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Sensory and Physicochemical Attributes of Chocolate Soft Candy with Different Gelling Agents

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Abstract

Indonesia is one of the cocoa-producing countries. One of the final processed cocoa products is chocolate soft candy. In the production of soft candy, an additional gelling agent is required as a stabilizer of product texture. This study aims to determine the effect of different gelling agents on the sensory and physico-chemical characteristics of chocolate soft candy. The study employed a completely randomized design with one factor, involving several gelling agents, namely gelatin, carrageenan, and konjac, with the control being soft candy without any added gelling agent. The data represents an average of triplicate analyses. Soft candy is made by cooking, which involves melting glucose and sugar until the sugar caramelizes. During this cooking process, the gelling agent is added. Subsequently, cooking and stirring continue until the mixture thickens. The thick dough is then combined with melted dark chocolate while stirring. The resulting dough is poured and left at room temperature. To assess the quality of the soft candy, the observed quality parameters include texture, moisture content, ash content, reducing sugar levels, and sensory evaluation. The results indicate that the addition of various gelling agents significantly impacts the soft candy produced. The soft candy treatment with the highest moisture content, 12.26%, used gelatin. The lowest ash content, 0.71%, was found in the gelatin-added treatment, while the highest reducing sugar levels, 10.21%, were achieved with carrageenan. The best taste and texture parameters were obtained by adding konjac to the soft candy. In terms of physical parameters, all treatments met the requirements of Indonesian National Standard (SNI) 3547-2: 2008. The selected formulation for dark chocolate soft candy was the one with the addition of konjac.

Keywords: Chocolate, gelling agent, soft candy

INTRODUCTION

Soft candy is candy with a soft texture, processed with the addition of hydrocolloid components used to modify the texture, resulting in a chewy and molded product. It undergoes an aging process before being packaged (BSN, 2008). In general, the main components of soft candy include sweeteners, water, gelling agents (various hydrocolloids), stabilizers, fats, emulsifiers, coloring agents, flavorings, and antioxidants (Gunes *et al.*, 2022). da Silva *et al.* (2016) classified the hardness value of soft candy into the following categories: very soft (0.18–0.77 N), soft (4.08–15.43 N), hard (56.39 N), and very hard (171.09 N).

Indonesia is one of the world's largest cocoa-producing countries, with a total production reaching 732 thousand tonnes (Kementan, 2022). Among the various processed products derived from cocoa beans, chocolate soft candy stands out. Chocolate soft candy can be crafted from dark, milk, or white chocolate. Dark chocolate with its higher cocoa content, lower sugar content, and reduced saturated fat, contains higher levels of flavonoids and theobromine, making it notably beneficial compared to milk and white chocolate (Velciov *et al.*, 2021). Therefore, for this study, dark chocolate was selected as the primary ingredient for creating soft candy.

The production of soft candy necessitates the incorporation of hydrocolloids as gelling agents and stabilizers. Gelling agents play a pivotal role in shaping the appearance and texture of food products through their gel formation process. Common gelling agents include alginate acid, sodium alginate, carrageenan, agar, pectin, and gelatin. Understanding the distinctive characteristics of each gelling agent is of paramount importance, as it can significantly influence the physical and chemical quality of soft candy products. Additionally, each gelling agent imparts unique organoleptic properties to the final product.

Carrageenan is a compound extracted from seaweed in the Rhodophyceae family, such as *Eucheuma spinosum* and *Eucheuma cottonii*. Due to its biodegradability, carrageenan finds extensive use as a viscosity regulator, stabilizer, and thickening agent (Thakur & Thakur, 2016). Carrageenan is commonly used in dairy, meat and confectionery products as a gelling agent. The carrageenan content in food products is between 0.005 to 2% (Bartlová *et al.*, 2022). Carrageenan also has excellent developer, gelling, and stabilizing properties, so it is widely used in food manufacturing to improve texture (Campo *et al.*, 2009).

Gelatin is derived from the partial hydrolysis of collagen and exists as a soluble protein (Alipal *et al.*, 2019). The source of gelatin raw materials can come from animal skins, bones, and white fibrous tissue. For the food industry, gelatin can function as a stabilizer, thickener, emulsifier, jelly former, and water binder (Pelu *et al.*, 1998). Gelatin has many functions, including stabilizer, emulsifier, binding agent, thickening agent, edible film, and implant matrix material. In the food industry, gelatin is found in marshmallows, jelly, yogurt, and ice cream products. Meanwhile, gelatin makes hard and soft capsule shells in the pharmaceutical industry (Febriana *et al.*, 2021). Konjac, on the other hand, is a water-soluble food fiber derived from the tubers of the Amorphophallus plant. Its primary component is glucomannan, consisting of mannose and glucose linked by β–1,4 bonds. Konjac readily dissolves in both hot and cold water, forming a highly viscous solution (Sinurat & Murniyati, 2014).

Ramadani *et al.* (2020) developed ‘pedada’ fruit soft candy using carrageenan, while Sudaryati & Kardin (2013) developed soursop soft candy with gelatin. Research conducted by Ahmad & Mujdalipah (2017) revealed that panelists preferred sweet potato jelly candy made with carrageenan over gelatin. Other studies have shown that higher concentrations of carrageenan and konjac in jelly candy with ‘pegagan’ extract led to increased hardness and a decrease in organoleptic value (Dhina *et al.*, 2019). These findings emphasize the impact of the gelling agent on product quality. In this research, various gelling agents were employed to create chocolate soft candy. The objective of this study was to investigate the influence of the gelling agent type on the sensory and physicochemical characteristics of chocolate soft candy.

MATERIALS AND METHODS

Materials

The raw materials used in this experiment were dark chocolate (chocolate with high percentage of cocoa component, usually more than 60%), glucose syrup, granulated sugar, gelatine, kappa carrageenan, and konjac jelly powder.

Process of Making Soft Candy

The research was conducted in the food processing laboratory of the Research Center for Appropriate Technology, National Research and Innovation Agency, located in Subang, West Java, Indonesia. The first stage involved weighing all the ingredients and melting the dark chocolate, which served as the primary raw material. These ingredients included sugar (23.26%), glucose syrup (23.26%), dark chocolate (23.26%), water (23.26%), and a gelling agent (6.98%). The subsequent step consisted of the cooking process, where glucose and granulated sugar were dissolved in a ratio 1:1 using water until all the water had evaporated and the sugar had caramelized. In this cooking process, the gelling agent was added. The cooking and stirring continued until the water from the gelling agent solution completely evaporated, and the mixture thickened. The thickened sugar and gelling agent mixture were then added to the melted dark chocolate. The resulting dough was promptly poured into a plastic pan and allowed to cool at room temperature. Details of the additional gelling agent treatments can be found in Table 1.

Texture Analysis (da Silva *et al.*, 2016)

Texture measurements on chocolate soft candy were conducted using a texture analyzer (Stable Micro System, TA-XTplus). The type of penetration used in measuring the texture of this candy is the P2 type probe (2 mm cylinder probe). The P2 probe was attached to the texture analyzer, and the candy samples were placed on the testing table. The texture analyzer was operated via a connected computer. Measurements were taken at a pretest and posttest speed of 2.0 mm s^{-1}, a test speed of 2.0 mm s^{-1}, a trigger force of 0.05 N, and a penetration distance of 6.0 mm. The chocolate soft candy was cut into 1 cm x 1 cm x 1 cm dimensions. The reported results are averages of 10 replicates for each sample.

Moisture Content Analysis (SNI 3547.2-2008)

The empty cup was initially dried in an oven at 105 ^{0}C for 30 minutes and then placed in a desiccator for 20 minutes. The empty cup was initially dried in an oven at 105 ^{0}C for 30 minutes and then placed in a desiccator for 20 minutes. Subsequently, the cup was weighed (W0). This drying process was repeated until a constant weight of the cup was achieved. Next, 2 g of the sample were weighed into the cup (W1). The cup with the sample was then inserted into a vacuum oven at a pressure of 50 mmHg and a temperature of 70 ^{0}C for 6 hours. After heating, the cup containing the sample was carefully removed from the oven using cup tongs and placed in a desiccator for 20 minutes. The cup, along with the dry sample, was then weighed. The sample cup was returned to the vacuum oven and dried until a constant weight (W2) was reached. The following formula was used to calculate the water content:

Table 1. Treatment of the addition of the type of gelling agent

Treatment	Information
A	Glucose syrup (control)
B	Glucose syrup + Gelatin 7%
C	Glucose syrup + Carrageenan 7%
D	Glucose syrup + Konjac 7%

Moisture content =

$$\frac{W1-W2}{W1-W0} \times 100\% \quad ....(1)$$

Ash Content Analysis

Ash content was evaluated by following SNI 3547.2-2008. The porcelain cup was heated in the oven at 105 ^{0}C ± 20 ^{0}C for approximately one hour. Afterward, the cup was placed in a desiccator for 30 minutes, then weighed using an analytical balance (W0). Next, 2 g of the sample was added to the cup and measured its weight (W1). The cup containing the sample was then placed in the oven at 105 ^{0}C ± 20 ^{0}C until all moisture (H_2O) had evaporated. Then, a few drops of pure olive oil was added and the sample was heated over a flame until no further development occurred. The cup with the sample was placed into the furnace at 550 ^{0}C until white ash is formed. The cup containing the sample was transferred into the desiccator for 30 minutes, then weighed again (W2). The ash content was calculated using the following formula:

Ash content =

$$\frac{W1-W2}{W1-W0} \times 100\% \quad .... (2)$$

Analysis of Reducing Sugar Levels

Approximately 2 g of the sample was weighed and placed into a 250 mL volumetric flask. A small amount of distilled water was added and shook in the flask. Then, 5 mL of half-alkaline Pb-acetate was added and the solution was stirred. The solution was then allowed it to settle. A single drop of 10% $(NH_4)_2HPO_4$ solution was added resulted in teh appearance of white precipitate Then, 15 mL of $(NH_4)_2HPO_4$ solution was added. If adding a drop of $(NH_4)_2HPO_4$ solution did not produce a white precipitate, it meant that the addition of 10% $(NH_4)_2$ HPO_4 was adequate. The solution was added with distilled water up to the marked line on the volumetric flask, stirred, and then filtered. Pipetted 10 mL of the filtered solution was placed into a 500 mL erlenmeyer flask. It was added with 15 mL of distilled water and 25 mL of Luff Schoorl solution. The erlenmeyer flask was then connected to a condenser and heated on an electric heater. The heating was done for 10 minutes after it started boiling, then immediately cooled in a water bath. After cooling, 10 mL of 20% KI solution was added into the erlenmeyer flask, followed by 25 mL of 25% H_2SO_4 solution. Titration was done using 0.1 N thiosulfate solution and 0.5% starch indicator (V1). The same procedure was carried out to determine the blank, using 25 mL of distilled water and 25 mL of Luff Schoorl solution (V2). The reducing sugar level was calculated using the following formula:

Reducing sugar =

$$\frac{W1 \times fp}{W} \times 100\% \quad .... (3)$$

where: w_1 = glucose weight; fp = dilution factor; w = sample weight

Sensory Evaluation

The sensory evaluation of chocolate soft candy was conducted using the hedonic test method, specifically a preference test carried out by a panel of 38 semi-trained panelists. The evaluation included various parameters such as color, taste, texture, and aroma. One of the advantages of the hedonic test is its fast and suitability for a variety of samples. The panelists were composed of researchers and technicians specializing in the fields of food and post-harvest technology at the Research Center for Appropriate Technology, all of whom possessed knowledge of food. The observation parameters were based on preference levels, rated on a scale of 1-5, where (1) represented ‘very much dislike,’ (2) ‘dislike,’ (3) ‘fair,’ (4) ‘like,’ and (5) ‘like very much.’”

Statistical Analysis

The experimental design used in this study was a completely randomized design (CRD) with one factor, namely using several types of gelling agents (gelatin, carrageenan, and konjac). The data represents an average of triplicate analyses. These data were analyzed using ANOVA, followed by the DMRT (Duncan's multiple range test), with a significance level of 5% and PCA (principal component analysis).

RESULTS AND DISCUSSION

Physical Properties

Two parameters for the physical measurement of soft candy were examined in this study: hardness and stickiness. Generally, hardness is defined as the force required to compress a material to a specified degree (Di Monaco *et al.*, 2008), while stickiness, also known as adhesiveness, refers to the force required to overcome the attractive force between the surface of the sample and the material (probe) in contact with the product (Szczesniak, 2002). The results of the texture measurements for chocolate soft candy are presented in Figure 1 and Figure 2.

The results of DMRT indicated significant differences among the treatments in terms of the texture attributes, specifically hardness and stickiness, of dark chocolate soft candy. Notably, the treatment involving the addition of carrageenan to the soft candy, along with the control group, exhibited the highest hardness values compared to the other treatments, measuring 1010 and 1013 gf, respectively. The elevated hardness in the carrageenan-treated group can be attributed to the unique properties of carrageenan, which contribute to the candy's firmness. Basuki *et al.* (2014) supported this observation by demonstrating that carrageenan enhances the texture of soft candy, with kappa carrageenan yielding the most robust gel properties (Fardhyanti & Julianur, 2015). As a result, the candy produced with carrageenan is notably firmer than those produced using other treatments.

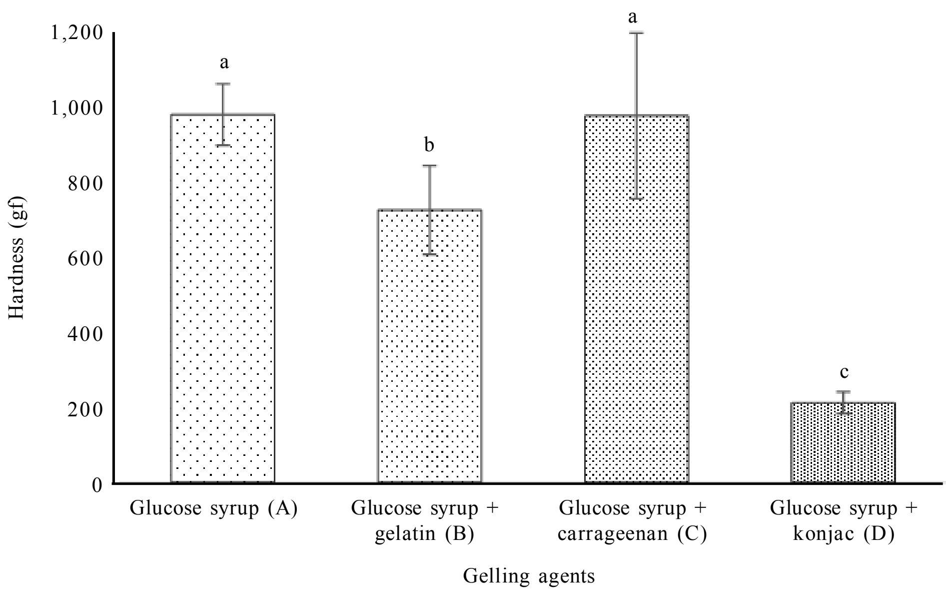

Figure 1. Hardness analysis of soft candy; Similar subscript indicates the samples are not significantly different at a 95% confidence level

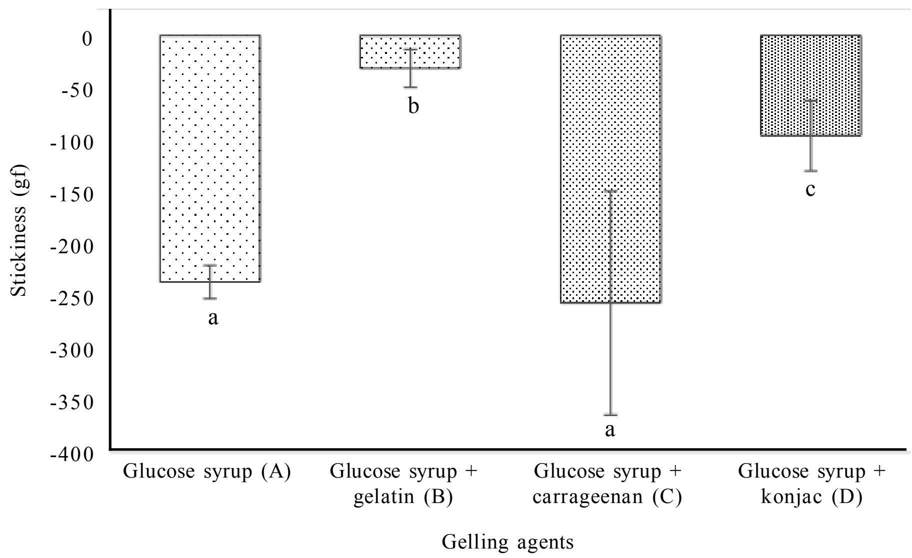

Figure 2. Stickiness analysis of soft candy; Similar subscript indicates the samples are not significantly different at a 95% confidence level

The hardness value of soft candy with the addition of konjac exhibited the lowest value, measuring 219 gf. In contrast, the hardness value for the gelatin-added treatment was significantly higher at 751 gf. The inability of konjac to form a gel is attributed to the presence of acetyl groups, which hinder the interaction of glucomannan chains. Nevertheless, konjac can achieve gelation when heated to 85 ^{0}C under alkaline conditions, as demonstrated by Kaya *et al.* (2015). This gelation leads to reduced pressure on the probe when testing the soft candy's texture. Research conducted by Anggreana *et al.* (2019) revealed that the hardness of black grape juice jelly candy falls within the range of 201 to 561 gf. Notably, a lower quantity of konjac added results in a more liquid or softer gel formation. Hutami *et al.* (2019) found that the hardness value of Cilembu sweet potato jelly candy, when incorporating carrageenan, ranges from 695 to 1261 gf. In other food products, research by Indrianti *et al.* (2013) indicated that noodles made from corn flour with substitute ingredients such as canna starch, tapioca, and mocaf exhibited hardness levels ranging from 2773 to 3588 gf.

The stickiness test for candy is employed to determine how long soft candy remains in the mouth when chewed. Stickiness value is calculated as the magnitude of the sample's tensile force in the opposite direction of the probe force as the texture analyzer withdraws the force, resulting in a negative sign (Sinurat & Murniyati, 2014). Among the soft candy samples, those with the addition of carrageenan and the control exhibited the highest stickiness values, measuring -257 and -237 gf, respectively. This stickiness value differs from the findings of Kusumaningrum *et al.* (2016), who created pumpkin jelly candy with carrageenan-konjac additives, recording a stickiness value of 98.78 gf. In contrast, corn noodle products prepared with substitutes such as canna starch, tapioca, and mocaf displayed stickiness values ranging from -16.8 to -37.1 gf (Indrianti *et al.*, 2013). Kusumaningrum *et al.* (2016) noted that the stickiness of candy increases with a harder texture. The more negative value obtained in the stickiness test, the stickier the candy correlating with the duration of candy retention during chewing. In the case of dark chocolate soft candy, three treatment groups, namely those with carrageenan addition, konjac addition, and no gelling agent addition, demonstrated that the candy remained in the mouth for approximately a few minutes longer during chewing compared to the dark chocolate soft candy with added gelatin.

Chemical Properties

The results of the analysis of the moisture content of the soft candy can be seen in Figure 3. The results of the water content test for the control treatment, the addition of the gelling agent gelatin, carrageenan, and konjac, were 5.08, 12.27, 6.59, and 6.13 percent, respectively. Further tests using Duncan's multiple range test showed that each treatment with a gelling agent had significantly different results. The soft candy with the highest moisture content resulted from the addition of gelatin. The variation in water content of the soft candy resulting from the addition of different gelling agents is attributed to the distinct properties and characteristics of each gelling agent. The soft candy's moisture content reached 12.27% with the addition of gelatin, primarily due to gelatin's superior water-absorbing properties compared to carrageenan and konjac. Connective tissue (collagen) can enhance water-binding capacity when used in food product formulations. This increase in water-binding capacity is the result of the proteins in gelatin binding to water molecules (Lenzun *et al.,* 2021). Lees & Jackson (1995) stated that heating gelatin at temperatures above 70 ^{0}C causes the dissolution of gelatin, as the molecular aggregates and liquid components that were initially free become trapped. Consequently, the gelatin solution thickens, causing water to be bound within the aggregate of gelatin molecules. Soft candy with carrageenan and konjac exhibits lower water absorption properties compared to gelatin. This is evident from the sugar mixture, which, after caramelization, is diluted with carrageenan and konjac solutions.

Figure 4 displays the results of the ash content analysis of soft candy. Subsequent DMRT follow-up tests revealed differences in the ash content of dark chocolate soft candy

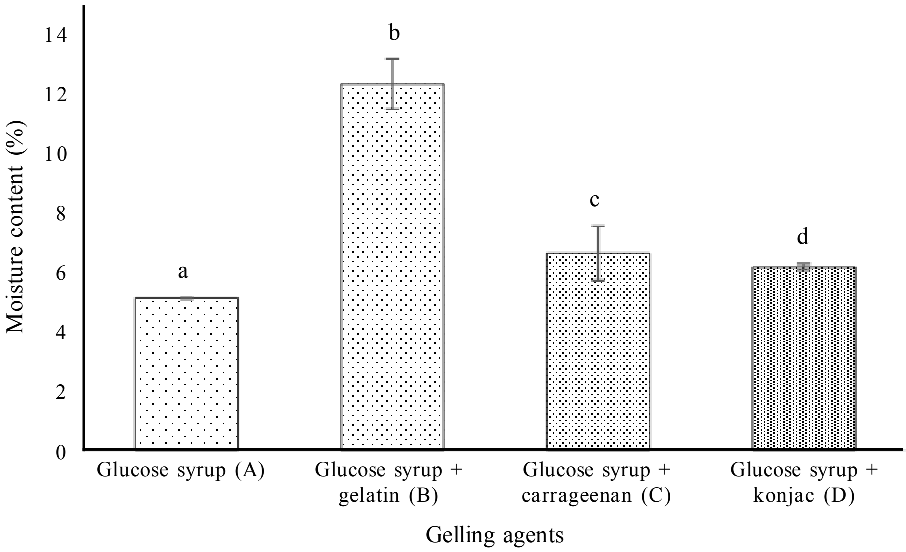

Figure 3. Moisture content analysis of soft candy; Similar subscript indicates the samples are not significantly different at a 95% confidence level

among treatments involving gelling agents. The control treatment and the addition of gelatin exhibited the lowest ash content, while the other two treatments showed higher ash content. Nelwan *et al.* (2015), in his research, reported that the ash content of soft candy with the addition of gelatin could decrease due to ion exchange, leading to a reduction in mineral content in gelatin, resulting in a lower ash content. The highest ash content was observed in the soft candy treatment with added carrageenan, as carrageenan also contains mineral content.

Research conducted by Diharmi *et al.* (2011) reported that carrageenan extracted from seaweed contains 26.3% ash. The substantial mineral content in carrageenan results in soft candy with added carrageenan having a high ash content. Total ash content is a proximate analysis used to determine the nutritional value of a food ingredient and to quantify the total minerals present, some of which can be toxic (Pangestuti & Darmawan, 2021). Assessing ash content is also closely linked to the purity and cleanliness of the final product. Higher ash content indicates lower food quality. The ash content from all treatments meets the quality standards for soft candy (BSN, 2008), which stipulate a maximum of 3%.

Reducing sugars are sugars that possess free aldehyde and ketone groups. Consequently, reducing sugars have the ability to reduce electron-accepting compounds, such as glucose and fructose. The results of the analysis of reducing sugars in soft candy are presented in Figure 5. The DMRT results indicated that each treatment had a significantly distinct impact on the reducing sugar content of dark chocolate soft candy. The control treatment yielded the highest level of reduced sugar content. This high sugar content is attributed to the fact that the sugar present in the dough does not diminish, but with the addition of a gelling agent, the sugar becomes absorbed. Therefore, the reduced sugar content in the soft candy with the addition of konjac and gelatin was less than the control. While the treatment of adding carrageenan to soft candy, the reduced sugar

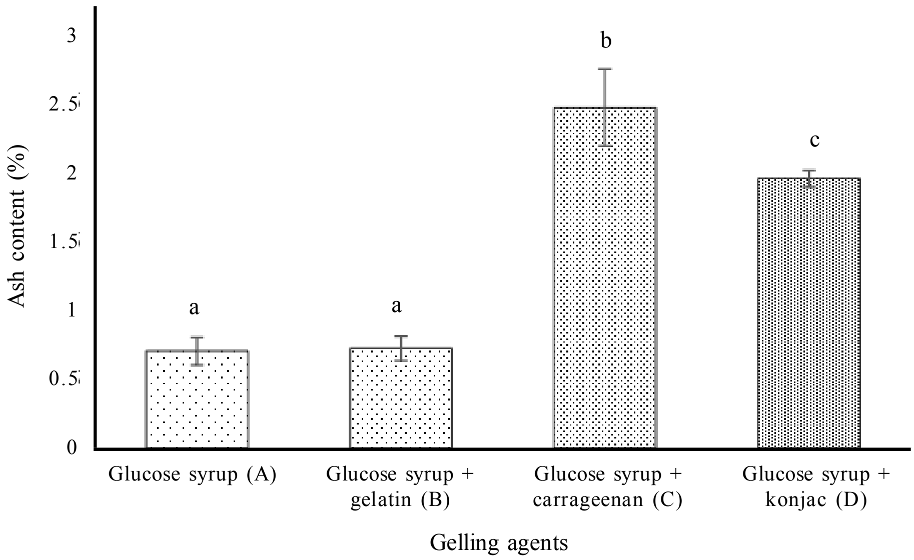

Figure 4. Ash content analysis of soft candy; Similar letter on the bar indicates the samples are not significantly different at a 95% confidence level

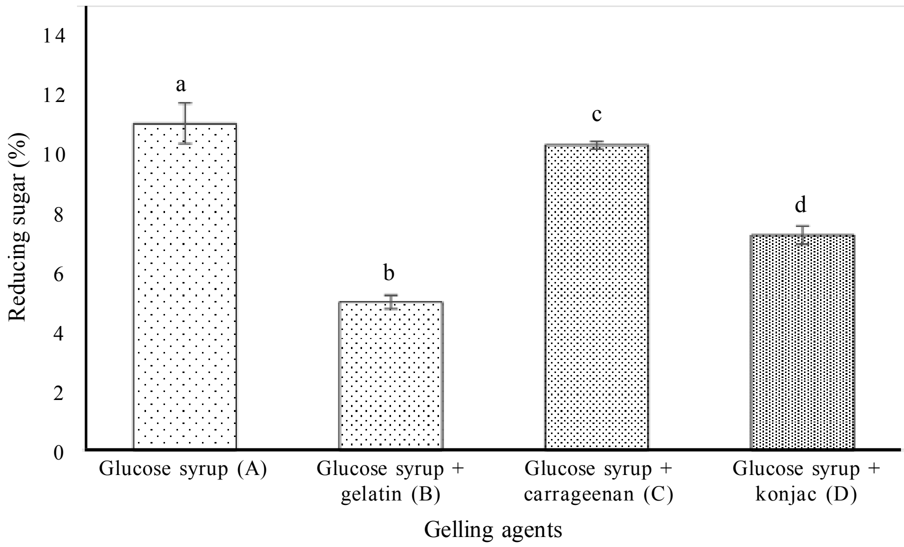

Figure 5. Reducing sugar levels analysis of soft candy; Similar letter on the bar indicates the samples are not significantly different at a 95% confidence level

content was almost the same as the control treatment because, in the structure of carrageenan, there is a galactan molecule with its central units, namely galactose which belongs to the group of reducing sugars containing reactive hydroxyl groups (Basuki *et al.*, 2014). Reducing sugars are essential macronutrients for the body since they serve as a source of calories and nutrients (Ngginak *et al*., 2020). The level of reducing sugar content also plays a crucial role in the browning process. The brownish color of soft candy results from the Maillard browning reaction and caramelization, which produces melanoidin pigments (brown pigments). An incomplete browning reaction leads to a color that is too pale (Wilberta *et al*., 2021).

Table 2 demonstrates that all treatments meet the water content, ash content, and reducing sugar content standards outlined in the Indonesian National Standard (SNI 3547.2-2008). Soft candy with the addition of carrageenan, konjac and control group yields a chewy end product with a texture that significantly differs from jelly candy. Furthermore, these variations in texture result in a longer-lasting experience when consumed.

Sensory Evaluation

The sensory evaluation carried out on soft candy is a hedonic test. The results of the sensory evaluation are presented in Table 3. Soft candy with the addition of gelatin has the highest color preference value. Moreover, soft candy with the addition of gelatin exhibited a notably distinct color compared to the other treatments. It had a clear brown hue, whereas the other treatments had a slightly darker brown color. The clear brown color observed in the gelatin-infused soft candy can be attributed to the primary ingredient used in making gelatin. According to Pelu *et al.* (1998), gelatin is a type of modified protein derived through the hydrolysis process of collagen found in skin, bones, and white fibrous tissue. This collagen type is a fibrous protein with a clear yellowish appearance and high clarity value.

Soft candy with the addition of konjac has the highest taste preference value. Adding konjac to soft candy does not alter the taste of the candy itself, as konjac is a glucomannan found in porang (*Amorphophallus muelleri*) tubers. Therefore, the taste of soft candy is

Table 2. Comparison of the results of analysis of soft candy with SNI 3547.2-2008

Treatment	Parameter	Analysis results (%)	SNI 3547.2-2008 (%)
Control	- Moisture content	5.08±0.02	Max. 20.0
	- Ash content	0.70±0.10	Max. 3.0
	- Reducing sugar	10.95±0.69	Max. 25.0
Gelatin	- Moisture content	12.27±0.84	Max. 20.0
	- Reducing sugar	0,72±0.09	Max. 3.0
	- Ash content	4.96±0.23	Max. 25.0
Carrageenan	- Moisture content	6.59±0.92	Max. 20.0
	- Ash content	2.45±0.28	Max. 3.0
	- Reducing sugar	10.22±0.13	Max. 25.0
Konjac	- Moisture content	6.13±0.11	Max. 20.0
	- Ash content	1.94±0.06	Max. 3.0
	- Reducing sugar	7.20±0.30	Max. 25.0

Table 3. Physical and sensory evaluation of soft candy

	Color	Aroma	Texture	Taste
Control	2.87±0.66 a	2.79±0.70 a	2.47±0.56 ab	2.61±0.59 a
Gelatin	3.24±0.85 b	2.26±0.64 b	2.00±0.46 c	1.89±0.56 b
Carrageenan	2.95±0.70 ab	2.66±0.67 a	2.37±0.67 b	2.18±0.56 b
Konjac	3.03±0.75 ab	2.71±0.65 a	2.68±0.66 a	3.08±0.82 c

Notes: (1) represented 'very much dislike,' (2) 'dislike,' (3) 'fair,' (4) 'like,' and (5) 'like very much.'

primarily determined by its main ingredients, namely chocolate and sugar (Putra & Sulandri, 2013).

Texture is a physical parameter that can be subjectively evaluated using the human senses or objectively measured using tools. The soft candy produced in each treatment exhibited varying textures, with the konjac-added soft candy receiving the highest preference for texture. This indicates that the konjac-added treatment was the most favored. The treatment involving carrageenan had a lower texture parameter preference value compared to konjac, likely due to the kappa type of carrageenan used. However, it is worth noting that Peranginangin *et al*. (2013) mentioned that kappa carrageenan has the ability to form solid and dense gels, which can result in the soft candy with carrageenan having a rough texture.

Soft candy with various treatments exhibits a distinctive chocolate aroma, primarily due to dark chocolate being the main ingredient in candy production. All soft candy treatments have almost the same aroma value. However, the highest value of aroma was obtained by the control treatment. In comparison, the addition of gelatin treatment has the lowest aroma score. Based on the hedonic or panelist preference test, it is evident that jelly soft candy with the addition of konjac outperforms other treatments in taste, texture, and color parameters. Therefore, it is recommended for the production of chocolate soft candy.

Principal Component Analysis

PCA data processing results indicate that three components were formed. PC 1 proportion for 63.20%, and PC 2 for 27.10% of the variance (see Table 4). The PCA analysis results in Figure 6 demonstrate that the three types of gelling agent treatments are distributed across three quadrants. According to the score plot, both the control treatment and the carrageenan addition treatment are placed in the same quadrant, suggesting that soft candy treated with glucose syrup and soft candy treated with glucose syrup + carrageenan share similar physicochemical properties.

In Figure 7, it is evident that the reducing sugar parameter has a positive correlation with hardness. This implies that the lower

Table 4. Eigenanalysis of the correlation matrix

Variable	Eigenvalue	Proportion (%)	Cumulative (%)
PC1	5.69	63.20	63.20
PC2	2.44	27.10	90.30
PC3	0.87	9.70	100.00

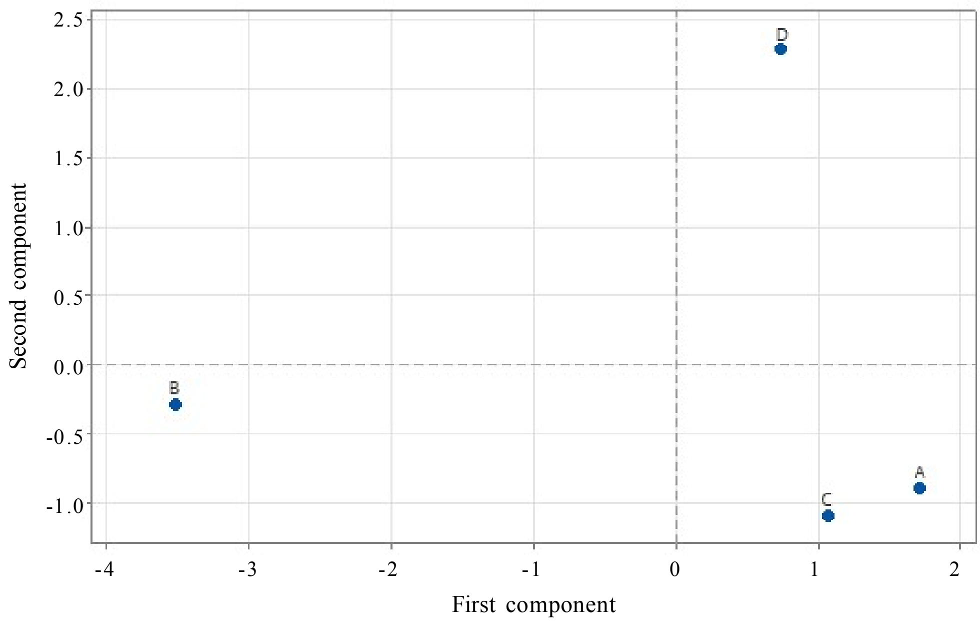

Figure 6. Score plot PCA chocolate soft candy (A = Glucose syrup; B = Glucose syrup + gelatin; C = Glucose syrup + carrageenan; and D = Glucose syrup + konjac)

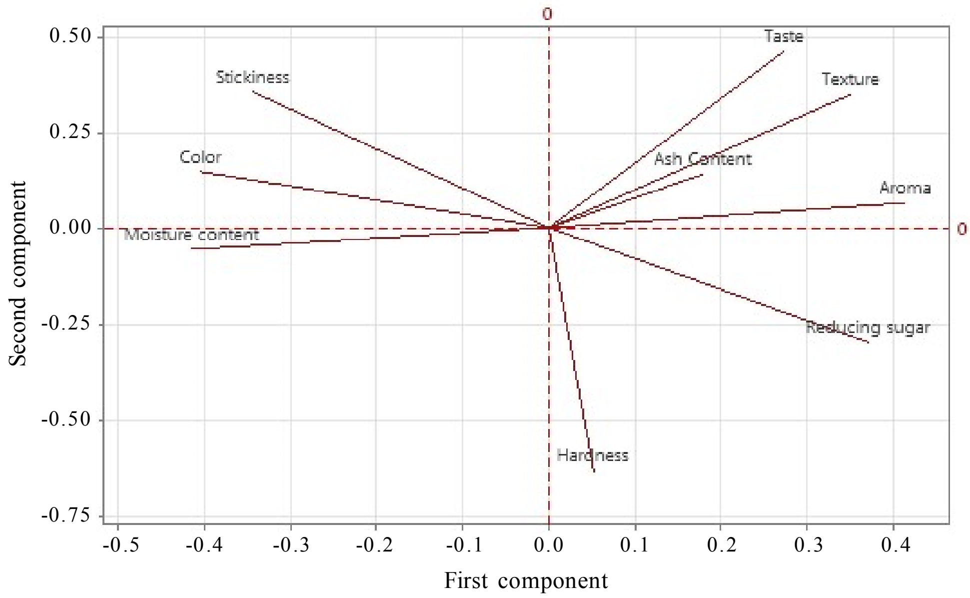

Figure 7. Loading plot PCA chocolate soft candy

the reducing sugar content, the firmer the soft candy becomes. Moreover, reducing sugar and hardness parameters exhibit negative correlations with stickiness and color parameters. On the other hand, sensory parameters such as color, aroma, and taste do not display any relationship with chemical parameters such as ash content, reducing sugar content, hardness, and stickiness. In this study, it appears that consumer perception is not significantly influenced by the physical and chemical characteristics of the soft candy. Only the water content parameter demonstrates a negative relationship with the sensory parameters of aroma, taste, and texture.

For future research, it is recommended to explore various concentrations of each type of gelling agent and consider the addition of aroma-producing ingredients to enhance panelists' preferences. Additionally, conducting microbial and shelf-life tests on chocolate soft candy is necessary.

CONCLUSIONS

The results showed that the addition of gelatin and konjac had a significantly different impact on the hardness and stickiness of the soft jelly candy compared to the control treatment. In contrast, the addition of carrageenan did not have a significant effect. The inclusion of gelatin and konjac contributed to a reduction in the hardness and stickiness of the soft candies. Furthermore, the addition of a gelling agent significantly increased the water content of the soft candy, with gelatin resulting in the highest water content. Carrageenan and konjac additions led to a significant increase in ash content, while gelatin did not significantly affect the ash content. The reducing sugar content of the soft candy decreased significantly with the addition of a gelling agent compared to the control. In general, the inclusion of gelling agents affected the sensory quality of chocolate soft candy in comparison to the control. The addition of konjac significantly improved consumer acceptance of the taste parameter, and it also increased the acceptance score for texture, though the increase was not statistically significant. The highest hedonic test score for color parameters was obtained from chocolate soft candy with the addition of gelatin. On the other hand, the inclusion of a gelling agent had a negative impact on the organoleptic acceptance score of soft candy in terms of aroma. PCA results revealed that sensory properties like taste, texture, and aroma were correlated with water and ash content but not with the reduced sugar content of soft candy. Based on the findings of this research, the treatment involving the addition of konjac had the highest value of taste and texture.

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