

Conference Paper

Characteristics of Fruit Jelly Candy (Study of The Proportion of Siwalan Juice (*Borassus flabellifer*) and Beetroot (*Beta vulgaris* L) Juice with Sorbitol Addition)

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ABSTRACT

Siwalan is a local fruit that has nutritional content and has not been processed. The addition of beetroot root juice to the siwalan jelly candy was expected to improve sensory and chemical characteristics such as increasing antioxidant activity. This study aims to determine the effect of the proportion of siwalan juice: beetroot juice and the addition of sorbitol on the characteristics of the siwalan fruit jelly candy. This study used a completely randomized design (CRD) with a two-factor factorial pattern. The first factor was the proportion of siwalan juice: beetroot juice (90:10, 80:20, and 70:30). While the second factor was the addition of sorbitol 50%, 60%, and 70%. The data obtained were tested using ANOVA and continued with the DMRT test. The results showed that the treatment of siwalan juice: beetroot juice (90:10) with a sorbitol concentration of 70% was the best treatment with a water content value of 14.33%, ash content 1.09%, vitamin C content 8.75 mg/100g, antioxidant activity 56.63%, total phenol 7.41 mg TAE/gr, gel strength 13.13 N, and organoleptic test including color 4.68 (slightly like), taste 4.72 (slightly like), aroma 3.92 (slightly like), texture 3.68 (slightly like).

Keywords: Jelly candy, siwalan, beetroot root, sorbitol

Introduction

Candy is a processed food product that is liked by many people from adults to children. There are two types of candy circulating in the community, namely hard candy and soft candy. The difference between the two types of candy is in the texture. One type of soft candy is jelly candy made from water or fruit juice and gelling materials. Jelly candy has general characteristics that vary from having a chewy texture to a slightly hard texture (Sudaryati & Kardin, 2013). Siwalan is a tropical fruit that is widely produced on the coast of Indonesia, and has the potential to be processed into jelly candy. Siwalan is a low-calorie fruit with 43 calories per 100 grams, 11 grams of carbohydrates, and is rich in calcium and phytonutrients. This fruit also contains fiber, protein, and iron, as well as vitamins C, A, E, K, and B7. Jelly candy made from siwalan has a less attractive color. therefore it is necessary to add other ingredients as a source of color. Beetroot has the potential as a natural colorant in food products. The pigment found in red beetroot is betalain which gives it a purplish-red color. Betalain compounds in beetroot are different from anthocyanin pigments in other plants because these pigments also contain nitrogen compounds that have a positive effect on free radical activity so beetroots are also being developed as an alternative to coloring in food products (Winanti, 2013). The red pigment in beetroots belongs to the antioxidant group consisting of flavonoid compounds, betacyanins, betalains, ascorbic acid, and carotenoids (Slavov, 2013). Besides that, beetroots are rich in nutrients, namely folic acid, potassium, vitamin

How to cite:

Sarofa, U., Yulistiani, R., Alfiana, D., & Ismuningtyas, R. (2022). Characteristics of fruit jelly candy (study of the proportion of siwalan juice (*Borassus flabellifer*) and beetroot (*Beta vulgaris* L) Juice with Sorbitol Addition). 3rd International Conference Eco-Innovation in Science, Engineering, and Technology. NST Proceedings. pages 266-270. doi: 10.11594/nstp.2022.2739

C, magnesium, iron, copper, and phosphorus (Hanifan, 2016). To get a low-calorie jelly candy, it is necessary to avoid the use of sucrose as a sweetener. Types of natural sweeteners or artificial sweeteners that provide health effects are needed in the food processing industry. The types of sweeteners that can be used in the processing of jelly candy are High Fructose Syrup HFS and sorbitol. (Syafutri et al., 2010). Sorbitol has the advantage of being able to retain moisture in food-stuffs and its use in processing at high temperatures does not cause Maillard browning reactions. Another use of sorbitol is to prevent crystallization in food products, because of its ability to retain moisture in foods that tend to dry out and harden to keep the food fresh (Rusli, 2017). Sorbitol which is added to jelly candy has the property of improving plastic texture. Sorbitol has the advantage of reducing internal hydrogen bonds in intermolecular bonds so it is good for inhibiting the evaporation of water from the product. Sorbitol can also maintain protein so that the protein is not denatured quickly (Praseptiangga, 2016). Based on these considerations, it is necessary to research to study the effect of the proportion of siwalan juice: beetroot juice, and the addition of sorbitol on the characteristics of the jelly candy produced.

Material and Methods

The material used in this research is siwalan fruit obtained from Tuban, East Java, beetroot and sorbitol obtained from the grocery in Surabaya, gelatin, gum arab, and citric acid obtained from a chemical shop in Surabaya. The materials for analysis (DPPH, metanol, H₂SO₄, HCL, yodium, amilum, Nelson A reagent, Nelson B reagent, Glukosa, NaOH,) were obtained from Merck KGaA, Darmstadt, Germany. The tool used in this research includes mixer, waring blender, oven, furnace, analytical balance, spectrophotometer uv-vis, and texture analyzer. Preparation of materials includes the manufacture of siwalan juice which is siwalan fruit peeled, weighed then blended with the addition of water 1:2 then filtered. The manufacture of beetroot juice includes washing, peeling, weighing then blending with the addition of water 1:1 then filtering. The manufacture of fruit jelly candy includes mixing siwalan juice: beetroot juice (90:10 ; 80:20 ; 70:30) , sorbitol (50%, 60%, 70%), and gum arab 1% then heating 80°C, 10 minutes , adding gelatin 20% and citric acid 0.3% then forming, cooling 5°C, 24 hours and then cutting. The product then analyzed included: moisture content, ash content, vitamin C content(AOAC, 2005), total phenol(Rusita et al, 2016), antioxidant activity (Abbot, 2013), Gel strength (Suptijah et al., 2016) and sensory evaluation (Rahayu, 1998).

This study used a Complete Randomized Design factorial pattern with 2 factors and 3 repetitions. The data was processed using ANOVA 5% and further tested DMRT 5%. Sensory evaluation was carried out by organoleptic test on 25 panelists using the hedonic scale scoring method. The hedonic scale was transformed into a numerical scale according to the panelist's level of preference (1 = dislike, 2 = dislike, 3 = rather like, 4 = like, and 5=really like). The data obtained were processed using the Friedman test at a significance level of 5%. To determine the best treatment based on all parameters, used effectiveness index (DeGarmo et al., 2004).

Results and Discussion

Raw material analysis

The results of the analysis of raw materials from siwalan juice and beetroot juice on several components, namely water content, ash content, total phenol, antioxidant activity, and vitamin C can be seen in Table 1. Differences in the results of the analysis can also be caused by the test methods used in the preparation of chemical samples and different analytical instruments, which can also cause different analysis results. This is also supported by Andarwulan et al. (2011) that sample preparation, instruments used, analysts who perform tests, calibrations, analytical conditions, chemicals, and data computing are factors that can affect the final data analysis carried out.

Table 1. The results of the analysis of siwalan juice and beetroot juice

Parameter	Siwalan Juice	Beetroot Juice
Water content (%)	94.27±0.12	90.03±0.21
Ash content (%)	0.31±0.05	1.06±0.14
Total Fenol (mg TAE/ gr)	7.13±0.25	14.02±0.24
Antioxidant activity(%)	38.42±0.20	76.47±0.31
Vitamin C (mg/100g)	11.40±0.13	8.62±0.17

Physicochemical analysis

Based on the result of statistical analysis, there was a significant interaction ($p \leq 0.05$) between the proportion of siwalan juice: beetroot juice and sorbitol addition for the parameters of water content, ash content, vitamin C, total phenol, antioxidant activity, and gel strength. Table 2, showed the average value of water content, ash content, vitamin C content, total phenol, antioxidant activity, and gel strength of fruit jelly candy affected by the proportion of siwalan juice: beetroot juice, and sorbitol addition.

Table 2. The average value of water content, ash content, vitamin C content, total phenol, antioxidant activity, and gel strength of fruit jelly candy

Treatment		Water content (%)	Ash Content (%)	Vit. C content (mg/100g)	Total fenol (mgTAE/g)	Antioxidant Activity (%)	Gel Strength (N)
Siwalan juice : Beetroot juice	Sorbitol Concentration						
90 : 10	50	13.66±0.06 ^g	1.02±0.09 ^a	8.46±0.01 ^c	7.27±0.02 ^a	53.78±0.36 ^a	15.60±0.14 ^f
	60	13.80±0.03 ^h	1.07±0.06 ^a	8.59±0.05 ^d	7.36±0.02 ^c	54.45±0.11 ^b	14.04±0.17 ^c
	70	14.33±0.06 ⁱ	1.09±0.05 ^a	8.80±0.01 ^e	7.41±0.01 ^d	56.63±0.12 ^f	13.13±0.14 ^a
80 : 20	50	12.43±0.05 ^d	1.10±0.08 ^b	8.41±0.11 ^b	7.31±0.02 ^b	54.36±0.23 ^b	15.72±0.16 ^f
	60	12.78±0.02 ^e	1.14±0.02 ^b	8.52±0.13 ^c	7.46±0.02 ^e	55.45±0.12 ^d	14.64±0.10 ^d
	70	13.00±0.08 ^f	1.16±0.07 ^c	8.74±0.07 ^e	7.51±0.01 ^e	56.80±0.12 ^f	13.46±0.13 ^b
70 : 30	50	11.13±0.06 ^a	1.21±0.05 ^c	8.31±0.02 ^a	7.37±0.01 ^c	54.95±0.12 ^c	15.94±0.16 ^f
	60	11.29±0.05 ^b	1.27±0.07 ^d	8.39±0.08 ^b	7.48±0.01 ^e	56.12±0.11 ^e	15.16±0.14 ^e
	70	11.62±0.04 ^c	1.34±0.09 ^e	8.50±0.06 ^c	7.59±0.02 ^f	57.05±0.23 ^f	13.63±0.16 ^b

Description: The average value accompanied by different letters expresses a significant difference ($p \leq 0.05$)

Table 2 shows that the higher the proportion of siwalan juice and the higher the addition of sorbitol, the higher the water content. This is because siwalan juice has a high water content, besides that sorbitol has a hydroxyl group that can affect water absorption in the product (Afif et al., 2018). According to Indriyani et al. (2010), the hydroxyl group functions to bind free water that is outside and can form hydrogen bonds with water, so it tends to produce high water content.

The ash content in jelly candy is mainly influenced by the proportion of beetroot juice, where the mineral content in beetroot is high, especially Mg, K, P, Mn, Ca, and Fe. According to Andarwulan et al. (2011), the high ash content of the resulting food indicates the high mineral content of the material.

The higher the proportion of siwalan juice or the lower the beetroot juice and the higher the sorbitol addition, the higher the vitamin C content of the fruit jelly candy produced. This is because

the vitamin C content of siwalan juice (11.40 mg/100g) is higher than that of beetroot which contains vitamin C (8.62 mg/100g). So that the higher the proportion of siwalan juice, the higher the vitamin C content of fruit jelly candy. Sorbitol as a humectant that could protect the vitamin C content because the water trapped in the hydroxyl group can protect the vitamin C component during heating (Rusli et al., 2017). According to Afif et al. (2018), the presence of hydroxyl groups can increase water absorption. The more water that is absorbed, the more likely sorbitol can protect the vitamin C in the material from heating and oxidation during the jelly candy processing.

In total phenol, the higher the proportion of beetroot juice the higher the total phenol produced, this is due to the high content of phenolic components in beetroot. In addition, the presence of sorbitol can protect against the damage of phenol components from the heating process. According to Yuyun et al. (2016), phenolic compounds have an aromatic ring and phenolic compounds are more likely to dissolve in water, so the more water is absorbed, the sorbitol can protect the phenolic compounds from heating.

In line with the content of phenol components in fruit jelly candy, antioxidant activity also showed an increase with increasing phenol components. The high antioxidant activity in beetroots will provide high antioxidant activity in the product. Likewise, the presence of sorbitol will protect the antioxidant components so that their activity can be maintained from damage (Rusli et al., 2017). The strength of the gel in fruit jelly candy is related to the water content, where the higher the water content the lower the gel strength (Sari et al., 2016). The higher addition of sorbitol produces fruit jelly candy with low gel strength, this is due to the formation of hydrogen bonds which can reduce the bond between polymers, thereby reducing gel strength.

Sensory evaluation

Based on Friedman's test, it was shown that the proportion of siwalan juice: beetroot juice and sorbitol concentration were significantly different ($p \leq 0.05$) on the color and taste of the jelly candy produced. While the aroma and texture were not significantly different ($p \geq 0.05$). The average value of preference for color, taste, aroma and texture of fruit jelly candy with different proportions of siwalan juice: beetroot juice and sorbitol addition can be seen in Table 3.

Table 3. Average value of preference for color, taste and aroma in jelly candy

Treatment		Color	Taste	Aroma	Texture
Siwalan juice : Beetroot juice	Sorbitol Addition				
90 : 10	50	4.10	3.76	3.80	3.64
	60	4.32	4.16	3.84	3.76
	70	4.68	4.72	3.92	3.68
80 : 20	50	3.92	4.12	3.76	4.00
	60	4.16	3.96	3.60	3.96
	70	3.72	4.40	3.20	4.04
70 : 30	50	4.04	4.04	3.32	4.12
	60	3.68	3.68	3.48	4.20
	70	4.43	3.92	3.40	4.24

Description: The greater the value, the more preferred

Based on Table 3, the panelists' preference for the highest color was obtained in the treatment of the proportion of siwalan juice: beetroot juice 90: 10 and the addition of sorbitol 70%. The color of the product is mainly influenced by beetroot juice as a natural dye Gumansalangi et al. (2019). Panelists prefer softer colors to darker colors. Similarly, the response of the panelists to the taste preferences obtained the highest taste preference in the treatment of the proportion of siwalan juice: beetroot juice 90: 10 and the addition of sorbitol 70%. The taste is mainly influenced by the addition of sorbitol as a sweetener, the higher the addition of sorbitol, the more preferred by the

panelists. The panelists' preference for aroma did not show a significant effect. On average, the panelists did not like the smell of jelly candy. This may be influenced by the presence of an earthy aroma in beetroot juice (Magfiroh & Maryam, 2019). The preference for texture does not have a significant effect on jelly candy products. the average preference score is between 3.64 - 4.24 . The effect of sorbitol on texture is due to its ability to retain moisture in foods that tend to dry out and harden (Afif et al., 2018).

Effectivity test

An effectivity test was conducted to determine the best treatment. Based on the results of the effectivity test on all research parameters including the physiochemistry test and sensory evaluation, treatment of the proportion of siwalan juice: beetroot juice 90: 10 and the addition of sorbitol 70% is the best treatment with the results of water content value of 14.33%, ash content 1.09%, vitamin C content 8.75 mg/100g, antioxidant activity 56.63%, total phenol 7.41 mg TAE/gr, gel strength 13.13 N, and organoleptic test including color 4.68 (slightly like), taste 4.72 (slightly like), aroma 3.92 (slightly like), texture 3.68 (slightly like).

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