TOTAL PHENOLIC CONTENT AND ACCEPTANCE OF GOTU KOLA STICK WITH VARIOUS CONCENTRATIONS OF GOTU KOLA LEAVES *(Centella asiatica)*

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Abstract

Background: Gotu kola leaves contain many active compounds, such as various types of phenols, which are beneficial for the human body when consumed. Gotu kola plants can be consumed directly or added to products. *Gotu kola sticks* are an elongated snack with gotu kola leaf paste added to the mixture and then fried.
Purpose: This research aims to study the total phenolic content and acceptability of gotu kola sticks with various concentrations of gotu kola leaves.
Methodology: The research method was done by making gotu kola leaf paste and gotu kola sticks with various concentrations of gotu kola leaves. Then, the total phenolic content, sensory, and hedonic tests were carried out. Data were analyzed using the SPSS Analysis of Variance (ANOVA) and Duncan's Multiple Range Test (DMRT) with α 5%
Results: Based on the research results obtained, the Gotu kola stick product was selected based on the best sensory and hedonic acceptability and the total phenolic content. The Gotu Kola stick was chosen with a concentration of 10%.
Keywords: Gotu kola sticks, Gotu kola leaves, sensory analysis, total phenolic content

I. INTRODUCTION

Gotu Kola *(Centella asiatica)* is a plant that has long been used as a vegetable by the people of West Java. Besides being consumed directly, gotu kola can be added to products to increase their nutritional value. Several active compounds can be found in the leaves, stems, and roots of gotu kola, with the highest total phenolic content in the leaves (Saputri, 2014). The compounds contained in gotu kola can help increase immunity, improve brain performance, and even improve blood circulation to the brain (Sutardi, 2016). Apart from that, gotu kola is also known for its benefits in improving memory because it contains asiaticoside compounds and fiber, which is suitable for digestion (Lee et al., 2000; Mirza et al., 2013).

Several studies related to the use of gotu kola leaves were carried out by Bilqiis (2018) on cupcake products using gotu kola leaf powder. Cupcakes added with gotu kola leaf powder are famous and contain 5.6729% fiber (Bilqiis, 2018). Saputri and Damayanthi (2015) used gotu kola powder to make sago cookies, and Ariyasa et al. (2018) used gotu kola leaf paste to make cookies. Handayasari (2023) also makes decamping by adding pieces of gotu kola leaves. Based on previous research, gotu kola leaves can be used in various products with various forms of gotu kola leaves.

One snack product that various groups like is sticks. The sticks have an elongated shape with a salty and savory taste. The main ingredient in making sticks is flour. This stick can be modified by adding other ingredients to increase its nutritional and sensory value. In this research, gotu kola leaf paste was added to stick products with various concentrations.

II. METHODOLOGY

Materials and tools

The materials used are gotu kola leaves, wheat flour, tapioca flour, eggs, margarine, water, cooking oil, materials for analysis, namely, distilled water, methanol solvent, Follin - Ciocelteau reagent, $NaCO_3$ 7%, and methanol p.a.

The tools used are stove, digital balance, bowl, spoon, tray, grinder (ampia) brand Weston ATLAS 150, blender brand Philips HR2056, basin, pan, knife, pan, spatula, frying strainer, spektrofotometer UV-VIS, and tools for carrying out analysis.

Research methods

Making Gotu Kola Leaf Paste

At this stage, gotu kola leaves are sorted and separated from the roots and stems. After that, the gotu kola leaves are washed with running water until they are clean from stuck-on dirt. Then, the gotu kola leaves were steamed using the steam-blanching method at 60°C for 3 minutes. Next, the steamed gotu kola leaves are crushed using a blender to produce gotu kola leaf paste (Ariyasa et al., 2018).

Making Gotu Kola Sticks

Weighed 250 g of wheat flour and 50 g of tapioca flour for each treatment. Weighed 70 g of margarine. After that, gotu kola paste was weighed 30g (10%), 45g (15%) and 60g (20%) respectively. The ingredients that have been weighed are each mixed in a separate container according to the concentration of gotu kola added, after which each is given one egg. Then, 50 ml of water is added to the dough and kneaded until it is even and smooth. Once smooth, the dough is weighed 10 g so that it is uniform, then rolled ± 3 times using a grinder set to power number 3 to thin the dough. After that, the dough is rolled a second time with strength number 5 ± 3 before finally being molded using a pasta mold. Next, the molded gotu kola stick dough is measured. Each stick is 10 cm long, and then it is fried in preheated oil until it reaches a temperature of 170°C. Gotu kola sticks are fried until golden brown for 3 minutes and then drained (Wachyuni, 2019).

Data analysis

The data obtained from the research was processed using the Statistical Product and Service Solution (SPSS) 20 program. Then, the statistical test was the ANOVA (Analysis of Variance) test of variance to determine whether the treatments used in the research had a natural effect. If the p-value is <0.05, the treatment of adding gotu kola leaf paste to gotu kola sticks has a natural effect and is followed by a follow-up test with the Duncan test at a 95% confidence interval level α 5%

III. RESULTS AND DISCUSSION

A. Total Phenolic Content of Gotu Kola Stick

Active compounds originating from the phenol group are a source of antioxidants that are naturally contained in plants. Total phenolic compounds are one of the components contained in gotu kola and play an essential role in its antioxidant activity. On the other hand, total phenol consists of various types of phenolic compounds with different solubility (Saputri, 2014). Therefore, total phenolic content testing was carried out on gotu kola stick samples using the Folin Ciocalteau method. The principle of the Folin Ciocalteau method is colorimetric oxidation-reduction. The reagent oxidizes the phenolic hydroxyl group to form a phenolic ion. The more phenolic ions there are, the more heteropolyacid will be reduced to a molybdenum-tungsten complex, which can then be measured using a UV-Vis spectrophotometer (Andriani, 2018). The following are the results of testing the total phenolic content in gotu kola sticks, as shown in Table 1.

Table 1. Total phenolic content of gotu kola stick

Gotu Kola Concentration (%)	Total Phenolic Content (ppm)
10	3532,49[a]
15	4597,80[b]
20	5067,52[b]

The results of the test of variance (ANOVA) showed that the treatment with the addition of gotu kola leaf paste had a significant effect on the total phenolic content of gotu kola sticks ($p<0.05$). Based on Duncan's further test results, the 10% sample differed significantly from the 15% and 20% samples, while the 15% and 20% samples were not significantly different. In the research that was carried out, samples with the addition of 20% gotu kola leaf paste had the highest average total phenolic content of 5067.52 ppm. Meanwhile, the lowest average total phenolic content in the sample with the addition of 10% gotu kola leaf paste was 3532.49 ppm. In research by Saputri and Damayanthi (2015) regarding the addition of gotu kola powder with a concentration of 5.5 – 7.5% to sago gotu kola cookies, the total phenolic content in sago gotu kola cookies ranged from 866.8 – 905.4 mg/100 g. Saputri and Damayanthi (2015) also stated that 100 g of dried gotu kola powder contains 43,862.6 mg of phenol.

Phenolic compounds are active compounds that can act as antioxidants and affect food flavor and shelf life (Purnama, 2020). *Total phenolic compounds* are the main compounds that play a role in the antioxidant activity of gotu kola (Saputri & Damayanthi, 2015). The highest total phenolic content in gotu kola plants is in the leaves, followed by the roots, and the part with the lowest total phenols is in the stem (Zainol et al., 2003). Frying at over 100°C can reduce the total phenolic content in gotu kola sticks. The longer and higher the cooking, the more phenolic compounds will disappear (Anggraeni, 2015).

B. Sensory Characteristics of Gotu Kola Stick

In the research on gotu kola stick products with the addition of the concentration of gotu kola leaf paste, sensory testing included sensory and hedonic quality. Thirty semi-trained panelists carried out this test. Sensory testing includes sensory and hedonic quality using an unstructured line scale assessment of 0 – 10 cm.

1. Sensory Quality Test Results for Gotu Kola Sticks

Apart from the level of preference, sensory quality needs to be considered when making or developing a product. Apart from functional and nutritional value, the aspect that significantly influences the acceptability of food products being made or developed is the sensory quality aspect (David & David, 2020). According to Tarwendah (2017), sensory evaluation is a scientific method that measures, analyzes, and interprets the response of what is felt by the five human senses. In the research on gotu kola sticks with a concentration of gotu kola leaf paste, sensory quality analysis was carried out with parameters including color, aroma, taste, texture, and aftertaste. This test was carried out by 30 semi-trained panelists using an unstructured line scale assessment of 0 – 10 cm. The following are the average sensory analysis results of gotu kola stick products, listed in Table 2.

Table 2. Results of sensory quality analysis of gotu kola sticks

Parameter	Gotu Kola Leaf Paste Concentration		
	10%	15%	20%
Color	8,453[c]	5,773[b]	3,810[a]
Aroma	7,617[b]	6,850[b]	5,703[a]
Flavor	7,250[b]	6,903[ab]	5,980[a]
Texture	7,880[b]	7,790[b]	7,210[a]
Aftertaste	8,050[b]	7,843[ab]	6,993[a]

Note: Different letter notations on the same line indicate significant differences at $\alpha = 0.05$
Color assessment 0 – 10 cm (dark green – light green)

Aroma assessment 0 – 10 cm (very strong smell of gotu kola leaves – very no smell of gotu kola leaves)
Taste rating 0 – 10 cm (very not savory – very savory)
Texture assessment 0 – 10 cm (very not crunchy – very crunchy)
Aftertaste rating 0 – 10 cm (very bitter – not very bitter)

Color

Color is one of the first impressions received through the appearance of a product (Saputri, 2014). Color impressions are received through the sense of sight and influence product evaluation. The color of gotu kola sticks is influenced by the addition of gotu kola leaf paste mixed into the mixture. The resulting gotu kola sticks are bright green to dark green, the green color of the sticks is caused by the chlorophyll content in gotu kola leaves. The chlorophyll content makes the stick with the addition of gotu kola leaf paste green. Apart from that, the steam-blanching process in making gotu kola leaf paste also affects the green color produced, this process tends to make the resulting green color lighter (Putri, 2021).

Based on the results of the test of variance (ANOVA), it showed that the treatment with the addition of gotu kola leaf paste had a significant effect ($p<0.05$) on the color of gotu kola sticks. From Duncan's further test results, the 10%, 15% and 20% samples were significantly different. The results of the color sensory quality test on the 10% sample showed that gotu kola sticks tended to be bright green in color, while the 20% sample tended to be dark green.

The difference in color intensity on gotu kola sticks is caused by differences in the concentration of gotu kola leaf paste added to gotu kola sticks. The higher the concentration of gotu kola leaf paste added, the darker the resulting color on the pengagan sticks will be. The appearance of gotu kola sticks influenced the panelists' assessments. This is in line with Bunga's (2013) research on Bilqiis (2018) that the higher the percentage of gotu kola juice added to the jelly, the lower the panelists' assessment of the color.

Aroma

The aroma of a food product can influence the level of acceptance of the product. Aroma arises due to chemical stimulation received by the olfactory nerve group (olfactory nerve) in the nasal cavity (Winarno, 2002; Erda, 2011). In this study, the results of the test of variance (ANOVA) showed that the treatment with the addition of gotu kola leaf paste had a significant effect ($p<0.05$) on the sensory quality value of the aroma of gotu kola sticks. Duncan's further test results showed that the 10% and 15% samples were similar. Meanwhile, the 20% sample significantly differs from the 10% and 15% samples. Regarding the aroma attribute, the results of the sensory quality assessment showed that the gotu kola stick samples tended to have no aroma of gotu kola leaves. Gotu kola leaves have their aroma; on gotu kola sticks, the aroma of gotu kola leaves cannot be smelled because the concentration of the addition is not much. In gotu kola, essential oil compounds such as β-caryophyllene, β-cymene, trans-β-farnesene, germacrene-D, α-terpineol, limonene, and linalool were identified (Devkota et al., 2013). Devkota et al. (2013) also mentioned that among hydrocarbon compounds, several compounds such as β-element, limonene, and β-cymene are essential in fragrance applications. Research conducted by Devkota et al. (2013) identified essential oil compounds with relatively high contents, namely, γ-caryophyllene, β-caryophyllene, and caryophyllene oxide.

Flavor

Taste attributes are an essential factor that causes a product to be accepted in sensory evaluation (Erda, 2011). The taste of a product can be detected by the taste buds on the papillae on the tongue (Winarno, 2002; Erda, 2011). The results of the test of variance (ANOVA) showed that the treatment with the addition of gotu kola leaf paste had a significant effect ($p<0.05$) on the sensory quality value of gotu kola sticks. According to Duncan's further test results, the 15% sample was similar to the 10% and 20% samples. Meanwhile, the 20% sample significantly differs from the 10% sample. 10% gotu kola sticks have a very savory taste, while 15% and 20% gotu kola sticks have a savory taste; the intensity of the

savory taste decreases as the concentration of gotu kola leaf paste increases. Bilqiis (2018) describes the taste caused by adding gotu kola to his product as having a sweet, bitter taste and a slightly fresh taste in the mouth. The presence of gotu kola sticks reduces the intensity of the savory taste of gotu kola sticks.

Texture

The textures of food products that can be assessed include crispness, hardness, and elasticity. Texture also dramatically influences the acceptance of food products (Saputri, 2014). The texture of gotu kola sticks assessed in this sensory quality analysis is crispness. Based on the results of the test of variance (ANOVA), the treatment with the addition of gotu kola leaf paste had a significant effect ($p<0.05$) on the texture of gotu kola sticks. In Duncan's further test, it was discovered that the 20% sample was significantly different from the 10% and 15% samples, and the 10% sample was not significantly different from the 15% sample. This is in line with research conducted by Ariyasa (2018) that shows that adding gotu kola leaf paste causes the water content to increase, affecting the product's crispness level. A high water content will cause more water molecules to be evaporated during the frying process; this will produce air cavities in the product, making the product texture crispier.

Aftertaste

The aftertaste attribute is no less critical than other sensory quality attributes. Aftertaste, or residual taste, is the intensity of the taste left in the mouth after the food product is swallowed. The results of the test of variance (ANOVA) showed that the treatment with the addition of gotu kola leaf paste had a significant effect ($p<0.05$) on the aftertaste of gotu kola sticks. According to Duncan's further test, the 15% sample was similar to the 10% and 20% samples. Meanwhile, the 10% sample significantly differs from the 20% sample. Adding gotu kola to food products can cause a lingering taste in the mouth called aftertaste. This is because the vallerine compound contained causes a bitter taste in gotu kola (Bilqiis, 2018). In the 10% and 15% samples, it tends to lead to a very non-bitter aftertaste; this can be shown by testing the sensory quality of the aftertaste attribute, which leads to a very non-bitter. On the other hand, in the 20% sample, the aftertaste attribute is not bitter.

2. Hedonic Test Results for Gotu Kola Sticks

Hedonic testing was conducted to determine the panelists' preference level for gotu kola stick products by adding various concentrations of gotu kola leaf paste. The parameters used in this test include color, aroma, taste, texture, aftertaste, and overall. The following are the average values of the hedonic test listed in Table 3.

Table 3. Results of hedonic analysis of gotu kola sticks

Parameter	Gotu Kola Leaf Paste Concentration		
	10%	15%	20%
Color	7,480[a]	7,353 [a]	6,910 [a]
Aroma	7,547[b]	6,603[a]	6,897[ab]
Flavor	7,470[b]	6,880[ab]	6,073[a]
Texture	7,927[b]	7,633 [ab]	7,160[a]
Aftertaste	7,603[a]	7,273 [a]	6,800[a]
Color	7,520 [a]	7,273 [a]	6,857 [a]

Note: Different letter notations on the same line indicate significant differences at $\alpha = 0.05$

Color assessment 0 – 10 cm (very dislike – very like)
Scent rating 0 – 10 cm (very dislike – very like)
Taste rating 0 – 10 cm (very dislike – very like)
Texture assessment 0 – 10 cm (very dislike – very like)
Aftertaste rating 0 – 10 cm (very dislike – very like)
Overall rating 0 – 10 cm (very dislike – very like)

Color

Color is one of the first things present and gives a particular impression of the appearance of a product (Saputri, 2014). Therefore, color appearance dramatically influences the panelists' assessment of the level of liking of a product. In this study, the color attribute of gotu kola sticks had no significant effect ($p>0.05$); based on Duncan's further test results, gotu kola sticks were not significantly different from the color attributes. The 10% sample is similar to the 15% and 20% samples. Based on the assessment of the sensory quality of color attributes, the brighter the green Color of the gotu kola stick, the higher the sensory quality value of the gotu kola stick by the panelists. In line with this, the sample with 10% gotu kola leaf paste was the most preferred by the panelists, followed by the 15% and 20% samples, respectively. This aligns with Bunga (2013) and Bilqiis (2018), who said that adding gotu kola juice will reduce panelists' liking for the Color.

Aroma

Apart from the color attribute, the aroma attribute also plays a vital role in the level of liking of a food product. According to the results of the analysis of variance (ANOVA) test, it was shown that the treatment with the addition of gotu kola leaf paste had no significant effect ($p>0.05$); based on Duncan's further test results, the 10% sample was significantly different from the 15% sample. Meanwhile, the 20% sample is similar to the 10% and 15% samples. Regarding the aroma attribute, the three samples have no aroma of gotu kola leaves. Based on the panelists' assessments, the most preferred samples were the aroma attributes with the addition of gotu kola leaf paste at 10%, 20%, and 15%.

Flavor

The taste attribute is one attribute that plays a vital role in assessing preferences for gotu kola stick products. Based on the test of variance (ANOVA), it showed that the addition of gotu kola leaf paste had a significant effect ($p<0.05$) on the taste of gotu kola sticks. Duncan's further test results showed that the 10% and 20% samples differed significantly. However, the 15% sample is similar to the 10% and 20% samples. In the taste attribute, the 10% sample was most liked by the panelists. Then, followed by samples of 15% and 20%.

Texture

Another attribute that influences the liking assessment is Texture. In this study, the Texture assessed was the crunchiness of gotu kola sticks. The results of the test of variance (ANOVA) showed that the addition of gotu kola leaf paste had no significant effect ($p>0.05$) on the Texture of gotu kola sticks. According to Duncan's further test results, the 10% sample was significantly different from the 20% sample; the 15% sample was not significantly different from the 10% and 20% samples. The 10% sample obtained the highest crispness value, which aligns with the results of the panelists' assessment that the 10% sample was the most preferred, followed by the 15% and 20% samples.

Aftertaste

The results of the test of variance (ANOVA) on the aftertaste attribute showed that the treatment with the addition of gotu kola leaf paste had no significant effect ($p>0.05$). Duncan's further test results show that the 10%, 15%, and 20% samples are not significantly different. Gotu kola sticks do not cause a bitter aftertaste in the oral cavity, and the most preferred sample is the 10% sample, followed by the 15% and 20% samples, respectively.

Overall

The product with the highest overall value is the most preferred. The results of the test of variance (ANOVA) showed that the treatment with the addition of gotu kola leaf paste had no significant effect ($p>0.05$) on the overall variable value. Duncan's further test results showed that the 10%, 15%, and 20% samples were similar. Based on the overall assessment of the panelists, the most preferred sample was the

sample with the addition of 10% of gotu kola leaf paste, followed by samples of 15% and 20%, respectively.

IV. CONCLUSIONS AND NEWNESS

Based on the results of research that has been carried out, differences in the concentration of gotu kola leaves influence the total phenolic content, sensory quality in the parameters of color, taste, texture, aroma, and aftertaste, as well as hedonic quality in the parameters of aroma, taste, and texture. Meanwhile, differences in the concentration of gotu kola leaves did not influence the hedonic quality of color, aftertaste, and overall parameters.

This Gotu kola stick has the potential to be further developed and marketed.

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