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Analysis of Proximate and Dietary Fiber of Beetroot (*Beta vulgaris L.*) and Cinnamon (*Cinnamomum Burmanii*) Yogurt

Eka Fadilla Rahma

Student, Department of Health and Nutrition, Universitas Gadjah Mada, Indonesia

Fatma Zuhrotun Nisa

Lecturer, Department of Health and Nutrition, Universitas Gadjah Mada, Indonesia

Rio Jati Kusuma

Lecturer, Department of Health and Nutrition, Universitas Gadjah Mada, Indonesia

Abstract:

Yogurt is one of the functional foods that have a positive effect on health. Beetroot and cinnamon have the potential to be added to functional foods because they contain bioactive substances that are beneficial for health, but can affect the chemical and physical properties of products.

This study aims to determine the content of dietary fiber and proximate contents in the formulation of beetroot and cinnamon yogurt. As a result, the addition of beetroot and cinnamon to yogurt had a significant effect on dietary fiber and carbohydrate content, but did not affect the moisture, ash, protein, and fat content of yogurt.

Keywords: *Yogurt, beetroot, cinnamon, dietary fiber, proximate*

1. Introduction

In response to changes in health status for the better, the development of functional foods should be continued. The Functional Food Center (2015), defines functional foods as natural or processed foods containing known or unknown biologically-active components, effective non-toxic quantities, clinically proven and beneficial for health (Martirosyan & Singh, 2015). Yogurt is one of the functional foods that have good nutrition and have a positive impact on health. It is a fermented milk product using lactic acid bacteria *Lactobacillus bulgaricus* and *Streptococcus thermophilus*.

Beetroot is one of the potential food sources to be added to functional foods. Beetroot is one of the sources of dietary fiber. According to the USDA, red beets contain 8% dietary fiber or 2.8 grams in 100 grams of fresh beetroot (Lingga, 2010). Also, beetroot is a food source containing bioactive substances, such as antioxidants and some micronutrients that are beneficial for health (Kushwaha et al., 2018).

Dietary fiber is a part of edible plants, composed of carbohydrates that are resistant to digestive processes and absorption in the small intestine, it is fermented in the colon (Lattimer & Haub, 2010). Dietary fiber has many health benefits, such as lowering the risk of cardiovascular disease, lowering cholesterol concentrations (Mcrae, 2017), improving blood sugar control and lowering excess insulin increase (Fuller et al., 2016). Foods containing high fiber can contribute to increased added value in food or functional foods (Nandi & Ghosh, 2015).

Cinnamon is a spice plant that is used as a flavor enhancer in food or beverages (Sukandar et al., 2014). Cinnamon contains carbohydrate chemical components in the form of starch and coarse fiber, low in protein and fat (Putri & Fibrianto, 2018). The addition of beetroot and cinnamon will certainly affect the chemical and physical properties of yogurt. Therefore, this study aims to find out the chemical properties, especially the levels of proximate and dietary fiber of beetroot and cinnamon yogurt.

2. Materials and Methods

2.1. Materials

Beetroot was purchased from cultivation in Yogyakarta, cinnamon was purchased from a local market in Yogyakarta, Indonesia. *Lactobacillus bulgaricus* and *Streptococcus thermophilus* were obtained from *Pusat Studi Pangandan Gizi* (Center of Food and Nutrition Studies), Universitas Gadjah Mada and cultivated in The Faculty of Animal Science, Universitas Gadjah Mada.

2.2. Yogurt Making Process

The beetroot was blanched for 3 minutes then was extracted using a juice extractor. The cinnamon was boiled for 15 minutes then filtered by filtrate paper. All ingredients according to the formula (Table 1) were blended and pasteurized at 72°C for 15 seconds, then cooled down until ±45°C. The starter cultures were mixed to the substance and incubated at 37°C for 18 h.

Ingredients	F0	F1	F2	F3	F4
UHM milk	100 ml				
Sugar	5 g	5 g	5 g	5 g	5 g
Skim milk	6 g	6 g	6 g	6 g	6 g
Starters	2,5%:2,5%	2,5%:2,5%	2,5%:2,5%	2,5%:2,5%	2,5%:2,5%
Beetroot	0 ml	5 ml	5 ml	10 ml	10 ml
Cinnamon	0 ml	0,5 ml	1 ml	0,5 ml	1 ml

Table 1: Formulation of Beetroot and Cinnamon Yogurt

- Formula 0 : yogurt without the addition of beetroot and cinnamon
- Formula 1: yogurt with the addition of 5% beetroot and 0.5% cinnamon
- Formula 2: yogurt with the addition of 5% beetroot and 1% cinnamon
- Formula 3: yogurt with the addition of 10% beetroot and 0.5% cinnamon
- Formula 4: yogurt with the addition of 10% beetroot and 1% cinnamon

2.3. Dietary Fiber Analysis

The dietary fiber was analyzed using the multienzyme method described by AOAC, 1995. Dietary fiber content was calculated by summing the content of soluble fiber and insoluble fiber.

2.4. Proximate Analysis

The proximate analysis of samples, moisture, ash, protein, and fat were determined using procedures described by AOAC, 1995. Moisture and ash were analyzed using thermogravimetry method, the protein was analyzed by micro kjeldahl method, and the fat was analyzed by soxhlet method while the carbohydrate content was calculated by the difference method. All determination was performed in duplicate.

2.5. Statistical analysis

All data were analyzed statistically using a computer program, SPSS system for windows. Normally distributed data were analyzed using One Way ANOVA and comparison of means by Post Hoc Duncan Multiple Range Test where the result significantly different. Meanwhile, data that were not normally distributed were analyzed using Kruskal Wallis test.

3. Results and Discussion

3.1. Dietary Fiber

Samples	Dietary Fiber (%)
Formula 0	4,72 ± 0,22 ^a
Formula 1	3,15 ± 0,14 ^b
Formula 2	4,81 ± 0,24 ^a
Formula 3	5,21 ± 0,26 ^a
Formula 4	6,11 ± 0,00 ^c
P	<0,001

Table 2: Dietary Fiber Content of the Beetroot and Cinnamon Yogurt

Values are reported as mean ± standard deviation. Means with a different superscript letter(s) in a column are significantly different at the level of p<0.05

The result of the dietary fiber contents can be seen in Table 3. The overall dietary fiber content of beetroot and cinnamon yogurt will tend to increase with increasing concentrations of beetroot and cinnamon added. Statistically, using One Way ANOVA analysis, there was a significant difference between the dietary fiber content of beetroot and cinnamon yogurt. The increase in dietary fiber is influenced by the components in the added substances. According to the USDA National Nutrient Database, 100 grams of beetroot contain 2.8 grams of dietary fiber. Besides, cinnamon and beetroot are thought to have a role in the increase dietary fiber through the mechanism of decreasing Lactic Acid Bacteria (LAB) in yogurt. LAB can metabolize fibers, especially insoluble fibers, because they have hydrolytic enzymes. Therefore, dietary fiber and total LAB have an inverse relationship, the more total LAB there is the decrease in dietary fiber content (Karppinen, 2003; Zubaidah et al., 2012). It was in agreement with the study by Pasca *et al.*, (2016). Cinnamon has a content of cinnamaldehyde which is antibacterial, causing the amount of LAB tends to decrease.

3.2. Proximate

Samples	Moisture (%)	Ash (%)	Protein (%)	Fat (%)	Carbohydrate (%)
Formula 0	79,28±0,00	1,07±0,00	4,40±0,02	3,01±0,17	12,23±0,14 ^a
Formula 1	80,26±0,07	0,99±0,03	4,41±0,24	2,88±0,15	11,45±0,18 ^{bc}
Formula 2	80,23±0,26	0,99±0,66	4,10±0,09	2,73±0,10	11,95±0,19 ^{ac}
Formula 3	80,75±0,05	1,01±0,02	4,18±0,16	2,82±0,09	11,24±0,32 ^{bc}
Formula 4	80,66±0,00	0,98±0,04	4,43±0,19	2,78±0,18	11,14±0,41 ^b
P	0,080	0,305	0,275	0,458	0,038

Table 3: Proximate Nutrients Composition of the Beetroot and Cinnamon Yogurt

Values are reported as mean ± standard deviation. Means with a different superscript letter(s) in a column are significantly different at the level of p<0.05

The proximate composition of beetroot and cinnamon yogurt are shown in Table 3. The moisture contents were statistically similar (p>0.05) Which indicates that the addition of beetroot and cinnamon did not affect the moisture content in yogurt. The increase in the moisture content of the formula can be influenced by the added components which are liquid, but the difference is not significant because the added concentration is not much different.

Based on the results of statistical analysis, there was no significant difference in ash content between the five beetroot and cinnamon yogurt formulas. According to (Kavalcová et al., 2015) beetroot are foods containing vitamins and minerals. This should have the potential to increase the ash content of yogurt, but the results are not significant because not all parts of beetroot are used as an addition to yogurt, it is thought that there are some minerals left in the residue when extracting beetroot juice.

Statistically, the addition of beetroot and cinnamon did not affect to the protein content of the yogurt. The protein content of yogurt is influenced by its basic ingredients, especially milk. The higher the protein content of milk the better the quality of yogurt produced (Wahyudi, 2006). In this study, milk used in all five formulas had the same amount. While the added ingredients, beetroot and cinnamon, contain not too much protein.

The addition of beetroot and cinnamon did not affect the fat content of yogurt because there was no statistically significant difference in the fat content of beetroot and cinnamon yogurt. Changes in fat levels during fermentation are caused by the hydrolysis process so that fats turn into fatty acids, glycerol, aldehydes, ketones, etc. (Iyyah et al., 2019).

The results of the measurement of carbohydrate levels of beetroot and cinnamon yogurt showed quite diverse results. Based on statistical analysis, the carbohydrates of beetroot and cinnamon yogurt had significant differences between the control group and the treatment group, but there were no significant differences in carbohydrate levels between the formula yogurts added beetroot and cinnamon. Yogurt with the addition of beetroot and cinnamon has a lower carbohydrate content than yogurt without the addition of beetroot and cinnamon. Fermentation can lower carbohydrate levels due to the use of carbohydrates by microbes as an energy source during the fermentation process (Wiliaingsih et al., 2016). (Utami et al., 2010) researched the kinetics of fermented yogurt enriched with sweet potatoes, said that yogurt control has a higher efficiency of lactic acid formation than yogurt with the addition of sweet potatoes because the substrates in yogurt are utilized optimally for the manufacture of products while yogurt with the addition of purple yams has the lowest efficiency because the substrate is utilized optimally for cell formation. The mechanism is also thought to occur in yogurt added beetroot, namely carbohydrates are widely used as substrates for the formation of microbial cells. According to (Lingga, 2010) the most carbohydrates contained in beetroot are simple sugars, glucose and sucrose. The content is thought to be used by microbes in yogurt as a source of substrates. *Lactobacillus bulgaricus* can metabolize homofermentative forming pure lactate or almost 90% pure lactate derived from glucose as a substrate(Machmuh et al., 2013).

4. Conclusion

Based on the result of the research can be concluded that the addition of beetroot and cinnamon on yogurt can affect the dietary fiber and carbohydrates content while it does not affect moisture, ash, fat, and protein content.

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