Effect of Extract Concentration of Robusta Coffee (*Coffea canephora*) Husk Extract and Cooking Temperature on Quality Characteristics of Hard Candy

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ABSTRACT

Coffee is a popular commodity in practically every country, and demand is growing. Coffee processing produces more than 50% by-products, the majority of which is coffee husk (48%). It includes phenolic content and caffeine, as well as antioxidants in the range of 60.25%, making it a potential functional food ingredient. Candy is thought to be a quick source of energy, and using coffee skins as ingredients in hard candy could be a novel way to use by-products. This study aimed to determine the effect of coffee peel extract concentration and cooking temperature on hard candy chemical characteristics. The study used an experimental method with a two-factor Completely Randomized Design method analysis at concentrations of coffee skin extract at levels of 2%, 5%, and 8% and cooking temperatures of 140°C, 150°C, and 160°C with three repetitions. Candy products were tested for chemical characteristics, namely water content, ash content, and antioxidant activity. The results of the ANOVA chemical characteristic test at the 95% confidence level showed that adding extract concentration, cooking temperature, and their interaction significantly affected water content and antioxidant activity but had no significant effect on ash content. The results of the chemical test showed that the best treatment was candy with the addition of an extract concentration of 8% with a cooking temperature of 150°C.

Keywords: *Coffee, husk, antioxidant, candy, functional food*

1. INTRODUCTION

Coffee is in great demand and widely consumed because of its distinctive taste, aroma, color, and benefits on health [1]. Coffee consumption is estimated at 3.5 billion cups of coffee worldwide every day [2], which is dominated by Coffea arabica L. (arabica) and Coffea canephora Pierre (robusta) [3]. Antioxidant, anti-inflammatory, antibacterial, antiviral, anti-aging, anti-cancer, anti-cellulite, and sunscreen properties can be found in coffee components [4]. The bioactive compounds are not only contained in coffee beans but in all parts of the coffee fruit. Coffee cherries consist of seeds, silver skin, parchment, mucilage, pulp, and skin. All other portions or so-called by-products are discarded or turned into animal feed, and only the beans are used in the production of coffee beverages. By-products account for more than half of all coffee cherries. The percentage of coffee husk is as much as 48% of the total coffee cherries [5].

The coffee husk is a useful substrate for producing molds, yeasts, and enzymes due to the high amount of fermentable sugar [6]. The coffee husk is a dietary supplement because it is high in dietary fiber and natural antioxidant components. The coffee husk is also rich in nutrients and can be used to extract caffeine and polyphenols [7]. The presence of compounds rich in benefits in the coffee husk makes it potential for coffee husks to be used as functional food ingredients.

Candy is a food product liked and consumed by everyone [8]. Hard candy is one of the most sought-after

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sweets by consumers, especially adult consumers. The manufacture of hard candy made from Sunkist orange peel showed the effect of different concentrations of Sunkist orange peel extract of 60%, 80%, and 100% on the chemical content of the candy [9]. The manufacture of jelly candy from coffee husk was tested with gelatin and lemon juice concentrations; the best results showed antioxidant activity of 14.09%, vitamin C content of 3.03 mg/100 g, reducing sugar of 2.88%, and texture value of 44. 0.0 g/mm [10]. The presence of antioxidant activity in jelly candy is obtained from coffee skin which contains 30.45% antioxidants. The availability of coffee husks in Indonesia, as well as several coffee skin extract products, such as cascara tea, have sparked the invention of coffee husk hard candy.

Based on the Indonesian National Standard (SNI) hard candy No. 01-3547 2008 for the quality characteristics such as water and ash content, reducing sugar, and saccharose. So, in addition to testing the antioxidant activity, this study aims to determine the effect of coffee husk extract concentration and cooking temperature on the chemical characteristics of hard candy products. The chemical characteristics measured were water, ash, and antioxidant activity.

2. MATERIAL AND METHOD

2.1 Sample preparation

The primary raw material used in this research is the Robusta coffee (Coffea canephora) husk from dry processing. The ingredients for making hard candy are granulated sugar, glucose syrup, coffee husk extract, and water. The coffee husk was extracted using 96% food-grade ethanol solvent by brewing. The temperature of the coffee skin extract is not more than 60°C as the boiling point of ethanol for 1 hour.

2.2 Hard candy production procedure

Coffee extract with four formulations was prepared to make hard candies. The ratio of sucrose and glucose syrup is 70:30. Water and sucrose were heated at a temperature of 100°C to produce hard candy. After that, the addition of glucose syrup until it reaches the cooking temperature that has been determined. Coffee rind extract was added at the end, then stirred until homogeneous.

2.3 Chemical analysis

The moisture content measurement was carried out using the thermogravimetric method. Then to the oven stage at a temperature of 105°C for 22 and 24 hours or until constant. Moisture content is calculated using Equation 1 (11):

$$Moisture\ content(\%) = \frac{(W_1 - W_2)}{(W_1 - W_0)} \times 100\% \qquad (1)$$

Ash content is measured using the gravimetric method. A sample of 3 g was put into an ash cup, then burned on an electric stove until it was smokeless. The sample is then burned in a kiln at 600°C for 4 hours until the ash is white.

Antioxidant activity was measured using the DPPH method. Starting with maceration of the product for 48 hours, continued with the manufacture of 50 ppm DPPH. 2 ml of 100 ppm sample solution was taken, and 2 ml of DPPH stock solution was added. The solution was incubated for 30 minutes in the dark. Absorbance measurement with a spectrophotometer at a wavelength of 517 nm

2.4 Statistical analysis

The experimental design was an experimental laboratory with a 2-factor Completely Randomized Design. Factor 1 is the concentration of coffee skin extract with 3 treatments including control F1 = 2%, F2 = 5%, and F3 = 8%, and factor 2 is cooking temperature with 3 treatments including T1 = 140°C, T2 = 150° C, and T3 = 160°C. All treatments were three replication. The data were analyzed with the Two Way ANOVA test and Tukey's test with a level of 0.05 using SPSS.

3. RESULT AND DISCUSSION

The results of the chemical test were compared with the standard SNI for Candy Quality. Table 1 shows the findings of the data analysis of the difference in treatment with extract concentration, temperature, and the interaction between the two variables.

From Table 1, it can be seen that the addition of extract concentration, temperature, and their interaction significantly affected the decrease in the water content and the increase in antioxidant activity of the coffee husk candy. On the other hand, the ash content variable had no significant effect on the treatment of water content, ash content, or the interaction of the two.

Table 1. ANOVA results influence the concentration of extracts, temperature, and interactions on the chemical characteristics of candy

Variable	ANOVA		
	Extract concentration	Cooking temperature (T)	Interaction (K*T)
Moisture content	*	*	*
Ash content	-	-	-
Antioxidant activity	*	*	*

Description: (*) significant effect, (-) not significan

3.1 Moisture content

Moisture content shows the total water content in hard candy products that affect the stickiness properties of the candy. The ANOVA results showed that adding extract concentration and temperature significantly affected the moisture content of the hard candy. Therefore, it can be said that the addition of the right concentration and cooking temperature can produce candy with the desired moisture content. In addition, the ANOVA results for the interaction between the addition of extract concentration and cooking temperature also significantly affected the water content. This indicates that there is an effect between the addition of extract concentration and cooking temperature on the water content of the hard candy.

Table 2. The average value of moisture content (%) based on the interaction of extract concentration and cooking temperature

Extract concentration (%)	Moisture content (%)		
	140°C	150°C	160°C
2	4,382 ± 0,106[a]	1,386 ± 0,165[c]	0,542 ± 0,327[d]
5	4,536 ± 0,550[a]	1,608 ± 0,129[c]	0,601 ± 0,238[d]
8	5,806 ± 0,791[b]	1,875 ± 0,210[c]	0,875 ± 0,097[d]

The results of the ANOVA at the 95% confidence level showed that the addition of coffee husk extract, cooking temperature, and the interaction of the two variables had a significant effect on the water content of the coffee peel candy. Table 2 shows the average value of interaction between adding extract concentration and cooking temperature. The interaction indicates that each addition of extract concentration will have a different effect on each cooking temperature on the water content of the product.

3.2 Ash content

Ash content shows the total inorganic material, which is identical to the mineral content of the product. The ash content in the manufacture of candy can also be influenced by the content of the raw materials used [14]. Table 3 showed that the addition of extract concentration, temperature, and the interaction of the two variables had no significant effect on the ash content of the hard candies.

Table 3. The average value of ash content (%) based on the interaction of extract concentration and cooking temperature

Extract concentration (%)	Ash content (%)		
	140°C	150°C	160°C
2	0,033 ± 0,035[a]	0,037 ± 0,028[a]	0,057 ± 0,014[a]
5	0,054 ± 0,036[a]	0,046 ± 0,022[a]	0,069 ± 0,038[a]
8	0,081 ± 0,042[a]	0,021 ± 0,011[a]	0,055 ± 0,024[a]

Based on the SNI for hard candy, the maximum ash content in hard candy is 2%. However, from table 3, the ash content results in all treatments are below 0.1%, which means that the ash content follows the quality standard of hard candy. The lowest ash content was found in addition 8%, which was cooked to a temperature of 150°C.

3.3 Moisture content

The principle of the DPPH method is that there is a color change in the solution because it reacts with antioxidants [15]. One of the compounds that become a source of antioxidants is polyphenols. Polyphenols are one of the ingredients contained in coffee skin. The change in the DPPH solution which was initially purple will change to a yellow color that comes from the prikil group [16].

The results of the ANOVA in Table 4 show that there is a significant effect of the addition of extract concentration, cooking temperature, and their interaction on antioxidant activity. The difference in the interactions between each treatment is found in the results of Tukey's test. The results showed that the sample with the best antioxidant activity was found in the addition of 8% concentration treatment with a cooking temperature of 150°C at 91.418%.

Table 4. The average value of antioxidant activity (%) based on the interaction of extract concentration and cooking temperature

Extract concentration (%)	Antioxidant activity (%)		
	140°C	150°C	160°C
2	38,440 ± 0,467[a]	46,454 ± 0,325[b]	42,766 ± 0,425[d]
5	45,461 ± 0,443[b]	91,277 ± 0,212[c]	85,887 ± 0,325[e]
8	90,213 ± 0,975[c]	91,418 ± 0,245[c]	91,064 ± 0,369[c]

Table 4 shows that the number of antioxidants in the ingredients rose as the percentage of coffee rind extract increased. Meanwhile, in the temperature cooking treatment, the antioxidant temperature was still low at 140°C and increased to 150°C. The antioxidants were then reduced when the temperature was raised from 150°C to 160°C. Antioxidant levels in the product will increase when heated [17][18]. The increase in antioxidants was caused by the enzymatic browning reaction which caused the antioxidant compounds to be more active. Antioxidant levels are also degraded when it reaches a very high temperature [10]. Heating can damage the cell walls of antioxidant compounds and break chemical bonds.

4. CONCLUSION

The results showed that the addition of extract concentration, cooking temperature, and interaction of the two variables had a significant effect on the product's moisture content and antioxidant activity. Meanwhile, the ash content test results showed that the addition of extract concentration, cooking temperature, and the interaction of the two had no significant effect on the ash content of hard candy products. Based on the results of chemical characteristics, the best addition of extract concentration and the cooking temperature was in candy with the addition of an extract concentration of 8% with a cooking temperature of 150°C.

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