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To cite this article: Afriani Sandra *et al* 2019 *IOP Conf. Ser.: Earth Environ. Sci.* **287** 012024

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The chemical characteristics of yoghurt (*Lactobacillus fermentum* MGA40-6 and *Streptococcus thermophilus*) with additional puree from *Senduduk* fruit (*Melastoma malabathricum*, L.)

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Abstract. The purpose of this study was to know the effect of adding the puree of *senduduk* fruit on the chemical characteristics of yoghurt. The experiment is conducted by using a Completely Randomized Design (CRD) by adding different concentrations of *senduduk* fruit's puree into yoghurt; A (0%), B (1.5%), C (3%), D (4.5%), dan E (6%). The results of this study with adding the puree of *senduduk* fruit into yoghurt can significantly increased the total titratable acidity, protein concentration and antioxidant activity. The experiments also show the decrease on the pH value, but showing not significant differences at the water content and ash concentration of the yoghurt. In conclusion, adding 4.5% (D) of *senduduk* fruit puree into yoghurt is the best to produce a consumptive yoghurt with (1.54%) total titratable acidity, (5.18%) protein concentration, (56.72%) antioxidant activity, (4.4) pH, (77.59 %) water and (1.22%) ash.

Keywords – *Lactobacillus fermentum* MGA40-6, yoghurt, *senduduk* fruit puree, and chemical.

1. Introduction

Milk and other dairy products are familiar found in the today's market as food product. The variations of dairy products are available as a way to extend the storage life of the milk, because milk contains complete nutritional components which can easily be damaged, especially by microbes, if not handled properly.

Yoghurt is made by using Lactic Acid Bacteria (LAB) as the starter. The LAB is able to convert glucose to become lactic acid. The processed milk products using LAB are one of the applications of biotechnology which exploits bacteria. They have therapeutic or better known as *functional* terms.

LAB isolation and identification have been carried out by many researches to improve the quality of yoghurt processing and other processed food products. LAB can be isolated from *dadih* of Lima Puluh Kota District, which obtain the LAB type of *Lactobacillus fermentum* MGA40-6 [1]. LAB application on other fermented products like yoghurt has not been done, therefore this study explores the making of yoghurt by using the *Lactobacillus fermentum* MGA40-6 bacteria and *Streptococcus thermophilus*.

The nutritional value and function of consumptive yoghurt can be improved by adding useful components such as the puree of *senduduk* fruit into it. The fruit is a local fruit which is not optimally utilized yet. This fruit can easily found in many regions. Beside its wide availability, there are more functional benefits can be obtained from this fruit. The fruit contains anthocyanins which help the compound products produce more antioxidants.



The results of the existing studies prove that the use of 5% *senduduk* fruit's puree produces the best hard candy characteristics [2], and adding 6% of it produces the best Nagka straw jam [3]. The experiment of making yoghurt by using LAB *Lactobacillus fermentum* MGA40-6 and *Streptococcus thermophilus* with a starter of 5% and adding of the fruit's puree with varied concentrations between 0%, 1.5%, 3%, 4.5%, and 6 %, in terms of color and taste, are acceptable for the panelists, but the effect on the physicochemical properties of the produced yoghurt remains unknown.

This study is aimed at determining the effect of adding *senduduk*'s puree into yoghurt (*Lactobacillus fermentum* MGA40-6 and *Streptococcus thermophilus*) on its physicochemical properties such as pH level, total acid titration, water content, ash concentration, and the antioxidant activity.

2. Methods

This study was carried out by using a Completely Randomized Design method. The puree of *senduduk* fruit is added in several different concentrations (0%, 1.5%, 3%, 4.5%, and 6%) with 3 replications for each. The data were analyzed by using the Analysis of Variant or ANOVA which was followed by further DMRT tests with a 5% confidence interval [4]. The model is designed as follows: $Y_{ij} = \mu + P_i + \epsilon_{ij}$.

This research was carried out in several stages which include the making of the starter by using *Lactobacillus fermentum* MGA40-6 and *S.thermophilus* and the evaluation of physicochemical properties of the yoghurt [5].

3. Results and discussion

Treatment	pH	Total Titratable Acidity (%)	Water Content (%)	Protein (%)	Ash (%)	Antioksidan Activity (%)
A	5.30 ^a	0.86 ^a	79.43 ^a	4.21 ^a	1.09 ^a	13.35 ^a
B	4.80 ^b	1.52 ^b	77.12 ^a	5.25 ^b	1.23 ^a	19.71 ^a
C	4.40 ^c	1.53 ^b	77.76 ^a	5.31 ^b	1.21 ^a	48.00 ^b
D	4.40 ^c	1.54 ^b	77.59 ^a	5.18 ^b	1.22 ^a	56.72 ^c
E	4.70 ^d	1.66 ^b	79.19 ^a	4.41 ^{ab}	1.21 ^a	68.28 ^d

3.1. pH analysis

The analysis of variant (ANNOVA) shows that adding the *senduduk*'s puree created a significant effect with the value of $P < 0.05$ at the pH value of the yoghurt. Adding the *senduduk*'s puree up to 4.5% (D) can reduce the pH value of the produced yoghurt, but at a concentration of 6% added puree (E), the pH value increases again which is caused by the lower the pH, the lesser microbes will live there. Therefore, in general, lactic acid content produced by the fermentation and the effect of the acid from *senduduk*'s puree on the treatment of pH value E (6%) became relatively smaller compared to the pH value of yoghurt with the added puree in treatment B, C, and the lower pH value after the fermentation will cause less microbes to survive [6].

The results shows that the increasing of the puree concentration decreases the pH of the yoghurt. This is caused by the effect of sugar contained in *senduduk*'s fruit toward LAB activity in producing lactic acid. The LAB (*L. fermentum* MGA40-6 and *S. thermophilus*) exploits the milk carbohydrate and *senduduk*'s puree in the fermentation into lactic acid. That during the fermentation process, the LAB will utilizes the existing carbohydrates until it forms lactic acid, until the pH level is decreased and the acidity is increased [7]. The *senduduk* fruit contains 7.75% carbohydrates [8].

The pH of *seduduk*'s puree (4.1) also contribute to the pH of the yoghurt, so the pH value will decrease along with the addition of the puree concentration. The pH value from the study has matched the common pH of yoghurt. The minimum pH of yoghurt is 4.3, so it is concluded that the results of this study have met the standard of yoghurt fermented drinks [9].

3.2. Total titratable acidity

The experiments' results showed that the mean value of Titrated Total Acid (TTA) obtained is ranging between 0.86 - 1.66. TTA is stated by the percentage of lactic acid. Lactic acid is the largest component formed from the fermentation of milk into yoghurt. The increase of lactic acid in this study is consistent with its decrease of pH value, thus the TTA of the results showed an inversion to the pH value. The TTA value is inversely proportional to the pH value [10]. The results show that TTA has met the standard of yoghurt fermented drinks which is 0.5-2% (% lactic acid)[11].

3.3. Water content

The results of statistic analysis showed that the yoghurt without the additional senduduk's puree implies an insignificant results with the value of $P > 0.05$. However, in general, the results of the water content analysis in the table above shows that the yoghurt water content without additional senduduk's puree and the one with additional puree showed that the water content is decreased in almost all treatments. The decrease of water content on the yoghurt with additional senduduk's puree is caused by adding of puree which reduce the pH value of the yoghurt, so that the protein will experience coagulation. The condition is indicated by the increasing formations of coagulants or clots which lead to the increase of total solidity. The acidic pH, the yoghurt protein undergoes coagulation [12].

3.4. Protein

The increase of yoghurt protein concentration along with the addition of senduduk's puree to yoghurt causes condition of yoghurt to become acidic. Thus, lowering the pH value, so this condition will affect the hydrolysis of the yoghurt protein, which means lowering the pH value, so this condition will affect the hydrolysis of the yoghurt protein. Acidity formed by the activity of yoghurt bacteria so that the total solidity increases and the texture of the yoghurt produced becomes thicker. The acidic pH condition the yoghurt protein will experience coagulation which form more clots or coagulants [12].

Yoghurt protein have increased along with the addition of senduduk's puree. It is also caused by the phenol content in the senduduk fruit's puree which is bonded with the peptide from the hydrolyzed protein, so that the protein of the produced yoghurt is higher. The interaction between polyphenols and milk protein or polysaccharides will cause an increase in protein levels.

The high protein content of yoghurt with addeed senduduk's puree is resulted by the protein contribution from the senduduk fruit it self. The senduduk fruit contains protein as much as 1.46% / 100 grams. Yoghurt produced from this study has met the quality standards. Requires a minimum protein content of yoghurt [13].

3.5. Ash concentration

The analysis on the ash concentrations show that the addition of senduduk's fruit puree made no significant effect on the yoghurt. In Table 1, It can be seen that the highest average ash content is 1.23 (Treatment B) and the lowest is 1.09 (Treatment A). The results table also implies that adding different senduduk's fruit puree concentrations as in treatments A, B, C, D, and E lead to insignifinact difference. Thus, it can be used for the real measurements, but the general results shown in the table above implies that the ash content of yoghurt with different additional senduduk's purees concentration are all in average gray level, or it is not showing signifincant improvement at each treatments. This is due to the more senduduk's puree is added also increase the amount of chemical components available in the yoghurt. One of the many chemical components which can be used as indicators for determining ash levels is minerals. The minerals contained in fresh iron senduduk fruit are 2.60 mg / 100 g, manganese 12 mg / 100 g, calcium 1.92 mg / 100 g and copper 2.60 mg / 100 g [14].

3.6. Antioxidant activity

The analysis of the antioxidant activity shows that the addition of the senduduk puree into the yoghurt makes a significant effect on the value of its antioxidant activity. The highest antioxidant

activity was shown by treatment E (68.2) and the lowest antioxidant activity was found in treatment A (13.35%). This implies that the more senduduk's puree is added into the yoghurt, the higher will the antioxidant activity be. Senduduk fruit contains anthocyanin which triggers the increase of activity in the produced yoghurt. The fruit contains anthocyanins which have reddish purple pigments which can act as antioxidants [15].

4. Conclusion

The addition of the senduduk's fruit puree into the yoghurt increases total titrated acid, protein content and antioxidant activity, yet decreases the pH value. However, the water content and ash content show no significant differences. Adding senduduk puree into yoghurt as much as 4.5% (D) is best method for producing yoghurt.

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Acknowledgment

Author express gratitude to the Institute of Research and Community Service, Andalas University for the Cluster Young Lecturer No. 10/UN.16.17/PP.RDP/LPPM/2018 and the Animal Product Technology Laboratory in the Faculty Animal Science, Andalas University, who provided facilities for research.