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Abstract. This paper was aimed to analyze nutritional composition during *tempeh gembus* processing. Processing of *tempeh gembus* may cause an increase or decrease in its nutritional value such as amino acids, fatty acids, vitamins, and minerals. Regardless, *tempeh gembus* may still be potentially beneficial to help fulfill nutrient needs. This was a descriptive study with three samples: soybeans, tofu residue, and *tempeh gembus*. Soybeans used were varieties of Grobogan, Central Java. Minerals identified in all three samples include sodium, calcium, potassium, phospor, and iron. Soybeans, tofu residue, and *tempeh gembus* each contain 34.12%, 5.40%, and 4.80% of amino acids. Saturated fatty acids were the lowest in soybeans (12.01%), marginally surpassed by tofu residue (12.41%) and *tempeh gembus* (12.55%). Total levels of monounsaturated fatty acids were also found in a similar pattern (34.1%, 36.5%, 36.7% respectively). In contrast, soybeans had significantly more polyunsaturated fatty acids than other samples, containing up to 43.6% in comparison with 38.29% in tofu residue and 30.18% in *tempeh gembus*. Overall, the nutritional profile of soybeans was generally better than tofu residue and *tempeh gembus*. However, fermentation process may play a role in enchancing the fatty acid profile.
Keywords: nutritional profile, soybeans, tofu residue, *tempeh gembus*

1. Introduction

Food not only be acceptable and have a high nutritional value, but also have functional properties. Therefore, the function of food was varied increasingly, in addition to supplying nutritional needs with delicious flavor, but also served to maintain our health. The development of functional food requires raw materials that can fulfill these aims [1].

Functional foods are defined as foods that contain bioactive ingredients thought to enhance health, not only fulfill of basic energy needs, macronutrients (proteins, carbohydrates, fats) and micronutrients (vitamins and minerals) but also provide nutritional and physiological benefits for our body [2]. Functional food ingredients are associated with the prevention and treatment of several leading causes of death, such as cancer, diabetes, hypertension, and heart disease [3]. Soybeans had many beneficial health effects when we consumed. Soybeans are an excellent source of digestible protein. The content of vitamins and minerals in soybeans is high, and saturated fatty acids in soybeans is low and contains high unsaturated fatty acids such as linoleic and linolenic acids [4].

One of the nutrients which contained in functional food is protein (amino acids). Amino acids are nutrients that have an important function in the human body, such as leucine, isoleucine, and valine that can prevent protein catabolism caused by decreased levels of glycogen in muscle. Soybeans are one of the foods that contain high protein [5]. In addition, the most commonly used bioactive compounds of the oil or fat groups in functional food formulations are Omega-3 fatty acids, which are classified as polyunsaturated fatty acids (PUFAs) [6]. PUFA plays an important role in fat transport and metabolism, immune function, maintaining fumigation and integrity of cell membranes. PUFA has been showed to reduce levels of VLDL and LDL in the blood because the liver will not convert it into VLDL [7]. Vitamins are organic compounds essential for a proper functioning of the human body. They required in small amounts and are obtained from a correct diet [8]. A balanced and varied diet will probably supply the amounts of vitamins and minerals necessary for a proper functioning of the body [9].

In Indonesia, soybeans can be processed into several processed food products, one of them is tofu. Processing of tofu will produce solid waste and liquid waste. Solid waste is known as tofu residue. However, the nutrients value of tofu residue is lower than soybeans, since the tofu residue is the soybeans residue filtration. The tofu residue in wet conditions per 100 grams contains 11.07% of carbohydrate, 4.71% of protein, 1.94% of fat and 0.08% of ash [10]. The tofu waste can still be further processed through fermentation process and produce new processed product that is *tempeh gembus*. *Tempeh gembus* is a fermented food made from tofu residue with the help of the same microorganisms in the process of making soybeans of tempeh, namely *Rhizopus oligosporus* [11]. Fermentation process will affect the nutritional value of food. The nutrient content of a material will change during fermentation. In addition, fermentation causes the product to have a higher value, such as organic acids, single cell proteins, biopolymers and antibiotics [12].

Based on these of *tempeh gembus* was containing nutrient components such as amino acids, fatty acids, vitamins, and minerals that are beneficial of health. However, the processing of food in particular fermentation causes changes in the value of these nutrients. Until now there has been no research on the change in fatty acid profile in the process of *tempeh gembus* from soybeans, tofu residue, to become *tempeh gembus*. Therefore, researchers interested to analyze the profile of amino acids, fatty acids, vitamins, and minerals in soybeans, tofu residue, and *tempeh gembus*.

2. Methods

2.1 *Materials*

Sample was using soybeans, tofu residue, and *tempeh gembus*. Soybeans was using Grobogan varieties were obtained from soybean farmers in Grobogan Village, while the tofu residue and *tempeh gembus* were obtained from tempeh producers in Wulung Village, Blora.

2.2 Processing of tempeh gembus

Tempeh gembus were processed traditionally, including the process of extortion, steaming, cooling, the addition of tempeh inoculum containing *Rhizopus oligosporus* spores, packaging with hollow plastic bags, and incubation. The result is a solid, grayish-white substrate, since the entire surface is covered in mushroom mycelium and has a distinctive odor.

2.3 Chemical analysis

Analysis of amino acids protein constituents with HPLC (High Performance Liquid Chromatography) Shimadzu CBM 20A made by North America, as well as fatty acids with Gas Liquid Chromatography Shimadzu GC 2010 made by North America.

2.4 Data analysis

This research is descriptive research to know the profile of amino acids, fatty acids, vitamins and minerals in soybeans, tofu residue, and *tempeh gembus*. Samples will be analyzed by duplo to know the profile of amino acid, fatty acid, vitamins and minerals of soybeans, tofu residue, and *tempeh gembus*.

3. Result

3.1 Proximate composition

In this present study the energy, moisture, ash content, fat, protein, and carbohydrate of soybeans, tofu residue, and *tempeh gembus* were investigated. Soybeans contain a high content of energy, moisture,

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ash content, fat, protein, and carbohydrate than tofu residue and *tempeh gembus*. Table 1 and figure 1 show the proximate composition of soybeans, tofu residue, and *tempeh gembus*.

Table 1. Proximate composition of soybeans, tofu residue, and *tempeh gembus* (%w/w)

Component	Mean ± SD			
	Soybeans	Tofu residue	*Tempeh gembus*	Unit
Energy	438,98 ± 0,42	107,32 ± 0,58	109,08 ± 0,26	kkal/100 g
Moisture	10,69 ± 0,01	77,22 ± 0,35	75,75 ± 0,01	%
Ash content	4,48 ± 0,02	0,8 ± 0,01	0,78 ± 0,03	%
Fat	19,94 ± 0,05	3,88 ± 0,07	3,04 ± 0,01	%
Protein	34,95 ± 0,04	3,7 ± 0,02	6,7 ± 0,04	%
Carbohydrate	29,94 ± 0,02	14,4 ± 0,00	13,73 ± 0,07	%

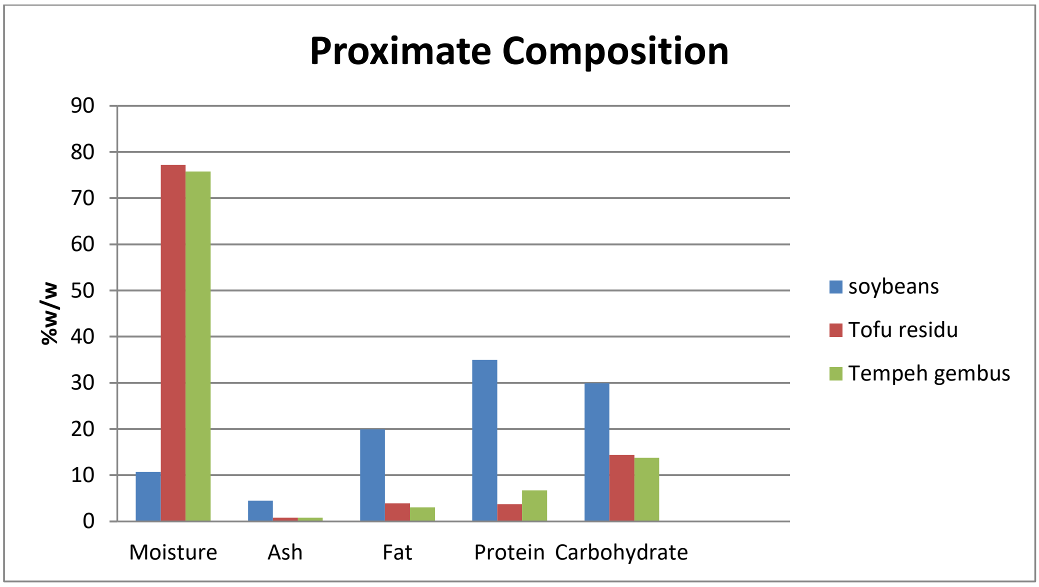

Figure 1: Proximate composition of soybeans, tofu residue, and *tempeh gembus*

3.2 Amino Acids

The present investigation shows totally fifteen amino acids present in soybeans, tofu residue, and *tempeh gembus*. The leucine levels are the highest level of essential amino acids of soybeans, tofu residue, and *tempeh gembus* whereas in non-essential amino acids glutamic acids are the highest level. The amino acids are shown in Table 2 and Figure 2

Table 2. Amino acids component of soybeans, tofu residue, and *tempeh gembus* (%w/w)

Amino Acids	Mean ± SD		
	Soybeans	Tofu residue	*Tempeh gembus*
Essential amino acids			
Histidine	0,82 ± 0,01	0,14 ± 0,01	0,12 ± 0,01
Isoleucine	1,93 ± 0,00	0,33 ± 0,02	0,29 ± 0,02
Leucine	2,92 ± 0,00	0,52 ± 0,02	0,44 ± 0,02
Lysine	1,63 ± 0,01	0,24 ± 0,01	0,24 ± 0,04
Methionine	0,42 ± 0,01	0,07 ± 0,01	0,05 ± 0,00
Phenylalanine	2,15 ± 0,02	0,36 ± 0,02	0,31 ± 0,02
Threonine	1,16 ± 0,22	0,22 ± 0,01	0,21 ± 0,01
Valine	1,94 ± 0,02	0,36 ± 0,02	0,31 ± 0,02
Non essential amino acids			
Tyrosine	1,21 ± 0,14	0,19 ± 0,01	0,20 ± 0,02
Alanine	1,74 ± 0,04	0,13 ± 0,01	0,31 ± 0,02
Arginine	2,48 ± 0,12	0,34 ± 0,02	0,28 ± 0,00
Aspartic acid	4,50 ± 0,07	0,67 ± 0,04	0,59 ± 0,04
Glutamic acids	7,51 ± 0,22	1,05 ± 0,08	0,88 ± 0,07
Glycine	1,70 ± 0,13	0,29 ± 0,00	0,26 ± 0,02
Serine	1,83 ± 0,00	0,28 ± 0,00	0,28 ± 0,02

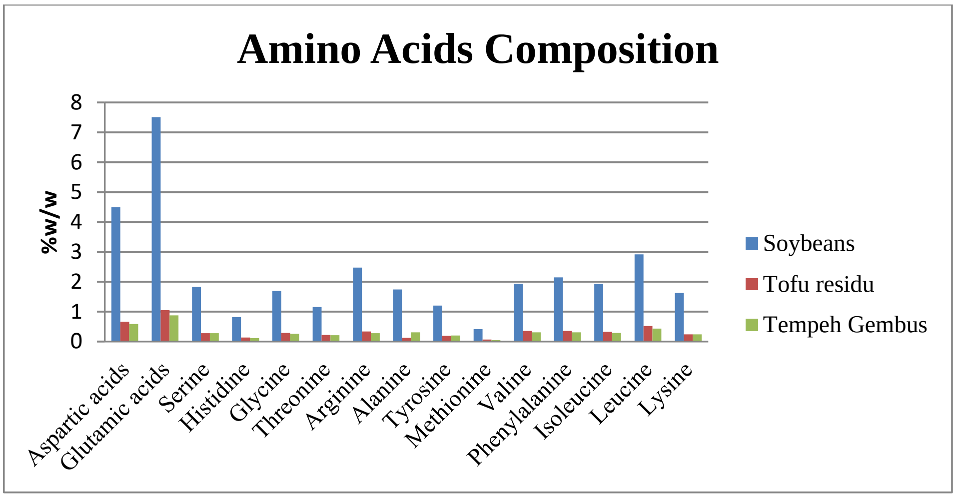

Figure 2: Amino acids composition of soybeans, tofu residue, and *tempeh gembus*

3.3 Fatty acids

In this present study, there are seventeen fatty acids were observed. Linoleic acids are the highest levels of fatty acids in soybeans, tofu residue, and *tempeh gembus*. In *tempeh gembus*, there is a fatty acid that is not contained in soybeans namely lauric acids, and one amino acids loss in *tempeh gembus* is heneikosanoat acids. The fatty acids are shown in Table 3

Table 3. Fatty acids composition of soybeans, tofu residue, and *tempeh gembus* (w/w)

Fatty acids	**Mean** ± SD		
Saturated Fatty Acid (SFA)	Soybeans	Tofu residue	*Tempeh gembus*
Lauric acid (C12:0)	-	-	0,04 ± 0,01
Miristic acid (C14:0)	0,07 ± 0,00	0,05 ± 0,01	0,08 ± 0,00
Palmitic acid (C16:0)	9,42 ± 0,13	9,62 ± 0,55	9,21 ± 0,39
Heptadekanoat acid (C17:0)	0,05 ± 0,01	0,06 ± 0,00	0,06 ± 0,01
Stearic acid (C18:0)	1,64 ± 0,08	1,85 ± 0,12	2,12 ± 0,07
Arakhidat acid (C20:0)	0,21 ± 0,02	0,23 ± 0,01	0,23 ± 0,01
Heneikosanoat Acid (C21:0)	0,02 ± 0,02	0,01 ± 0,01	
Behenic acid (C22:0)	0,40 ± 0,02	0,38 ± 0,02	0,41 ± 0,01
Trikosanoat acid (C23:0)	0,04 ± 0,00	0,04 ± 0,01	0,05 ± 0,00
Lignoserat acid (C24:0)	0,14 ± 0,01	0,15 ± 0,01	0,33 ± 0,00
Total	**12,01 ± 0,25**	**12,41 ± 0,7**	**12,55 ± 0,45**
Monounsaturated Fatty Acid (MUFA)			
Palmitoleic acid (C16:1)	0,08 ± 0,01	0,09 ± 0,00	0,1 ± 0,01
Oleic acid (C18:1n9c)	33,99 ± 0,76	36,36 ± 1,52	36,53 ± 1,42
Elaidic acid (C18:1n9t)	0,03 ± 0,00	0,04 ± 0,01	0,07 ± 0,01
Total	**34,1 ± 0,77**	**36,5 ± 1,53**	**36,7 ± 1,39**
Polyunsaturated Fatty Acid (PUFA)			
Linoleic acid (C18:2n6c)	38,01 ± 0,44	33,79 ± 0,72	26,83 ± 1,49
γ-linoleic acid (C18:3n6)	-	0,05 ± 0,01	0,82 ± 0,01
Linolenic acid (C18:3n3)	5,53 ± 0,02	4,38 ± 0,01	2,46 ± 0,11
Cis-11.14 Eikosedienoat acid (C20:2)	0,05 ± 0,01	0,06 ± 0,00	0,06 ± 0,01
Total	**43,6 ± 0,42**	87,21 ± 2,95	**30,18 ±1,58**
Fatty acid total	**89,72 ± 0,59**	**87,21 ± 2,95**	**79,44 ±3,44**

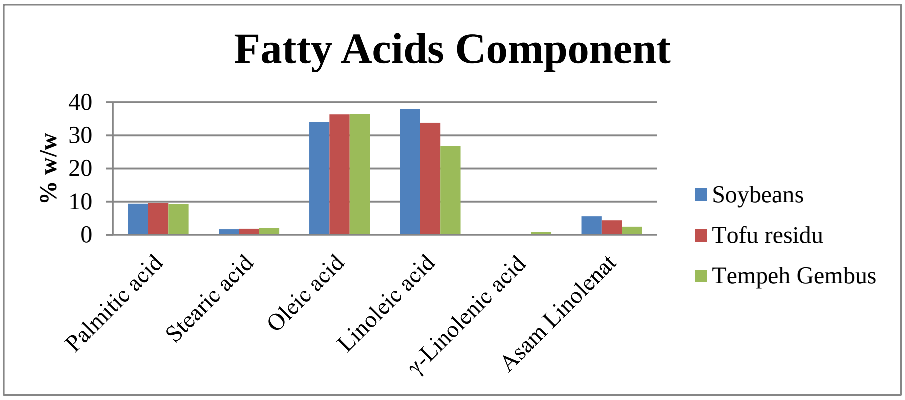

Figure 3: Fatty acids composition of soybeans, tofu residue, and *tempeh gembus*

3.4 Vitamins and Minerals

In this present study sodium, calcium, potassium, phosphorus, iron, vitamin B1, vitamin B12, vitamin A, vitamin C were investigated. However, mostly vitamins were not detected. Table 4 shows minerals and vitamins composition of soybeans, tofu residue, and *tempeh gembus*.

Table 4. Vitamins and minerals composition of soybeans, tofu residue, and *tempeh gembus* (%w/w)

	Mean ± SD			
Parameter	Soybeans	Tofu residue	*Tempeh gembus*	Unit
Mineral				
Sodium	19,2 ± 0,19	10,89 ± 0,23	11,69 ± 0,76	mg/100 g
Calsium	197,84 ± 0,26	223,07 ± 1,55	232,09 ± 2,46	mg/100 g
Potassium	914,46 ± 4,63	28,94 ± 0,03	28,73 ± 0,09	mg/100 g
Phospor	4367,8 ± 36,37	815,7 ± 3,17	751,42 ± 1,21	Ppm
Iron	32,39 ± 0,39	4,52 ± 0,79	20,04 ± 0,04	Ppm
Vitamin				
Vitamin B1	Not detected	Not detected	Not detected	mg/100 g
Vitamin B12	Not detected	Not detected	Not detected	Ppb
Vitamin A	Not detected	165,31 ± 0,42	Not detected	mcg/100 g
Vitamin C	Not detected	Not detected	Not detected	mg/100 g

4. Discussion

4.1 Proximate, vitamin, and mineral

The processing method of making *tempeh gembus* such as soaking, steaming, and fermentation caused decreasing or increasing proximate, mineral, and vitamin contents in soybeans, tofu residue, and *tempeh gembus*. Time and temperature can affect the value of water content (moisture) of food. The longer processing time and higher temperature used will result in more water released. The moisture content of soybeans decreased during fermentation. The decrease in soybean moisture was due to the activity of mold metabolism during fermentation releasing heat that made the fermentation temperature increased. Increasing temperature was followed by evaporation of the water content in soybeans. Thus, the next fermentation results decreasing of soil moisture.

The ash content on tofu residue decreased compared with soybeans. The decrease of ash content is caused as a result of the loss of solids during soaking and cooking. The decrease of ash content indicates that the minerals contained in soybeans are found in the epidermis. In addition, the carbohydrate in both tofu residue and *tempeh gembus* decreased. Decreasing occured due to enzymatic activity of mold during fermentation. Kapang digested carbohydrates resulting in a drastic decrease in hexoses and slow hydrolysis of stakiosa.

Soaking process of soybeans into tofu residue caused changing of fat content. At first, soybeans contained 19.94 % and decreased to 3.88%. Soaking can alter the fat content in soybeans due to temperature changes during soaking. In addition, fat changes occur during the fermentation process. Fermentation caused fat content decreased to 3.04% in *tempeh gembus*. During the fermentation the mold will synthesize the lipase enzyme that will hydrolizethe triacylglycerol into free fatty acids. Furthermore, fat is used by mold to be source of energy to grow so fat content decreases.

The process of washing, soaking, dehulling, and cooking affects the loss of protein soybean. Soybeans contained 34.9% protein, after processing the protein of tofu residue decreases to 3.7%. However, during fermentation process, the proteint content increased to 6.7 %. The changes that occur during fermentation were caused by enzyme produced by the mold. Generally, mold produced alpha amylase, betha amylase, phosphorilase, isoamylase, maltase, and amyloglukosidase enzyme. The increase in protein content is thought to be caused by rhyzopus oligosporus synthesizing urease enzymes used to break down urea into ammonia acid and CO_2.

There was a decrease in mineral content from soybeans to tofu residue. The sodium content in *tempeh gembus* was 11.69 mg/100 mg. The decrease of sodium level in *tempeh gembus* was 7.51 mg/100 mg while *tempeh gembus* increases 1.07 mg/100 mg. Levels of potassium in soybeans was 914 mg/100 mg, in tofu residue decreased 885,5 mg/100 mg and in *tempeh gembus* was 885.73 mg/100 mg. Level of phosphor in soybean was 4367.8 ppm, level tofu residue decreased 3552.1 ppm, and in *tempeh, gembus* decreased 3616,38 ppm. Level iron in soybeans was 32,39 ppm, in tofu residue decreased 27,87 ppm, and in *tempeh, gembus* decreased 12,35 ppm. However, iron content increased 15.52 ppm in *tempeh gembus*. Calcium level increase 25.23 mg/100mg in tofu and 34.25 mg/100mg in *tempeh gembus*.

The process of decreasing mineral content is caused by a heating process that resulted in food cell wall broken and occurs discharging of component composing material. Mineral will be damaged in most processing because the mineral is sensitive to pH, oxygen, light, and heat. The heating process occurred in soybeans producing tofu residue. There was a decrease in sodium, potassium, and iron content caused by heating process. Loss of sodium during processing can not be retained because sodium melts at 97,5˚C. Level of phosphor on tofu residue decrease caused by high temperature leading to evaporation of water molecules. The iron content in tofu residues decreased caused by heating process.

4.2 Amino Acids

Amino acids analyzed in soybeans, tofu, and *tempeh gembus* was nine essential amino acids and six nonessential amino acids. The essential amino acids are arginine, phenylalanine, histidine, isoleucine, leucine, lysine, methionine, threonine, and valine. The nonessential amino acids are alanine, aspartic acid, glutamic acid, glycine, serine, and tyrosine. The glutamic acid was higher than other amino acids. It can be caused by glutamine deamination into glutamic acid [12].

The total content of amino acids decreased 28.70% from soybean to tofu residue, 0.60% from tofu residue to *tempeh gembus*, and 29.32% from soybeans to *tempeh gembus*. Decreased amino acids can be caused by high temperature made during boiling and steaming that cause protein denaturation due to amino acids reactive to heat. In addition, soaking can decrease amino acids level because amico acids are generally powder-shaped and soluble in water but not soluble in nonpolar organic solvent [13].

Table 5. The need for amino acids

Amino acids	Requirements	
	mg/hari	mg/kgW per day
Histidine		10
Isoleucine	700	10
Leucine	1100	14
Lysine	800	20-30
Methionine	1100	13
Phenylalanine	1100	14
Threonine	500	7
Valine	800	10
Tyrosine	1100	14

Source: WHO (1985)

Fermentation consists of three strages namely growth stage (0-30 hours), transition stage (30-50 hours), and advanced fermentation stage (50-90 hours). Mold grwoth in tempeh reachs optimal 48 hours fermentation. However, protein decrease at 72 hours and subsequent [14]. Likewise in fermentation in *tempeh gembus,* there is a tendency to increase and decrease protein content according to fermentation time. The texture of tofu residue also affects the amout and component of nutrition in *tempeh gembus*. After fermentation, *Rhyzopus oligosporus* secretes proteinase enzyme affecting quality substrate [17].

Total amino acids in *tempeh gembus* is less than soybean and tofu residue. However, the amino acid profile has not changed. The highest essential amino acid in *tempeh gembus* is leucine. The leucine requirement according to WHO is 1100 mg [15] or 14 mg/kgW (table 5) [16]. Leucine in *tempeh gembus* was 0,44 mg/100mg. This amount can meet 40% requirement of leucine requirement. Although amino acids in *tempeh gembus* have decreased significantly but amino acids can still be utilized to complemen the fulfllment of protein needs. Research conducted on Sparque Dawley mice showed that there was a greater weight gain when given *tempeh gembus* that not given *tempeh gembus* [16].

4.3 Fatty Acids

The result of the analysis of fatty acids in soybean, tofu residue, and *tempeh gembus* consist of satureated fatty acids (SFA), monounsaturated fatty acids (MUFA), and polyunsaturated fatty acids (PUFA). In this study, the level of unsaturated fatty acids was higher (soybean: 77.69%, tofu residue 74.77% and *tempeh gembus* 68.87%) while compared with saturated fatty acids (soybean: 11.99%, tofu residue 12.39% and *tempeh gembus* 12.53%). The dominant saturated fatty acids are palmitic acid and sterat 9.21 ± 0.39% and 2.12 ± 0.07% respectively. The same study war conducted on *tempeh gembus* that dominant saturated fatty acids were lauric acid (3.46%), palmitic acid (8.23%), and stearic acids (3.42%) [18].

Soybeans is source of linoleic, oleic, and linolenic acids. In this study linoleic acid content (38.01 ± 0.44 %), linolenic acid (15.53 ± 0.02 %), and oleic acid (33.99 ± 0.76 %). This is similar to research on soybeans that linoleic acid content (25-64%), linoleic acid (1-12%), oleic acid (11-60%) while in *tempeh gembus*, linoleic acid (26.83 ± 1.49 %), linolenic acid (2.46 ± 0.11 %), and oleic acid (36.53 ± 1.42 %). The results are consistent with other studies conducted on *tempeh gembus* that linoleic acid, linolecin acid, and oleic acid is higher than other fatty acids in *tempeh gembus*. In this study, oleic and linoleic acids level in *tempeh gembus* have higher levels compared with previous studies, in other studies, *tempeh gembus* has linoleic and linolenic acid 21.51% and 1.82 respectively [18]. It is because of different types, varieties of raw materials, and microorganisms used for fermentation.

The *tempeh gembus* processing such as soaking until fermentation stage causes changes composition of fatty acids in soybeans, tofu residue, and *tempeh gembus*. Processing from soybeans to tofu residue through soaking and heating process decreased linolei and linolenic acids. This study is in line with research conducted on rice bran. The heating process can cause the conversion of fatty acid component into volatile compound such aldehydes, ketones, acids, and hydrocarbons. These compound will evaporate when heat-treated that makes the fatty acid decrease [19].

The fermentation process in *tempeh gembus* caused a decrease linoleic acid and linolenic acid. This is similar to the research on fermentation of tiger nut in Nigeria that linoleic acid and linolenic acid decreased, wherein linoleic acid with 9.00 ± 0.01% to 7.74 ± 0.00%. The oxidation process of linoleic and linolenic acids are influenced by temperature and light intensity. The higher temperature makes formation of fatty acids may be decreased [20]. However, the processing of soybeans into *tempeh gembus* causes oleic acid levels to increase, where oleic acid from 33.99 ± 0.76% to 36.53% ± 42%. This is similar to Nigerian study of the process of fermentation of nuts flour which increased oleic acid from 18.59% to 20.15% [21].

A study conducted on tempeh fermentation occurs an increase essential fatty acids level that occcur at 24, 72, 69 hours of fermentation time. Soybean changes to be tempeh after incubation for 12 to 24 hours of fermentation time. Rhyzopus oryzar secretes lipase enzynes that can breakdown fat into fatty acids [22]. While the decline occured in 48 hours of fermentation time due to microbial activity, where microbes that grow in *tempeh gembus* increased slightly and a decrease free fatty acids [23]. A study sugegests that fatty acids have increased again in the 24 hours. This is because, *Rhyzopus oligosporus* has lipolytic hydrolize and hydrolize one third of fatty acid for 72 hours of fermentation [24.] After 96 hours of fermentation the levels of essential fatty acids increased. In the phase of decay or further fermentation occur an increase of number bacteria, the amount of free fatty acids and the growth, the growth of the mold decresed [23].

The fermentation process cause an increase γ-linolenic acid. It was caused during syntjhesis of fatty acids, *Rhyzopus sp*, only produce γ-linolenat instead of α-linolenat. The data show that there is γ-linolenic acid in tofu (0,05 ± 0,01) and *tempeh gembus* (0,82 ± 0,01). A research showed that fermentation using *Rhizopus s.p* can produce γ-linolenic acid. Another study on fermentation in glutinous rice showed that γ-linolenic acid in fermented rice, which in terms of length of processing, γ-linolenic increased to 1,4 ± 1,1% [25].

During fermentation of soybean products occured degradation process of fat by mold, which can eventually be liberated into fatty acids. The main components of fatty acid from triglyceride in tempeh are unsaturated fatty acids which are dominated by linoleic acid, linoleic acid, and oleic acid. Although, the essential fatty acids in *tempeh gembus* average decreased, but in *tempeh gembus* still contain linoleic and linolenic fatty acids which if consumed will get any benefits, among others, pay a role in the maintenance of cell membranes, regulation of cholesterol metabolism, loweing blood pressure, inhibit hepatic lipogenesis, and lipid transport. It is also a precusor of group eikosnoid compounds similar to hormones, namely prostaglandins, prostacyclines, thromboxanes, and leukotrienes. These compounds regulate blood pressure, heart rate, immune function, nervous system stimulation, muscle contraction and wound healing [26].

The bioactive compound of the oil or fat group most widely used in functional food formulation is the Omega-3 fatty acid, which is classified as polyunsaturated fatty acid (PUFA). The replacement of a diet high in saturated fatty acids from foods by consuming unsaturated fatty acids such as linoleic and linolenic acids is recommended in an attempt to prevent coronary heart disease [27]. WHO recommends a sufficient intake of PUFAs ranging from 6 to 10% of daily intake [25]. PUFA can lower levels of VLDL and LDL in the blood because the liver will not convert it to triglyceride VLDL. The liver transports unsaturated fatty acids to tissues for oxidation without leaving lipoprotein remnant in the form of LDL. Meanwhile, ketone compounds will be removed through the lungs (respiration), urine or sweat, and some can be converted into fatty acids or glucose to be used as an energy source [29].

5. Conclusion

Levels of nutritional composition in soybeans is higher than tofu residue and *tempeh gembus*. However, there are some increase of some fatty acids caused by fermentation process.

6. Acknowledgements

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