

Nutritional Value and Organoleptic of Gembili Yogurt With the Addition of Red Dragon Fruit Juice

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ABSTRACT

In Indonesia, the prevalence of cancer increased to 1.8% in 2013-2018. Cancer incidence can be prevented by consuming foods containing antioxidants to prevent oxidative stress and cancer. Red dragon fruit juice and yoghurt are known as food with antioxidants. This study aims to investigate the nutrition content and consumer acceptance by organoleptic, and to determine the best formula for gembili (lesser yam) yoghurt with the addition of red dragon fruit juice. The study design was experimental, with organoleptic test analysed by Kruskal Wallis and Mann-Whitney statistical test. The results showed that the addition of red dragon fruit juice had a significant effect ($p < 0.05$) on the hedonic test for taste parameters ($p = 0.001$) and texture ($p = 0.001$). Yoghurt formula F2 with 15% addition of red dragon fruit was selected by Bayes Method based on the organoleptic test. It contains 87.23% water, 0.83% ash, 1.75% protein, 0.97% fat, and 9.2% carbohydrate.

Keywords: Yoghurt, Gembili, Red Dragon Fruit Juice, Organoleptic, Nutrition Value

1. INTRODUCTION

The prevalence of cancer in Indonesia has increased from 14% to 1.8% of the total population in five years (2013-2018) [1]. Cancer can be triggered by continuous oxidative stress as a result of free radicals' accumulation in the body [2]. Antioxidants can inhibit the formation of free radicals and oxidative stress in the body by giving one or more electrons to prevent the formation of free radicals and inhibit chain reactions that lead to cell and tissue damage in the body [3]. Antioxidants can be found in vegetables and fruits; one of them is red dragon fruit (*Hylocereus polyrhizus*). Per 100 grams of red dragon fruit flesh contains 8.8 mg anthocyanin [4].

A previous study found that the addition of 20% red dragon fruit to yoghurt can increase the antioxidant activity up to ± 53.70 [5]. Yoghurt contains probiotics in the form of *Lactobacillus bulgaricus* and *Streptococcus Thermophilus* bacteria [6]. The addition of prebiotics in the form of inulin to yoghurt, called synbiotics, can increase the number of *Lactobacillus* and *Bifidobacterium* bacteria [7]. Inulin is found in gembili that has the largest percentage of inulin content compared to other tubers, which is 14.77% [8].

In terms of taste, red dragon fruit has a sweet and slightly sour taste. It also has a purplish red colour which is excellent for natural colouring in food. However, not everyone likes the red dragon fruit. Other

than that, Gembili has bitter taste and a distinctive tuber aroma. Thus, we are interested in conducting research related to gembili yoghurt with the addition of red dragon fruit juice and analysing its nutritional content in the hope that yoghurt with the best organoleptic value and meeting nutritional standards will be obtained.

2. METHODS

Study Design

This study used an experimental research method with a completely randomised design (CRD) with two repetitions. We made three formulations of gembili yoghurt with the addition of red dragon fruit extract. The organoleptic analysis was carried out on all formulations, but laboratory analyses were carried out for the selected formulations most preferred by the panellists only.

Tools & Materials

The tools used were basins, knives, slicers, grinders and sieves, coconut filters and filter cloths, digital scales, pans, thermometers, spoons, gas stoves, incubators. The materials used to make yoghurt were gembili flour, red dragon fruit extract, skimmed milk, *Lactobacillus acidophilus* and *Bifidobacterium longum*. The materials used for the proximate analysis were K_2SO_4 , H_2SO_4 , HgO , $NaOH$, HNO_3 , HCl , N-Hexane, and distilled water 98%.

Research Procedure

The Making Process of Gembili Tuber Flour

We conventionally made gembili flour by modifying the procedures that had been previously published by Rochmayani, et al. (2019) [9]. The first step was preparing the gembili tubers by peeling and washing them thoroughly. Gembili tubers were thinly sliced to a thickness of 0.5 - 1cm using a slicer. The sliced tubers were dried under the hot sun for two days until dry evenly. After that, the dried tubers were mashed using a grinder and sieved with an 80-mesh sieve.

The Making Process of Dragon Fruit Extract

Red dragon fruit extract was made by peeling red dragon fruit to get the flesh of the fruit. Red dragon fruit flesh was later mashed using a blender for ± 3 minutes then sieved using a wire filter then followed by a filter cloth. This filtration process was done twice.

Determination of Gembili Yoghurt Formulation with the Addition of Red Dragon Fruit Extract

The synbiotic formulation of gembili yoghurt with the addition of red dragon fruit extract is based on several considerations. The administration of 2% gembili flour was based on the study by Rochmayani et al. (2019), stating that the ideal addition of gembili flour was at the concentration of 2%. To get the best antioxidant value, the minimum amount of red dragon fruit extract added was 10% [9]. Based on the study by Maleta & Kusnadi (2018), the addition of 10% antioxidant to the Caspian Sea yoghurt with a storage time of 0 days could produce the best antioxidant value of 25.68% [5].

Table 1. Gembili Yoghurt Formulation with addition of Red Dragon Fruit Extract

Materials	F1	F2	F3
Skimmed Milk (ml)	200	200	200
Gembili Flour (%)	2	2	2
Red Dragon Fruit extract (%) (b/v)	10	15	20
Starter <i>Lactobacillus acidophilus</i> and <i>Bifidobacterium longum</i> (%) (v/v)	3	3	3

The Making Process of Gembili yoghurt with Addition of Red Dragon Fruit Extract

The making process of gembili yoghurt was adapted from Jannah et al (2014). We modified the process by preparing 200 mL of skimmed milk, then adding 2% of gembili flour. Then, this mixture was pasteurised at 80°C for 15 minutes and cooled down until 42°C. Red

dragon fruit extract was added according to the formulation. The inoculation of *Lactobacillus acidophilus* and *Bifidobacterium longum* was done by giving the mixture the bacteria starters as much as 3% of the milk volume, then incubated at 40°C for 12 hours. The finished yoghurt was stored at 5°C to prevent fermentation [10].

Proximate Analyses of Selected Formula

The most preferred formula at the organoleptic tests was selected to have further proximate analyses: moisture content, ash content, protein content, fat content, and carbohydrate content [11].

Data Analysis

Organoleptic test data were analysed using the Kruskal Wallis test. When a significant difference (p <0.05) was shown, the Mann Whitney test would later be performed. The formulas were selected by the Bayes test.

3. RESULTS

Organoleptic Test Results

The mean values of hedonic test results on gembili yoghurt with the addition of red dragon fruit extract are presented in Table 2.

Table 2. The Mean Value of Hedonic Test on Gembili yoghurt with the Addition of Red Dragon Fruit Extract.

Parameter	Mean Value		
	F1	F2	F3
Colour	3.43 (1-5) ^a	3.80 (2-5) ^a	3.60 (2-5) ^a
Taste	2.87 (1-4) ^a	3.43 (3-4) ^b	2.77 (1-4) ^a
Texture	3.63 (2-5) ^a	3.93 (2-5) ^a	3.1 (2-5) ^b
Aroma	3.30 (2-4) ^a	3.57 (3-5) ^a	3.53 (2-5) ^a

Note: 1= dislike a lot, 2= dislike, 3= neither like nor dislike, 4= like, 5= like a lot. ^{a,b} the numbers on the same line followed by the same letter were not significantly different at 5% test level (Mann-Whitney test)

Colour

The hedonic test results (Table 2) show that the mean value for the panellist level of preference towards the colour of gembili yoghurt with the addition of red dragon fruit extract in F1 = 3.43 (neither like nor dislike), in F2= 3.80 (neither like nor dislike), and in F3 = 3.60 (neither like nor dislike). The Kruskal Wallis test results show that the addition of red dragon fruit extract to the colour of gembili yoghurt is not statistically

significant ($p > 0.05$). For this reason, the Mann Whitney test was not performed.

Taste

The results of the hedonic test on yoghurt taste in this study show that the mean value in F1= 2.87 (dislike), in F2= 3.43 (neither like nor dislike) and in F3=2.77 (dislike). These results mean that the panellists preferred F2 yoghurt formula with the addition of 15% red dragon fruit extract. The Kruskal Wallis test showed statistically significant results ($p=0.001$) for the addition of red dragon fruit extract to the taste of gembili yoghurt. Therefore, the Mann Whitney test was performed to see the significance of the difference in each formula of the gembili yoghurt. Based on the results of Mann Whitney test, we found that the mean value differences of the panellists' preference for the gembili yoghurt taste with the addition of red dragon fruit extract are statistically significant for F1 and F2 ($p=0.004$), as well as for F2 and F3 ($p=0.001$). However, the Mann Whitney test for F1 and F3 is not statistically significant ($p=0.521$).

Texture

The next parameter tested using the hedonic test was the texture. The hedonic test results for the texture of the gembili yoghurt with the addition of red dragon fruit extract indicate that the mean value of F1= 3.63 (neither like nor dislike), F2= 3.93 (neither like nor dislike), and F3= 3.17 (neither like nor dislike). The Kruskal Wallis test results show that the addition of red dragon fruit extract on the gembili yoghurt texture is statistically significant ($p=0.001$). The Mann Whitney test was performed to see the significance of the differences in each gembili yoghurt formula. The results of the Mann Whitney show that the mean value differences of the panellists' preference for the gembili yoghurt texture with the addition of red dragon fruit extract were statistically significant for F1 and F3 ($p=0.022$), as well as for F2 and F3 ($p=0.000$). However, the result is not statistically significant for F1 and F2 ($p=0.084$).

Aroma

The mean values of the hedonic test results for the gembili yoghurt aroma with the addition of red dragon fruit extract in this study were F1= 3.30 (neither like nor dislike), F2= 3.57 (neither like nor dislike), and F3= 3.53 (neither like nor dislike). In terms of aroma, the panellists prefer F2; the panellists prefer F1 for overall values. The Kruskal Wallis test results show that the addition of red dragon fruit extract on gembili yoghurt aroma is not statistically significant ($p>0,05$). Therefore, the Mann Whitney test was not performed.

Determination of the Selected Formula

The Bayes method is one of the most widely used methods in making the best decision among several

alternatives. To perform the Bayes method, we ranked the parameters used based on the index of importance according to the expert's opinion. Table 3 presents the results of the analysis using the Bayes method. The parameter with the highest value was given a score of 5, while the parameter with the lowest value was given a score of 1.

Table 3. The Results of Analysis using Bayes Method

	10%	15%	20%	Weight Value
Taste	1	3	2	0,20
Texture	2	3	1	0,20
Aroma	2	3	1	0,25
Colour	1	3	2	0,34
Total Value	1.44	2.97	1.53	
Rank	3	1	2	

Based on the results of the Bayes analysis, the F2 was selected as the chosen formula with the addition of 15% red dragon fruit extract. This formula has produced the best yoghurt in terms of taste, texture, aroma and colour.

Proximate Test Results

The proximate test results on the gembili yoghurt with 15% addition of red dragon fruit extract was presented in Table 4.

Table 4. The Proximate Test Results on Gembili Yoghurt in F2

Components	Results	Yoghurt SNI *
Water Content (%)	87.23	-
Ash Content (%)	0.83	Max. 1.0
Protein Content (%)	1.75	Min. 2.7
Fat Content (%)	0.97	Max. 3.0
Carbohydrate Content (%)	9.2	-

*SNI 2981: 2009

4. DISCUSSIONS

Colour

The colour of the gembili yoghurt products with the addition of red dragon fruit extract in this study was strongly affected by the intense colour of red dragon fruit. The red dragon fruit has a purplish red colour, which derived from anthocyanin pigments found in the fruits [12, 13]. Besides, the colour of the gembili yoghurt products with the addition of red dragon fruit extract is also influenced by the mixing process quality. The even colour of the yoghurt is due to a thorough mixing procedure or processing method [14].

Taste

The yoghurt taste came from lactic acid, acetaldehyde, acetic acid, and other volatile compounds [14]. The sweet taste of the gembili yoghurt with the addition of red dragon fruit extract was affected by the raw materials used, that is red dragon fruit which contains sugar with a sweetness level of 13-15° brix [12]. In general, the sweet taste in yoghurt was from the addition of sugar into the yoghurt or the natural sugar contained in the raw material of the yoghurt. The sweetness of yoghurt was also from the carbohydrate breakdown into simple sugars by lactic acid bacteria during the fermentation process. Moreover, the sour taste of the yoghurt came from lactose breakdown process in milk by the lactic acid bacteria [15].

Texture

The yoghurt texture was affected by gelatinisation process & the isoelectric pH conditions of the yoghurt at the pH ranging from 4-4.5 [16]. The isoelectric pH condition causes a decrease in protein solubility, resulting in protein coagulation which produces a thicker yoghurt texture [17].

Aroma

During the fermentation process of milk in yoghurt making process, lactic acid bacteria were used to ferment almost all of the lactose in milk into lactic acid and produce a distinctive aroma of yoghurt with diacetyl and acetaldehyde [14]. In this study, the distinct aroma of yoghurt tends to be sour.

Proximate Test Results

Water Content

The water content of the gembili yoghurt with the addition of red dragon fruit extract using selected formula was 87.23 %. Water content in a yoghurt based on Indonesian Food Composition Table (TKPI) in 2017 was 88% [18]. Water content in a yoghurt will influence its texture and consistencies [19]. The gembili yoghurt in this study has a slightly thick texture. According to Rochmayani et al. (2019), the thick texture of yoghurt products is caused by a decrease in pH, which results in casein coagulation [9].

Ash Content

Table 3 shows that the ash content of the gembili yoghurt with the addition of 15% red dragon fruit extract has met the SNI 2981:2009 criteria, which is 0.83%. The SNI 2981:2009 suggests that the ash content for yoghurt product is maximum at 1.0%, while the ash content based on TKPI (2017) is 2.2 grams per 100 grams of 100% edible portion [18, 20]. The ash content is the residual product of organic compound combustion using a furnace [21]. The presence of mineral elements found

in yoghurt products is related to the ash content [22]. According to Kusumawati (2019), the mineralisation process also affects the ash content in yoghurt [21]. In this study, the method of measuring ash content in yoghurt products was a drying process that reduces the mineral and ash content of yoghurt [23].

Protein Content

The protein content of the gembili yoghurt with the addition of red dragon fruit extract using the selected formula was 1.75%. The recommended protein content by the Indonesian National Standard (SNI) is at least 2.7%, while the protein content found in a yoghurt based on TKPI (2017) is 3.3 grams per 100 grams of 100% edible portion [18,20]. Therefore, the yoghurt protein content in this study did not meet the minimum levels of SNI 2981:2009 criteria. The protein content produced is affected by the type of milk used [21]. The phenolic content in red dragon fruit extract may cause a decrease in protein levels. This consideration is based on the study by Oktanauli et al. (2011), which stated that phenolic compound has antibacterial properties that causing damage in the bacterial cytoplasmic membrane, thereby reducing the number of bacteria as well as protein levels in food products [24]. This finding is in line with Ganiswara study (1995) in Poeloengan (2010), which stated that phenolic compounds tend to bind the protein [25].

A strong acidic environment in yoghurt causes the majority of protein to coagulate resulting in a decrease of measured protein value [26]. Besides, the use of gembili tuber as the raw material contributes to the protein content in final yoghurt products in this study. The protein content of gembili tubers is 1.1 grams per 100 grams [27].

Fat Content

The result of fat content analysis in gembili yoghurt with the addition of red dragon fruit extract using the selected formula was 0.97% (Table 3). Based on TKPI (2017), the fat content found in yoghurt is 2.5 grams per 100 grams of 100% edible portion [18]. The milk used in this study was non-fat skimmed milk. In addition, the presence of lactic acid bacteria in yoghurt, resulting in a decrease of fat concentration by breaking down the fats into fatty acids [28, 29].

Carbohydrate Content

The carbohydrate content in a yoghurt based on TKPI (2017) is 4 grams per 100 grams of 100% edible portion [18]. Meanwhile, the carbohydrate content analysis using by difference method was 9.2%. This could be due to amylose (24.3%) and amylopectin (75.7%) contained in gembili flour [30]. Moreover, gembili tuber is a local plant that contains high inulin (14.77%) [8]. Inulin is prebiotic that can stimulate and increase the number of

Bifidobacteria and Lactobacilli in yoghurt [7]. The red dragon fruit also contains 9.1 grams of carbohydrates per 100 grams of 67% edible portion [18].

5. CONCLUSION

The conclusions from the analyses of gembili yoghurt with the addition of red dragon fruit extract are:

- a. The formulation of gembili yoghurt with the addition of red dragon fruit extract was based on the previous study to obtain the expected nutritional value and antioxidant activity. The addition of red dragon fruit extract generated three formulations: F1, F2, & F3.
- b. The addition of red dragon fruit extract to the gembili yoghurt had a significant effect on the organoleptic tests, especially in terms of taste ($p=0.001$) and texture ($p=0.001$). Significant differences in the taste parameter were observed in F1 & F2 ($p=0.004$), and F2 & F3 ($p=0.001$). Meanwhile, in the texture parameter, significant differences were found in F1 & F3 ($p=0.022$) and F2 & F3 ($p=0.000$). After the organoleptic test results had been analysed, the selection of the best formulation was obtained using Bayes Test. The gembili yoghurt with the addition of 15% red dragon fruit extract (F2) had been selected as the best formulation.
- c. The selected yoghurt formulation has 87.23% water content, 0.83% ash content, 1.75% protein content, 0.97% fat content, and 9.2% carbohydrate content.

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