Improving characteristics of goat milk yogurt drink fortified by mangosteen rind (Garcinia mangostana Lin.) extract

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Abstract. Peranakan Etawah (PE) milk is highly nutritive, goat-like flavor, making it not preferable by consumer. Processing of yogurt drink made PE goat milk enhances palatability. Goat yogurt drink can be supplemented high antioxidant activity by mangosteen rind extract. Completely Randomized Design (CRD) was throughout the research with different concentrations of mangosteen rind extract (0, 1, 2, 3, and 4% (v/v)). The organoleptic analysis showed the significant enhancement by fortification with mangosteen rind extract. The highest antioxidant activity was shown on the yogurt drink 4% (v/v) of mangosteen extract. In conclusion, the fortification of mangosteen rind extract was enhanced of characteristics of yogurt drink.

Keywords: goat’s milk, mangosteen extract, yogurt drink

1. Introduction
Yogurt is daily product manufactured by fermentation of lactic acid bacteria such as Streptococcus thermophilus, Lactobacillus bulgaricus and Lactobacillus acidophilus [1]. It provides healthy drink from natural ingredients. Yoghurt enriched with antioxidants would be improves the functionality and acceptability of consumers. Yogurt drink could be made from goat’s milk. Goat milk’s have high nutrition (vitamins and minerals) and benefits for body health [2]. They have also small fat globules and reduce allergic reactions, which is suitable for lactose intolerance people. The fat composition contains volatile fatty acid such as capric, caprilic and caproic. They cause unique odor and flavor of goat milk [3].

Mangosteen (Garcinia mangostana Lin.) is one of the most favorite fruits in Indonesia. Mangosteen characteristics have slightly acidic, sweet taste, an edible soft, brown pericarp and purple exterior [4]. The studies have shown that obtained xanthones from mangosteen have benefits for antibacterial, antioxidant, antiallergy, antiviral, antitumor and antifungal activities [5]. Xanthones compound could be obtained from peel, rind, leaves, bark and whole fruit. Yellow latex of mangosteen would make the fruit tasted bitter [6].

Yogurt drinks of goat milk were produced as alternative diversification milk product. Fortification of mangosteen extract with goat milk expected to improve health’s benefits. It’s also contributing to the produces antioxidant beverages. Therefore, the objective of this research was to investigate the influence of fortification between mangosteen’s rind on the characteristics and antioxidant activities of yogurt drink from goat milk.
2. Methods

The research has been done at the Terpadu Laboratory of Muhammadiyah Purworejo University and The Chemistry and Biochemistry Laboratory of Gadjah Mada University, Indonesia

2.1. Bacterial culture, raw goat milk and mangosteren rind

There were materials for this research: mangosteen rind, goat’s milk, and yogurt culture (Lactobacillus bulgaricus, Lactobacillus acidophilus and Streplococcus thermophilus). The fresh goat milk used in this study was supplied by Peranakan Etawah (PE) from Goat Breeding Farm in Kaligesing, Central Java Province.

2.2. Mangosteen rind extract

Mangosteen rinds were collected from local markets Kaligesing, Purworejo, Indonesia. The selection was performed fresh fruits. They were first cleaned by water. After washing, they were put and weight into sterile glass jars. Water was added and the samples were homogenized for 15 minutes. The solvent was removed. The clear supernatant was collected. Mangosteen rind was showed in Figure 1.

![Mangosteen Fruits and Rind](image)

(a) mangosteen fruits  (b) mangosteen rind

Figure 1. Mangosteen

2.3. Yogurt preparation

Yogurt drinks were manufactured from goat’s milk. They were pasteurized by temperature at 71°C for 15 seconds and cooling to 45-43°C for incubation. The yogurt cultures (2%) was added to the milk. They were separated into five lots and fortification with mangosteen rind’s extract at different level. Following incubation, yogurt drinks were cooled at room temperature for 24 hour’s. After incubation, the yogurt drink samples are refrigerator and analyzed. Completely Randomized Design (CRD) was throughout the research with differences level concentration of mangosteen rind extract (0, 1, 2, 3, and 4% (v/v)).

2.4. pH value

Yogurt drink sample were monitored for active acidity (pH) by using a digital pH meter. The pH value The tool was standardized by buffer solution (pH 4 and 7). The electrode was dipped into the yogurt drink and then the pH was determined value.

2.5. Antioxidant activity

The antioxidant activity of yogurt drink with mangosteen rind’s extract were carried out by DPPH method. Different concentration (20-100 m) of yogurt drink was taken in test tube. 5 ml of 0.1 Mm methanol solution of DPPH were added into sampels. They were shaken vigorous each of tubes. they were put into 37°C for 20 minutes. The absorbance was measured at 517 nm. The % inhibition was calculated, where \( A_{DPPH} \) is the absorbance of the control and \( A_{sample} \) is the absorbance of the tested sample. The yogurt drink’s were provided without mangosteen rind’s extract.

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\text{% inhibition} = \frac{A_{DPPH} - A_{sample}}{A_{DPPH}} \times 100\% 
\]

2.6. Organoleptics analysis

Organoleptics analysis used was hedonic and test scoring [7]. Organoleptics analysis of the samples
was evaluated by 25 semi trained panelist who are conversantly with yogurt and consisting of students of Muhammadiyah University of Purworejo for sensory attributes. Each panelist assessed five samples treatment. The panelists evaluated yogurt drink using 4 point scale. The panelist were responsible to his perception of flavour, color, odor, viscosity, and preference. Hedonic score for degree of preference are 4=like extremely; 3=like; 2=like moderately; 1=dislike. Statistical analysis was performed by Friedman test.

2.6. Statistical analysis
Statistical analysis calculated by SPSS programe (Statistical Packaging for social Science). All result was colected in a completely randomized design using analysis of variance (ANOVA) for each experiment. It means comparison in each experiment was performed using Least Significant Differences (LSD) and Duncan in degrees of freedom (df) 0.05.

3. Result and discussion

3.1. Antioxidant activity
In this experiment, the antioxidant activity of mangosteen rind extract was shown in Figure 2. Yogurt drink with fortification of mangosteen rind’s extract was showed significant differences (p<0.05). Antioxidant activity of yogurt drink of mangosteen rind extract T0; T1; T2; T3; and T4 was founded value 1.09; 4.42; 5.07; 8.50; 11.83%, respectively. The highest was found in yogurt drink with fortification mangosteen rind extract with level 4%, while the lowest values were earned in control samples. The yogurt drinks with fortification 4% of mangosteen rind extracts were found the highest antioxidant activity among these extract when compared to another level. The antioxidant activity of yogurt drink could be attributed xanthones compound of mangosteen rind extract. They were considered responsible as antioxidant activity. Differences level of mangosteen rind extract could have contributed to the antioxidant activity. It was possible that because the different in level of mangosteen rind extract.

![Figure 2. Antioxidant Activity of Yogurt Drink by DPPH](image)

Antioxidant activity was correlated with xanthon content. Among these extract from mangosteen part showed antioxidant activity with different values. [5] reported the antioxidant activities (IC$_{50}$) with the extract from mangosteen’s peel was 0.023μg/ml. These extract from mangosteen part, each part (peel, leaves, and bark) showed antioxidant activity with different IC$_{50}$ values. [8] showed that yellow peels (48.8μg/ml) showed higher antioxidant activity compared with the pulp extract (153.2μg/ml).

3.2. pH result
The pH result of yogurt drink is shown in Figure 3. Based on the statistically analysis, that pH value control were significantly different (p<0.05) comparison to yogurt drink of mangosteen rind extract.
The pH value of yogurt drink extract 0, 1, 2, 3, and 4% were obtained 5.41; 5.42; 5.23; 5.24, and 5.22, respectively. Generally, yogurt drinks with mangosteen extract were found value lower than control. They have similarly value each other treatment. The pH values were related viability of microorganism and incubation temperature. It’s also may be due to xanthones compounds in mangosteen extract.

![Figure 3. pH value of yogurt drink](image)

The decreasing of pH value was observed through the storage period and this may be because of the growth of bacteria that converts lactose into lactic acid [9]. [2] reported that inoculation and incubation temperature have effects on acidity, pH value and the total bacterium counts in goat yogurt. The longer fermentation time the lower the pH values. Changes of pH value and acidity were caused amount of bacteria. The lactose was utilized by bacteria such as *Lactobacillus casei* and *L. acidophilus* [10].

### 3.3. Organoleptics Result

The organoleptic data were presented in Table 1. also demonstrated that mangosteen rinds extract changes of yogurt characteristics. Statistically significant differences were presented analysis for color and odor between yogurt drink control and yogurt drink with fortification of mangosteen extract (p<0.05). Significant differences the result may be due to affected mangosteen rink extract. They were attributed level of extract. However the result of flavour, viscosity, and preference were no statistically significant differences (p>0.05) in control sample compared to mangosteen rind’s extract treatment. The result of organoleptics analysis caused fermentation of lactic acid bacterium. [11] shown that characteristics composition, texture and sensory affected by bacteria such as *Lactobacillus bulgaricus* and *Streptococcus thermophiles*.

The color score of yogurt with mangosteen rind’s extract were significantly higher comparison to the yogurt without extract (p<0.05). They were showed yellowness color in Figure 3. Organoleptics analysis for odor were significantly differences (p<0.05). The fortification of mongosteen rind extract were exhibited decrease goaty odor. In our opinion, this may be because of the presence of compound of mangosteen rind extract. The differences in odor and flavour were related to lactic acid bacteria’s activities with supplementation of mangosteen rind extract.
Table 1. Organoleptics Analysis of Yogurt Drink

| Treatment | Color  | Odor   | Flavors | Viscosity | Preference |
|-----------|--------|--------|---------|-----------|------------|
| 0%        | 1.72<sup>a</sup> | 2.12<sup>a</sup> | 2.52    | 2.56      | 2.82       |
| 1%        | 2.2<sup>b</sup>    | 2.67<sup>b</sup> | 2.08    | 2.60      | 3.00       |
| 2%        | 2.4<sup>b</sup>    | 2.76<sup>b</sup> | 2.08    | 2.84      | 2.72       |
| 3%        | 3.12<sup>c</sup>  | 3.28<sup>c</sup> | 2.32    | 2.64      | 3.26       |
| 4%        | 3.48<sup>c</sup>  | 3.60<sup>c</sup> | 2.56    | 2.76      | 3.20       |

Subscript indicates significant differences (p < 0.05)

Figure 4. The color of yogurt drink

The fermentation process also reduces the bitter taste of the mangosteen rind’s extract. Perhaps, those compounds stimulated viability of lactic acid bacteria. [12] reported that unique flavour of goat milk that caused fatty acids (capric, caproic and caprylic). Based on scoring test of preference, it was selected the highest score yogurt drink with fortification 3% mangosteen rind extract. Different level of mangosteen rind extract affected the formation of flavor compounds.

4. Conclusion
Fortification of mangosteen rind extracts was enhances of characteristics and the consumer preferences of yogurt drink. The results suggest that yogurt drink of mangosteen rind extract tested in this study have the potential to contribute of antioxidant baverage.

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