Organoleptic properties evaluation of purple *Hibiscus sabdariffa* L (Roselle) calyx extract-fortified yogurt

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Abstract. Yogurt is a bacteria fermented milk product, containing bioactive peptide components, which potential as antioxidant, reducing damage of cells caused by free radicals. Purple *Hibiscus sabdariffa* L (roselle) calyx has anthocyanin and phenolic compound which has capacity as antioxidant. The addition of purple rosella calyx extract to yogurt increases the antioxidant potential, as well as in organoleptic value. The aim of this study was to determine which the best concentration of purple *Hibiscus sabdariffa* L (roselle) calyx extract-fortified yogurt, based on organoleptic evaluation. This study used organoleptic evaluation was involving 30 panellists, consist of the hedonic test comprised color, taste, aroma, texture and the overall value, and the hedonic quality test comprised color, sour taste, roselle taste, sweet taste, dairy aroma, and texture. Factor of treatment was the concentration of purple roselle calyx extract-fortified in pasteurized cow’s milk fermented by lactic acid bacteria, *Lactobacillus bulgaricus*, *Streptococcus thermophiles*, and *Lactobacillus acidophilus*, consisted of 3 levels, i.e. 0.5; 1; 1.5% (v/v). Data was analysed using Kruskal-Wallis nonparametric test, if the result was significantly different (p<0.05) then it processed using Mann-Whitney test (α=5%). The result of this study showed that 1.5% was the most preferable concentration of fortification by panellist based on its color. The average panellist also stated that the 1.5% was has darker color (less red) compared to 0.5 and 1%. The color of 1.5% concentration is most preferable (highest average value, 3.83) because on its darker color than the others.

1. Introduction

Milk known as a highly nutritious product that used for health worldwide. Milk contains several physiological functional components, including protein, vitamins such as vitamin E and C as well as carotenoids and flavonoids with antioxidant content. Antioxidant has a capacity provide protection from the exposure of oxidative stress, that causing acute and chronic disease [1, 2]. In recent year, people efforts to diversify processed products from milk are growing. Yogurt is one of the functional foods derived from milk [3].

Yogurt is a fermented milk product that rich in nutrient, which obtained by fermentation of fresh milk or milk solution with lactic acid bacteria (LABs). Yogurt has effect in improving the intestinal environment and immunity [4]. Based on its taste, yogurt is divided into plain, fruit, and flavored yogurt. Plain yogurt is pure yogurt, fermented from milk using *Lactobacillus bulgaricus*, *Lactobacillus acidophilus* and *Streptococcus thermophilus* cultures. Fruit yogurt is yogurt and addition of fruit juice, fruit flesh, or other part of fruits as taste, color and aroma as enhancer to increase the organoleptic
nature of yogurt [5]. Flavored yogurt are prepared by adding sugar or other sweetening agents and synthetic flavorings and colorings to plain yogurt. The addition of roselle extract can be conducted to improve the quality of yogurt.

Roselle (Hibiscus sabdariffa L.) is a herbal plant that belongs to the family Malvaceae [6]. Roselle calyx contains protein, fat, fiber, minerals like calcium, phosphorus, and iron, and vitamins like thiamine, riboflavin, niacin, and ascorbic acid. Besides that it contains carotenoid, flavonoids, and alkaloids compounds. Roselle is potential as antihypertension, antihyperlipidemic, hepatoprotective, anticancer, and antioxidant activity [7]. Therefore, it is necessary to conduct a study in order to evaluate the organoleptic characteristic of purple roselle-fortified yogurt.

2. Materials and methods

2.1. Materials
A well-pasteurized cow’s milk yogurt was used for yogurt making, fermented using 3 strain of lactic acid bacteria (Lactobacillus bulgaricus, Streptococcus thermophilus, and Lactobacillus acidophilus) starter (Yogourmet®, Lyo-SAN INC: 500 Aeroparc, C.P. 589, and Lachute, QC. Canada, J8H, 464). Purple Roselle (Hibiscus sabdariffa L.) calyx used was purchased from local supplier, East Java, Indonesia.

2.2. Extraction of purple roselle calyx filtrat
Dried purple calyx were finely ground into flour, sieved using a 60-mesh sieve. 20 gr roselle flower flour was dissolved in 100 mL water and pasteurized at 63-65°C for 30 min. The liquid (upper solution) was separated carefully and moved to another bottle for next process [8].

2.3. Making of purple roselle-fortified yogurt
Raw cow’s milk was pasteurized at 72°C for 5 minutes and inoculated with aliquot of starter culture (3%) when the temperature was cooled down at 43°C, the incubated at 43°C until the required pH of yogurt 4.5±0.1 was reached. Previously, the starter culture was made by adding 0.35 gram of starter into 70 ml pasteurized milk and incubated in 45°C for 4 hours until its pH was 4.5±0.1. The yogurt was fortified with several levels of extract of purple roselle, i.e. 0.5; 1; 1.5 (% v/v).

2.4. Organoleptic evaluation
Organoleptic evaluation methods were using hedonic and hedonic quality test, involving 30 panelists. The hedonic test comprised color, taste, aroma, texture and the overall value, and the hedonic quality test comprised color, sour taste, roselle taste, sweet taste, dairy aroma, and texture. These products and materials were provided for every panelist desk in the following manners: (1) a cup of purple roselle-fortified yogurt, (2) a cup of drinking water for mouth cleansing, and (3) questionnaire form. Every panelist should fill in the questionnaire form for the assessment of the product.

2.5. Data Analysis
The data in the form of average value from hedonic and hedonic quality test was collected and analysed using Kruskal-Wallis nonparametric test. If the result was significantly different (p<0.05) then it processed using Mann-Whitney test (α=5%).

3. Result and discussion
Hedonic test is the most used test for measuring the level of favorability or acceptance towards a product. This level of assessment is called hedonic scale, i.e. dislike very much, dislike moderately, neutral, liked moderately, liked very much. The average value of organoleptic evaluation using hedonic test was listed in table 1.
Table 1. Average value of organoleptic evaluation using hedonic test

| Concentration of roselle (%) | Organoleptic properties | Color | Taste | Aroma | Texture | Overall Value |
|-----------------------------|-------------------------|-------|-------|-------|---------|--------------|
| 0.5                         |                         | 2.97  | 2.90  | 3.40  | 3.50    | 3.23         |
| 1                           |                         | 3.30  | 2.80  | 3.40  | 3.53    | 3.00         |
| 1.5                         |                         | 3.83  | 2.83  | 3.30  | 3.33    | 3.33         |
| p                           |                         | 0.001 | 0.879 | 0.818 | 0.822   | 0.173        |

Note: five-points hedonic scale; (1) dislike very much; (2) dislike moderately; (3) neutral; (4) liked moderately; (5) liked very much. Different superscript notation (a, b) is showing that the value is significantly different (p<0.05).

The hedonic test results showed that there was a significant difference in the panelists preference on the color of the purple-roselle fortified yogurt (p<0.05), and the most favorable was the color of 1.5% concentration (average value 3.83). There was no significant difference on taste, aroma, texture, and overall value.

Hedonic quality test is used to identify important sensory properties in a product and to give information about the level or intensity of the property. Properties to be determined in this research are color, sour taste, roselle taste, sweet taste, dairy aroma, and texture. The average value of organoleptic evaluation using hedonic quality test was listed in table 2.

Table 2. Average value of organoleptic evaluation using hedonic quality test

| Concentration of roselle (%) | Organoleptic properties | Color | sour taste | roselle taste | sweet taste | dairy aroma | texture |
|-----------------------------|-------------------------|-------|------------|---------------|-------------|-------------|---------|
| 0.5                         |                         | 2.20  | 2.60       | 3.37          | 3.40        | 3.43        | 3.33    |
| 1                           |                         | 2.67  | 2.53       | 3.33          | 3.27        | 3.30        | 3.33    |
| 1.5                         |                         | 3.37  | 2.80       | 3.50          | 3.30        | 3.60        | 3.03    |
| p                           |                         | 0.00  | 0.884      | 0.773         | 0.679       | 0.474       | 0.253   |

Note: five-points hedonic quality scale; color (1)pale red, (2) pink, (3) less red, (4) red, (5) deep red; sour taste (1) very sour, (2) moderate sour, (3) less sour, (4) not sour, (5) sour; roselle taste (1) bitter taste, (2) very tasteful, (3) tasteless, (4) moderate tasteful, (5) tasteful; sweet taste (1) bitter taste, (2) very tasteful, (3) tasteless, (4) moderate tasteful, (5) tasteful; dairy aroma (1) very smelly, (2) less smelly, (3) no smell, (4) yogurt-smell, (5) very yogurt-smell; texture (1) watery, (2) less watery, (3) a bit thick, (4) thick, (5) very thick. Different superscript notation (a, b) is showing that the value is significantly different (p<0.05).

The result of hedonic quality test showed that there was a significant difference in the panelists preference on the color of the purple roselle-fortified yogurt (p<0.05), and there was no significant difference on sour taste, roselle taste, sweet taste, dairy aroma, and texture.

The average value of organoleptic evaluation about the color of purple roselle-fortified yogurt was significantly different in both hedonic or hedonic quality test (p<0.05). Table 1 data showed that extract of purple roselle calyx addition with different level of concentration affect the preference of the panelist. The most favorable was the color of 1.5% concentration (highest average value, 3.83). Organoleptic value of purple roselle-fortified yogurt’s color was about 2.20-3.37, that is on pink and less red category. The yogurt with the darker color was shown at 1.5% (3.37) and the yogurt with the lightest color is shown at 0.5% (2.20). The higher concentration of purple roselle fortification, the higher level of panellist preference. Purple roselle addition was making the original yogurt color (white) turn into less red. It was caused by the anthocyanin compound in roselle. Roselle is rich with anthocyanin [9], which is a pigment that forming reddish-purple color in roselle calyx. Anthocyanin has function as an antioxidant, and useful in diuretics and sedative treatments [10, 11]. Color is one of the quality
attributes that play an important role in the identification and final selection of food [12]. It is one of the parameters that used for food assessment and quality improvement [13]. Visually, the color factor will appear first and often determine the value of a product [14]. If a food product has an attractive color, it can increase the will of consumers to try the food.

The level of acceptance about the taste of purple roselle-fortified yogurt was no significant difference between the concentration (p>0.05). The panelist opinion about its taste was neutral. There was no significant difference either about the level of sour, roselle, nor sweet taste of this product. It means that the different concentration of purple roselle fortification to the yogurt (0.5; 1; 1.5 %) did not affect the taste of this product significantly. The average value of sour and roselle taste was increasing with higher concentration. Otherwise, the average value of sweet taste was decreasing with higher concentration. Originally, yogurt has sour taste derived from lactic acid as the metabolic product of lactic acid bacteria (LABs) as it utilize milk lactose as a source of carbon and energy [15]. LABs that was used as the starter of the yogurt in this study was Lactobacillus bulgaricus, Streptococcus thermophilus, and Lactobacillus acidophilus. LABs fermentation produce lactic acid which determine the sourness of yogurt [16]. The more concentration of roselle, the more sour the product got. The sourness was influenced by the compound derived from roselle, i.e. citric acid and malic acid [17].

There was no significant difference on the average value of aroma in different level of concentration of purple roselle-fortified yogurt (p>0.05). The panelist preference about its aroma was neutral (average value 3.30-3.40). It means that the fortification of yogurt with purple roselle extract was not affect the preference of the panelist on its aroma. Their assessment about its dairy aroma was about 3.30-3.60. They opined that there was no dairy aroma smell in this product, when the yogurt should has yogurt smell, normally. Aroma is related to sense of smell. Testing on aroma is important in food industry because it is an assessment whether the consumer liking or disliking its product. The aroma and taste of soured milk products is characterized by numerous volatile bacterial metabolites, some of which are by-products of lactic acid fermentation or are produced by other reaction mechanisms. Lactic acid itself is suggested to be one of the major compounds significantly contributing to yogurt flavour. The characteristic of yogurt smell is caused by lactic acid fermentation which forms volatile compound, such as acetaldehyde, diacetyl, acetoin, and acetone. The presence of nonvolatile or volatile acids and carbonyl compounds, and especially the group of carbonyl compounds is believed to have a significant influence on the final yogurt aroma due to their relatively higher concentrations [18]. The lack of yogurt smell in this product might be affected by the roselle aroma, which has sour aroma. Roselle has several acid compound, i.e. citric acid and malic acid [17]. The roselle aroma might covers the yogurt smell on this product.

There was no significant difference on the average value of texture in different level of concentration of purple roselle-fortified yogurt (p>0.05). The panelist preference about its aroma was neutral (average value 3.33-3.53). It was implied that the purple roselle addition into yogurt made the texture a bit thick. Yogurt consistency generally is soft and thick. LABs fermentation is changing milk particles into smaller molecules, causing protein molecule degradation into peptides [19]. LABs fermentation, such as Streptococcus thermophilus has ability to produce lactase, which influenced yogurt consistency. Lactase degrade lactose and produce lactic acid, that increasing yogurt thickness. Yogurt viscosity also influenced by its pH. Decreasing consistency on this product might due to the addition of purple roselle extract liquid that increasing the watery content of the yogurt. Relatively high water levels make the viscosity decrease.

4. Conclusion
There was a significant difference in the panelists preference on the color of the purple-roselle fortified yogurt (p<0.05), and no significant difference on taste, aroma, texture, and overall value. There was a significant difference in the panelists preference on the color of the purple roselle-fortified yogurt (p<0.05), and there was no significant difference on sour taste, roselle taste, sweet taste, dairy aroma,
and texture. The color of 1.5% concentration is most preferable (highest average value, 3.83) because its darker color than the others.

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