Utilization of Yellow Sweet Potato (*Ipomoea batatas*) and Butterfly Pea Flower (*Clitoria ternatea*) Juice to Increase Antioxidants of Cookies

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Abstract. The purpose of this study was to determine the effect of adding yellow sweet potato and telang flower juice on antioxidants and other nutrients in cookies. The method used was an experimental method with experiments in the laboratory. The design used was a single factor with completely randomized design with treatment P = wheat flour: yellow sweet potato flour: telang flower extract, namely P1 (100:0:0), P2 (50:50:0), P3 (50:50: 2), P4 (50:50:4), P5 (50:50:6), and P6 (50:50:8) with 3 repetitions. Parameters observed were chemical properties (moisture content, antioxidant activity), physical properties (fracture strength and color). Observational data were analyzed using Costat. Significant data tested with Honest Significant Difference (HSD) at a 5% significance level. The results showed that the addition of telang flower juice in the manufacture of cookies resulted in a significant effect on moisture content, antioxidant activity, fracture power, color (Hue and lightness), organoleptic except taste (hedonic). The best treatment in making cookies was the addition of 2% telang flower juice with a moisture content of 5.11%; antioxidant activity 95.51%; fracture strength 28.5 N; lightness 56.38; hue 64.37; and organoleptic properties that are still acceptable to the panelists.

Keywords: Butterfly Pea Flower Juice, *Clitoria ternatea*, Cookies, Yellow Sweet Potato

1 Introduction

Sweet potato (*Ipomoea batatas* L) is a tuber which originates from Central America and belongs to the Convolvulaceae family [1]. According to [2], sweet potatoes are among the seven most important food crops in the world. This tuber grows well in tropical and subtropical areas such as Southeast Asia, one of which is Indonesia. There are various types of sweet potatoes, such as white, yellow, red, and purple sweet potatoes [3].

Sweet potatoes can be processed into various products such as flour, chips, pudding, cakes, puddings, etc. Processing sweet potatoes into various types of food will increase their acceptance by urban communities. This will have positive impacts such as

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increasing economic value, expanding markets, and developing local food so that it can replace imported food [4]. Based on [5], sweet potato flour has a moisture content of 2.2-8.2%; ash content 2.6-5.6%; crude protein 3.2-6.6% and fat content 3.1-6.2% and according to [4], yellow sweet potato flour high in vitamin C and β-carotene; protein content of 4.33%; fat content 3.73%; ash 3.13%; crude fiber 2.34% ; carbohydrates 77%.

The higher proportion of sweet potato flour used in making cookies will increase the total carotenoids and fiber but reduce the fat and protein content [6]. The research by [7] showed that adding more than 10% sweet potato flour would reduce the overall acceptability of cookies. Several efforts to improve the quality of sweet potato cookies include adding other ingredients such as butterfly pea flowers.

In Southeast Asia, butterfly pea is used as a natural food coloring. Butterfly pea is high antioxidants, flavonoids and peptides and has shown considerable promise in animal studies as a natural remedy for a range of health complaints [8]. The antioxidant activity of fresh butterfly pea flowers reached 98.72% [9]. The optimal total anthocyanin yield and yield of butterfly pea were obtained by extracting it by maceration at a tartaric acid concentration of 0.75% with a total anthocyanin and yield of 0.82 mg/ml and 24.21% [10]. The anthocyanin content of butterfly pea flowers has the potential to be developed as a local natural coloring in various food industries. Dye local natural products in various industries besides improving color quality attributes can also be used provides antioxidant, anticancer and anti-inflammatory effects. The research by [11] showed that cendol with addition of 0,75 g butterfly pea extract was the higest total antocyanin content (235,24 mg/L). Cookies with the addition of 6% butterfly pea flower powder are the best product based on chemical, physical analysis and organoleptic acceptance [12]. Butterfly pea flower extract can be used as a local natural dye in the various other types of food products.

2 Materials and Methods

Yellow sweet potatoes were obtained from the Jenggik area of East Lombok and butterfly pea flowers were obtained from Cakranegara, Mataram.

2.1 Preparation of Yellow Sweet Potato Flour.

The process based on modification by [13] begins with peeling and washing, reducing the size, blanching by dipping in hot water for 10 minutes, drying in the sun until the yellow sweet potato slices are dry. The final step is grinding and sieving with a sieve size of 80 mesh.

2.2 Preparation of butterfly pea flower juice

The butterfly pea flowers that were obtained were dried using an oven at 60°C for 2 hours. The dried butterfly pea flowers are ground using a blender to produce powder.

Water is added to the powder at a temperature of 40°C with a ratio of butterfly pea flowers: water (1: 2, w/v) [14].

2.3 Production of cookies

Mix sugar, salt and butter until homogeneous. Add eggs and mix until pale yellow. Next, add powdered milk, baking powder, yellow sweet potato flour, and butterfly pea flower juice. The dough is rolled and shaped. The last step is baking for 30 min at 160˚C [15].

The design used was a single factor with completely randomized design with treatment P = wheat flour: yellow sweet potato flour: telang flower extract, namely P1 (100:0:0), P2 (50:50:0), P3 (50:50: 2), P4 (50:50:4), P5 (50:50:6), and P6 (50:50:8) with 3 repetitions. Parameters observed were chemical properties (moisture content, antioxidant activity), physical properties (fracture strength and lightness). Observational data were analyzed using Costat. Significant data tested with Honest Significant Difference (HSD) at a 5% significance level.

3 Result and Discussion

3.1 Material Analysis (Raw Material)

Table 1. Characteristics of Wheat Flour, Yellow Sweet Potato Flour, and Butterfly Pea Flower Juice.

Parameters	Wheat Flour	Yellow Sweet Potato Flour	Butterfly Pea Flower Juice
Moisture content (%)	7.41	-	-
Antioxidant activity (%)	10.23	38.4	79.33

Table 2 Characteristics of Cookies with Addition of Butterfly Pea Flower Juice.

Treatments (Wheat Flour: Yellow Sweet Potato Flour: Butterfly Pea Flower Juice)	Moisture content	Antioxidant activity	Fracture strength	Lightness
P1 (100:0:0)	7,86b	81,43b	3,64b	68,39a
P2 (0:50:0)	4,07a	95,48a	26,08a	60,75b
P3 (50:5:2)	5,11a	95,51a	28,50a	56,38c
P4 (50:50:4)	6,58ab	95,68a	20,68ab	55,54c
P5 (50:50:6)	4,48a	95,35a	34,48a	54,12c
P6 (50:50:8)	10,07b	95,63a	6,35b	54,25c

3.2 Moisture Content

One of the most basic and important analysis procedures that can be performed on food products is moisture content. It is often a composition standard for food products [16]. The moisture content in food also determines the freshness and shelf life of the food [17].

Table 2 shows that the addition of butterfly pea flower juice causes an increase in the moisture content of the cookies. Cookies made from 100% wheat have a moisture content of 7.86% and the moisture content decreases to 4.07% when substituted with 50% yellow sweet potato flour. The addition of butterfly pea flower juice up to 6% did not have a significantly different effect on the cookies, but had a significantly different effect on the addition of 8% butterfly pea flower juice. According to [18], the addition of 75% rosella extract caused an increase in the moisture content of bika ambon to 36.69%. The addition of 5% butterfly pea flower extract increased the water content of purple sweet potato donuts by up to 25.19% [19]. Based on SNI 01-2973-1992, the maximum moisture content of cookies is 5% so only P2 and P5 treatments meet SNI requirements.

3.3 Antioxidant Activity

Antioxidants are chemical compounds that can inactivate the development of oxidation reactions, so they are often used as free radical inhibitors, while antioxidant activity is the ability of antioxidant compounds to inhibit the reaction rate of free radical formation [20].

The treatment ratio of flour, sweet potato flour and butterfly pea flower essence had a significantly different effect on the antioxidant activity of cookies. The antioxidant activity of cookies ranges from 81.43-95.68% (Table 2). Cookies made from 100% wheat and without the addition of butterfly pea flower essence have the lowest antioxidant activity which is caused by the antioxidant activity of wheat which is lower than the other ingredients, namely 10.23%. The addition of butterfly pea flower essence did not have a significantly different effect on the antioxidants of the cookies; this is thought to be caused by the low concentration of butterfly pea flower essence added. The result is supported by [14] the addition of 2-10% butterfly pea flower essence, the antioxidant activity of steamed sponge cake was 42-69.66%. Present study resulted the addition of 0.25 g to 0.75 g of butterfly pea flower extract will increase the antioxidant activity of cendol from 653.11 ppm to 1205.70 ppm [11].

3.4 Fracture Strength

Fracture strength is one of the main parameters in determining the quality and consumer acceptance of food ingredients. Fracture strength of cookies was measured until the sample broke due to pressure [21]. This parameter can be influenced by the ingredients used in processing the product.

The result of analysis of cookies characteristics shown in Table 1 indicates that the treatment with the addition of butterfly pea flower juice up to 6% caused an increase in

the fracture strength of cookies, then the fracture strength decreased with the addition of 8% butterfly pea flower juice. Fracture strength is influenced by many factors, one of which is moisture content. The high moisture content in cookies causes the texture to become less hard so that the breaking strength is reduced. According to [22], low moisture content in food ingredients will make the product easier to break.

3.5 Lightness

The color of food is influenced by the pigments found in food such as fruits, vegetables, animals and processing processes. Pigments not only depict color but also provide health benefits. Pigments are unstable to temperature, light and oxygen [23].

The treatment given had a significantly different effect on the color of the cookies, both lightness (Table 2). The higher the addition of butterfly pea flower juice causes the lightness to decrease. Cookies that don't have butterfly pea flower juice added are yellow to brownish yellow, while cookies that have butterfly pea flower juice added are green. Butterfly pea flowers have anthocyanin pigments which cause their color to become purplish blue. This pigment is water soluble. At high temperatures, decomposition of anthocyanins occurs from aglycone form to chalcone (colorless). Anthocyanins will turn a faded red color at pH 3; purplish red at pH 4; purple at pH 5-6; and purple blue at pH 7 [24].

3.6 Conclusion

The treatment of adding butterfly pea flower juice in making cookies produces a significant effect on moisture content, antioxidant activity, fracture strength, and lightness. The higher the addition of butterfly pea flower juice causes an increase in moisture content, antioxidant activity, fracture strength but decreases lightness. The best treatment in making cookies is the addition of 2% butterfly pea flower juice with a moisture content of 5.11%; antioxidant activity 95.51%; fracture strength 28.5 N; and lightness 56.38

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