Study of solvent temperature on physical quality of yogurt green tea powder

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Abstract. This kind of yogurt is generally found in semi-liquid form. Processing yogurt into powder will be more *flexible* when transporting or when being carried anywhere and does not require more storage. Green tea has polyphenolic compounds such as catechins, epicatechins, and gallic acid. The application of green tea in the processing of powdered yogurt requires a solvent temperature study to produce a good quality product. The purpose of this study was to determine the effect of solvent temperature on viscosity, color, taste, aroma, and preferences of panelists in reconstituted green tea yogurt. This study used a completely Randomized Design (CRD) 4 treatments with 3 replications. Treatment using solvent temperatures of 30°C, 45°C, 60°C, and 75°C. The results showed that the use of 75°C solvent temperature in reconstituted green tea yogurt produced greater viscosity than 30°C, 45°C, and 60°C. Using different solvent temperatures did not affect color, aroma, and taste. There was a decrease in the preference rating for reconstituted green tea yogurt as the solvent temperature increased. All these studies indicated that the best solvent temperature for reconstituted green tea yogurt was 30°C.

1. Introduction

Various dairy products, both food [1–5] and non-food [6,7] with various development concepts are increasingly being studied. Products with the application of natural ingredients [8–13] and the development of processes that can target and facilitate consumers are increasingly in the market. In this study, yogurt was made with the addition of green tea to add a distinctive color and flavor to the product. Green tea has polyphenolic compounds such as catechins, epicatechins, and gallic acid. These polyphenols have a positive effect on the viability of *Lactobacillus spp* [14] and provide a distinctive color and flavor [15]. The content of polyphenols in green tea can also reduce the risk of heart disease and inhibit the growth of lung cancer cells, colon cancer, especially skin cancer cells [16].

This type of yogurt is generally found in semi-liquid form. This form requires more storage space and that is less flexible when transporting or carrying it everywhere. The application of powder preparations is the choice to overcome these conditions. Generally, powder in food has a longer shelf life than liquid preparations, but the study of the temperature of the dissolution of yogurt powder is needed. This is due to the presence of microorganisms in the product.

On the other hand, the dissolving temperature plays a very important role in the solubility of powdered yogurt during reconstitution. A well-dissolved powder will determine the viscosity (viscosity)

of the yogurt product. On the other hand, using the right solvent temperature will release aromatic compounds that determine aroma (acetaldehyde in yogurt and catechins in green tea), as well as taste (catechins) and color (chlorophyll) which characterize the specific product. Brewed green tea at a temperature of 70℃ can obtain high levels of tannins and catechins and low levels of caffeine [17]. The right dissolving temperature can maintain the antioxidant activity and other chemical qualities of yogurt powder. In accord with the explanation, physical quality (viscosity) and organoleptic (color, taste, aroma, and liking) quality will be examined using powder solvent temperature.

2. Materials and methods

2.1. Research and procedure

2.1.1. Preparation of the yogurt starter. The starter media was made from 10% (w/v) reconstitution milk. The media was placed in a test tube and heated at 121℃ for 15 minutes by *autoclaving*. The media that has been cooled was then inoculated with a commercial product culture of 3% (w/v). The media was homogenized and incubated at 37℃ for 14 hours. Activation was carried out 2 times before being used as a starter for yogurt and culture storage in frozen conditions [3,9].

2.1.2. Making green tea extract. Green tea extract was made from dry green tea which was extracted with hot water then filtered. Green tea used was dry green tea which was sold commercially. The green tea extraction process was carried out for 3 minutes with water at 90℃. The comparison of green tea with water used in making green tea extract was 1: 20 [18].

2.1.3. Making reconstituted green tea yogurt. The process of making yogurt was made from reconstituted 10% (w/v) skimmed milk, 20% (w/v) green tea extract and 5% (w/v) sugar. The mixture was heated at 105℃ for 5 minutes. After chilling, the mixture was inoculated with a commercial product culture as much as 3% and incubated at 37℃ for 14 hours. Powder texture using an oven at 50℃. Powdered yogurt was stored for 1 day first, then reconstituted with warm water according to the treatment, namely 30℃, 45℃, 60℃, and 75℃ with a ratio of 1 : 3 (powdered yogurt: water volume). Carried out observations of physical and organoleptic qualities [9,19].

2.2. Measured parameters

The parameters measured in this study were viscosity, color, aroma, taste, and preference for reconstituted green tea yogurt using solvent temperature.

2.3. Data analysis

Data were analyzed variants and processed with IBM SPSS Statistics 23. Treatment that showed influence, was further tested by Duncan's method.

3. Results and discussion

3.1. The viscosity of reconstituted green tea yogurt

Viscosity is the friction caused by a moving fluid. The amount of viscosity is expressed by a number that determines the viscosity of a liquid. The viscosity of reconstituted green tea yogurt with the use of different solvent temperatures is presented in figure 1.

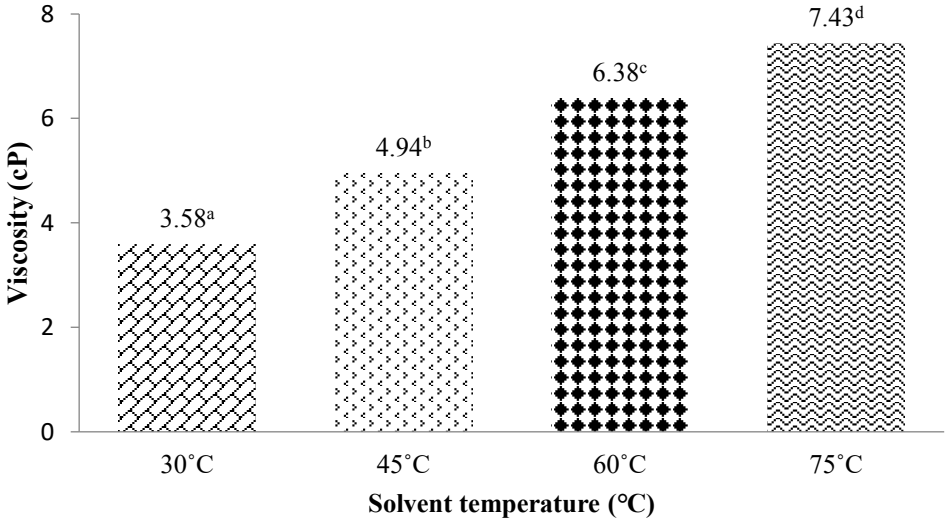

Figure 1. Viscosity of reconstituted green tea yogurt using different solvent temperatures.
Note: Different [abcd] superscripts showed marked differences (P<0.01).

The results of the analysis of variance showed that the different solvent temperatures had a very significant effect (P<0.01) on the viscosity of reconstituted green tea yogurt. Even so, based on further tests the 75℃ solvent temperature has high viscosity compared to the temperature of other solvents (figure 1). This was because the solvent temperature affects solubility. Each soluble organic component has a different temperature for the solvent to dissolve properly. Indeed, the higher temperature of the solvent, the higher solubility, and the effect of the viscosity of reconstituted green tea yogurt. The higher the temperature of the water used as a solvent in powder products, the greater the possibility of the powder being dissolved in water [20]. In this case, the viscosity of fermented milk products is between 8.28–13.00 cP [21]. The yogurt drink viscosity was around 1–2 cP [22].

3.2. Reconstituted green tea yogurt color

Color is an indicator of the assessment of organoleptic tests that is influenced by several factors, namely the brightness and clarity of the product. The color of reconstituted green tea yogurt by using the temperature of the solvent is presented in figure 2.

The results of the analysis of variance showed that the different solvent temperatures did not have a very significant effect (P>0.05) on the color of reconstituted green tea yogurt. The average color value of reconstituted green tea yogurt ranged from 3.50 to 3.90 with the color criteria tending to be dark green (figure 2). This was because the concentration of green tea was the same and there was a mixing between the color of milk and the color of green tea in case the temperature of the solvent did not affect the color change of the reconstituted green tea yogurt.

The formation of color in green tea yogurt due to an overhaul of protein and fat as well as in the fermentation process of green tea yogurt. Whereas, the fermentation process of yogurt occurs overhaul of nutritional compounds due to the activity of *L. bulgaricus* and *S. thermophilus* in the yogurt starter. This reshuffle affected the nutritional compounds found in green tea yogurt so that it affected the formation of the color of the resulting yogurt [23].

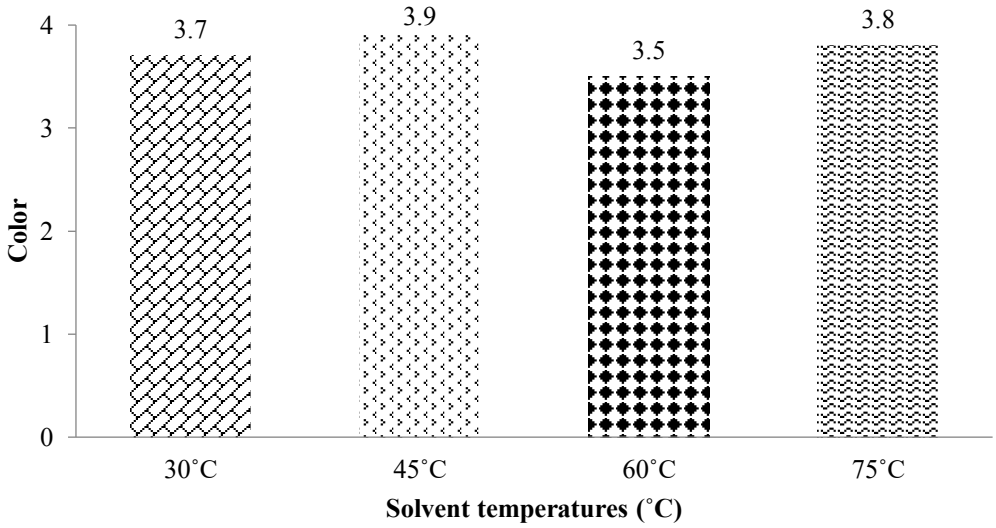

Figure 2. Color reconstituted green tea yogurt using different solvent temperature.
Description: score, 1-6 (light green-dark green).

3.3. Aroma of reconstituted green tea yogurt

The aroma is one of the physical parameters measured by the use of the sense of smell. Aroma extremely determines the quality of a product because it can decide whether a product tastes good or not. The aroma of reconstituted green tea yogurt with the use of the solvent temperature is presented in figure 3.

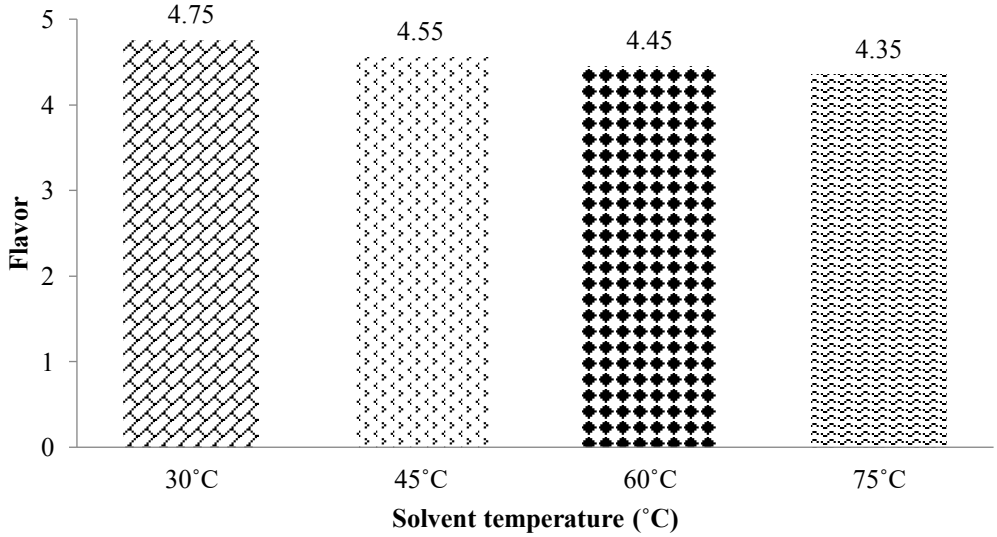

Figure 3. Reconstitution green tea yogurt aroma using different solvent temperature
Note: Score score, 1–6 (not tea scented-tea scented).

The results of the analysis of variance showed that the different solvent temperatures did not have a very significant effect ($P>0.05$) on the aroma of reconstituted green tea yogurt. The average value of the aroma in the green tea yogurt reconstitution ranged from 4.35 to 4.75 with the criteria for the scent tends to smell the tea. However, the aroma of tea decreases with increasing solvent temperature (figure 3). This was because the high temperature can remove the aromatic compounds found in reconstituted green tea yogurt. Not all treatments can produce a distinctive herbal tea aroma. The aroma in food ingredients can be generated by volatile components, but these volatile components can be lost during the

processing, especially heat [24]. The higher the temperature and duration of the reconstitution of green tea yogurt, the more volatile compounds that evaporate so that it affected the aroma [25].

3.4. Reconstituted green tea yogurt flavors

Taste is one of the parameters measured by using the sense of taste. Components that can cause flavor in a product depend on its constituent compounds. The taste of reconstituted green tea yogurt with the use of solvent temperature is presented in figure 4.

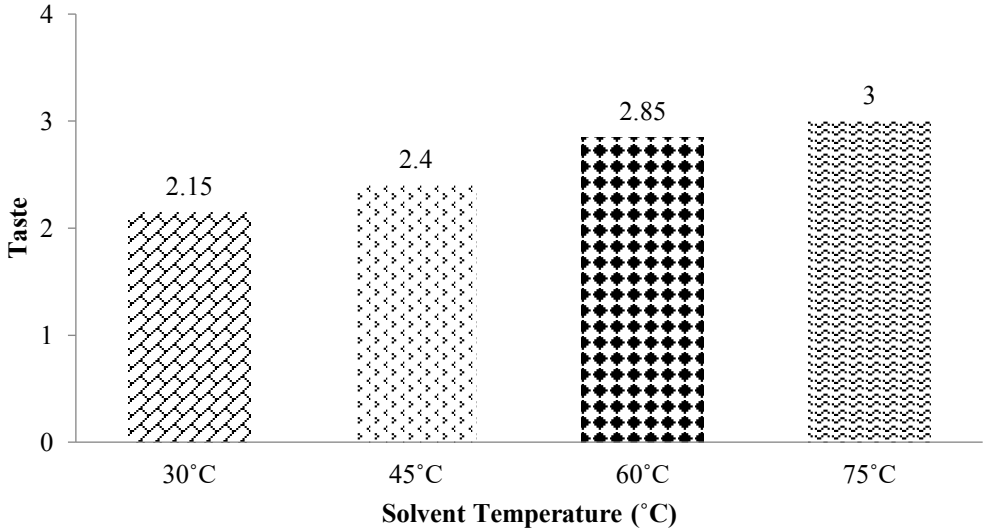

Figure 4. Reconstitution of green tea yogurt taste using different solvent temperature.
Information: Score value, 1-6 (disagree-very rapid).

The results of the analysis of variance showed that the temperature of the different solvents had no significant effect (P>0.05) on the taste of reconstituted green tea yogurt. The average value of the taste of reconstituted green tea yogurt ranged from 2.15–3.00 with the taste criteria tending to be rapid. However, the taste in reconstituted green tea yogurt rised with increasing solvent temperature (figure 4). This was because the higher the temperature of the solvent the catechin compounds in green tea yogurt increased. Catechin levels increased with increasing temperature [26]. Catechins have physical and chemical properties that were colorless, soluble in water, as well as giving a bitter and bitter taste to tea [27].

3.5. Favorite reconstitution green tea yogurt

The favorite is one of the parameters measured from the level of panelist preference on a product. A favorite of reconstituted green tea yogurt with the use of a solvent temperature was presented in figure 5.

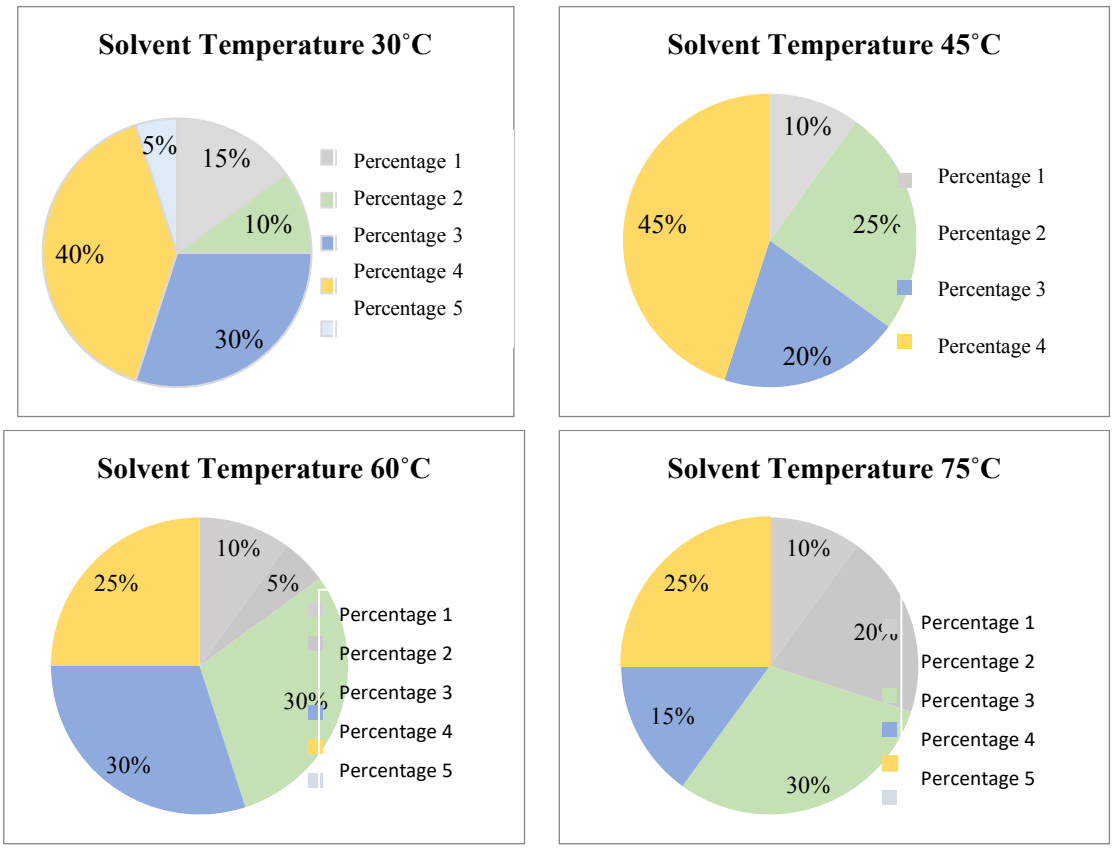

Figure 5. Percentage of panelist likes of reconstituted green tea yogurt with use of different solvent temperature. Information: score, 1-6 (dislike-really like).

The results of testing the preference for the reconstitution of green tea yogurt (figure 5) from panelists (20 people) illustrated that panelist preferences decreased with increasing solvent temperature. This was likely due to the higher solvent temperature, the catechins and tannins in green tea increased. As a result, the taste produced in green tea yogurt was a bitter or septic reconstitution. The higher the brewing temperature, the more bioactive components in the product will dissolve into the water as a brewing medium. Furthermore, these conditions will cause the antioxidant content in brewing water to be high [24]. Catechins have physical and chemical properties that were colorless, soluble in water, as well as giving a bitter and rapid taste to steeping tea [27].

The use of high solvent temperature in this study can lead to decrease the aroma of green tea yogurt. This caused the panelists' preference for reconstituted green tea yogurt to decrease as the temperature of the solvent increased. The higher the temperature and duration of the reconstitution of green tea yogurt, the more volatile compounds that evaporate so that it affected the aroma [25]. The level of preference by panelists were influenced by several things namely color, taste, attractive appearance, high nutritional value, and beneficial for consumers [28].

4. Conclusion

The use of high solvent temperature increased the viscosity of reconstituted green tea of yogurt but did not change the color, aroma, taste, and preference of reconstituted green tea yogurt. According to these findings, the best solvent temperature in reconstituted green tea yogurt was 30℃.

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