Terminalia catappa Linn Seed Yogurt with Honey Substitution for Food Security

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Abstract. Tropical almond nut (*Terminalia catappa Linn*) seeds have potential to be developed into yogurt because has a high nutritional content. In addition, honey has potential to be used as substitute for sugar in process of making yogurt. This research aims to determine effect of variations concentration honey in Tropical almond nut seed yogurt on the protein content to achieve food security. Variation of addition honey in this research is 6% (w/v), 8% (w/v), and 10% (w/v). Analysis protein content carried out using Kjeldahl method. The results showed that protein content in Tropical almond nut seed yogurt with addition of honey with concentration of 6% (w/v) is 3.06%, 8% (w/v) is 3.11%, and 10% (w/v) is 3.116%. These results had met the requirements of Indonesian National Standards (SNI) number 2981: 2009. The highest protein content was found in yogurt with the addition of 10% (w/v) honey with analysis result of 3.13%.

Keyword: Yogurt, *Terminalia catappa Linn*, Fermentation, Food Security

1. Introduction

The strength of Indonesia's demographic bonus can be a strong provision in realizing an advanced Indonesia, the high demographic bonus cannot be separated from the number of human resources owned, it is recorded that Indonesia's population in 2020 is 273.5 million people and is expected to increase to 319 million in 2045 [1]. Food is a fundamental factor that must be fulfilled because without food, human activities will be disrupted, because humans need food to get energy [2].

Sugar is a human need that cannot be replaced, chemically sugar is a monosaccharide and disaccharide carbohydrate compound containing the elements carbon, hydrogen, and oxygen [3]. Sugar has the property of being able to change the taste to sweet, so it is commonly used in food and beverage mixtures [4]. In addition, the sweet taste of sugar can be identified in the hypothalamus so that it affects the brain's sensing processes [5]. This suggests that sweet taste receptors are involved in homeostatic processes throughout the body, including chemosensory function in the gut and transmitting information about energy homeostasis and glucose metabolism throughout the body [6]. However, based on data from the statistical center, sugar production in Indonesia in 2020 has decreased to 4.52%, even though the rate of population growth in Indonesia is always increasing [7]. The decline in sugar production is due to the narrowing of sugarcane plantation land as the basic material for sugar production [8]. Based on this, a material that can replace sugar cane is needed but can still meet human needs as an energy supply and form food security.

Tropical almond nut (*Terminalia catappa Linn*) is a plant that can grow in areas that lack nutrients and its grow this spread throughout almost all parts of Indonesia, making it easy to cultivate [9]. Generally, Tropical almond nut is only used as a shelter with seeds scattered underneath. In fact, if examined more deeply, Tropical almond nut has a high nutritional content such as 4.3 (g/100g) moisture, 23.3 (g/100g) protein, 4.2 (g/100g) ash, 12.5 (g/100g) carbohydrates, 0.2 (mg/100g) minerals, and 3225.2 (mg/100g) calcium [10]. The high content of protein and other nutritional values in Tropical

almond nut seeds is a potential use as raw material for making yogurt that can replace sugar. The presence of carbohydrates, protein, minerals, and calcium in Tropical almond nut seeds can be useful as nutrients for lactic acid bacteria during the fermentation process and as a source of energy for growth, cell formation and biosynthesis of metabolite products [11].

Table 1. Compotition of Tropical Almond Nut (*Terminalia catappa Linn*) [10]

Compotition	Total
Moisture (g/100g)	4.3
Protein (g/100g)	23.3
Ash (g/100g)	4.2
Carbohydrate (g/100g)	12.5
Minerals (mg/100g)	0.2
Calcium (mg/100g)	3225.2

In addition, in order for bacteria to grow properly, it is necessary to have a source of sugar as a carbon source such as glucose, fructose, lactose, and sucrose [12]. Some food stuffs contain various types of sugar, one of which is honey. Honey contains 35% glucose, 41% fructose and 1.9% sucrose [13]. Nutrient compotition of honey such as 328 kal calories, 0.5 g protein, 82.4 g carbohydrate, and 0.1 g fat [13]. In addition, honey also contains vitamins A, B1, B2, B3, B5, B6, C, D, E, K beta carotene, flavonoids, minerals, and salt, as well as antibiotics and digestive enzymes [14]. So that honey can be used as an energy source for the growth of lactic acid bacteria.

Table 2. Nutrient Compotition of Honey [13]

Compotition	Total
Calories	328 kal
Protein	0.5 g
Carbohydrate	82.4 g
Fat	0.1 g

Based on this background, researchers are interested in making yogurt made from Tropical almond nut seeds with the addition of honey as a substitute for sugar in fulfilling nutrition and establishing food security in accordance with the requirements of Indonesian National Standards (SNI) number 2981: 2009.

2. Material and Methods

2.1 Raw Materials

The raw materials used in this research were Tropical almond nut seeds from the district of Demak, Indonesia. The seeds taken are old seeds marked by the yellowish outer color of the seeds. Other supporting materials are nitrogen-free 98% H_2SO_4 (Merck), nitrogen-free $CuSO_4.5H_2O$ 0.05 g/ml H_2O, nitrogen-free K_2SO_4, aluminum foil (WITA), starter culture (Biokul) and honey (Granova) obtained from e-commerce, and water.

2.2 The Process of Making Tropical Almond Nut Seed Extract

The process of extracting the seeds of Tropical almond nut obtained from modification [15]. Tropical almond nut seeds are separated from the outer rind and washed. The clean Tropical almond nut seeds

are steamed for 5 minutes then soaked for 10 minutes. Furthermore, the Tropical almond nut seeds were ground with water in a ratio of 1:6 (w/v). After that, it was filtered using a filter cloth to obtain the Tropical almond nut seed extract. Then the Tropical almond nut seed extract is heated at a temperature of 80-85°C for 3 minutes.

2.3 The Process of Making Tropical Almond Nut seed yogurt

The process of making yogurt from the extraction of Tropical almond nut seeds uses a modification from [16] research. Add skim milk (10% w/v) to the extracted Tropical almond nut seeds, then added skim milk (10% w/v). The mixture is heated at 85°C for 15 minutes and cooled to 40-42°C. Then, divide into 3 containers and add honey with a concentration of 6% (w/v), 8% (w/v), 10% (w/v) in each container. Add plain yogurt with a ratio of 1:1 for each treatment, do the homogenization process. Cover the container with aluminum foil and incubate at 37°C for 8 hours. After the incubation is complete, the resulting yogurt is immediately cooled in the refrigerator.

2.4 Method of Analysis Protein

Analysis of protein content was carried out using the Kjeldahl method with the Indonesian National Standards (SNI) yogurt number 2981:2009 [17], the principle of testing the protein content of this yogurt is the destruction test with H_2SO_4 using $CuSO_2 4.5H_2O$ as a catalyst and K_4SO_4 to increase the boiling point in order to release nitrogen from protein as ammonium salt which is then to NH_3 during distillation using $NaOH.NH_3$ bound with boric acid, producing ammonium borate which is quantitatively titrated with a standard acid solution to obtain total hydrogen. Milk protein content was obtained by multiplying the total nitrogen by 6.38. The tools used in the analysis of protein content are kjeldahl flask, distillator, destruction apparatus, burette, and boiling stone.

2.5 Interpretation of results

Calculation of protein content in a sample is presented in Equation 1 [17]:

$$\text{Protein content (\%)} = \frac{(Vp-Vb)\times N\times 14{,}007\times Fk}{\text{sample weight } (g)} \quad (1)$$

Explanation:
Vp = Volume of HCL required for sample titration (mL)
Vb = Volume of HCL required for blanco titration (mL)
N = Normality of HCL Volume
Fk = Protein conversion vactor (6.25)

3. Results and Discussion

The purpose of this research was to determine how much effect of addition honey on the protein content in Tropical almond nut seeds yogurt produced. To produce yogurt, there are several stages, namely making Tropical almond nut seed extract, making Tropical almond nut seed yogurt, analysis protein content, and interpretation of results.

Effect of Addition of Honey on the Protein Content in Tropical Almond Nut Seeds Yogurt

Analysis the protein content of Tropical almond nut seed yogurt with the addition of honey was carried out using the Kjeldahl method (18-8-31/MU/SMM-SIG Kjeltec). The data of results as shown in the Table 3 and Figure 1.

Table 3. Relationship between Honey Concentration (%) with Protein Content (%)

Honey Concentration (% w/v)	Protein Content (%)

6	3.06
8	3.11
10	3.13

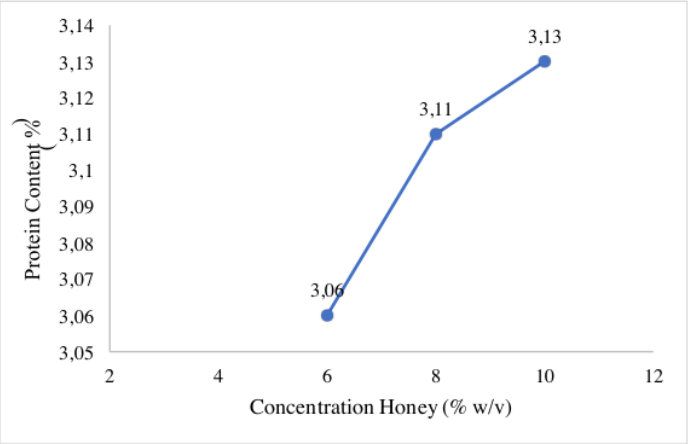

Figure 1. Relationship between Honey Concentration (% w/v) with Protein Content (%)

Table 3 and Figure 1 is a quantitative data that showing the relationship between honey concentration (% w/v) with protein content (%). The data shows that the protein content (%) with a concentration of 6% (w/v) is 3.06, the concentration of 8% (w/v) is 3.11, and the concentration of 10% (w/v) is 3.11. From the analysis of protein content, it is known that the more honey is added, the protein increases. This is in line with research from [18] that the addition of honey concentration has a

significant effect on the protein content produced, this is because the higher the concentration of honey added, the number of lactic acid bacteria in yogurt will increase. The added honey contains fructose which is then degraded by sucrase into glucose [19]. Lactic acid bacteria tend to use lactose first, which is found in Tropical almond nut seed milk because the lactase enzyme in lactic acid bacteria is already available to break down lactose substrates [11].

In carrying out metabolism, during fermentation, the starter uses the nutrients in the Tropical almond nut seeds and the fructose in the honey to get carbon and energy. During the fermentation process, lactic acid is formed from the metabolism of milk lactose into simple sugars, namely glucose and galactose and fructose in honey which is degraded by sucrase to glucose, glucose will be transformed into pyruvate with the help of the enzyme phosphoglyceraldehyde and from pyruvic acid to lactic acid by a starter under anaerobic conditions [20].

Table 4. Data of yogurt quality standards

No	Testing Criteria	Unit	Yogurt Without Heat Treatment After Fermentation	Yogurt With Heat Treatment After Fermentation
1.4	Consistency		homogeneous	homogeneous
2	Fat level (b/b)	%		
4	Protein (b/b)	%	min 2.7	min 2.7

5	Ash content	%	maks 1.0, 0.5-2.0	maks 1.0, 0.5-2.0
6	Acidity (b/b)	%		

Source: Indonesian National Standards (SNI) number 2981: 2009 [21]

Table 4 is a quality standard for yogurt, based on these data, the protein content in yogurt is at least 2.7%. In Tropical almond nut seed yogurt with variations in the addition of honey, the protein content is 3.06 %, 3.11% and 3.13%, so that Tropical almond nut seed yogurt is meets quality standards of yogurt.

Comparison between Tropical almond nut seeds yogurt and corn yogurt with variations in the concentration of the addition of honey

In research of making yogurt from corn extract with the addition of 2% (w/v), 4% (w/v), 6% (w/v), 8% (w/v), and 10% (w/v) honey, it was found that corn yogurt with protein content at the concentration of the addition of 2% (w/v) honey is 1.79%, 4% (w/v) is 2.08%, 6% (w/v) is 2.20%, 8% (w/v) is 2.58%, and 10% (w/v) is 3.15% [22]. The comparison between Tropical almond nut seeds yogurt and corn yogurt with variations in the concentration of the addition of honey can be seen in Table 5.

Table 5. Comparison between Tropical almond nut seeds yogurt and corn yogurt with variations in the concentration of the addition of honey

Honey Concentration (% w/v)	Protein Content (%)	
	Tropical Almond Nut Seeds Yogurt	Corn Yogurt
6	3.06	2.20
8	3.11	2.58
10	3.13	3.15

Table 5 shows the comparison between Tropical almond nut seeds yogurt and corn yogurt. Based on the table, it can be seen that Tropical almond nut seeds yogurt produces higher levels of protein than corn yogurt. This shows that Tropical almond nut seeds yogurt has more potential to be produced into yogurt.

4. Conclusion

Based on the results of the research that has been done, it can be concluded that the making of Tropical almond nut seed yogurt with the addition of honey as much as 6% (w/v), 8% (w/v), 10% (w/v) has met the requirements of Indonesian National Standards (SNI) number 2981: 2009 and the more the addition of honey, the higher the protein content obtained. This is in line with previous research with corn milk yogurt which stated that the addition of honey had a significant effect on the protein content of yogurt. The optimum concentration of the addition of honey in Tropical Almond Nut seed yogurt is at a concentration of 10% (w/v) with the acquisition of a protein content is 3.13%. Therefore, the substitution of honey in the manufacture of yogurt Tropical almond nut seeds can be replaced a sugar.

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