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Nutritional Content and Amino Acid Profile of *Juleh*: A Balinese Traditional Food Fermentation

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Abstract

Juleh was a typical food in Sibetan Karangasem Bali area made from koro beans which boiling and soaking process for four days. It was then fermented naturally for one day without using special bacteria. Juleh was consumed by fried or fermented for a day then mixed with the Balinese spices further stir fried or made soup. The study was intended to determine the nutrients content, the amino acid composition in Juleh. The results showed that the nutrient content of fried Juleh was higher than fermented, with protein content 50,23%, fat content 14,94%, and carbohydrate content 28,24%. Juleh fermentation contains 15 types of the amino acids that were dominated by the glutamic acid that causes Juleh taste to be tasty. The amino acid content in fermentation Juleh was higher than all types of the amino acids, both essential and nonessential, rather than amino acid content in Seredele.

Contents

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1. Introduction

The nutritional content of dried Koro Benguk beans consists of 29.8 g protein, 4.2 g of fat, 7.37 g of fiber, 50.8 g of carbohydrate, and 1560.3 kj of energy (Doss et al., 2011). Koro Benguk has a very high essential amino acid content of 55.5% higher than soybean which is only 40% (Yuniastuti, 2008; Sudiyono, 2010). According to Retnaningsih (2014), during the fermentation process increased protein from 31.49 to 33.03 in Koro Benguk beans. The foods that have undergone a fermentation process will provide better its health benefits. The fermentation can also affect the value/composition of the amino acids contained in food (Deliani 2008). The fermented foods can be sourced from both animal and vegetable foods. The traditional fermented foods that are well known in Bali included *bebontot, tape, tempe, seredele, brem, vinegar, etc.*

One of the fermented bean curd foods is Juleh. Juleh is a fermented bean food that has a distinctive taste and is typical food in Karangasem regency. In Gianyar regency, there is a similar product unlike Juleh but its different ingredients are soybean called "*seredele*", which has already been explored by the several researchers. The purpose of the present study was to explore the content of nutrients and amino acids contained in Juleh and then compare it with the amino acid content consisted in Seredele.

2. Research Method

The present study is an experimental study, whose the researchers analyzed the nutrients content of (fat, protein, carbohydrates, and amino acids), ash content, moisture content in Juleh fermented products produced in Sibetan Village, Karangasem. The data sample of Juleh study is done in Sibetan Village, Karangasem. The proximate analysis (fat, protein, carbohydrate, ash content, and moisture content) and the antioxidants were conducted at Udayana University, the Faculty of Agricultural Laboratory Service Unit. The amino acid testing was conducted at Central Laboratory, IPB Bogor. This research was conducted in June to October 2016. The primary data collected in the form of the water content, ash content, fat, protein, carbohydrate and amino acid content. The sample is tested by direct measurement. It was obtained through the results of the water content analysis using Oven Method (SNI 01 - 2891 - 1992 point 5.1, food and beverage test method), the fat content by Soxhlet method, ash content is determined by dry method (SNI 01 - 2891 - 1992 point 6.1. test method of food and beverage). The protein content is determined by Semi-micro Kjeldahl method (SNI 01-2891-1992 point 7 test method of food and beverage). The carbohydrate is determined by *proximate analysis* (also called *Carbohydrate by Difference*) and acid content amino by HPLC method.

The research procedures are conducted in three steps, *i.e.,* preparation, implementation, and data analysis.

1. Preparation
   This step is conducted to prepare the tools and materials used during the implementation steps. The data sample is conducted at the existing Juleh production place in Sibetan Village, Karangasem by using a sterile plastic bag.
2. Implementation
   In the implementation steps, the analysis is conducted included: a) Water content analysis, b) Fat Level, c) Ash Content, d) Protein levels, e) Carbohydrate levels, and f) Amino Acid Content.
3. Data Analysis
   The data that is obtained from the test results in the next laboratory is presented in the form of tables or graphs and narrated in accordance with the relevant literature review.

3. Results and Analysis

Juleh is the production of the process of soaking and boiling the Koro beans. Juleh is traditionally produced by the society in Sibetan village, Karangasem. At the time of collecting of the data sample in Sibetan Village, there is only one maker of Juleh, whose products are sold in several places in Sibetan Village. The Koro beans used are the special beans imported from Sraya Village, Karangasem.

The process of making Juleh is started with the sorting of the Koro beans, then soaked for one day, then the next day boiled for approximately 4 hours until the skin is easily peeled. After the skin is peeled followed by a soaking process for three days, wherein the water immersion is replaced two times, morning and evening. It is further drained and done a frying process with seasoned garlic, *kencur* (*kaempferia galangal*) and salt first, until crunchy. There is also to be fermented for one day at the room temperature without the addition of the special microbes, then just processed into side dishes or mixed with jackfruit vegetable.

The Juleh is just sliced has a brownish-black to blackish color, with a slightly soft texture and a soaked bean aroma. The fried Juleh has a hard texture with brown, and a savory taste, whereas, the fermented Juleh has a

purplish brownish of the white color, soft texture, and a distinctive aroma. The laboratory analysis result is conducted to Koro raw bean, Juleh, fried Juleh, and fermentation Juleh. The laboratory analysis of four samples included amino acid analysis and nutrient content (fat, protein, carbohydrate, ash, and moisture content). The composition and amino acid content consisted of the sample can be seen in the following Table 1.

Table 1
The Composition and amino acids content of Koro beans, Juleh, fried Juleh, and Juleh fermentation

Amino Acids Types	Amino Acid Level (%)				
	Koro beans	Juleh	Fried Juleh	Juleh Fermentation	Seredele*
Essential Amino Acids					
Histidine	0.45	0.34	0.59	0.50	0.04
Threonine	0.83	0.53	0.99	0.82	0.08
Methionine	0.20	0.01	0.08	0.19	0.04
Valine	1.03	0.85	1.42	1.29	0.08
Phenylalanine	1.01	0.85	1.47	1.24	0.20
I-leucine	0.97	0.83	1.37	1.25	0.08
Leucine	1.40	1.19	2.01	1.77	0.16
Lysine	1.42	1.09	1.65	1.46	0.16
Non-Essential Amino Acids					
Aspartic acid	2.32	1.87	3.25	2.72	0.28
Glutamic acid	2.54	2.08	2.93	2.98	0.60
Serine	0.94	0.68	1.24	0.97	0.16
Glycine	0.87	0.65	1.01	0.98	0.08
Arginine	1.21	0.87	1.46	1.21	0.36
Alanine	0.72	0.52	0.90	0.88	0.08
Tyrosine	0.97	0.57	1.22	1.06	0.72

Description: *(Sutiari et al. 2010)

If it is compared the amino acid levels between Juleh fermentation with Seredele in Gianyar can be seen in Figure 1.

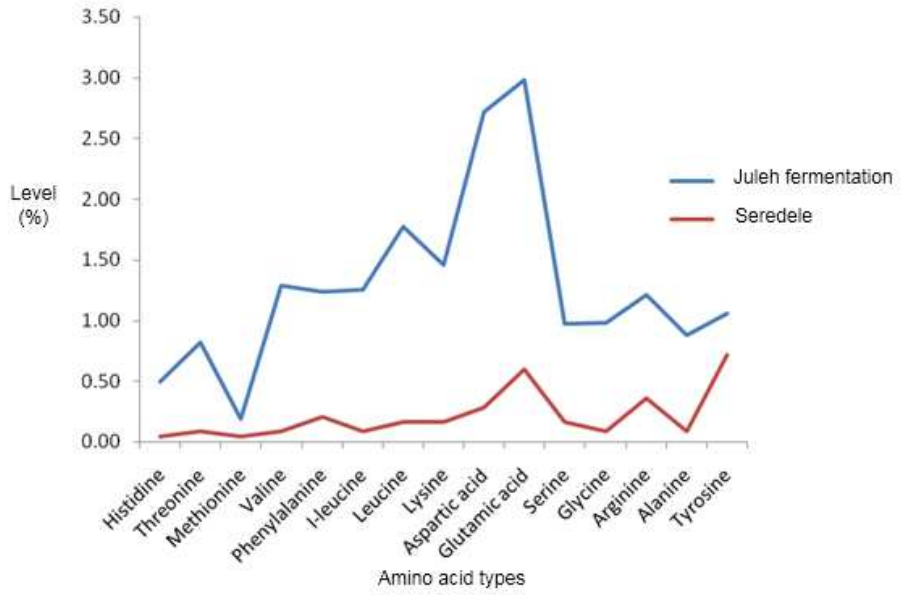

Figure 1. The comparison of the amino acid of Juleh Fermentation with Seredele

The nutrient content consisting of the ash content, water content, protein, fat, and carbohydrate. It can be seen in the following Table 2.

Table 2
The nutrient contents of the Koro beans, Juleh, fried Juleh, and Juleh fermentation

Nutrient Content	Koro Beans	Fried Juleh	Juleh fermentation
Water	16.5433	2.3577	64.0927
Ash	3.3144	4.2309	0.2982
Protein	16.7337	28.2370	11.5253
Fat	4.1203	14.9433	1.9418
KH	59.2882	50.2314	22.1419

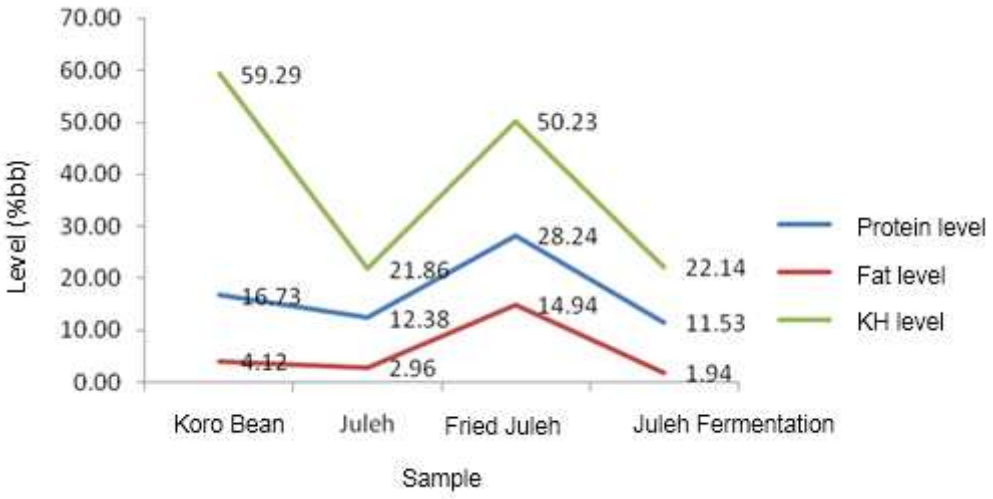

Figure 2. The level of protein, fat, and carbohydrate in the Sample

Analysis

1. Fat level

   The highest fat level is found in the fried Juleh. It is caused by the remaining oil in the frying process of Juleh. The lowest levels of fat in the fermented Juleh are caused by the triglycerides already hydrolyzed into free fatty acids due to the presence of the lipase enzymes. The presence fungi of the lipolytic in the Juleh fermentation will utilize free fatty acids in energy (Mayasari 2012). In the process of making Juleh is a soaking process for four days, this results due to decrease in the fat content of the sample. This is in accordance with the research results by Kasita et al. (2016), which stated that by the soaking process, the fat content of the soybean flour meal decreased caused by the process of fat hydrolysis of the water to fatty acid and glycerol, fat in acid form tends to dissolve in soaking media.

2. Protein level

   The Juleh that is fermented occurred a decrease in the protein levels; this is by the research results by Andarti & Wardani (2015) which stated that during the fermentation process of the miso protein levels decreased due to the rupturing process of the protein into amino acids and short chain peptides. The proteolytic microorganisms grown during the fermentation process can degrade the protein into dipeptide and subsequently become the lost NH3 and N2 compound by evaporation. The high protein level in the fried Juleh can be caused due to the low water content, therefore, regarding the same amount of analysis for all samples of the protein level in the highest form the fried Juleh.

3. Carbohydrate level

   The results of the carbohydrate analysis showed that the highest carbohydrate levels found in Koro beans and the lowest carbohydrate levels were found in the Juleh after soaking, this is in accordance with the research result by Syarifudin (2016) which stated that a long immersion time, thus, the lower carbohydrate levels. According to Suarti et al. (2013), the soaked material will expand and be semipermeable, therefore, the molecules of the organic compounds, unlike sugars and amino acids freely can penetrate the cell wall and then dissolve in the immersion water. During the immersion process, there will be the dissolution of the soluble substances, unlike carbohydrates and vitamins that are washed in immersion. During the fermentation process, there is also a decrease of the carbohydrate levels compared with the raw material. According to Zuhro et al. (2015), during the fermentation process, the components in the material will be lost and dissolved in the water during the fermentation process.

4. Water level

   The highest water level is in the Juleh fermentation due to the breakdown of the food components by microbes during the fermentation process. Whereas, the lowest water level is in the fried Juleh due to the evaporation process during the frying process.

5. Ash level

   The ash level in the food depends on the food type and is related to the type of the minerals contained in the foodstuffs. It is a material left end when the food is burned at a temperature of 500-800^{o} C. The highest ash level found in the fried Juleh is 4.2309. This is in accordance with the research by Sundari et al., (2015) stated that that the fried foods will increase the ash level.

6. Amino Acids

   Regarding the Table 1, it can be seen that the testing results on amino acids performed of Koro beans sample, Juleh, fried Juleh, and Juleh fermentation showed amino acids detected by HPLC method about 15 types of the amino acids consisting of 8 types of the essential amino acids and seven types nonessential acids. The amino acid content in Juleh decreased when it is compared with the amino acid content in raw Koro beans. This is in accordance with the research result by Nurjanah et al. (2014) stated that a decrease of the amino acids in the process of boiling due to the nature of the amino acids easily dissolve in the process of boiling. The process of making Juleh has been through the process of soaking and boiling long enough the many amino acids are denatured during the process of boiling and dissolving in the water on the immersion process conducted for four days.

   If it is compared with amino acid levels that are consisted of the Seredele products (Sutiari et al. 2010), then, for all types of the amino acids both essential and nonessential, it turns out the amino acid content in the Juleh fermentation is higher than the amino acid content in Seredele. It indicates that Juleh fermentation can serve as one of the locally processed products that have complete and high enough amino acids and can potentially be developed into one of the mainstays of the culinary tourism, particularly for Karangasem district. The highest levels of the amino acids in Juleh are glutamic acid, high glutamic acid content causes the fried Juleh taste to be tasty (Nurjanah et al. 2014).

4. Conclusion

Based on the research results can be concluded that the content included fat, protein, and carbohydrates in fried Juleh higher than Juleh fermentation. The highest water content is found in Juleh fermentation, and the lowest water content is found in fried Juleh. The highest ash content is found in raw beans, and the lowest is found in Juleh fermentation. The amino acid content of the Juleh fermentation is higher than amino acid of Seredele.

Suggestions

It is needed further research on the acceptance or organoleptic test of the fried Juleh, Juleh fermentation, and the existence of more intensive socialization process about Juleh, therefore, the Juleh can be recognized by the public.

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