Effect Of Fermentation On Nutrition Content (Protein, Fat, Carbohydrate And Fiber) In Processed Red Beans (Phaseolus Vulgaris L.)

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ABSTRACT

Red bean tempeh is a processed product from nuts which is formed by the help of Rhizopus sp, mold through a fermentation process. One of the uses of red bean production through the boiling and fermentation process is an effort to increase the variety of red bean processing to increase the nutritional value of kidney beans. Purpose To determine the nutritional content and analysis of nutritional content in boiled red beans and red bean tempeh. This study was a pre experimental design. With a completely randomized design approach. The research carried out is by making preparations in the form of boiled red beans and red bean tempeh and then tested for nutritional content. The analysis test for protein content used the kjedahl method, the fat content used the Soxhlet method, the carbohydrate content used the anthrone method, and the fiber content used the reflux method. Statistical analysis of different tests was performed using the independent t test, with data distribution normally distributed. The average yield of nutrient content in boiled red beans was 18.77% protein, 4.03% fat, 27.40% carbohydrates, and 18.25% fiber. The nutritional content of red bean tempeh is 12.26% protein, 3.96% fat, 34.75% highest carbohydrate, and 22.10% fiber. The most significant test results were the carbohydrate content (p = 0.001) and the protein content (p = 0.021). Fat (p = 0.965) and fiber (p = 0.399) content showed no significant difference. There are differences in the nutritional content of boiled red beans and red bean tempeh, namely in the carbohydrate content and protein content, which shows a significant difference (p <0.05).

Key words : *Red beans, tempeh, fermentation, nutritional content*

INTRODUCTION

Red bean (*Phaseolus vulgaris L.*) is a legume commodity that is known to the world community and is available in Indonesia. This is according to the Central Statistics Agency (2014) which states the production of beans red in Indonesia in the year 2 013 reached 103 376 tonnes . Red beans are often consumed by people, among others, for a mixture of vegetable soup and a mixture for making cakes .

The high content of complex carbohydrates and fiber in red beans can reduce blood cholesterol, blood glucose and the risk of cancer (Messina, 2014). Red beans have a protein content that is high and almost on par with the green beans. The fat content in red beans is relatively low consisting of saturated fatty acids and

unsaturated fatty acids. High carbohydrate content of red beans is a good source of energy. The fiber content in red beans consists of water soluble fiber and water insoluble fiber, there are 0.7% types of pectin in 100 grams of red beans (Astawan, 2009) .

Red beans have active ingredients, one of which is isoflavones, in 100 grams of raw red beans contain isoflavones of 151.76 mg which is sufficient to prevent an increase in free radicals (Karisma, 2014). Red beans have not been widely used in the food production process in the community, so other alternative uses are sought so that red bean production is known to the public. Boiled red beans are one of the red bean processing efforts that are often used by the community. Boiled red beans can be used as ingredients for making jams, ice cream, and cakes.

Utilization of red bean production through a fermentation process is an effort to increase the variety of red bean processing. Fermentation technology is an alternative process for processing red beans into quality products that can increase the nutritional value of red beans. One of the potential uses of red beans is for making tempeh. Tempe is a fermented processed product originating from Indonesia and has been made from soybeans. Soybean production in 2012 was only 843.15 thousand tons, while the national demand was 2.3 million tons (BPS, 2014). On the other hand, soybeans are the main source of vegetable protein for the community, especially in Indonesia . If you look at the potential of Indonesia which has a very large biodiversity, you can find alternative solutions to overcome the scarcity of raw material for soybeans for making tempe.

Some domestically produced nuts have the potential to be developed into raw material for tempeh. Many types of nuts that can be used in research for the manufacture of tempeh products, including red beans. Red bean tempe is a processed product which is formed by means of a type of mold *Rhizopus sp,* through a fermentation process. The fermentation process in red beans will have an impact on several changes related to physical, biochemical, and microbiological changes that can add nutritional value to the resulting red bean tempe (Astawan, 2009). This study aims to describe the nutritional content of boiled red beans and red bean tempeh, and to analyze the differences in nutritional content (protein, fat, carbohydrates, and fiber) of boiled red beans and red bean tempeh.

METHODS

This study used a Pre Experimental Design research design. With a completely randomized design approach, the examination was repeated 3 times. The research carried out is by making preparations in the form of boiled red beans and red bean tempeh and then tested for nutritional content. Data analysis was carried out, namely the average value of nutritional content and differences in nutritional value of boiled red beans and red bean tempeh using independent t test. Data were processed with the help of the *SPSS*

program software with a significant level ($\alpha = 0.05$).

RESULTS AND DISCUSSION

1. Nutritional Content (Protein, Fat , Carbohydrate, and Fiber) in Boiled Red Beans

Table 1 Nutritional Content of Boiled Red Beans

Variable	Repetition			Mean	SD
	1	2	3		
Protein	19.59	15.79	20.93	18.77	2,6 6
Fat	6.63	3.87	1.61	4.0 3	2.51
Carbohydrate	27.10	27.04	28.08	27.4 0	0.58
Fiber	19.38	16.28	19.09	18.2 5	1.71

Based on table 1, it shows that the average nutritional content in boiled red beans is 18.77% protein, 4.03% fat, 27.40% carbohydrates, and 18.25% fiber . According to research Karisma (2014) the protein content of red beans boiled for 20.47% showed a high content of proein due to the addition of the water content of red bean seeds in order to obtain the protein greater. Fat content in boiled red beans tends to be higher with an average of 4.03%, this is influenced by the addition of 1800 ml of water at the time of boiling.

The carbohydrate content in the lower red beans boiled with an average of 27.40%, this happens because during the boiling process it can damage, precipitate, and eliminate carbohydrate content due to cell wall permeability so that starch easily leaves the cell walls of red bean seeds which can result in lower carbohydrate content (Moniharapon E, Sandra & Dina, 2017). The fiber content in boiled red beans is lower with an average yield of 18.25%, due to softening of the red bean seeds and loss of epidermis on red beans and during the boiling process, water absorption will occur into the red bean seeds which can produce fiber content tends to be lower (Diana N, 2016).

2. Nutritional Content (Protein, Fat , Carbohydrate, and Fiber) in Red Beans Tempe

Table 2 Nutritional Content of Red Beans Tempe

Variable	Repetition			Mean	SD
	1	2	3		
Protein	12.39	13.71	10.69	12.26	1.51
Fat	3.55	4.71	3.64	3,9 6	0.6 4
Carbohydrate	36.00	34.91	33.36	34.7 5	1,3 2
Fiber	29.59	16.13	20.58	22.10	6,8 5

Based on table 2 shows the average nutritional content in red bean tempeh, namely 12.26% protein, 3.96% fat, 34.75% carbohydrates, and 22.10% fiber. The protein content in red bean tempeh tends to be lower than the protein content in boiled kidney beans. This can be caused by the length of fermentation for 48 hours or 2 days when making red bean tempeh can affect the decrease in protein content in red bean tempe (Admin, 2010). According to Astuti, et al (2000) it is because total of free amino acids in tempeh is much greater due to the activity of the protease enzyme produced by mold, but after the 48-hour fermentation process, the total amino acid amount has decreased in the range of 3.62-27.9% .

This decrease in fat levels is caused by the enzyme lipase during fermentation which hydrolyzes fat into free fatty acids. The fatty acids produced in large quantities are linoleic, linolenic, and oleic fatty acids. *Rhizopus oligosporus* uses linoleic acid, oleic acid, palmitic acid as an energy source during fermentation, so that fat levels can decrease (Astuti et al. , 2000). In line with Wicaksono's research (2014), regarding thickness and plastic packaging in red bean tempeh, the fat content in red bean tempeh was lower, of 1.8% with a thickness of 1 cm tempe..

Microbes are often found in tempeh yeast is a fungus species *Rhizopus oligosporus* which can secrete the enzymes amylase and able to produce the compounds of carbohydrates a new thus helping to increase levels of carbohydrates in Tempe (Astawan, 2009). According to research by Asngad A, Suparti, and Priyonggo BL (2011), it is stated that red bean tempe with a fermentation time of 2 days resulted in a carbohydrate content 100 grams of red bean tempeh , which is 20.15%. The fiber content in red bean tempeh tends to be higher than boiled red beans. This happens because of the addition of yeast at the time of making red beans tempe, the cell wall of Rhizopus sp. hyphae consists mainly of polysaccharides. The addition of inoculum concentration will produce more Rhizopus sp. molds and mycelium that are formed so that the polysaccharide content in tempeh will be even greater and increase fiber content (Dewi L, Hastuti, & Kumalasari, 2013).

3. Differences in Nutritional Content in Boiled Red Beans and Red Beans Tempeh

Table 3 Differences in Nutritional Content between Boiled Red Beans and Red Beans Tempe

Variable	Group	Mean	SD	T	p-value
Protein	Boiled Red Beans	18.77	2,66	-3,676	0.021
		12.26			

	Red Bean Tempe Boiled		1.51		
Fat	Red Bean Boiled	4.0 3	2.51	-0.047	0.965
	Red Bean Tempe	3,9 6	0.6 4		
Carbohydrate	Red Bean Boiled	27.4 0	0.58	8,783	0.001
	Red Bean Tempe	34.7 5	1,3 2		
Fiber	Red Bean Boiled	18.25	1.71	0.943	0.399
	Red Bean Tempe	22.10	6,8 5		

Note: p.sig <0.05 indicates there is a difference

Based on table 4.4 the results of the independent t-test statistical analysis can be known that there is a difference significant content of protein include beans merahrebus with tempeh bean red. Boiled red beans do not undergo a fermentation process so that there is no breakdown of protein into amino acids or the breakdown of complex compounds into simple ones. Whereas in red bean tempe fermented with the fungus *Rhizopus sp.* during the fermentation process, there was a decrease in protein levels due to the breakdown of protein into amino acids and short-chain peptides, the decrease in protein content was caused by the fungus *Rhizopus oligosporus* being proteolytic and this is important in protein breakdown (Wang H, 1984). There was no significant difference in the fat content between boiled red beans and red bean tempeh. From these results, statistically the fat content in boiled red bean and red bean tempeh was not significantly different. This is in accordance with Astawan's (2009) theory which states that during the fermentation process the fat content changes only slightly.

The results on carbohydrate content showed that there was a significant difference , red beans fermented into tempeh would experience changes both physically and chemically, tempeh products from red beans through the fermentation process would increase the nutritional content of the products produced (Astawan, 2009). Judging from the content of fiber is not no difference significant statistically can be expressed not significantly different. According to Dwidjoseputro (1978), fermentation red bean tempe with the help of *Rhizopus s p* fungus

will produce mycelia on the surface of red bean seeds, an increase in the number of mycelia formed by *Rhizopus s p* indicates an increase in fiber content in red bean tempe, compared to boiled red beans which does not undergo the fermentation process and the addition of yeast.

According to research Ruben E, Ni Wayan E, and I Desak (2015), who examined red bean flour and red bean tempeh flour, each treatment was repeated 3 times . Analyzed by Paired T test confidence interval of 95% using SPSS (*Statistical Program for Social Science*) . After t-test analysis was carried out that the treatment of red bean flour and red bean tempeh flour was significantly different (P <0.01) , so that it was stated that there was a difference in the nutritional content of fat, protein and carbohydrates produced.

CONCLUSION

1. The average nutritional content in boiled red beans was obtained, the protein content of 18.77%, 4.03% fat, 27.40% carbohydrates, and 18.25% fiber content.
2. The average nutritional content in red bean tempeh was obtained, the protein content of 12.26%, 3.96% fat, 34.75% carbohydrates, and 22.10% fiber content.
3. There was a difference in the nutritional content of boiled red beans and red bean tempeh, the carbohydrate content of p= 0.001 and the protein content of p= 0.021 which indicated a significant difference (p <0.05). Meanwhile, the fat content of p = 0.965 and fiber p= 0.399 showed no significant difference (p> 0.05).

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