

Sensory Properties of Dadih Jelly Candy with The Addition of *Clitoria Ternatea* Flower Extract

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ABSTRACT

An essential aspect of food product development is the sensory evaluation of product characteristics to test consumer acceptance. Characteristic properties, such as color, texture, flavor, and aroma, significantly affect the perception and acceptance of consumers. This study aimed to determine the effect of adding various concentrations of *Clitoria ternatea* flower (CTF) extract to dadih jelly candy on the physical properties of color and sensory properties, especially on quality characteristics and levels of consumer acceptance, using a hedonic test. This study used an experimental randomized block design divided into five treatments with the addition of CTF extract at concentrations of 0%, 0.5%, 1%, 1.5%, and 2%. The results showed that the CTF extract had a significant effect on the level of brightness (L^*), the hedonic quality of color, and the hedonic color test, but had no significant effect on the value of a^* (redness), b^* (yellowness), and the hedonic quality and hedonic test of texture, flavor, and aroma of dadih jelly candy. The addition of 0.5% CTF extract was characteristic of dadih jelly candy that the panelists liked the most. It has a slightly soft texture, slightly sweet flavor, slightly dadih aroma, and high brightness.

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Introduction

Confectionery products have the main characteristics of flavor, aroma, texture, and attractive appearance; thus, they have a wide market share and can be accepted by all consumer categories. One type of confectionery commonly found is soft confectionery products, including jelly candy. Jelly candies, such as jellybeans and gummy bears, consist of a gelling agent (starch, pectin, or gelatin) with a relatively high sugar syrup and moisture content (Lungade et al., 2022). Based on the hardness level, soft candy can be divided into several categories: very hard, hard, soft, and very soft (Silva et al., 2016).

This confectionery product can quickly replace lost energy, but contains high sugar and low nutritional value, such as vitamins and minerals (Tamer, 2013). However, the current consumption trend is moving towards healthy foods that contain good nutrients and have health benefits. Many studies have improved the quality of jelly candy, such as by adding *Garcinia atrovividis* (Renaldi et al., 2022), fruit pulps (de Avelar & Efraim, 2020), red pitaya

(Hani et al., 2015), and substituting the type of sweetener with stevia (Samakradhamrongthai & Jannu, 2021), and honey (Mutlu et al., 2018) in an effort to reduce the high sugar content of jelly candy. Improving the quality of jelly candy can be achieved by adding food ingredients with functional properties that have a positive effect on the health of the body.

One of the traditional functional foods in Indonesia is Dadih, which is made from milk. Dadih comes from fermented buffalo milk products and has a yellowish-white color, soft texture, and a specific aroma typical of sour milk and contains high nutrition (Sisriyenni & Zurriyati, 2004). Buffalo milk is known to contain lactic acid bacteria, such as *Lactobacillus fermentum* L23, *Lactobacillus fermentum* 6704, and *Lactobacillus oris* strain J-1, which have antimicrobial properties against *Listeria monocytogenes* (Melia et al., 2017). Dadih has a protein content of 7.96% and a fat content of 5.53% (Putri et al., 2021). Unfortunately, the use of dadih is still limited, because it can only be found in West Sumatra. In addition, the use of natural

dyes can improve the appearance of the resulting product. *Clitoria ternatea* is a plant commonly used as a natural dye because it gives a blue color, which indicates the presence of anthocyanin pigments (Suebkhampet & Sotthibandhu, 2012). Another functional property of *Clitoria ternatea* flower (CTF) extract is that it has antimicrobial compounds that can inhibit growth of *Staphylococcus Aureus*, *Streptococcus faecalis*, *Salmonella enterica* serovar typhi, and *Escherichia coli* (Ezzudin & Rabeta, 2018).

In terms of product development in the industry, meeting consumer expectations for product acceptance is the main priority in addition to the added value of the product's functional properties for health. An important aspect of product development is sensory evaluation by conducting consumer tests to determine consumer acceptance of the product's characteristics (Lawless & Heymann, 2010). Hedonic testing is a way to obtain customer preferences based on the product's sensory attributes (flavor, texture, aroma, and color). In addition, hedonic testing can provide implicit assessment results, such as associations between sensory attributes, so that the best characteristics are known. Therefore, the purpose of this study was to evaluate the physical properties of color and sensory properties of the quality characteristics and acceptance level of dadih jelly candy with the addition of various concentrations of *Clitoria ternatea* flower (CTF) extract.

Method

In this study, jelly candy production used dadih as a raw material (derived from Bukit Tinggi, West Sumatra, Indonesia), and *Clitoria ternatea* flowers (CTF) as natural dyes. This study used an experimental randomized block design, which was divided into five treatments and four replications, with the addition of *Clitoria ternatea* flower (CTF) extract at concentrations of 0%, 0.5%, 1%, 1.5%, and 2%. This research was conducted at the Animal Products Technology Laboratory of Andalas University

Research Stages

Extraction of *Clitoria ternatea* flower (CTF)

Clitoria ternatea powder was obtained by drying the CTF for 1 hour at 60°C, then crushed and sieved to obtain a fine powder. As much as 250 g of *Clitoria ternatea* powder was macerated for 24 h using an ethanol solvent (70%) until the powder was completely submerged. The maceration results were then concentrated using a rotary evaporator at a temperature of 50°C for 30 min to obtain an extract of CTF paste.

Production of Jelly Candy

1 g of citric acid and 62.5 mL of distilled water were mixed with 200 mL of high-fructose syrup and then heated until a temperature of 90°C was reached.

Beef bone gelatin (60 g) was then added and stirred until a thick solution was obtained. The candy solution that had formed was then added with the CTF extract (0-2%) according to the treatment in this study. In the last stage, the candy solution with the CTF extract was poured into candy molds and cooled for 48 hours at 0-5°C.

Color measurement

The color test was carried out based on Mir et al. (2023) method using a colorimeter (Hunter Lab Color Flex EZ). The test was carried out using Hunter codes L*, a*, and b*, where L* indicates brightness, a* is a redness value, and b* is a yellowness value.

Sensory evaluation

In this study, a sensory evaluation was carried out based on the method of Lawless & Heymann, (2010), using affective testing with hedonic quality and a hedonic preference test. The sensory evaluation used 50 semi-trained panelists from Andalas University animal husbandry students to assess 20 samples from five treatments with four replications.

The hedonic quality test uses a value on a scale of 1-7 to describe the level of the specific impression of the character that can be detected. Sensory level assessment of texture, flavor, aroma, and color was performed by assigning values in the range of 1-7 hedonic scales as follows: textural attributes (very coarse-very soft), flavor (very sour – very sweet), aroma (strong dadih like aroma – very odorless), and color (very light – very dark). The preference test used a 7-point hedonic scale with a score of 1 (very dislike), 2 (considerably dislike), 3 (slightly dislike), 4 (not like, no dislike), 5 (slightly like), 6 (considerably like), and 7 (very like) for texture, flavor, aroma, and color attributes.

Data analysis

The mean and standard deviation were calculated for all measurements. All statistical tests were performed using SPSS for Windows, version 16 (IBM Corp., USA). Statistically significant differences were determined using ANOVA and Duncan's multiple range test.

Results

Color of Dadih jelly candy (L*, a*, b*)

The mean values of L*, a*, and b* dadih jelly candy with the addition of the CTF extract are shown in Table 1. The brightness value (L*) of the dadih jelly candy with the addition of CTF extract ranged from 57.80 to 66.86. Based on the results of statistical analysis, it was found that the addition of CTF to dadih jelly candy had a significant effect (P<0.05) on the level of brightness, where the lowest L* value was found in samples with 2% CTF extract, with a score of 57.80, and the highest was

in the control sample (without the addition of CTF extract), with a score of 66.86.

Table 1. L*, a*, and b* value of Dadih jelly candy

Concentration of CTF extract (%)	L*	a*	b*
0	66.86 ± 1.20 ^e	1.15 ± 0.50	23.36 ± 2.56
0.5	63.77 ± 1.21 ^d	1.32 ± 0.46	23.37 ± 1.27
1	61.24 ± 1.55 ^c	1.82 ± 0.86	23.92 ± 0.66
1.5	59.25 ± 0.58 ^b	1.33 ± 0.26	24.32 ± 1.44
2	57.80 ± 1.40 ^a	1.50 ± 0.32	24.02 ± 1.39

Note: Different superscripts for each treatment showed a significantly different effect (P < 0.05)

The addition of the CTF extract did not result in a significant difference (P > 0.05) in the redness (a*) and yellowness (b*) values of the dadih jelly candy. The a* and b* values of dadih jelly candy ranged from 1.15 to 1.82 and 23.36 to 24.32 respectively. The color differences of different CTF concentrations in dadih jelly candy are shown in Figure 1.



(a) (b) (c) (d) (e)

Figure 1. Dadih jelly candy with various additions of CTF concentration: (a) 0%, (b) 0.5%, (c) 1%, (d) 1.5%, (e) 2%

Quality Hedonic of Dadih jelly candy

The results showed that the addition of CTF extract to the hedonic quality of dadih jelly candy only had a significant effect (P < 0.05) on the color attribute, with an average value ranging from 2.26 to 4.02 (Table 2). These results indicate that a higher concentration of CTF extract results in a darker color of the dadih jelly candy, which is indicated by the higher hedonic quality value.

Table 2. Sensory hedonic quality of Dadih jelly candy

Concentration of CTF extract (%)	Texture	Flavor	Aroma	Color
0	5.36 ± 1.35	4.60 ± 1.31	2.84 ± 1.15	2.26 ± 0.96 ^a
0.5	5.56 ± 1.16	4.60 ± 1.33	3.00 ± 1.01	2.38 ± 0.90 ^a
1	5.58 ± 0.93	4.60 ± 1.57	2.72 ± 0.93	3.16 ± 1.06 ^b
1.5	5.48 ± 1.15	4.62 ± 1.67	2.72 ± 1.18	3.54 ± 1.34 ^c
2	5.42 ± 1.37	4.88 ± 1.73	2.48 ± 1.37	4.02 ± 1.39 ^d

Note: Different superscripts for each treatment showed a significantly different effect (P < 0.05)

The hedonic quality of the dadih jelly candy texture in each treatment was classified as slightly soft, with an average value ranging from 5.36 to 5.58. Regarding the flavor attribute, dadih jelly candy belongs to the neutral category and tends to have a slightly sweet flavor, with an average value ranging from 4.60 to 4.88. The aroma attribute showed that the dadih jelly candy had a specific dadih smell to a slightly dadih-like aroma, with an average value ranging from 2.48 to 3.00.

Sensory evaluation of Dadih jelly candy

The hedonic sensory evaluations are shown in Table 3, which shows that the addition of CTF extract only had a significant effect (P < 0.05) on the color attribute, with no significant effect (P > 0.05) on the texture, flavor, and aroma attributes of the dadih jelly candy.

Table 3. Sensory properties of Dadih jelly candy

Concentration of CTF extract (%)	Texture	Flavor	Aroma	Color
0	5.20 ± 1.31	5.40 ± 1.26	5.02 ± 1.34	5.78 ± 0.93 ^c
0.5	5.28 ± 1.13	5.44 ± 1.30	5.04 ± 1.12	5.92 ± 0.90 ^c
1	5.30 ± 1.07	5.32 ± 1.33	5.14 ± 1.25	5.12 ± 1.17 ^b
1.5	5.24 ± 1.13	5.08 ± 1.43	5.26 ± 1.39	4.80 ± 1.28 ^{ab}
2	5.14 ± 1.23	5.02 ± 1.56	5.22 ± 1.53	4.40 ± 1.55 ^a

Note: Different superscripts for each treatment showed a significantly different effect (P < 0.05)

The average values of the texture, flavor, and aroma attributes ranged from 5.14 to 5.30, 5.02 to 5.44, and 5.02 to 5.26, respectively, with slightly like categories for these three attributes. Meanwhile, the color attribute has an average value ranging from 4.40 to 5.92, and the category ranges from not like to dislike to slightly like. The addition of 0 and 0.5% CTF extract was significantly different (P < 0.05) from the addition of 1, 1.5, and 2% CTF extract.

Discussion

The color change in the dadih jelly candy is due to the anthocyanin content in the CTF extract, which functions as a colorant. This can be seen in the color test using a colorimeter, where the brightness level decreased with higher concentrations of the CTF extract. The control sample had the highest L* value and the addition of the CTF extract at the highest concentration (2%) had the lowest L* value (Table 1). A higher L* value indicates a higher brightness level. These results are consistent with the hedonic quality test of the color characteristics of jelly candy. The panelists gave a higher response value as the addition of the CTF extract showed that the jelly candy had a darker color.

Clitoria ternatea is an edible flower that is a rich source of anthocyanins and has a bright blue color that comes from 'ternatin.' This compound plays a role in providing blue color as a natural dye (Netravati et al., 2022). In addition to ternatin, *Clitoria ternatea* also contains other bioactive compounds such as delphinidin-3-glucoside, kaempferol, catechin, and quercetin (Chayaratanasin et al., 2019). Similarly, (Chusak et al., 2019) reported that cooked rice has a darker color with a higher addition of the CTF extract. Interestingly, the CTF extract did not show a difference in the value of b^* between the control sample and the sample treated with CTF extract. The b^* value indicates the level of yellowness, and the a^* value indicates the redness value. This study found that jelly candy added with CTF extract had a darker color, but did not affect the yellowness and redness of the jelly candy.

The CTF extract also did not affect the hedonic quality parameters of texture, flavor, and aroma with the characteristics of the candy produced in this study, with a slightly soft texture, a slightly sweet flavor, and dadih-like aroma. The hardness and texture of the jelly candy are affected by the type and amount of hydrocolloid used and the water content of the final jelly candy product. The lower the amount of hydrocolloid used and the higher the water content in the final product, the softer the texture of the candy (Burey et al., 2009). Regarding the flavor attribute, the sweet flavor produced from jelly candy comes from high fructose syrup (HFS), which is used in equal amounts in each treatment. According to White (2008), HFS contains glucose and fructose with sweetness level 1.12 times higher than sucrose and 2.5 times higher than glucose syrup.

The characteristic dadih-like aroma in jelly candy originates from dadih, which is the main raw material for making jelly candy. Dadih, a fermented milk product, generally has the distinctive aroma of fermented milk on bamboo (Usmiati & Risfaheri, 2013). This is supported by a report from (Adesokan et al., 2011), where isolates of lactic acid bacteria such as *L. casei* and *L. Plantarum* N07 produced high diethyl as an aroma-forming compound in milk fermented for 72 h. However, CTF extract tends to be odorless; therefore, the aroma of processed food depends on other ingredients.

Regarding the hedonic test, in general, the panelists gave slightly like values for the texture, flavor, and aroma attributes. As previously explained, the texture of jelly candy is more influenced by its constituent hydrocolloids, while the flavor and aroma are influenced by the use of sweeteners and the main ingredients for making jelly candy. Therefore, in this study, CTF extract at a concentration of 0.5-2% had no effect on the panelists' preference level for the three attributes. The interesting thing is in the color attribute where the higher the addition of CTF, the lower the level of acceptance from the panelists. This is because

the color of the jelly candy becomes darker according to the results of the color physical test and hedonic quality of the jelly candy characteristics. Visual appearance, especially color, greatly influences consumer perception and the level of consumer acceptance (Maina, 2018; Nisha et al., 2011). Therefore, in terms of the sensory properties of jelly candy in this study, it was found that the color attribute was the main attribute that was affected by the addition of the CTF extract, and addition at a concentration of 0.5% was the most preferred color attribute by the panelists.

Conclusion

The evaluation of sensory properties and the level of acceptance by consumers are essential indicators of product development because they affect consumers' responses to the product. Adding CTF extract to dadih jelly candy significantly affects the brightness level (L^*), the hedonic quality of the color, and the hedonic test. However, it had no significant effect on the values of a^* (redness), b^* (yellowness), and hedonic quality and hedonic test texture, flavor, and aroma. In terms of sensory properties, the addition of 0.5% CTF extract was the most preferred treatment by the panelists with the characteristics of jelly candy: a slightly soft texture, a slightly sweet flavor, a slightly dadih-like aroma, and a high brightness color.

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