Effect of sucrose addition to antioxidant activity and color in blue pea flower (ClitoriaternateaL.)yogurt

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Effect of sucrose addition to antioxidant activity and color in blue pea flower (*Clitoriaternatea*L.)yogurt

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Abstract

Blue pea flower (*Clitoria ternatea* L.) yogurt is the result of processing milk with the addition of Blue pea flower extract through Lactic Acid Bacteria's fermentation process *Lactobacillus bulgaricus* and *Streptococcus thermophilus*. Blue pea flower (*Clitoria ternatea* L.) contain bioactive components, particularly flavonol glycosides, anthocyanins, flavones, flavonols, phenolic acids and terpenoid. This study aims to determine the effect of sucrose on the antioxidant activity and color of blue pea flower yogurt. This study used a completely randomized design with four treatments, namely P1 = 0% sucrose, P2 = 4% sucrose, P3 = 8% sucrose, P4 = 12% sucrose. Data analysis using analysis of variance. The results showed that the highest antioxidant activity was P2 = 105.25 ppm. While the best color parameter is P2 = L * 42.42, a * 5.12, b * -5.54). Based on the results of the study, the addition of sucrose 4% increased the highest antioxidant activity and color of yogurt extract of blue pea flowers (*Clitoria ternatea* L).

Keywords: yogurt, antioxidant,blue pea

1. Introduction

Blue pea flower yogurt results from fermented milk using the bacteria *Lactobacillus bulgaricus* and *Streptococcus thermophilus* with blue pea flower extract. Yogurt is a drink that is quite popular around the world because it has sound health effects and has various flavors(Nurhartadi *et al*., 2017). Yogurt with the addition of fruit juice will increase consumer acceptance because it contains phenolic compounds and high antioxidant activity, which is useful for preventing degenerative diseases (Benozzi *et al*., 2015; Aryana and Olson, 2017). Yogurt processing with goat's milk is a diversified alternative to yogurt products. Therefore, it is necessary to develop goat milk processing methods with fermentation techniques that aim to diversify and reduce the smell of goat milk prengus. As consumer interest in yogurt products increases, consumers prefer products that use natural dyes over synthetic dyes because they are healthier and have no adverse side effects. Dyes derived from plants can be used as natural alternative dyes, one of which is the butterfly pea (Ghafoor *et al*., 2009; Yadav *et al*., 2018; Zhang *et al*., 2020).

Yogurt products with blue pea flower extract can produce a natural blue to purple color, thereby increasing the attractiveness of consumers to consume yogurt. Blue pea flower (*Clitoria ternatea* L.) contains natural purplish-blue pigments and anthocyanin compounds. Anthocyanins are color pigments that produce red, purple, and blue colors. However, anthocyanin colors are strongly influenced by pH; changes in pH will change the blue pea flower's color (Muzi Marpaung *et al*., 2017; Lakshan *et al*., 2019). Many studies have used natural dyes such as pandan leaves, turmeric, and dragon fruit extract as sources of natural dyes added to yogurt. The addition of blue pea flower extract as a natural colorant for

popsicles and various other food ingredients has been widely used (Baskaran *et al.*, 2019). Blue pea flower extract contains anthocyanin pigments used as an alternative to natural dyes that produce a purplish-blue color(Escher *et al.*, 2020).

Yogurt has long been recognized as a source of probiotics. The primary role of probiotics, in general, is to optimize digestive metabolism through the mechanism of improving the microbiota population in the digestive tract. Also, previous studies showed that anthocyanin extracts from blue pea flower were a more attractive color. The main compound is delphinidin glucoside (Chu*et al.*, 2016; Ibrahim *et al.*, 2019). (Nurhartadi *et al.*, 2017)reports that the sensory acceptance test of whey yogurt cheese with 12% sucrose is most preferred. (Octaviani and Rahayuni, 2014). reported that the addition of sucrose affected the antioxidant activity of Buni fruit juice. However, the effect of sucrose on blue pea flower yogurt is still unknown.

Therefore, research is required to study sucrose's effect on antioxidant activity and blue pea flower yogurt color. Research provides benefits to the development of science in food science and technology, especially food additives. This study aimed to determine the effect of sucrose on antioxidant activity and color in yogurt blue pea flower (*Clitoria ternatea* L.) yogurt.

2. Materials and methods

2.1 Extraction of blue pea powder

The blue pea (*Clitoria ternatea* L.) extract (BPE) is based on the research with a simple modification(Nurhartadi *et al.*, 2017; Agustine *et al.*, 2018; Escher *et al.*, 2020). The powdered blue pea flower petal was extracted using the maceration technique at a temperature of 60^{0}C for 45 minutes. Furthermore, the sample was filtered using a 70 mm Whatman filter paper.The extraction process was carried out with a blue pea flower ratio: distilled water at 3:1 (w/v).

2.2Preparation of yogurt starter

The starter of *Lactobacillus bulgaricus* (LB) and *Streptococcus thermophilus* (ST) obtained from FTP UGM. The bacterial starter was then grown on MRS media at 30^{0}C for 24 hours. The method used is slightly modified (Song *et al.*, 2016).

2.3 Yogurt production (without BPE addition)

Yogurt production with the addition of *Lactobacillus bulgaricus* and *Streptococcus thermophilus* follows the method used by (He et al., 2012; Nurhartadi et al., 2017) with modifications. Bacterial culture was added to pasteurized milk in a 1: 9 and incubated at 37^{0}C for 24 hours.

2.4 Blue pea yogurt (BPY) with sucrose addition

The fermentation procedure for blue pea flower yogurt followed the research (T. Zhang et al., 2019) with the addition of 10% extract of blue pea flower and the addition of sucrose by 0%, 4%, 8%, and 12% (v / v). Blue pea flower extract is added to pasteurized milk, then stir until well blended. *Lactobacillus bulgaricus* and *Streptococcus thermophilus* starter with a population of 1x10^9 CFU/ml was added to the milk solution. Fermentation was carried out in an incubator at 45^{0}C for 24 hours. Besides, yogurt is stored at 4 ° C.

2.5 Tested for DPPH and color yogurt

The yogurt was tested for DPPH antioxidant levels. DPPH was tested by 3.9 mL DPPH solution (DPPH concentration in ethanol 0.004 g / mL) mixed with 0.1 mL sample. The mixture was incubated for 30 minutes in a dark room. After that, the samples have recorded the absorbance at a wavelength of 515 nm (Octaviani and Rahayuni, 2014). Antioxidant activity was calculated by using a standard linear equation. The standard curve used BHT. Besides, yogurt has also been tested with an L * a * b * value using a CR-400 chroma meter(Igwemmar *et al.*, 2013).

2.6 Analytical methods

Data of DPPH antioxidant levels and color were analyzed descriptively using ANOVA with a significance level of 5% to determine the effect of differences in the treatment of blue pea flower extract to yogurt. Analysis continued with Duncan's test to see a significant difference. All data are processed using SPSS 16.

3. Results and discussion

3.1 Antioxidant activity

The results are shown inTable 1. It clearly showed the influence of blue pea flower extract on the antioxidant activity of yogurt. The results showed that antioxidant activity concentration of yogurt lactic acid control 27.33 ppm, P1 = 104.50 ppm, P2 = 105.25 ppm, P3 = 102.50 ppm and P4 = 93.03 ppm.

The higher the value indicates the compound used has the potential as an antioxidant. The research data showed that blue pea flower yogurt with the addition of sucrose showed an effect on yogurt's antioxidant activity. Based on the data in Table 1, the antioxidant activity of P2 (4% sucrose) is the highest compared to other treatments; the higher the addition of sucrose, the antioxidant activity decreases this is due to anthocyanin damage. The higher the added sugar in the buni fruit juice decreased the antioxidant activity(Karadag *et al.*, 2009; Muller *et al.*, 2012; Chusak *et al.*, 2018). It is known that anthocyanins are substances that act as antioxidants. *Clitoria ternatea* L. exhibits antioxidant and antihyperglycemic activity. Antioxidants are substances that can reduce free radicals and oxidative stress(Birben *et al.*, 2012; Chu *et al.*, 2016; Adipogenic *et al.*, 2019).

Blue pea flower has a blue color at neutral pH and a purple color when exposed to acids, so they have the potential to be an attractive food coloring (Muller *et al.*, 2012; Igwemmar *et al.*, 2013; Song *et al.*, 2016; Aldaw Ibrahim *et al.*, 2019). The color is known as anthocyanin, one of the antioxidants (Muller *et al.*, 2012; Octaviani & Rahayuni, 2014; Song *et al.*, 2016; Adipogenic *et al.*, 2019; Aldaw Ibrahim *et al.*, 2019; Escher *et al.*, 2020). Antioxidants are bioactive compounds with many benefits, including anti-aging (Birben *et al.*, 2012) to prevent degenerative diseases such as diabetes, heart disease. It also has antimicrobial properties for microbial food spoilage (Chusak *et al.*, 2018). In this study, blue pea flower extract to yogurt is expected to increase the antioxidant activity of the blue pea flower yogurt.

3.2 The color of yogurt

The results of the study about the effect of color on the addition of blue pea flower extract to yogurt are shown in Table 2. Based on Table 2 showed that the While the color parameters of yogurt control (L*

37.35, a* 2.02, b* -1.32) (P1= L* 44.79, a* 3.72, b* -4.63), (P2= L* 42.42, a* 5.12, b* -5.54), (P3= L* 42.59, a* 5.04, b* -5.56) and (P4= L* 44.49, a* 4.49, b* -4.92).

The addition of sucrose extract of blue pea flowers also affects the fermented milk products' color or the resulting yogurt. Color test result data or L * a * b * values use a chromameter. Table 2 shows that the addition of 4% sucrose increased the greenish red content of blue pea flower yogurt with the highest value.

The value of b shows a yellow-blue color, with a negative value greater than the blue color. The most significant blue color is yogurt with the addition of 4% sucrose. The value of b shows a yellow-blue color, with a negative value greater than the blue color. The most significant blue color is yogurt with the addition of 4% sucrose.

Blue pea flowers have a blue and purple color when exposed to acids to be an attractive food coloring. This color is known to be anthocyanin which is one of the antioxidants. Antioxidants are bioactive compounds with many benefits, including anti-aging, preventing degenerative diseases such as diabetes, heart disease, and others (Chusak *et al.*, 2018). Besides, it also has food-destroying antimicrobial properties. Many studies have shown that antioxidant-rich foods have an essential role in preventing various chronic diseases associated with oxidative stress. Antioxidants' mechanism in preventing oxidative stress in metabolism is very diverse, including free radical binding, inhibition of oxidative enzymes, acting as antioxidant enzyme cofactors (Karadag *et al*., 2009).

4. Conclusion

The sucrose from various presentations affected the blue pea flowers yogurt's antioxidant activity and color blue pea flowers (*Clitoria ternatea* L). The antioxidant activity and color of yogurt were better at presenting the addition of 4% sucrose.

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Table 1. DPPH Scavenging Antioxidant Activity

Treatment	DPPH (ppm)
	Yogurt Blue pea
Yogurts Control	27.33[c]
P1 (0% Sucrose)	104.50[a]
P2 (4% Sucrose)	105.25[a]
P3 (8% Sucrose)	102.50[a]
P4 (12% Sucrose)	93.03[a]

Different letters represent statistical differences in DPPH Scavenging Antioxidant Activity in yogurts ($p \geq 0.05$)

Table 2. L*, a*, and b* values of the yogurt with blue pea extract

Treatment	L, a, b value		
	L*	a*	b*
Yogurts Control	37.35[a]	2.02[a]	-1.32[b]
P1 (0% Sucrose)	44.79[b]	3.72[a]	-4.63[a]
P2 (4% Sucrose)	42.42[a]	5.12[b]	-5.54[a]
P3 (8% Sucrose)	42.59[a]	5.04[b]	-5.56[a]
P4 (12% Sucrose)	44.49[b]	4.49[ab]	-4.92[a]

Different letters represent statistical differences in yogurt's color parameters with different sucrose treatments ($p < 0.05$).

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