Fatty Acids Content of Yogurt Drink by Mangosteen Rind Extract (Garcinia mangostana L.)

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Abstract. This research was aimed to study the content of fatty acid from yogurt drink by mangosteen rind extract. Completely Randomized Design (CRD) was throughout the research with different concentrations of mangosteen rind extract (0, 1, 2, and 3% (v/v). The results were differences on the yogurt drink product. The addition of mangosteen rind extract on yogurt drink of goat's milk contains fatty acids both saturated and unsaturated fatty acids. The highest saturated fatty acids were observed on the palmitic fatty acids, while the highest unsaturated fatty acids were found on the oleic acid. There were changes in the profiles of fatty acids during processing of fresh goat milk into yogurt drink by mangosteen rind extract.

Keywords: fatty acid, mangosteen extract, yogurt drink

1. Introduction
Goat milk has a unique nutritional composition and characteristics compared to cow's milk that attracts consumers [1]. Fatty acid is one of goat milk composition that would give an impact syneresis and curd volume on product. The fatty acid profile, especially short-chain fatty acids (SCFA) was implicated to the sensory quality [2]. The volatile fatty acids (caproic, caprylic, and capric) influenced the specific odor and taste goat milk [3]. In addition, other types of fatty acids are acetic and butyric acid which can be beneficial as anticancer and antibiotic [4, 5]. The processing of goat milk can be done by fermentation. The fermentation process was treated by lactic acid bacteria becomes yogurt drink.

Improving the quality of yogurt drinks can be done by providing additional mangosteen rind extract [6]. Mangosteen rind were contains of xanthone compounds [7]. Xanthone compound and derivatives useful as an antioxidant activity [8]. Antioxidant compounds play a role in counteracting the activity of free radicals [9].

Yogurt drink with fortified mangosteen extract was one of alternative diversification beverage that could increase product characteristics, nutrition value, and shelf life. It was recommended for healthy and severe illness [10]. The purpose of this research was to estimate the fatty acid content of yogurt drink with the addition of mangosteen rind extract.
2. Material and Methods

2.1. Bacterial culture, raw goat milk and mangosteen rind

The materials used for this research: goat’s milk, yogurt culture (*Lactobacillus bulgaricus*, *Lactobacillus acidophilus* and *Streptococcus thermophilus*) and mangosteen rind extract. Fresh goat milk was provided Peranakan Etawah (PE) Lurisae Farm, Loano, Central Java Province. Mangosteen rinds were obtained from local markets Kaligesing, Purworejo, Indonesia. They used from mature fruits. The edible of mangosteen is milky white, while the rind is dark red.

2.2. Yogurt preparation

Completely Randomized Design (CRD) was throughout the research with differences level concentration of mangosteen rind extract (0, 1, 2, and 3% (v/v). The milk was carried to the laboratory in cool box avoid contamination. Yogurt drink was made from goat milk fresh. The milk was pasteurized (temperature at 71°C for 15 seconds), cooling to 45-43°C for incubation. After the cooling process was inoculated with 2% yogurt culture. The raw milk was divided into four lots and fortification with mangosteen rind’s extract with differences level concentration. Following incubation, yogurt drinks were cultivated at 40°C until coagulation. Then cooled and stored in a refrigeration. Yogurt drink samples were taken for analyzed.

2.3. Mangosteen rind extract

The making of mangosteen rind extract is done by selecting the dried mangosteen rind inside. Then weighing 200 g of mangosteen peel. The next step is adding 1L of distilled water and homogenized. Then filtering is done with filter paper. The results of the filter were put in a centrifuge with a speed of 6000 rpm for 10 minutes and obtained mangosteen rind extract [6].

2.4. Fatty Acid Determination

The determination of fatty acid of yogurt drink control and additional mangosteen rind extract was done using Gas Chromatography [11]. The extraction of the fatty acid of yogurt drink was added chloroform-methanol. The result was converted into FAME (fatty acid methyl esterase).

3. Result and Discussion

Table 1. showed the fatty acids in the sample yogurt drink control compared with yogurt drink by mangosteen rind extract. During the fermentation process, the total of fatty acids changes in proportion. An amount of 14 fatty acids were determined contents unsaturated and saturated fatty acids. [11] reported that total 26 fatty acid in the fresh milk, concentrated and yogurt from Etawah goat milk.

| Fatty Acid                  | 0%  | 1%  | 2%  | 3%  |
|-----------------------------|-----|-----|-----|-----|
| Saturated Fatty Acid        |     |     |     |     |
| Caprilic acid (C8)          | 0.933 | 0.854 | 1.083 | 1.027 |
| Capric acid (C10)           | 2.537 | 2.365 | 3.072 | 2.934 |
| Lauric acid (C12)           | 1.012 | 0.938 | 1.146 | 1.113 |
| Myristic acid (C14)         | 3.067 | 2.808 | 3.229 | 3.216 |
| Palmitic acid (C16)         | 12.834 | 11.045 | 11.866 | 11.672 |
| Stearic acid (C18)          | 11.212 | 9.821 | 10.647 | 9.649 |
| Behenic acid (C22)          | 0.036 | 0.027 | 0.07 | 0.031 |
| Lignoceric acid (C24)       | 0.078 | 0.068 | 0.088 | 0.08 |
| Unsaturated Fatty Acid      |     |     |     |     |
| Palmitoleic acid (C16:1)    | 0.549 | 0.518 | 0.501 | 0.524 |
Oleic acid (C18:1) 19.171 17.465 16.911 17.225
Linoleic acid (C18:2) 2.099 1.838 2.164 2.116
Linolenic acid (C18:3) 1.247 1.131 0.97 1.01
Arachidonic acid (C20:4) 0.152 0.084 0.158 0.135
Erucic acid (C22:1) 0.037 0.102 0.018 0.057

The highest of saturated fatty acid are presented on the palmitic acid, while unsaturated fatty acid on the oleic acid compared to control with yogurt drink by mangosteen rind extract. Unsaturated fatty acids play important role in human health. The mangosteen rind reported to contain a variety of bioactive compounds with potential applications as functional food additives such as phenolic acids. This is consistent with the study of [12] which states that the profile of saturated fatty acids from palmitic acid showed the highest value of more than 75% and for the highest unsaturated fatty acids was oleic acid.

Table 2. The proportion of saturated and unsaturated fatty acid

| Fatty Acids     | Level of Mangosteen Rind Extract |
|-----------------|----------------------------------|
|                 | 0%     | 1%     | 2%     | 3%     |
| Saturated Fatty Acid | 31.71  | 27.93  | 27.97  | 29.72  |
| Unsaturated Fatty Acid | 23.26  | 21.14  | 20.72  | 21.07  |
| Total of Fatty Acid    | 54.96  | 49.06  | 48.69  | 50.79  |

The major saturated fatty acid shows palmitic acid, stearic acid, myristic acid, caprylic acid, caprylic acid, lignoceric acid, and behenic acid. The palmitic acid higher in the control sample, compared to the yogurt drink with mangosteen rind extract. The major unsaturated fatty acid includes oleic acid, linoleic, linolenic, palmitoleic acid, arachidonic acid, and erucic acid. The total number of saturated and unsaturated fatty acid in yogurt drink control (0%) and with mangosteen rind extract showed in Table 2. The saturated fatty acid varied from 29.72% yogurt drink with mangosteen rind extract to 31.71% in the control sample. The unsaturated fatty acid of the yogurt drink was found lower than the control sample. The total fatty acid of the control sample was the highest value.

The total of short-chain fatty acid (SCFA) (from C8 to C10) in the control sample were higher as compared to the yogurt drink with mangosteen rind extract. The contents of medium-chain fatty acid MCFA (from C12 to C14) increased during the addition of mangosteen rind extract. The total number
of long-chain fatty acid LCFA (above C16) was higher control sample compared to the mangosteen rind extract. The SCFA of yogurt drink by mangosteen rind extract was involve on the sensory quality of yogurt. The SCFA (caprylic, capric and caproic acid) contributed for the specific odor and taste. [3] [6] [11] reported that differences of SCFA in volatile fatty acids are responsible for the development flavor and unique aroma. Fatty acid also would give an effect to curd volume and syneresis of milk.

Data on monounsaturated and polyunsaturated of yogurt drink are presented in Figure 3. Unsaturated fatty acids were given contribution for human health. The result that both monosaturated and polyunsaturated were higher in control than yogurt drink with mangosteen rind extract. The ratio of monosaturated of sample control and yogurt drink with mangosteen rind extract was found at 19.72; 17. 98; 17.41 and 17.75% respectively. A control sample was higher compared to the treatment of yogurt drink on the polyunsaturated fatty acid. The amount of polyunsaturated of the yogurt drink with mangosteen rind extract (1, 2 and 3%) and control were shows 3.18; 3.31; 3.2 and 3.53%. Linoleic acid higher in the yogurt with mangosteen rind extract than the control sample. The linoleic acid plays an important for health. [12] reported that fatty acid C18:1, C18:2 and C18:3 were improves human health.

![Figure 2](image-url)"
The fermentation process produces different amounts of fatty acids, yogurt drink control when compared with yogurt drink with the addition of mangosteen rind extract. The addition of mangosteen rind extract will affect yogurt drink. The chemical composition of mangosteen rind extract changes lactic acid bacteria activity. This causes the transformation to the structure of fatty acids. The additional of microorganism starter during the fermentation process may contribute to the lipolysis fat. During the lipolysis process triglycerides release from free fatty acids. [11] reported that the differences in fatty acid content from fresh goat milk and fermented product were caused by lactic acid bacteria. [3] The higher content of MCFA was responsible for a shelf life of bacteria.

4. Conclusion
The addition of mangosteen rind extract to yogurt drink from goat milk was changing in the fatty acid content. The chemical composition of mangosteen rind extract changes lactic acid bacteria activity. Palmitic acid was dominant in the saturated fatty acid. Oleic acid was the highest proportion in the unsaturated fatty acid.

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References
[1] Seelee W, Tungrajaroenchai W and Natvaratat M 2009 Development of low fat set-type probiotic yogurt from goat milk. As. J. Food Ag-Ind. 24: 771-779.
[2] Regula, A 2007. Free fatty acid profiles of fermented beverages made from ewe’s milk. Le Lait, INRA Editions. 87 1:71-77.
[3] Boycheva S, Dimitrov T, and Naydenova, N 2011 Quality characteristics of yogurt from goat ’s milk, supplemented with fruit juice. Biochemistry, 29 1:24–30.
[4] Parodi P 2013. Anti-cancer agents in milk fat. Aust. J. Dairy Technol. 58: 114–118.
[5] Wojotowski, J., Dankow, R., Skrzypek, R, and Fahr 2003 The fatty acid profile in kefir from sheep, goat and cow milk, Milchwissenschaft 58: 633–635.
[6] Wibawanti, J M W, Rinawidiastuti, Arifin H D and Zulfanita 2018 Improving Characteristics of Goat Milk Yogurt Drink Fortified by Mangosteen Rind (Garcinia mangostana lin.) Extract. IOP Conference Series: Earth and Environmental Science. 102 1, 012008. Doi 10.1088/1755-1315/102/1/012008.
[7] Jung H A, Su B N, Keller W J, Mehta RG, and Kinghorn A D 2006) Antioxidant xanthones from the pericarp of Garcinia mangostana (Mangosteen). J. Agric. Food. Chem. 54, 2077-2082.
[8] Chaverri, J P, Rodriguez, N C, Ibarra M O, and Rojas J M P 2008 Medical properties of mangosteen (Garcinia mangostana). Food and Chemical Toxiology. 46. 3227-3239.
[9] Arazo M, Bello A, Rastrell L, Monteller M, Delgado L and Panfet, C 2011 Antioxidant properties of pulp and peel of yellow mangosteen fruits. Emir. J. Food Agric. 23 6, 517-524.
[10]Wibawanti J M W and Rinawidiastuti 2018 Physical and sensory properties of yogurt drink from goat’s milk with supplementation of mangosteen rind extract (Garcinia mangostana L.). Jurnal Ilmu dan Teknologi Hasil Ternak (JITEK) (In Bahasa Indonesia), 13 1: 27-37. Doi : 10.21776/ub.jitek.2018.013.01.3
[11]Sumarmono J, Sulistyowati M, and Soenarto 2015 Fatty acids profiles of fresh milk, yogurt and concentrated yogurt from Peranakan etawah goat milk. Procedia Food Science, 3. 216–222.
[12]Boycheva S, Mihaylova G, Naydenova N and Dimitrov T 2012 Amino Acid and fatty acid content of yogurt supplemented with walnut and hazelnut pieces. Trakia Journal of Sciences, 10 2: 17-25.