pH**	**Aw**	**Texture (Toughness) (N)**	**Protein Content (%)**	**Reducing Sugar (%)**
P0	$7.56^{a} \pm 0.44$	$6.00^{a} \pm 0.08$	$0.79^{a} \pm 0.004$	$25.62^{b} \pm 3.38$	$3,12^{a} \pm 0.17$	$3.38^{b} \pm 0.24$
P1	$27.65^{b} \pm 0.57$	$6.41^{b} \pm 0.03$	$0.83^{ab} \pm 0.024$	$16.68^{a} \pm 2.28$	$7.33^{b} \pm 1.54$	$3.22^{b} \pm 0.10$
P2	$33.32^{c} \pm 0.49$	$6.21^{b} \pm 0.01$	$0.89^{b} \pm 0.014$	$13.00^{a} \pm 0.84$	$12.23^{c} \pm 1.13$	$2.40^{a} \pm 0.22$
P3	37.34 ± 0.54^{d}	$6.06^{ab} \pm 0.01$	$0.90^{b} \pm 0.016$	$25.38^{b} \pm 3.87$	$17.34^{d} \pm 0.57$	$2.12^{a} \pm 0.15$

Explanation: Different notations in the same column indicate highly significant differences (P<0.01) between one treatment and another

3.2.3 Water activity

Water activity is water that is neither bound nor free in a system that can support biological and chemical reactions [36]. Based on the test results, it is known that the average Aw content of milk candy consists of 0.79 ± 0.004-0.90 ± 0.016. The lowest average was obtained at P0 (0.79) and the highest average was obtained at P3 (0.90). Then in the ANOVA test it was discovered that the addition of gelatin to the manufacture of milk candy had a very significant effect (P<0.01) on the water activity content of cow's milk candy. The test results show that the average water activity content has a very significant effect on the addition of gelatin, the greater the concentration of added gelatin, the higher the Aw content value. Based on the results of tests carried out on cow's milk candy with the addition of gelatin, it is known that the average Aw content value is still quite high, above 0.7. The smaller the water activity values of a product, the longer the shelf life of the product because mold and microorganisms cannot live under certain Aw conditions [37]. The growth of bacteria and mold requires a minimum water activity of 0.7 so that under these conditions, milk candy products of all treatments are still at risk of having a short shelf life due to the high levels of water activity from each treatment.

3.2.4 Texture (toughness)

Gelatin concentration based on the results of analysis of variance shows that gelatin concentration has a very significant effect (P<0.01) on the texture of milk candy. The average score for texture parameters (toughness) ranges from 13.00-25.70 N. The highest texture (toughness) score was produced by P0 with a mean score of 25.62 N and the lowest texture (toughness) score was produced by P2 with a mean score of 13.00 N. The proteins and fats in cow's milk, such as gelatin, play a role in forming the texture of goat's milk jelly candy in the same way as cow's milk jelly candy and have a positive impact on the formation of the texture characteristics of the candy [11]. The addition of gelatin from beef bones significantly affects the chewiness of red dragon fruit (*Hylocereus polyrhizus*) marshmallow candy, which is part of the texture characteristics [32]. The more gelatin added (highest concentration 30% gelatin), the chewier the resulting candy. This is because a high amount of gelatin (the highest concentration is 30% gelatin) will produce a strong gel, making the candy harder and chewier. On the other hand, if the gelatin concentration is less than optimal (the smallest concentration is 10% gelatin), the candy will become soft and difficult to mold.

3.2.5 Protein content

Gelatin concentration based on the results of analysis of variance showed that the concentration of gelatin had a highly significant effect (P<0.01) on the protein content of milk candy. The average score for protein content parameters ranges from 3.11-17.35%. The highest protein content score was produced by P3 with an average score of 17.34% and the lowest protein content score was produced by P0 with an average score of 3.12%. Based on the results of analysis of variance data, it means that the addition of gelatin to the manufacture of milk candy can increase the protein content in milk candy. This increase in protein value has a positive side in that it can fulfill the body's protein needs, with safe consumption limits. The role of milk protein is to provide aroma, color characteristics and determine the texture of milk candy [38].

The highest protein content score was produced by P3 with an average score of 17.34 % indicating that the protein content score in the study exceeded the protein content value. The manufacture of goat's milk jelly candy with different concentrations of cow's gelatin (5%, 10%, 15%, 20%, and 25%) where the protein content is 5.65% in goat's milk candy [11]. The protein content was 1.5% in Etawa goat's milk candy [39]. The highest average value of protein content was 5.72 % found in P1 with 0.6% ginger flour treatment in caramel flavored candy ginger and ginger [40]. The milk hard candy contains 0.70% protein; caramel milk candy contains 0.58% protein and ginger milk soft candy contains 2.37% protein [7].

3.2.6 Reducing sugar

Gelatin concentration based on the results of analysis of variance shows that gelatin concentration has a highly significant effect (P<0.01) on the reducing sugar content of milk candy. The highest reducing sugar content was produced by P0 with an average score of 3.38% and the lowest reducing sugar content was produced by P3 with an average score of 2.12%. Reducing sugar can be formed from the process

of cooking candy dough until the dough becomes thick and smooth. The higher the candy dough heating temperature (±90-100 °C), the more reducing or inversion sugar is formed. For example, heating sucrose at 20 °C produces inversion. As much as 72% of the total sugar, while at a heating temperature of 30 °C, inversion reaches 80% [39].

Reducing sugar is an important component that needs to be considered in making candy. Reducing sugars come from glucose syrup and sucrose inversion. The level of reducing sugar greatly influences the characteristics of the product, high reducing sugar means the product tends to be sticky. Based on the data in Tab. 2, it is known that P0 (3.38%) and P1 (3.21%) are the samples with the highest reducing sugar content, where the higher the reducing sugar content (3.38 %) the stickier the product texture will be. the reducing characteristics of a sugar molecule depend on the presence of a reactive aldehyde group (CHO), where glucose which is a type of sugar has one aldehyde group (C-O-H) where one hydrogen atom is bonded to one oxygen atom then bound in the carbon framework of organic molecules, in comparison, sucrose is non-reducing where the two free anomer atoms bond with each other [38].

Limits on the reducing sugar content of soft candy have been regulated in SNI, the reducing sugar content of non-jelly soft candy is a maximum of 20.0% and soft jelly candy is a maximum of 25.0% [18]. The process of making goat's milk jelly candy with different cow gelatin concentrations (5%, 10%, 15%, 20%, and 25%) reducing sugar content in goat's milk candy corresponds to the SNI value of 13.56 % [11]. Based on the reducing sugar content in the study with an average range of 2.12-3.38% was appropriate, met and did not exceed the standards set for soft candy.

4. CONCLUSION

The addition of gelatin to the manufacture of milk candy affects the organoleptic and physicochemical quality of cow's milk candy. Milk candy with 10% of gelatin had some value of organoleptic contain of taste 2.67, texture 2.62, aroma 2.50, and color 2.88, physicochemical contain of water content 27.68%, pH 6.41, Aw 0.83, texture (toughness) 16.68 N, protein content 7.33%, and reducing sugar 3.38%. Based on the research results, it is known that the treatment of this study can be suggested that making milk candy is better if use the addition of gelatin as much as 10% because it produces milk candy with chewy physical characteristics, not mushy and soft texture.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Authors 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 manuscripts.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Meutia N, Rizalsyah T, Ridha S, Sari MK. Antibiotic residues in water fresh milk derivat from farms in the territory of Aceh Besar. Journal of Animal Science. 2016; 16:1-5.
   Available:https://bptuhptindrapuri.ditjenpkh.pertanian.go.id/site/images/files/Residu.pdf. Indonesian.
2. National Standards Agency. SNI 3141.1:2011. Fresh milk-part 1: cattle. Indonesian. 2011:1-4.
3. Patel, Aaradhana, Mohan Singh. Ohmic heating for food products- A review. Current Journal of Applied Science and Technology. 2018;27(3):1-7.
   DOI: 10.9734/CJAST/2018/40664.
4. Fiszman SM, Lluch MA, Salvador A. Effect of addition of gelatin on microstructure of acidic milk gels and yoghurt and on their rheological properties. International Dairy Journal. 1999 Dec 1;9(12):895-901.
5. Prasanna PH, Grandison AS, Charalampopoulos D. Bifidobacteria in milk products: An overview of physiological and biochemical properties, exopolysaccharide production, selection criteria of milk products and health benefits. Food Research International. 2014 Jan 1;55:247-62.
6. Anggraeni ED, Hidayat SI, Amir IT. Public perception and interest in milk consumption. Journal of Social Economics of Agriculture. Indonesian. 2021;10:41-49.
   DOI:10.26418/j.sea.v10i1.47753.

7. Widanti YA, Sutardi S. Assistance in developing milk candy products in Balerante Village, Central Java. JMM (Independent Community Journal). 2020;4: 1030-1039.
DOI: 10.31764/jmm.v4i5.3242. Indonesian.
8. Irvan MY, Darmanto S, Purnamayati L. Effect of adding gelatin from different fish skins on chikuwa characteristics. Journal of Food Science and Agricultural Products. 2019;3:78-93.
DOI:10.26877/jiphp.v3i1.3796. Indonesian.
9. Rousselot. A brief history of gelatin manufacturing; 2021. Accessed 23 February 2023.
Available:https://www.rousselot.com/functional/media/blog/a-brief-history-of-gelatin-manufacturing
10. Pangalila AG, Nurali EJN, Assa JR. Effect of gelatin and sucrose concentrations on the physical, chemical and sensory qualities of tomato jelly candy (*Lycopersicum esculentum* Mill). Journal of Agricultural Technology. 2021;12:81-88.
DOI:10.35791/jteta.v12i2.38962. Indonesian.
11. Eletra Y, Susilawati, Astuti S. Effect of gelatin concentration on the organoleptic properties of goat's milk jelly candy. Journal of Industrial Technology and Agricultural Products. 2013;18:185-195.
Available:https://jurnal.fp.unila.ac.id/index.php/JTHP/article/view/191/194. Indonesian.
12. Prayogi D. Organoleptic properties of milk hard candy with different types of sugar. (Organoleptic properties of milk hard candy with different types of sugar). Charm. 2016;2:58-72.
DOI: 10.26905/jpp.v1i2.512. Indonesian.
13. Laksono MA, Bintoro VP, Mulyani S. Water holding capacity, water content, and protein of chicken nuggets substituted with white oyster mushrooms (*Pleurotus ostreatus*). Animal Agriculture Journal. 2012;1:685-696.
Available:https://ejournal3.undip.ac.id/index.php/aaj/article/view/808/782. Indonesian.
14. National Standards Agency. SNI 01 – 2891 – 1992. How to test food and drinks; 1992. Indonesian.
15. Dipowaseso DA, Nurwantoro, Hintono A. Physical characteristics and spreadability of kolang-kaling jam made by substituting pectin with modified cassava flour (MOCAF) as a thickening agent. Journal of Food Technology. 2018;2:1-7.
DOI:10.14710/jtp.2018.20680. Indonesian.
16. Bruns KW, Wulf DM, Pritchard RH. Steps for warner-bratzler shear force assessment of cooked beef longissimus steaks at South Dakota State University. Open PRAIRE: South Dakota Beef Report. 2000; 12:72-78.
Available:https://openprairie.sdstate.edu/cgi/viewcontent.cgi?referer=&httpsredir=1&article=1014&context=sd_beefreport_2000
17. AOAC. Official methods of analysis, 18th edition. Association of official analytical chemistry international. Maryland, AOAC Press; 2005.
18. National Standards Agency. SNI 3547.2-2008. Confectionery-part 2: soft. 2008;1-42. Indonesian.
19. Zakiyyah, H. N. S. Cow's milk as medicine for body health: Study of takhrij and hadith sharia. Journal of Religion Research. 2021:1:375-388.
DOI: 10.15575/jra.v1i2.14672. Indonesian.
20. Santoso C, Surti T, Sumardianto. Differences in the use of citric acid solution concentration in making mondol stingray (Himantura gerrardi) cartilage gelatin. Journal of Fishery Product Processing and Biotechnology. 2015;4:106-114.
Available:https://ejournal3.undip.ac.id/index.php/jpbhp/article/view/9200/8931. Indonesian.
21. Iswandi E, Yusmaita, Pangestuti AD. Organoleptic test of corn juice at the Chemistry Laboratory, FMIPA UNP. Suluah Bendang: Scientific Journal of Community Service. 2019;19:108-116.
DOI: 10.24036/sb.0110. Indonesian.
22. Lamusu D. Organoleptic test of Jalangkote purple sweet potato (*Ipomoea batatas* L) as an effort to diversify food. Journal of Food Processing. 2018;3:9-15.
DOI: 10.31970/pangan.v3i1.7. Indonesian.
23. Novitasari M, Mappiratu, Sulistiawati D. Chemical and organoleptic quality of beef gelatin seaweed jelly candy. e- Science Partners Journal. 2016;4:16-21.
DOI:10.22487/mitrasains.v4i3.238. Indonesian.
24. Suptijah P, Suseno SH, Anwar C. Analysis of gel strength of jelly candy products from

shark skin gelatin with the addition of carrageenan and seaweed. Journal of Indonesian Fishery Product Processing. 2013;16:183-191.
DOI:10.17844/jphpi.v16i2.8053. Indonesian.

25. Fatmawati, Khalik A, Sutanto S, Laga L, Pance Y. Study of gelatin jelly candy formula with red dragon fruit Hylocereus polyrhizus L Ecosystem Scientific Journal. 2022;22:267-277.
DOI:10.35965/eco.v22i2.1522. Indonesian.
26. Putri RMS, Mardesci H. Hedonic test of simping shell biscuits (*Placuna placenta*) from downstream Indragiri waters. Journal of Agricultural Technology. 2018;7: 19-29.
DOI: 10.32520/jtp.v7i2.279. Indonesian.
27. Son of ZMSS, Suhardi, Abdurrahman ZH. Comparison of organoleptic qualities of marshmallows with different gelatin base ingredients. Tropical Animal Science. 2021;3:13-18.
DOI: 10.36596/tas.v3i1.375. Indonesian.
28. Ahmed MA, Al-Kahtani HA, Jaswir I, Abutarboush H, Ismail EA. Extraction and characterization of gelatin from camel skin (potentia l halal gelatin) and production of gelatin nanoparticles. Saudi Journal of Biological Sciences. 2020;27:1956-1601.
DOI: 10.1016/j.sjbs.2020.03.022
29. Hustiany R. Maillard reaction to form flavor and color in food products. Banjarmasin, Lambung Mangkurat University Press. Indonesian; 2016.
30. Saputrayadi A, Marianah M, Alia J. Study of temperature and cooking time on the quality of buffalo milk candy. Journal of Agritechnology and Food Processing. 2021;1:46-60.
DOI: 10.31764/jafp.v1i1.5821.
Indonesian.
31. Hidayat R, Maimun, Sukarno. Analysis of the quality of pindang tuna (*Euthynnus affinis*) using steam oven processing techniques. Fishtech Journal. 2020;9: 21-33.
DOI:10.36706/fishtech.v9i1.11003. Indonesian.
32. Zulfajri, Harun N, Johan VS. Differences in gelatin concentration on the quality of red dragon fruit (*Hylocereus polyrhizus*) marshmallow candy. Sago Journal. 2018; 17:10-18.
Available:https://id.scribd.com/document/635365839/Untitled. Indonesian.
33. Fillaili S, Ningtyias FW, Sulistiyani. The effect of adding tofu dregs flour on protein content, fiber content, water content, and acceptability of tilapia (*Oreochromis niloticus*) meatballs. Health System Farm Newsletter. 2020;23: 215-227.
DOI:10.22435/hsr.v23i4.2604. Indonesian.
34. Mufida RT, Darmanto YS, Suharto S. Characteristics of jelly candy with the addition of different fish scale gelatin. Journal of Fisheries Science and Technology. 2020;2:29-36.
DOI: 10.14710/jitpi.2020.8086. Indonesian.
35. Harvyandha A, Kusumawardani M, Rosyid A. Real-time telemetry measurement of acidity using raspberry PI. Jartel Journal. 2019;9:519-524.
DOI: 10.33795/jartel.v9i4.158. Indonesian.
36. Negara JK, Sio AK, Rifkhan, Arifin M, Oktaviana AY, Wihansah RRS, Yusuf M. Microbiological and sensory aspects (taste, color, texture, aroma) in two different forms of cheese presentation. Journal of Animal Production Science and Technology. 2016;04: 286-290.
Available:https://journal.ipb.ac.id/index.php/ipthp/article/view/17506/12562 .Indonesian.
37. Rismandari M, Agustini TW, Amalia U. Characteristics of jelly candy with the addition of iota carrageenan from seaweed *Eucheuma spinosium*. Fisheries Science. 2017;12:103-108.
DOI:10.14710/ijfst.12.2.103-108. Indonesian.
38. Astuti S, Zulferiyenni Z, Yuningsih NN. Effect of sucrose and glucose syrup formulations on the chemical and sensory properties of soy milk candy. Journal of Agricultural Products Technology and Industry. 2015;20:25-37.
DOI: 10.23960/jtihp.v20i1.25%20-%2037. Indonesian.
39. Amir F, Noviani E, Widari NS. Making Etawa goat's milk candy using dates as a substitute for sugar. Engineering Journal. 2017;15:43-50.
DOI: 10.36456/time.v15i1.443. Indonesian.
40. Sistanto, Soetrisno E, Saepudin R. Physicochemical and organoleptic

properties of milk candy (caramel) flavored with ginger (*Zingiber officinale* Roscoe) and ginger (*Curcuma xanthorriza* Roxb). Indonesian Journal of Animal Science. 2014;9:81-90.

DOI:10.31186/jspi.id.9.2.81-90. Indonesian.

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