

## Functional Properties of Soy Yoghurt with Red Dragon Fruit Substitution

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### ABSTRACT

This study investigated the antioxidant activity and lactic acid bacteria content of soy yoghurt with red dragon fruit substitution. Analysis included sensory evaluation, proximate analysis, quantification of antioxidant activity and estimation of total Lactic Acid Bacteria (LAB). Formula 3 with 35% red dragon fruit substitution was selected as the optimal formula. Proximate analysis showed water content of 92.75%, ash content of 0.23%, protein content of 0.48%, fat content of 3.08%, and carbohydrate content of 3.46%. The selected product had an increased antioxidant activity. In conclusion, soyghurt with red dragon fruit can increase the antioxidant activity of the product.

**Keywords:** antioxidant activities, lactic acid bacteria, red dragon fruit, soyghurt

### INTRODUCTION

The World Health Organization (WHO) estimated that nearly 17 million people died from degenerative diseases (WHO 2011). The 2018 Basic Health Survey (Riskesdas) reported an increase in the prevalence of non-communicable diseases (MoH RI 2018). These diseases are primarily caused by unhealthy diets, which lead to the formation of free radicals and oxidative stress that damage the body. Free radicals can damage cells and accelerate ageing, increasing the risk of degenerative diseases and cancer. Antioxidants, vitamins C and E and various plant compounds, can counteract free radicals (Nakagawa *et al.* 2017). Soy milk, a high-quality plant protein source, can be utilised to produce yoghurt enriched with probiotics for digestive health (De *et al.* 2022). Therefore, the substitution of red dragon fruit, which is rich in antioxidants and natural pigments, aimed to improve the antioxidant activity and aroma of soy yoghurt. This study investigated the antioxidant activity and lactic acid bacteria content of soy yoghurt with red dragon fruit substitution.

### METHODS

This three-month study involved various analyses, including organoleptic, chemical and physical property analyses, quantification of antioxidant activity, and isolation of total lactic

acid bacteria. Based on nutritional standards, the red dragon fruit should contain a minimum of 30% antioxidants, equivalent to 90 mg/100 g of vitamin C. The minimum weight of red dragon fruit for substitution in the control formulation (F0) was determined to be 58 g. The percentage of dragon fruit added to soyghurt were F0=0%, F1=25%, F2=30% and F3=35%. This study involved several stages: soy milk preparation, formulation determination for red dragon fruit soy yoghurt, fermentation process, and organoleptic evaluation.

The process of making soyghurt is divided into two main steps. The first step is the production of soybean milk, which begins by soaking the soybeans in a water ratio of 1:3 for 12 hours, and then draining them. After that, the soybeans are soaked in a solution of water and 0.5% NaHCO<sub>3</sub> for 30 minutes, then cleaned with running water. The next step involves mixing the soybeans with water in a blender for 10 minutes, then straining the soybean juice using a calico cloth. The final step at this stage is mixing the soybean juice with granulated sugar and skim milk powder, followed by cooking and cooling the soybean milk. The second step in the soyghurt-making process involves creating a starter bacterial culture by adding starter bacteria to 100–200 mL of soybean milk. Then, the soybean milk is inoculated with a starter bacterial culture. The next step is to incubate the soyghurt in a simple incubator for 18 hours at a temperature of 35–37 degrees Celsius.

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The final step is to cool the soyghurt in the refrigerator at 4° Celsius to stop the fermentation process.

The selected product undergone proximate analysis (ash, moisture, protein, fat, and carbohydrate content), as well as analysis of physical properties. Additionally, antioxidant activity and total lactic acid bacteria were analysed in the products of the soy yoghurt substituted with red dragon fruit. Lactic acid bacteria were isolated and analysed using Man- Rogosa-Sharpe Agar (MRSA) media, with observations for 1 week. Descriptive analysis was performed on the data, and organoleptic evaluation was analysed using Kruskal-Wallis and Mann-Whitney tests using SPSS software.

## RESULTS AND DISCUSSION

Organoleptic tests, including hedonic tests for color, aroma, taste, and texture, were performed on red dragon fruit soyghurt. The substitution of red dragon fruit significantly influenced the color preference for the soyghurt, which was attributed to the anthocyanin content. Analysis of the product aroma showed significant differences between the formulations, with F0 having a very strong aroma. F0 was disliked in texture liking, while F1, F2, and F3 were considered normal. Despite this, there was no significant difference in texture preference among the four red dragon fruit soyghurt formulas. F0 exhibited a slightly thick texture compared to the thinner texture of F1, F2, and F3. This difference was due to F0 containing more soybeans, resulting in higher viscosity. The soybean protein undergone coagulation due to acidity changes from lactic acid during fermentation, leading to a thicker texture in F0. A proximate chemical analysis was conducted to determine the composition of the soyghurt (Table 1).

The antioxidant activity of red dragon fruit soyghurt was evaluated using the DPPH method, which measures the ability of compounds to scavenge free radicals. The  $IC_{50}$  value represents the concentration that inhibits 50% of oxidation as determined through absorbance measurements. A lower  $IC_{50}$  value indicates greater antioxidant activity (Marjan *et al.* 2016). As the concentration of red dragon fruit substituted in soyghurt increased, the antioxidant activity also increased. The antioxidant activity increased after a certain

amount of soyghurt was substituted with red dragon fruit in the formulations F1, F2, and F3. The  $IC_{50}$  values for the scavenging of DPPH free radicals by red dragon fruit soyghurt are shown in Figure 1.

The substitution of red dragon fruit reduced the total Lactic Acid Bacteria (LAB) in soyghurt, although the LAB were able to utilise the carbohydrates in the fruit (Figure 2). The pH values of the soyghurt ranged from 3.63 to 4.26, which was within the desirable range for quality soyghurt. Viscosity was highest in the control formulation (F0) and decreased with the substitution of red dragon fruit because of its high water content. In a ranking test, soyghurt formulation F1 with red dragon fruit substitution was selected based on hedonic test results, antioxidant activity, total LAB, pH, and viscosity. Overall, the substitution of red dragon fruit to soyghurt improved the antioxidant activity and affected the physical properties of soyghurt. The composition of soy yogurt formula F1 is shown in Table 2.

The water content of red dragon fruit soyghurt was influenced by the soaking process of the soybeans and the natural moisture

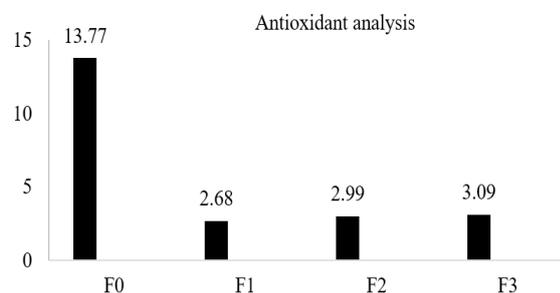


Figure 1. Antioxidant analysis

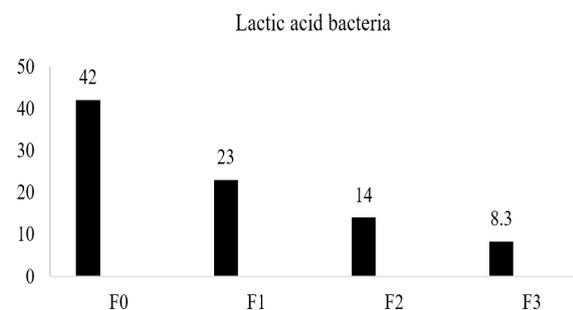


Figure 2. Lactic acid bacteria

Table 1. Hedonic organoleptic tes for red dragon fruit soyghurt

Parameter	Median value of hedonic test for red dragon fruit soyghurt			
	F0	F1	F2	F3
Color	3 (1–4) <sup>a</sup>	4 (2–5) <sup>b</sup>	4 (3–5) <sup>b</sup>	4 (3–5) <sup>b</sup>
Aroma	2 (1–4) <sup>a</sup>	3 (1–4) <sup>bc</sup>	2 (1–3) <sup>b</sup>	3 (1–5) <sup>c</sup>
Taste	2 (1–4) <sup>a</sup>	3 (1–4) <sup>ab</sup>	3 (1–5) <sup>b</sup>	3 (1–5) <sup>b</sup>
Texture	2 (1–4) <sup>a</sup>	3 (2–4) <sup>a</sup>	3 (1–4) <sup>a</sup>	3 (2–5) <sup>a</sup>

1: Dislike very much; 2: Dislike; 3: Average; 4: Like; 5: Like very much

Table 2. Proximate analysis results of red dragon fruit soyghurt

Proximate analysis	Yoghurt quality based on the the Indonesian National Standard (SNI)	Chemical property analysis (%)
Moisture (%)	-	92.75
Ash (%)	Maximum 1.0	0.23
Protein (%)	Minimum 2.7	0.48
Fat (%)	Minimum 3.0	3.08
Carbohydrate (%)	-	3.46

content of the fruit. The selected formulation, F3, had a high water content of 92.75% due to the high concentration of red dragon fruit (35% of the formulation). Soy milk generally has a lower mineral content than cow's milk, but the fermentation process slightly increases the mineral content. The study has limitations in that only one formula was analysed and specific types of antioxidants in the product were not determined.

### CONCLUSION

The antioxidant activity of red dragon fruit was determined by its weight in formulation 1 (F1). Different proportions of red dragon fruit

affected color preference but did not significantly affect taste preference. The water content of F1 was 92.75%. Antioxidant activity increased, while total LAB, pH, and viscosity decreased with red dragon fruit substitution.

### DECLARATION OF CONFLICT OF INTERESTS

The authors of this manuscript declare no conflicts of interest related to the preparation of this manuscript. They have no financial, personal, or professional relationships that could influence the content or bias the results presented in this manuscript. The authors are committed to conducting their research and reporting their findings with integrity and transparency.

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