Chemical properties of tempoyak from Lima Puluh Kota district of West Sumatera, Indonesia

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Abstract. Tempoyak is a traditional food from durian, which is made by processed, fermented durian flesh with the addition of salt and fermentation in anaerobic conditions stored in a closed state. This study aims to determine the chemical properties of tempoyak, namely the value of protein, fat content, water content, pH, and TTA (Total Titrable Acid) of the Lima Puluh Kota District. The method used is descriptive method and analysis in the laboratory. The samples used in this study are Durian meat (Duriozibethinus L.) with four treatments, the first treatment uses durian meat only (TC1), the second durian meat with banana leaf packaging (TC2), the third durian meat is added with chili (TC3), and the fourth durian slices of meat added with chili and banana leaf packaging (TC4). All treatments were then stored in anaerobic conditions and aged for two weeks. The results showed that the protein content was 1.42% - 6.49%. The highest was in TC1 tempoyak, 1.03% - 3.04% fat content and the highest was in TC1 tempoyak, 75.60% - 89.97% water content and the highest in tempoyak TC3, pH 3.8 - 4.1 and highest in tempoyak TC1, Total Titrable Acid 0.29% - 0.34% and highest in tempoyak TC3 and TC4.

1. Introduction

Food is the primary need for human consumption according to the nutritional needs needed by the body. One source of nutrients such as animal food products, where the product is produced must still pay attention to quality and consumer acceptance. Inline the more research is done, the higher is public awareness of health and maintaining body condition in order to stay well preserved. This can be seen from the number of food products having a high-quality value and a better level of food safety.

Traditional food is currently becoming the world's attention. Traditional food is a food ingredient, and spices include finished and semi-finished components traditionally processed by the Indonesian people. Tempoyak is a type of traditional food from West Sumatra with the essential components of durian fruit. Durian fruit (Durio zibethinus sp.) Is a tropical fruit that has high production and is seasonal.

Durian is a type of climatic fruit that is characterized by the production of CO₂ and its ethylene fast during ripening hence it's easy to experience damage due to chemical changes, enzyme, and microbial activity [1]. By therefore durian needs to be processed into a product hold storage and high economic value such as tempoyak. Traditional durian processed products that aim to extend the shelf life and into one form sufficient product diversification known.
Fermented durian processing is generally carried out by home industries that take advantage of the superior quality of durian or durian. Processing of durian using fermentation produces a product called tempoyak, and some call it pekasam, pikel durian, durian tamarind, and fermented durian. Durian or fermented tempoyak is used as a cooking spice in several ethnic Malay areas such as Lampung, Jambi, South Sumatra, West Sumatra (also known as durian acid), Aceh (called Pekasam), and West Kalimantan.

Tempoyak is a traditional food spread in various regions such as Sumatra and Kalimantan. By definition, the name tempoyak is absorbed from food processing techniques, namely from the word poyak, so it can be said that the name tempoyak is obtained because of the durian processing method, namely torn [2]. Tempoyak is a traditional durian food made by simple fermentation with added salt. Tempoyak is made by adding 1-1.5% salt to the pulp, which is then ripened for 3-4 days. Tempoyak has a sharp aroma and a very sour taste which is classified as a food product from lactic acid fermentation [3].

Spontaneous tempoyak fermentation generally occurs around 4 to 7 days [4]. Tempoyak has nutritional content namely water 63.73%, protein 1.1%, fat 2.2% [5]. Previous research results from [6] produced the nutritional content of tempoyak, namely water content of 15.12%, ash content 27.03%, fat content 2.69%, protein content 6.37%, and carbohydrate content 48.79%.

Tempoyak shelf life varies significantly between 2 months to 1 year. This extended shelf life results in suppressed growth of pathogenic microbes and spoilage by acids produced by lactic acid bacteria during the fermentation process in tempoyak [7]. The microbes that were active during the tempoyak fermentation were acid-producing Gram-positive bacteria which were a group of lactic acid bacteria. Lactic acid bacteria are bacteria that have health effects on the human body. Lactic acid bacteria constitute a group of large beneficial bacteria that have relatively the same properties. Currently, lactic acid bacteria are used for pickling and improving the texture and taste of food ingredients. Therefore it is necessary to measure the chemical quality of tempoyak to produce antibacterial compounds to obtain functional tempoyak which is probiotic.

1.1. The purpose of the research
The purpose of this research was to see the chemical properties of Tempoyak from Limapuluh Kota District of West Sumatra Indonesia as traditional fermented food.

2. Materials and methods

2.1. The material of the research
The ingredients used in the manufacture of tempoyak are durian, chili, and leaf packaging. The materials used to see the nutritional value of tempoyak are H$_2$SO$_4$, 30% NaOH, distilled water, methyl red indicator, 0.1 N NaOH, spiritus, benzene, phenolphthalein (pp). The equipment used in this study were label paper, porcelain plates, pH meter, electric oven, analytical scales, Kjeldahl flasks, funnels, distillation flasks, beaker glasses, Erlenmeyer, fume hoods, Bunsen, hyacinth pipettes, volumetric flasks, a set of Soxhlet tools, bunsen, grease paper, and aluminum foil.

2.2. Methods of the research
The method used in this research is a descriptive method and laboratory analysis.

2.2.1. Protein content. Tempoyak protein content was determined based on the guidelines of [8] using the Kjedhal method with the following work procedures:

- Digestion stage. Tempoyak samples dry using analytical scales were weighed as much as 1 g and put into a Kjeldahl flask. Then to the Kjeldahl flask, 1 gram of selenium catalyst was added, and 25 ml of concentrated H$_2$SO$_4$ was added and then heated so that destruction occurred. Heating is carried out continuously so that the solution becomes clear or colorless, occasionally shake the Kjeldahl flask so that the answer is homogeneous. The purification process is faster. Cool the pumpkin once it is clear.
The distillation stage. The solution was transferred to a 500 ml volumetric flask and then diluted with distilled water to mark the line. Then take 25 ml of sample solution plus 25 ml of 30% NaOH, which has been mixed with 150 ml of aqua dest, and put it in a distillation flask. The answer is heated (2/3 distil) until all N from the liquid in the flask is captured by H₂SO₄ 0.05 N, which is first mixed with methyl red indicator drops and Erlenmeyer.

Titration stage. Erlenmeyer containing the distillate was titrated with NaOH 0.01N (Z ml). Another Erlenmeyer added 25 ml of 0.05 N H₂SO₄ and three drops of methyl red indicator and titrated with 0.1 NaOH to change from pink to yellow as blank (Y ml).

2.2.2. Fat content. Calculating the tempyok fat content was determined by the Soxhlet method based on the guidelines of [8], with the following work steps: 1 gram of dried sample was wrapped in grease paper and then dried in an electric oven for 12 hours at 105 °C. The packages were weighed hot then extracted with benzene for 4 - 6 hours until the benzene in Soxhlet became clear. The extraction was stopped while the sample was cooled to dry, where the benzene would evaporate. The samples were dried in an electric oven at 105 °C for 4 hours to obtain a constant weight. The packages are weighed individually when hot. The weight difference before and after extraction is the weight of fat in the food.

2.2.3. Water content. The water content of the sample was determined based on the guidelines of [8] The aluminum plates were oven-dried at 110 °C for 1 hour and then cooled in a desiccator. The dishes are weighed and filled with a sample of 5 grams. Then dry in the oven at 105 °C for 8 hours. Cool in a desiccator and weighed then carried out repeatedly until the weight becomes constant.

2.2.4. pH. Tempoyak pH value can be observed based on the guidelines of [9] as follows; the sample was weighed as much as 50 ml and put into a beaker glass. The pH meter is standardized using a standard buffer solution with a pH of 7 (sterile distilled water). Next, the electrode is immersed in the beaker glass, which contains the sample; pH readings are made after the pH meter scale stabilizes.

2.2.5. TTA (Total Titratable Acidity). Measurement of sample acidity was carried out according to [10] Samples were weighed using analytical scales as much as 5 g to 10 ml of distilled water, then stirred using a stirring rod until the sample was homogeneous with distilled water. The prepared biuret was filled with 0.1 N NaOH, then added 2 ml of phenolphthalein (pp) indicator. Titrate with 0.1 N NaOH until the color changes (equivalence point), and the volume used by the titration is recorded and finally. The sample description used can be seen in Table 1.

| Sample code | Sample type | Additional material | Source | Documentation |
|--------------|-------------|---------------------|--------|---------------|
| TC1          | Durian      |                     | Tanjung Jati, LimaPuluh Kota |
| TC2          | Durian      | Banana leaf packaging | Tanjung Jati, LimaPuluh Kota |
| TC3          | Durian      | Chilli              | Tanjung Jati, LimaPuluh Kota |
| TC4          | Durian      | Banana leaf packaging and chilli | Tanjung Jati, LimaPuluh Kota |

Source: Research data
3. Results and discussion

3.1. Tempoyak chemical analysis
This analysis is shown to obtain the nutritional value of tempoyak. The results of the chemical analysis of tempoyak can be seen in Table 2 below.

Table 2. Results of chemical analysis of tempoyak from Lima Puluh Kota District

| Sample code | Protein content (%) | Fat content (%) | Water content (%) | pH | TTA (%) |
|-------------|---------------------|----------------|------------------|----|---------|
| TC1         | 6.49                | 3.04           | 75.60            | 4.1| 0.31    |
| TC2         | 3.10                | 2.73           | 77.30            | 3.8| 0.29    |
| TC3         | 1.42                | 1.03           | 89.97            | 3.8| 0.34    |
| TC4         | 1.92                | 1.97           | 82.05            | 3.9| 0.34    |

TC1 (Tempoyak without treatment), TC2 (Tempoyak with banana leaf packaging), TC3 (Tempoyak with chili), TC4 (Tempoyak with banana leaf packaging and chili)

3.2. Proteins content
The protein content of tempoyak TC1 was 6.49%, tempoyak TC2 was 3.10%, tempoyak TC3 was 1.42%, and tempoyak TC4 was 1.92%. The highest protein content of tempoyak was in tempoyak TC1 without treatment with the protein content of 6.49%, and the lowest protein content of tempoyak was in tempoyak TC3 with the addition of chili with the protein content of 1.42%.

The highest protein content was in the tempoyak TC1 sample without treatment. The yield of TC1 tempoyak protein content was higher than in previous studies. Namely, the resulting protein content was 2.72% [11]. The higher protein content is directly proportional to the number of lactic acid bacteria that grow in the TC1 tempoyak sample. It can be seen in the calculation of the entire colony of lactic acid bacteria, which is 1.92 x 10^8 CFU / g. Stating that the greater the number of lactic acid bacteria, the higher the protein content, because most of the components of lactic acid bacteria are protein [12]. Lactic acid bacterial cells have a cell covering layer in the form of a plasma membrane and cell walls that contain proteins and polysaccharides.

While the lowest protein content was obtained by tempoyak TC3 with the protein content of 1.42%, the tempoyak TC3 sample is a sample with the addition of chili. The decrease in protein content is caused by bacteria as an inhibiting agent for chili protein synthesis because chilies contain capsaicin compounds. The mechanism of capsaicin in inhibiting antimicrobial compounds begins with the penetration of capsaicin into microbial cells, and then capsaicin will inhibit protein synthesis and damage DNA [13]. Red chilies contain a chemically active compound, namely capsaicin (essential oil), which is stored in chili meat, seeds, or where the chili seeds are attached. Capsaicin acts as a bactericide and fungicide [14].

3.3. Fat content
The fat content of tempoyak TC1 was 3.04%, TC2 was 2.73%, TC3 was 1.03%, and TC4 was 1.97%. The highest fat content was obtained by the tempoyak TC1 sample, which was 3.04%, and the lowest was the TC3 tempoyak sample, which was 1.03%. The highest fat content is at tempoyak TC1, which is without treatment with a fat content of 3.04%. The results of this study were higher than in previous studies, which obtained fat content in tempoyak, which ranged from 2.09 to 2.69% [11]. The value of fat content is influenced by LAB activity in degrading fat. During fermentation, there will be degradation of fat due to the action of the lipase enzyme, which is naturally present in food or produced by microbes that grow in fermented food [15]. Fat will be broken down into volatile and non-volatile fatty acids to form aroma and flavor.

There is the degradation of the fat into diglyceride and monoglyceride fatty acids. Fat degradation occurs due to lipase activity produced by lipolytic microbes [16]. The lower the microbial activity that
degrades fat, the higher the fat content. The decrease in fat content in tempoyak TC3 was caused by the addition of chilies, and chilies are compounds that contain antioxidants. The antioxidants in red chilies are compounds that can slow down the oxidation of fat in the ingredients [17].

3.4. Water content
The water content of the tempoyak TC1, TC2, TC3, and TC4 was 75.60%, 77.30%, respectively. 89.97% and 82.05%. The results of the water content range of tempoyak in this study were 75.60% - 89.97%. The result of the water content in this study was higher than in previous studies, which stated that the water content of tempoyak was 55% - 67% [18]. The high water content of tempoyak in this study was due to the addition of treatment in each sample of tempoyak with banana leaves and chilies.

Metabolic processes produce by-products, among which is water [19]. The high water content is caused by the production of water as a by-product of bacterial metabolism in the tempoyak fermentation process, namely the formation of phosphoglyceric acid into phosphoenolpyruvic acid. In addition to the water content produced by bacteria in the metabolic process, banana leaves also provide hot and humid conditions. The release of heat and moisture slowly occurs because the wrapping with banana leaves produces an aeration system that maintains stability during the fermentation process [20].

Water content is inversely related to fat content. Water content has a close relationship with fat content [21]. The higher the water content, the lower the fat content. According to what was found in the study with the highest water content found in the TC3 sample, which was 89.97% and the lowest fat content in the TC3 sample with the lowest fat content was 1.03%.

3.5. pH value
The pH value of tempoyak TC1 was 4.1, TC2 was 3.8, TC3 was 3.8, and TC4 was 3.9. The results of the tempoyak pH value range in this study were 3.8 - 4.1. The range of pH values produced in this study is an acidic pH value because tempoyak is a fermented food product resulting in an acidic pH. Tempoyak fermentation is carried out for two weeks. The duration of fermentation also affects the pH value of tempoyak. Following previous studies that obtained an acidic pH range with a value of 3.56 - 4.59 [11].

Acid pH values are in line with the growth of lactic acid bacteria in the product; this is because lactic acid bacteria produce lactic acid compounds. The decrease in pH occurs with an increase in the number of lactic acid bacteria [22]. Adding a low pH is caused by lactic acid produced during lactic acid bacteria (LAB) [23]. LAB is a group of bacteria that decompose carbohydrates (glucose) into acids, which lower the pH and cause a sour taste. The more sugar that can be metabolized, the more organic acids will be produced to automatically be lower. The low pH value is what causes lactic acid bacteria to increase [21].

3.6. TTA (Total Titratable Acidity) value
TTA (Total Titratable Acid) tempoyak sample TC1 is 0.31%, TC2 is 0.29%, TC3 is 0.34% and TC4 is 0.34%. The results of this study indicate that high acid content is due to the fermentation process. Tempoyak is processed by durian fruit obtained by simple fermentation, in the form of pulp with a sour taste. That LAB is a group of bacteria that decompose carbohydrates (glucose) into acids, which lower the pH and cause a sour taste [24].

4. Conclusion
Tempoyak is a traditional food from West Sumatra, which contains a good nutritional value for health. Tempoyak is a traditional food from durian, which is made by processed, fermented durian flesh with the addition of salt and fermentation in anaerobic conditions stored in a closed state. Analysis result protein content was 1.42% - 6.49%, The highest was in TC1 tempoyak, 1.03% - 3.04% fat and the highest was in TC1 tempoyak, 75.60% - 89.97% water content and the highest in tempoyak TC3, pH 3.8 - 4.1 and highest in tempoyak TC1, TTA (Total Titratable Acid) 0.29% - 0.34% and highest in tempoyak TC3 and TC4. The conclusion is tempoyak has good nutritional quality.
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