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Activity antioxidant and sensory profile of jelly candy with addition of butterfly pea (*Clitoria ternatea L.*) extract powder

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Abstract

An antioxidant is a compound that can capture free radicals which are active substances that cause various diseases such as cancer. One type of antioxidant is anthocyanin. Anthocyanin pigments in butterfly pea can be used as natural dyes. This study aimed to analyze the anthocyanin content in the manufacturing of jelly candy with butterfly pea extract and preferences that include color, taste, aroma, texture, and acceptability in toddlers. The research design was experimental (posttest only design) with three treatments consisting of the addition of 0.25, 0.50, and 0.75 g of butterfly pea extract. Anthocyanin content was measured using the differential pH method and hedonic organoleptic test. Data were analyzed using the Excel application; if $Fh > 0.5$, then the Duncan test continued. The most liked jelly candy by panelists was the addition of 0.50 g of butterfly pea extract. The nutritional content in 100 g of jelly candy with butterfly pea extract is 289.3 calories, 74.4 g carbohydrates, and 965.75 ppm (965.75 mg/kg) antioxidant activity. The conclusion of the three selected formulations is the addition of 0.50 g.

Keywords: butterfly pea; jelly candy; antioxidant activity.

Practical Application: Concentration of natural dyes of jelly candy.

1 INTRODUCTION

Jelly candy is a type of snack product that is much favored by the public, especially children and adolescents. The soft texture makes this type of candy easy to digest. The main attractive characteristics of jelly candy are the sweet taste, attractive shapes and colors, and various types of packaging, especially for toddlers. However, jelly candies that are available generally use high levels of synthetic dyes, which are not good for human health, especially for toddlers. Based on the data from BPOM (2018) from 3,925 samples of PJAS (School Snacks) consisting of ice mambo, lollipops, syrup, agar-agar, and snacks, 1.02% of the samples were positive for rhodamine B. In addition to the use of rhodamine B, out of the 4,418 samples of snack products for school children, 0.05% were positive for the synthetic dye metanil yellow.

The use of food colorants in food products is important in increasing product appeal. Food colorants are broadly categorized into natural and artificial food colors. Synthetic food colorants showed an adverse effect on human health. Side effects that can be caused by the use of dyes for food in excessive quantities can pose a health hazard due to the presence of heavy metal residues in these dyes that are toxic. The continuous consumption of synthetic food dyes can cause damage to the liver. Prevention against the use of unsafe synthetic dyes as an additive in food is possible by making natural dyes. One of the natural color pigments that can be used is anthocyanin derived from the butterfly pea.

Butterfly pea (*C. ternatea* L.) is a plant originating from central South America and has spread throughout the tropics, especially in Southeast Asia. Butterfly pea plants can naturally grow in open places such as forests, shrubs, and riverbanks, can grow as vines on trees and fences, and are among the most important and largest leguminous plants that are widely cultivated (Dalimartha, 2008). Butterfly peas can produce flowers throughout the year and develop 4–6 weeks after planting. The blue color of the butterfly pea indicates the presence of plant pigments, namely, anthocyanins. Anthocyanins are a group of flavonoid compounds and the largest group of natural pigments in plants. According to Vankar and Srivastava (2010), the anthocyanin content in fresh butterfly peas is 227.42 mg/kg flowers. In addition to providing color to plants, anthocyanins act as a source of antioxidant.

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Antioxidant plays an important role in overcoming and preventing oxidative stress. Oxidative stress is closely related to the pathophysiology of the aging process and degenerative diseases, such as cancer, diabetes mellitus, and its complications, as well as atherosclerosis that underlies heart disease, blood vessels, and stroke. Oxidative stress is a condition in which there is an imbalance between the amount of free radicals present and the amount of antioxidants in the body. Free radicals can cause changes in the structure of DNA so that mutant cells arise by taking electrons from DNA. If it persists for a long time, it will cause cancer (Werdhasari, 2014). Free radicals also play a role in the aging process by initiating free radical reactions in the mitochondria causing the production of reactive oxygen species. The results of the body's metabolism and external factors, such as cigarette smoke, ultraviolet radiation, chemicals in food, and other pollutants, are sources of free radicals.

Butterfly pea is one of the natural ingredients that can be used as a source of antioxidants and natural dyes. According to Lakshmi et al. (2014), butterfly pea contains a number of phenols and flavonoids which show significant inhibition compared with standard gallic acid and quercetin. This shows that the leaves and flowers of Telang have antioxidant activity against free radicals such as DPPH, hydroxyl radicals, and hydrogen peroxide. Antioxidants from butterfly pea steeping water are believed to cure eye pain and are given to infants or children; this is reinforced by research which states that butterfly pea has antibacterial properties, including bacteria that cause eye infections (Rohman, 2007 apud Kusrini et al., 2017).

The use of butterfly pea as an alternative to natural dyes is still limited, and the antioxidants of butterfly pea can be beneficial for toddlers. The use of butterfly pea extract in jelly candy has more advantages, namely, as an alternative to natural dyes and a source of antioxidants that are safe for consumption and good for toddlers' health.

2 MATERIALS AND METHODS

2.1 Experimental design

This research method is experimental, which aims to determine the effect or effects arising from variations in the addition of butterfly pea extract to jelly candy products. The instrument used in this study was an organoleptic (hedonic) form. The data obtained from the hedonic test panelists in each sample were analyzed using the Excel 2013 software. The collected data were then analyzed using one-way ANOVA with a significance level of 95% ($\alpha = 0.05$). To test the difference in treatment, the Duncan test was performed.

3 RESULTS AND DISCUSSION

3.1 Product description

Jelly candy is one of the popular snack products among people. Jelly candy generally contains only calories and has no functional value for the body. To enrich the nutritional value, especially the antioxidants, the researchers used the extract of the pea flower as a natural dye. The counterweight ratios used were 100%:0.25%, 100%:0.50%, and 100%:0.75%. Furthermore, the jelly candy was tested organoleptically by the hedonic method. Figure 1 shows a jelly candy product with three different balances of butterfly pea extract.

Color is one of the factor that plays an important role in food. The first impression obtained from food is color. Color becomes characteristic that determines the acceptance or rejection of a product by consumers (Sharif et al., 2017). Color is the first factor which is seen directly so that it affects consumer consideration (Pitunani, 2016). Color is directly seen by the sense of sight because color gives a subjective impression of visible objects (Soekarto, 1985). To determine whether there is an effect of adding pea flower extract to the color of the jelly candy, the normality test is performed first. The normality test used ANOVA analysis, and the results were (0.000) (0.05), which means that there was an effect of eggplant extract with jelly candy produced. Duncan's test is used to find out which formulas are different. The results of Duncan's test on the color of jelly candy from three different formulas can be seen in Table 1.

Taste is defined as a stimulus caused by the material eaten, which is felt by the sense of taste or smell, as well as other stimuli such as touch and acceptance of the degree of heat by the mouth. Taste sensing can be divided into four main parts, namely, salty, sour, sweet, and bitter. The taste of food can be recognized and distinguished by the buds located on the papillae, namely, the orange-red stains on the tongue (Winarno, 2008). To determine whether there is an effect of adding pea

F1 (0.75 g of pea flower extract) F2 (0.50 g of pea flower extract) F1 (0.25 g of pea flower extract)

Figure 1. Jelly candy with the addition of butterfly pea extract.

flower extract to the color of the jelly candy, the normality test is performed first. Based on the results of statistical analysis of the three formulations of the addition of butterfly pea extract to the manufacturing of jelly candy *Fh* > F0.5, there is a significant difference in taste preferences. When analyzing each treatment, for treatment F1 with F2 and F2 with F3, there is no significant difference in the treatment; it can be observed that there is the same value, namely, the value of a for F1 and F2 and the value of b for the treatment of F2 and F3. However, treatment F1 with F3 gives a real difference. The best formulation from the results of statistical analysis of the assessment of taste is the F1 formulation with the addition of 0.25 g of butterfly pea extract.

Flavor is the most difficult sensory property to classify and explain because of its huge variety. Responses to smells or odors are usually associated with the smell of certain products or compounds that are commonly known such as the smell of oranges and cakes. The aroma in the jelly candy will be stronger when the candy has entered the mouth, which is in accordance with the theory put forward by Setyaningsih and Apriyantono (2010), that the flavor of candy can be carried out on the product directly through the aroma that comes out when the product is inside the mouth. To determine whether there is an effect of adding pea flower extract to the color of the jelly candy, the normality test is performed first.

3.1.1 Flavor rating

Based on the results of statistical analysis of the three formulations of the addition of butterfly pea extract to the manufacturing of jelly candy *Fh* > F0.5, there is a significant difference in aroma preferences. When analyzing each treatment, for treatment F1 with F2 and F2 with F3, there was no significant difference in the treatment. For F3, a significant difference is indicated by the absence of different letters in the test results. The best formulation from the results of statistical analysis of the assessment of flavor is the F1 formulation with the addition of 0.25 g of butterfly pea extract.

Texture is a characteristic of a material as a combination of several physical properties which include size, shape, amount, and elements of the formation of materials that can be felt by the senses of touch and taste, including the senses of mouth and sight. Texture can be assessed by palpation through the fingers. Texture is complex and related to the structure of the material, which consists of two elements, namely, mechanical (hardness and elasticity) and geometric (sandy, crumbly) (Setyaningsih & Apriyantono, 2010). To determine whether there is an effect of adding pea flower extract to the color of the jelly candy, the normality test is performed first. Based on Table 2, the results of statistical analysis of the three formulations of the addition of butterfly pea extract to the manufacturing of jelly candy *Fh* > F0.5, there is a significant difference in color preference. When analyzing each treatment, for treatment F1 with F2, there is no significant difference, which can be observed by the presence of a value in each test result, but treatment F1 with F3 or F2 with F3 shows a significant difference, which is indicated by the presence of a significant value, i.e., the same letter in the test results. The best formulation from the results of statistical analysis of color assessment is the F1 formulation with the addition of 0.25 g of butterfly pea extract.

Based on the results of statistical analysis of the three formulations of the addition of butterfly pea extract to the jelly candy *Fh* > F0.5, there was a significant difference in antioxidant activity for formulas F1, F2, and F3. Significant differences can be seen from the test results which show that the three formulas have different results. The antioxidant activity of the three formulas showed that the greater the amount of addition of butterfly pea extract given, the higher the antioxidant activity produced. The formulation with the highest antioxidant activity was the formulation with the addition of 0.75 g of butterfly pea extract.

The content of antioxidants in jelly candy with butterfly pea extract was carried out by testing the ingredients in the laboratory using the differential pH method. Based on Table 3, the anthocyanin content in the jelly candy of butterfly pea extract ranged from 769.58 to 1,119.79 ppm depending on the addition of the butterfly pea extract added to the formula. The higher the butterfly pea extract added to the formula, the higher the antioxidant activity contained in the butterfly pea. According to BPOM (2011), the maximum limit for the use of anthocyanins as natural dyes in jelly candy is 10,000 mg/kg, so the addition of 0.50 g of butterfly pea extract in 100 g of jelly candy is included in the safe limit category for consumption.

According to Vankar and Srivastava (2010), the anthocyanin content in the butterfly pea has higher antioxidant activity compared with anthocyanins from other flower extracts. This is

Table 1. Effect of manufacturing substitution jelly candy with eagle flower extract on color*.

Treatment	Color	Taste	Flavor
F1 (0.25 g extract)	3.65 ± 0.04^{a}	3.61 ± 0.07^{a}	3.48 ± 0.04^{a}
F2 (0.50 g extract)	3.87 ± 0.02^{b}	3.67 ± 0.04^{a}	3.43 ± 0.06^{ab}
F3 (0.75 g extract)	4.13 ± 0.10^{c}	3.70 ± 0.07^{a}	3.25 ± 0.02^{b}

*The average value of the treatment marked with the same letter stated that it was not significantly different at the 5% test level according to Duncan's test.

Table 2. Effect of manufacturing substitution jelly candy with pea flower extract on texture*.

Treatment	Average result (cp)
F1 (0.25 g extract)	3.43 ± 0.03^{a}
F2 (0.50 g extract)	3.30 ± 0.01^{ab}
F3 (0.75 g extract)	2.80 ± 0.03^{c}

*The average value of the treatment marked with the same letter stated that it was not significantly different at the 5% test level according to Duncan's test.

Table 3. Effect of manufacture substitution jelly candy with eagle flower extract on antioxidant activity*.

Treatment	Average result (ppm)
F1 (0.25 g extract)	769.58^{c}
F2 (0.50 g extract)	965.75^{b}
F3 (0.75 g extract)	$1{,}119.79^{a}$

*The average value of the treatment marked with the same letter stated that it was not significantly different at the 5% test level according to Duncan's test.

evidenced by the addition of butterfly pea extract to jelly candy, where 0.50 g of butterfly pea extract has an antioxidant activity of 965.75 ppm or equivalent to 965.75 mg/kg. Based on BPOM (2018), the maximum limit for the use of anthocyanins as natural dyes in jelly candy is 10,000 mg/kg, so the addition of 0.50 g of butterfly pea extract in the jelly candy formulation with the addition of 0.50 g of butterfly pea extract is included in the category within the safe limit for consumption.

The benefits of anthocyanin antioxidants are to protect the stomach from damage, inhibit tumor cells, improve eye vision, and function as anti-inflammatory compounds that protect the brain from damage (Jusuf, Rahayuningsih, & Erliana, 2008). In Indonesia, antioxidants from butterfly pea steeping water are believed to cure eye pain and are given to infants or children, which is reinforced by research which states that butterfly pea has antibacterial properties, including bacteria that cause eye infections (Rohman, Sugeng, & Diah, 2006). The compound developed for the treatment and prevention of cataract is N-acetylcarnosine (NAC) which acts as a carnosine compound carrier and an antioxidant and protects cells from oxidative damage and protein structures from oxidation processes caused by free radicals (Babizyahev et al, 2002 apud Kusrini et al., 2017). The health benefits of antioxidants include preventing cancer and tumors, narrowing of blood vessels, premature aging, and others. Antioxidants in food can be used to prevent the oxidation process that can cause damage, such as rancidity changes in color and aroma, and other physical damage (Tamat et al., 2007).

4 CONCLUSION

The results of organoleptic statistical tests indicate that the jelly candy with the addition of 0.25 g of butterfly pea extract was the most preferred by panelists in terms of color, taste, aroma, and texture. However, the best formulation to be developed is candy with the addition of 0.50 g of butterfly pea extract.

The antioxidant content of the jelly candy of butterfly pea extract with 0.25 g of butterfly pea extract is 769.58 ppm, 0.50 g of butterfly pea extract contains anthocyanin, 965.75 ppm, and 0.75 g of butterfly pea extract is 1,119.79 ppm.

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