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Effect of green tea extract addition on antioxidant activity, physicochemical, and organoleptic properties of functional beverages

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ABSTRACT

Antioxidants are compounds that can capture free radicals. Green tea is an herbal beverage that contains antioxidants. Non-dairy creamer is an additive made from vegetable oil. Green tea can be made into powdered instant beverages with the addition of non-dairy creamer. This study aimed to determine the effect of the addition of green tea extract on organoleptic properties, acceptability, antioxidant content, nutritional content, and the results of the economic value of non-dairy creamer functional beverage products. The research design used was a complete randomized design (CRD) using three treatments, namely the addition of 0.8 g, 0.9 g, and 1.0 g of green tea extract, with three replications. Organoleptic test was conducted on each treatment to determine the best treatment in terms of taste, color, and aroma. Antioxidant activity test was also performed on each treatment. A proximate test was then conducted on the best treatment to determine the nutritional content. The results reveal that the addition of green tea extract has generated a significantly different effect on organoleptic properties and antioxidant activity in non-dairy creamer functional beverages. The best treatment was F1, namely the addition of 0.8 g green tea extract, which has generated results in the form of color 4.05, taste 5.67, aroma 4.15 on a scale of 1–7, then antioxidant activity of 4,973.53 ppm, water content 1.42%, ash content 1.35%, protein content 2.30%, fat content 2.13%, and carbohydrates 90.52%.

1. Introduction

Herbal tea is a mixed beverage product of tea and herbal plants that is efficacious to help cure various diseases and beneficial as a body refreshing beverage (Hambali et al., 2005). Green tea is a kind of tea product that is processed without using an enzymatic oxidation method. Green tea in Indonesia is usually processed using the planning method (roasting). As a result, the content of chemical compounds in green tea, such as catechin and other polyphenolic compounds, are still quite high and very beneficial for health. Polyphenols contained in green tea consist of several compounds, such as flavanols, flavandiols, flavonoids, and phenolic acids, which can amount to 30% by weight of dry tea. Among all compounds, the largest component is the flavanol compound, commonly referred to as catechin (Anggraini, 2017).

Antioxidants are compounds that can protect cells from damage owing to their ability to inhibit the oxidative damage process caused by free radicals (Hartanto, 2012). Free radicals are a group of chemicals, either atoms or molecules, that have unpaired electrons on their outer layer or have various other active ingredients. Free radicals that take electrons from DNA can cause alteration in the structure of DNA, causing the emergence of mutant cells. This can cause the oxidative stress, namely an imbalance condition between the amount of free radicals present and the amount of antioxidants in the body. Antioxidants are needed to prevent oxidative stress (Werdhasari, 2014).

Instant powdered beverages are processed foods that are commonly in powder form, easily soluble in water, practical in serving, and have a long shelf life due to their low water content (Kumalaningsih, 2005). For example, non-dairy creamer can be used as a creamer substitute. Non-dairy creamer can be referred to as non-milk produts creamer, as it is made from vegetable oil. Non-dairy creamer has a longer storage period than milk. Besides, non-dairy creamer is also safe for consumption by people who suffer from lactose intolerance as it is made from vegetable fats that do not contain lactose. In addition, the raw material price of vegetable fat from palm oil is relatively cheaper than milk. Non-dairy creamer products can replace milk creamer products commonly added in tea, coffee, and chocolate drinks (Affandi et al., 2003). One of the innovations or ways to enjoy green tea is to make it an instant powder beverage with the addition of non-dairy creamer. Based on this description, this study aims to (1) diversify powder beverage products, namely making non-dairy creamer functional beverages with the addition of green tea extract in different levels, and (2) determine the effect of the addition of green tea extract on organoleptic properties, acceptability, antioxidant content, nutritional content, and the results of the economic value of non-dairy creamer functional beverage products.

2. Methods

2.1 Tools and materials

The materials used in this study were water, non-dairy creamer, green tea extract (from Lembang), dextrose, DPPH solution, and distilled water. The tools used in this study were measuring cup, erlenmeyer flask, filter paper, analytical balance, cup, desiccator, ultrasound bath, evaporator, spray dryer, oven, and mesh 80.

2.2 Treatment and analysis

This study employed the complete randomized design (CRD) method with three treatments (F1: addition of 0.8 g green tea extract; F2: addition of 0.9 g green tea extract; and F3: addition of 1.0 g green tea extract) in three replications. Next, at the analysis stage, as many as 30 moderately trained panelists conducted organoleptic tests on each treatment using a scoring test with assessment criteria on the parameters of color, taste, and aroma, with the assessment scores used ranging from 1–7 (score 1 indicates very dislike and score 7 indicates very like). Antioxidant activity (DPPH) test was also performed on each treatment. Then, proximate analysis was carried out on the best treatment of non-dairy creamer functional beverages to determine the nutritional content.

Figure 1. Non-dairy creamer functional beverage products.

3. Results and Discussion

Organoleptic tests are very commonly used to assess quality in the food and other agricultural products. Occasionally, these assessments can generate very precise results. In several cases, the accuracy of assessment using the sensory perception even exceeds the accuracy of the most sensitive tools (Susiwi, 2009). Organoleptic test results on each treatment are presented in Table 1.

Table 1. Organoleptic test results of each treatment of green tea addition

Treatment	Organoleptic Test		
	Color	Taste	Aroma
F1 (addition of 0.8 g green tea extract)	4.05 ± 0.02^{b}	5.67 ± 0.02^{a}	4.15 ± 0.03^{b}
F2 (addition of 0.9 g green tea extract)	4.26 ± 0.02^{b}	4.56 ± 0.03^{b}	4.26 ± 0.03^{b}
F3 (addition of 1.0 g green tea extract)	5.17 ± 0.04^{a}	4.04 ± 0.02^{c}	4.78 ± 0.01^{a}

Description: The same letter indicates no significant difference at the 5% Duncan test level

Based on the results of the statistical analysis of the Duncan test, the addition of green tea extract has generated a significantly different effect on organoleptic properties, both in terms of color, aroma, and taste in non-dairy creamer functional beverages. The panelists tended to prefer the non-dairy creamer functional beverages, as seen from the scores they gave, namely ranging from 4.05–5.67 on a rating scale of 1–7. Among the three treatments of green tea addition to non-dairy creamer functional beverages, the most preferred treatment was F3 (addition of 1.0 g green tea), which has resulted a value on color of 5.17, taste 4.04, and aroma 4.78.

Color is a sensory attribute that can be measured using the sense of sight. The sensory quality of the product can be evaluated by looking at the form, dimensions, clarity, turbidity, style, and surface properties of the material being tested (Setyaningsih et al., 2010).

The addition of green tea generates a significantly different effect on the color of non-dairy creamer functional beverages; the more green tea is added, the darker or more intense the green color of the beverage will be. The color alteration is caused by the chlorophyll content in green tea, causing the color of the beverage to become green (Syah, 2006), also caused by the boiling duration (Fadilla et al., 2022). The green tea used in this study is green tea in powder form or better known as matcha, so that the generated green color is more clearly visible than green tea brewed with hot water.

Taste is one of the essential factors that can determine whether a product is acceptable or not by consumers. Taste is a sensory sensation perceived by the tongue. Human taste sensing includes four main flavors, namely sweet, bitter, sour, and salty. There are also additional responses when the taste perceived by the tongue is previously modified (Zuhra, 2006).

The addition of green tea generates a significantly different effect on the aroma of non-dairy creamer functional beverages. The more the addition of green tea, the more the average panelist disliked the non-dairy creamer functional beverage. This is because the generated functional beverage exhibits the bitter aftertaste, even though honey has been added. The bitter taste is due to the caffeine and L-theanine content of green tea (Heiss, 2008). The flavor of green tea powder (matcha) is resulted through processing, namely steaming, drying, removing stems, midribs, and leaf fibers, then grinding until fine using a stone mill (Tokunaga, 2004).

Aroma is one of the parameters in testing sensory properties (organoleptic) using the sense of smell. Aroma is said to be acceptable if the tested material generates a specific aroma according to the desired parameters (Kusmawati et al., 2000).

The addition of green tea generates a significantly different effect on the aroma of non-dairy creamer functional beverages, because with the addition of more green tea, the generated aroma is more distinctive. The distinctive aroma of green tea has resulted due to the reaction of amino acids (L-theanine) with catechins at high temperatures to generate aldehydes, but it is also caused by the content of organic acids and resinous substances in green tea (Syah, 2006).

Table 2. Effect of addition of green tea extract at different level on antioxidant properties

Treatment	IC50 Value (ppm)
F1 (0.8 g of green tea extract)	4,973.5
F2 (0.9 g of green tea extract)	5,147.2
F3 (1.0 g of green tea extract)	5,465.4

According to Molyneux (2004) and Tristantini et al. (2016), antioxidant properties are classified as very strong if the resulted IC50 value is less than 50 ppm, while it is classified as strong if the IC50 value ranges from 50 ppm to 100 ppm. This means the smaller the IC50 value, the stronger the antioxidant properties. Hence, in this study, the antioxidant content of the most preferred treatment, namely F1 treatment, shows a value of 4,973.53 ppm, indicating that the antioxidant properties in it are classified as weak or not strong. The addition of antioxidants can be conducted by increasing the amount of green tea extract into the beverage, but this can change its taste to become bitter, even though the antioxidant properties are weak.

Based on the results of organoleptic test and antioxidant activity analysis, the best results were obtained in F1 treatment, because this treatment has generated the best antioxidant activity value, also has generated a less bitter taste based on organoleptic test. Proximate test was then conducted on F1 treatment to determine its nutritional content.

Table 3. Proximate test results on F1 treatment as the best treatment

No.	Analysis's Parameter	Result	Result's Unit	Testing Method
1.	Water content	1.42	%	SNI-01-2891-1992
2.	Ash content	1.35	%	SNI-01-2891-1992
3.	Protein content	2.30	%	SNI-01-2891-1992
4.	Fat content	2.13	%	SNI-01-2891-1992
5.	Carbohydrates	90.52	%	By difference
6.	Total Plate Count (TPC)	2.1 x 102	CFU/g	SN1-01-2897-1992
7.	Salmonella - Shigella	Negative	-	Qualitative
8.	*Escherichia coli*	Negative	-	Qualitative
9.	Coliform	< 2.0	APM/gr	Qualitative
10.	Yeast and mold	2.1 x 101	Colony/gr	Qualitative

Nutritional content is the content of nutrients contained in a food or beverage, and is generally divided into two, namely macronutrient content and micronutrient content. Macronutrients include protein, fat, and carbohydrates. In this study, the macronutrient content in non-dairy creamer functional beverage with the addition of 0.8 g green tea extract, namely the total calories contained in each serving portion (33 g), comprises the water content of 1.42%, ash content 1.35%, protein content 2.30%, fat content 2.13%, and carbohydrates 90.52%.

4. Conclusions

The addition of green tea generates a significantly different effect on organoleptic properties and antioxidant activity in non-dairy creamer functional beverages. The best results were obtained in the F1 treatment, namely with the addition of 0.8 gr of green tea extract, the results obtained were color 4.05, taste 5.67, aroma 4.15 on a scale of 1–7, antioxidant activity of 4,973.53 ppm, water content 1.42%, ash content 1.35%, protein content 2.30%, fat content 2.13%, and carbohydrates 90.52%. The resulted green tea products can be applied to various other food and beverage products.

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