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THE FUNCTIONAL PROPERTIES OF RABBIT SKIN GELATIN COMPARED TO COMMERCIAL GELATIN AND ITS APPLICATION IN JELLY CANDY

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ABSTRACT

Rabbit skin can be utilized as an ingredient in gelatin making. Gelatin can be used in jelly candy. The study aims to compare the functional properties of rabbit skin gelatin and commercial gelatin in gel strength, viscosity, and ash content and to determine the different test and hedonic test of jelly candy. This study used the t-test with 2 treatments and 8 replications. The rabbit skin gelatin was prepared using hydrochloric acid solution. The commercial gelatin is gelatin from cowhide (*Gelita bronze gelatin*). The results showed that P1 (rabbit skin gelatin) and P2 (commercial gelatin) were not different on gel strength, however, there was a difference on viscosity and ash content. The difference test on jelly candy state that there was a significant difference between rabbit skin gelatin jelly candy and commercial gelatin jelly candy. The hedonic test on jelly candy gave no difference on texture, flavor, taste, and overall, except there was a difference on color. The color of jelly candy with rabbit skin gelatin is a cloudy white, while jelly candy with commercial gelatin is a clear white. Both jelly candies can be distinguished and accepted by the panelist.

Keywords: Gelatin; rabbit skin; jelly candy

INTRODUCTION

Jelly candy is one product that is very popular with consumers from children to adults. Nowadays there are many jelly candy products with various shapes and flavors to increase appealing for consumers. Jelly candy includes soft candy made from fruit juice and gelling material which has a clear, transparent appearance, and has a certain elasticity. (Susanti and Asyik, 2019). The ingredients in making jelly candy are sucrose, glucose syrup, citric acid, and gelling agents (Putri *et al.*, 2015). Gelling material commonly used in the manufacture of jelly candy is gelatin. Gelatin is a water-soluble protein obtained from collagen tissue derived from skin, bone, and connective tissue which is hydrolyzed by acid or base (Abustam *et al.*, 2020). The gelatin in jelly candy roles to improve the shape and texture of jelly candy and inhibit sugar crystallization (Eletra and Astuti, 2013).

Indonesia has been imported 2000-3000 tons of gelatin products or worth 25,036.10 from various countries such as China, Japan, France, New Zealand, and Australia (Atma, 2016). Gelatin from pork skin is a problem for Muslims, while gelatin from cow skin and bones is not accepted by Hindu society. This encourages the search for alternative sources in gelatin production (Ratnasari *et al.*, 2013). Rabbit skin has not been fully utilized to its full potential. The chemical composition of rabbit skin is a protein content of 22.98%; fat 5.6%; ash 3.49%; and other ingredients 2.03% (Mas'ud *et al.*, 2015). Rabbit skin has a high protein content such as collagen protein so it has the potential to be extracted into gelatin (Wuysang *et al.*, 2016). The amino acid

composition of rabbit skin is similar to that of pork skin (Liu, T *et al.*, 2019). Films made from rabbit skin gelatin had the same trend of mechanical properties as films from pork skin gelatin at the same ratio of gelatin and glycerol (Ma, L, *et al.*, 2018). In this study, the functional properties of rabbit skin gelatin were compared with commercial gelatin from cowhide. The purpose of this study was to determine the differences in the functional properties of rabbit skin gelatin and commercial gelatin in terms of gel strength, viscosity, and ash content and to determine the differences in the characteristics of jelly candy in terms of organoleptic tests.

MATERIALS AND METHODS

Materials

The research material was the skin of male New Zealand rabbits aged 6 months, distilled water, 0.5 M NaOH, 0.3 M HCl, sucrose, glucose syrup, citric acid, commercial gelatin from cowhide (*Gelita bronze powder*). Research equipment includes measuring cups, stirrer, filter cloth, pans, stoves, thermometers, analytical balances, jelly candy, plastic cups, trays, porcelain dishes, desiccators, water baths, furnaces, refrigerator, freezer, Brookfield viscosimeter, texture analyzer, erlenmeyer, cabinet dryer.

Methods

Extraction of Rabbit Skin Gelatin

The rabbit skin was washed and the remaining fat was cleaned, then it was soaked in 2% lime water for 24 h. The soaking water was removed and the rabbit skin was re-washed and the fur was cleaned.

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The rabbit skin was cut into pieces 1 x 1 cm and weighed per 100 g, then soaked in 300 mL of 0.25 M NaOH solution for 2 h and rinsed with water repeatedly. The skin was re-soaked in 300 mL of 0.3 M HCl solution for 4 h, then washed to neutralize the pH between 5-6. Extraction was carried out in 3 stages, namely at temperature 65°C for 5 h, 68°C for 5 h, and 70°C for 5 h in the water bath. The extract was filtered and the filtrate was dried in a cabinet dryer at temperature 50-55°C for 48 h (Mulyaniet *al.*, 2017).

Making of Jelly Candy

Sucrose (40 g) and glucose syrup (40g) were heated at 40°C, and then added 0.3 g citric acid (for one experimental unit). Gelatin (5g) dissolved in hot water (50°C) as much as 50 ml in a different container. The gelatin was added to a mixture of sucrose, glucose syrup, and citric acid. Heating was continued at 100°C for 10 min until thickened, then removed and poured into the mold and cooled at room temperature 28°C for 1 hour. Candy stored in the refrigerator at 5°C for 24 h, then left at room temperature 28°C for 1 hour and removed from the mold (Sachlan *et al.*, 2020)

Design Research

The study used a descriptive method by comparing the two treatments using the independent t-test. The treatments consisted of gelatin from rabbit skin and commercial gelatin from cowhide (*Gelita bronze powder*). Comparisons were made based on the functional properties of gelatin and the characteristics of jelly candy made from the two gelatins. The concentration of gelatin used in both treatments was the same, namely 10 percent of the volume of water used.

Measurement

Gel Strength

Gel strength was determined three times according to the previously reported method (Mulyani *et al.*, 2017). Gelatin powder (6.67 g) was dissolved in 100 mL of

distilled water (6.67%; w/v) and was stirred using magnetic stirrer and then heated at 60°C for 15 min and incubated 16-18 h at 10°C. Subsequently, it was measured using texture analyzer TA-XT plus HD (Stable Micro System Ltd., UK) at the probe speed of 0.5 mm/sec and 4 mm depth.

Viscosity

Viscosity was measured with a Brookfield Viscometer at a speed of 60 rpm. 6.67 g of gelatin was dissolved in 100 ml of distilled water and heated on a water bath at 60°C for 12 min. Then the solution is cooled and tested on a viscosimeter with a solution temperature of 25°C (Santoso, *et al.*, 2019).

Ash Content

The porcelain dish was dried at 100°C, then cooled in a desiccator and weighed. The sample was weighed 2 g, then put into a porcelain dish. Then the samples were ashed in a furnace at a temperature of 550°C for 5-6 h or until ash was formed. Then the sample was cooled in a desiccator and weighed. Calculation of ash content is carried out by calculating the ratio of weight before and after the furnace process (Male *et al.*, 2014).

Organoleptic Test

Organoleptic tests for jelly candy include discriminatory test (Syukroni *et al.*, 2013) and hedonic test (Megantara *et al.*, 2017). Both tests used 25 semi-trained panelists. The semi-trained criteria means that the panelist understands the product description well and has been given a briefing before testing. Differentiation test is carried out based on the assessment of color, shape, clarity, texture, smell, and taste in jelly candy. Panelists are asked to fill out a form by giving a score of 0 if the products are the same and value of 1 if the products are different. The hedonic test was carried out based on an assessment of the color, texture, aroma, taste, and overalls of jelly candy products. The score scale used is 1 = dislike very much, 2 = do not like, 3 = like, 4 = like very much.

RESULTS AND DISCUSSIONS

Results

Gel Strength

Gel strength is a functional property of gelatin that is important to determine the

quality of gelatin because it can convert liquids into solids or change the sol into a reversible gel.

The results of testing the gel strength of rabbit skin gelatin and commercial gelatin can be seen in Table 1.

Table 1. Gel strength, viscosity, and ash content of rabbit skin gelatin compared to commercial gelatin

Treatment	Gel strength (Bloom)	Viscosity (cP)	Ash Content (%)
Rabbit skin gelatin	238.1 ± 16.07	10.4 ± 1.45a	1.2 ± 0.059a
Commercial gelatin	243.0 ± 33.55	13.7 ± 1.53b	0.4 ± 0.061b

Remarks: Data is displayed in the form of mean ± standard deviation. ^{a,b}, Different lowercase superscripts showed a significant difference ($P < 0.05$)

Based on Table 1, there was no significant difference ($P > 0.05$) between the gel strength of rabbit skin gelatin and commercial gelatin. According to SNI 06-3735-1995 states that the gel strength value ranges from 75-300 g Bloom. Gel strength is divided into 3 classifications, namely low (50-100 Bloom), moderate (100-200 Bloom), and high (200-300 Bloom) (Oktaviani et al. 2017).

Viscosity

Viscosity is the degree of consistency of a solution (Pelu et al., 2017). The results of testing the viscosity of rabbit skin gelatin and commercial gelatin can be seen in Table 1. There was a significant difference ($P < 0.05$) between viscosity rabbit skin gelatin and commercial gelatin (cowhide gelatin from *Gelita bronze powder*). The protein content of rabbit skin is 28.51% while the protein content of cowhide is 62.01% (Sasmitaloka et al. 2017).

Ash Content

Ash content is one of the requirements

that must be met by gelatin. Tests for the ash content of rabbit skin gelatin and commercial gelatin can be seen in Table 1. The results showed that there was a significant difference ($P < 0.05$) between the ash content of rabbit skin gelatin and commercial gelatin.

Organoleptic Test

Organoleptic tests carried out include differentiation tests and hedonic test. Difference test on jelly candy is used to find out the differences or similarities between two jelly candies with different gelatins. The difference test on jelly candy state that there was a significant difference between rabbit skin gelatin jelly candy and commercial gelatin jelly candy. The product differentiation is clarified with the difference in color between both jelly candies.

The hedonic test on jelly candy is used to determine the level of preference between two jelly candies with different gelatin. The results of hedonic test carried out on 25 panelists using a scale 1-4 can be seen in Table 2.

Table 2. Hedonic test of jelly candy made from rabbit skin gelatin and commercial gelatin

Type of gelatin	Texture	Color	Taste	Aroma	Overall
Rabbit skin gelatin	2.92 ± 0.86	3.36 ± 0.57 ^a	3.12 ± 0.88	2.56 ± 0.77	3.12 ± 0.67
Commercial gelatin	3.04 ± 0.79	2.72 ± 0.79 ^b	2.96 ± 0.73	2.48 ± 0.87	3.04 ± 0.61

Remarks: Data is displayed in the form on mean ± standard deviation. ^{a,b}, Different lowercase superscripts in the same column showed a significant difference ($P < 0.05$) Hedonic scale = 1 (dislike very much), 2 (dislike), 3 (like), 4 (like very much)

The results of hedonic test conducted by 25 panelists (Table 2) showed that there was a significant difference ($P < 0.05$) on color, but there was no significant difference ($P > 0.05$) on texture, taste, aroma, and overall.

Discussion

Gel Strength

The gel strength of commercial gelatin and rabbit skin gelatin is high (238,1-243,0 Bloom). This means that the gel strength of rabbit skin gelatin is equivalent to that of commercial gelatin. This is caused by the extraction that has been optimally carried out. Extraction using HCl can help collagen break down the triple helix into single chains. Kusumawati and Wawasto (2008) stated that acid solution can convert triple helix collagen into single chains in a short time, therefore more collagen can be hydrolyzed. Extraction was carried out at optimal temperatures therefore the resulting gel strength is high. Rabbit skin gelatin extraction was carried out at temperature 65-70°C, while temperature 70°C would convert unbreakable collagen to temperature 65°C, hence the collagen in rabbit skin could be converted into gelatin optimally.

Extraction optimization is influenced by the optimal extraction time (Wulandari *et al.* 2013). The extraction process for 5 h was the optimal time to convert the collagen into gelatin, should it was more than 5 h, the skin would be destroyed and more dissolved with distilled water (Pratiwi *et al.*, 2018). The optimal extraction process on rabbit skin gelatin produces gel strength that has not different from commercial gelatin. Gel strength is an important property of gelatin to determine the quality of jelly candy.

Viscosity

Different viscosity happened due to different protein content. The protein content will affect the level of collagen, the higher the amount of protein, the amount of collagen will increase. Collagen content depends on the type of animal. The commercial gelatin is made from cowhide,

which collagen content is higher than rabbit skin. This can be seen from the protein content of cowhide that is higher than protein content of rabbit skin. High collagen content is directly proportional to the levels of amino acids proline and hydroxyproline in gelatin which will ultimately contribute to gelatin viscosity (Suseno, 2013, Sugihartono, 2014).

Another factor that affects the viscosity of gelatin is the age of the livestock. The age of rabbits in this study was only 6 months hence the viscosity value of rabbit skin gelatin was lower than commercial gelatin. The age of livestock is one of the factors that affect the amount of collagen protein in animal skin. The older the animal, the more protein will increase (Putro *et al.*, 2019).

The high and low viscosity of gelatin can be caused by the ash content of gelatin. low ash content will produce high viscosity (Sasmitaloka *et al.*, 2017). The high ash content of rabbit skin gelatin is caused by its water-insoluble mineral content in the demineralization process. Suboptimal demineralization caused low gelatin viscosity (Wulandari *et al.*, 2013).

Ash Content

The ash content of rabbit skin gelatin is higher than commercial gelatin, this may occurred because the preparation of rabbit skin using a lime solution. A lime solution is used to remove rabbit fur from the skin. Incomplete leaching of lime solution can cause high ash content in gelatin, especially high calcium residues in gelatin. The ash content is matched with the SNI 06-3735-1995 quality standard with a maximum ash content of 3.25% and the GMIA standard with ash content ranged 0.3-2%. Ash content is an indicator of gelatin purity. The higher the ash content, the larger the gelatin impurities, while the lower the ash content, the higher the collagen purity (Amin, 2017). The purity of gelatin is affected by impurities from the raw material or in the gelatin manufacturing process. The presence of deposits produced on rabbit skin gelatin

is suspected as an impurity resulting in higher ash content. Kusnadi and Putri (2020) stated that raw materials that are not clean will increase ash content.

The high ash content is due to the presence of minerals bound to collagen in the washing process thus mineral impurities will also be extracted (Islam, 2018). In addition, the high and low ash content of gelatin is determined by washing or demineralization, the more minerals that dissolve in the washing process, the lower the ash content (Juliasti *et al.*, 2014). Sompie *et al.* (2012) stated that the ash content in gelatin indicates its mineral content.

Organoleptic Test

Difference test showed that 21 panelists stated different and 4 panelists stated the similar from 25 panelists. The color of jelly candy with rabbit skin gelatin is a cloudy white, while jelly candy with commercial gelatin is a clear white. The shape of the jelly candy with rabbit skin gelatin and commercial gelatin is bear-shaped since it is formed with a bear-shaped mold. The aroma of jelly candy with rabbit skin gelatin and commercial gelatin are distinctive with no addition of essence. The taste of jelly candy with rabbit skin gelatin and commercial gelatin are sweet and sour due to sucrose, glucose syrup, and citric acid in the manufacture of jelly candy.

The product differentiation is clarified with the difference in color between both jelly candies. The high ash content in rabbit skin gelatin affects the color difference. Rabbit skin gelatin has dark brownish-yellow and affects the color of jelly candy as its final product. The high mineral content in gelatin causes the color of the gelatin to become cloudy. Gelatin which is brownish-yellow in color affects the color of jelly candy (Arima and Fithriyah, 2015; Rahmawati and Pranoto, 2015).

The results showed that there was no significant difference ($P>0.05$) in texture between candy jelly with rabbit skin gelatin and commercial gelatin since the gel strength of gelatin from rabbit skin and

commercial gelatin was similar. The texture of the jelly candy is influenced by the gel strength of the gelling agent (Estherella *et al.*, 2018). Jelly candy has a chewy and elastic texture. The texture of the jelly candy with rabbit skin gelatin and commercial gelatin was acceptable to the panelists. The gelatin in jelly candy binds water, consequently, the texture will become chewy. Gelatin added in jelly candy can improve the texture, which is chewy and not too soft, and increase the preference of the panelists (Mufida *et al.*, 2020; Nelwan *et al.*, 2014).

There was no significant difference ($P>0.05$) in the taste of jelly candy. The taste of jelly candy is more influenced by the ingredients for making jelly candy such as sucrose, glucose syrup, and citric acid. Sucrose and glucose syrup are added to balance the sour taste in jelly candy (Simorangkir *et al.*, 2017; Fajarini *et al.*, 2018; Johan and Herawati, 2017). There was no significant difference ($P>0.05$) in the aroma between jelly candy with rabbit skin gelatin and commercial gelatin. Jelly candy has a caramelized aroma, fragrant aroma, and a slight aroma from the main ingredient in making jelly candy (Mansur, 2017). The addition of essence can affect organoleptic assessment and consumer acceptance therefore it can provide the aroma that consumers like (Mahardika *et al.*, 2014).

There was no significant difference ($P>0.05$) overall between jelly candy with rabbit skin gelatin and commercial gelatin. Overall acceptance is the key to determine whether a product is accepted or not thus it can help to understand the consumer's insight or preference (Parnanto *et al.*, 2016). In general, both are acceptable and liked by the panelists.

CONCLUSION

The gel strength of rabbit skin gelatin is the same as commercial gelatin but differs in viscosity and ash content. Jelly candy with rabbit skin gelatin and commercial gelatin can be distinguished by panelists, but

both jelly candies are still in the medium preferred level by panelists, only differ in color acceptance.

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