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The Improvement of Protein Content by the Use of Dried Fish Meal of *Oreochromis niloticus* in Tempeh as Aquaculture Product Diversification for Sustainable Aquaculture

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Abstract. The consumption of freshwater fish such as tilapia (*Oreochromis niloticus*) is favored by most Indonesian society, especially in *Kabupaten* Magelang, Central Java. Mungkid, a village in Magelang which is one of the places that was developed as a Minapolitan. This study is aimed to support the development of aquaculture product diversification, especially tilapia fish as a flagship product in the area. The farmed tilapia fish were used as a source of animal protein for a variety of fermented food products; one of them is tempeh. The utilization of dried fish meal as a mixture in the production of tempeh was assessed in the laboratory for the best concentration to improve the protein substance. Several procedures were carried out, including making dried fish meal/fish flour, fermentation of boiled soybean, incubation of mixed fish flour and soybean, and the measurement of water, protein, fat, ashes, and carbohydrate. After the process of incubation in the room tempehrature (27°C) for 48 hours, the mixing of fish flour and soybean in tempeh fermentation produced the fish tempeh. Organoleptic test was also conducted for the taste and physical performance. The result showed that 3 % fish flour is the best concentration for making fish tempeh. At this mixture, the contents of water, protein, fat, ash, and carbohydrate in fish tempeh were 17.4%, 26,62%, 6,78%, 1,6%, and 47,6% respectively. The optimum growth of fish tempeh was then applied by workshop/training activities. These activites involved academicians of *Poltiteknik* Magelang, fish farming group of Mungkid and Muntilan districts, and groups of "*Dharma Wanita*" of Magelang Regency.

Keywords: fish tempeh, aquaculture product diversification, *Kabupaten* Magelang, fish farming group.

Introduction

Tilapia fish (*Oreochromis niloticus*) is a consumeable fresh water fish. Many people like tilapia fish because of its taste and the thickness of its body. Indonesia own many protein-source products such as tilapia fish, that can be used for income commodity.

Variety of food made of tilapia fish had been made in Ngrajek, because of the mass production of tilapia fish. In Ngrajek, many kinds of product made from tilapia such as fish flour, *abon ikan, krupuk ikan* have been produced. The composition of tilapia (%) per 100 grams fish fillet are:

Water : 73,83 – 79,5
Protein : 19,53 – 18,65
Fat : 3,51 – 0,55
Mineral : 0,91 – 1,30

The combination of protein from animal and plant is the best type of food that can be consumed by human.

The aims of the study are: (i) To use tilapia fish as a animal source of protein (ii) To improve the food variety based on tilapia as a *Tempeh Ikan* (fish tempeh) (iii) To choose the optimal concentration of Tilapia flour that should be added in tempeh fermentation

Material and Method

Procedure of Making Tilapia Flour

For about 1 kilograms of fresh Tilapia fish were washed with flowing water. Then, the scales were also cleaned. After getting the fillets of tilapia, the fillets were cut into

small pieces, and later the fillet pieces were dried in an oven at a tempehrature of 70° C, for 2-3 days. Then, the dried tilapia fillets were blended repeatedly to make tilapia powder.

The tilapia fish powder was sifted and separated between fine powder and the part of the ballpark. Next, the fine powder were called fish flour, and the remaining part of the rough shredded fish were called tilapia fish meal.

Procedure of Making Fish Tempeh (*Tempeh Ikan)*

Boiled soybeans that were ready for the process of fermentation were given yeast of tempeh and tilapia fish flour by a certain measurement. Then, they were wrapped in leaves or plastic, and incubated for 48 hours. The final results of fish tempeh were tested for levels of carbohydrates, protein, water, ash, total fat and organoleptic tests to determine consumer preferences

Measurement of Protein with Kjeldahl Method (Sudarmadji *et al.*, 1997)

One g of tempeh was measured and put into a Kjeldahl flask. Then, 10 ml concentrated H_2SO_4 was added into the Kjeldahl flask. After that, 5 g of Na_2SO_4 was also added as a catalyst. The tempeh was destructed for approximately 2 hours until a clear solution was produced, and was left cool (clot). 10 ml of distilled water was also added to dissolve the clots. Once dissolved, put in a distillation apparatus and add 35 ml solution of NaOH-$Na_2S_2O_3$. Distillation was done, the distillate was collected in an Erlenmeyer containing 25 ml of a saturated solution of boric acid and 2 drops of red metal indicator/methylene blue. Distillation was stopped after the erlenmeyer solution changed green. The solution obtained was titrated with 0.1N HCl. Then N or % total protein in the sample was calculated.

Measurement of Mineral (Sudarmadji , *et al.*, 1997)

One g of tempeh was measured on a dry porcelain bowl with known weight. Then, the bowl was burnt inside a muffle until it turned into white ashes. The bowl with ashes later was put inside a desiccator and when the ashes had already been cooled, the weight of the ashes was measured.

Measurement of Water Substance (AOAC, 1970)

One g of tempeh was measured on a petri dish with known weight and was put inside an oven with the tempehrature of 100-102^0 C for 4 hours. Then, the petri dish was left cool inside a desicator and was measured. The treatment was repeated until a constant weight was achieved (the difference of continuous measurement is less than 0,2 mg).

$$\text{Percentage of water} = \frac{\text{Initial weight-final weight}}{\text{Initial weight}} \times 100\%$$

Measurement of Fat (Sudarmadji, *et al.*, 1997)

4 g of sample was extracted using soxhlet with 150 ml of dietil eter as the solvent in the tempehrature of 50 - 60 ^{0}C for 3 – 4 hours. The remaining solvent was then evaporated using rotary evaporator. To measure the percentage of fat in the *tempeh*, the difference of weight of the flask with fat inside and the empty flask was measured.

Measurement of Carbohydrate with *by difference* method (Andarwulan *et al.*, 2011)

The percentage of carbohydrate was measured using 'by difference method'. This method involves a calculation of the percentage of water, the percentage of ashes, the percentage of protein and the percentage of fat.

Percentage of carbohydrate (%) = 100 – (water percentage + ashes percentage + fat percentage + protein percentage)

Result and Discussion

Table 1 shows the data of proximate analysis and it can be seen that the addition of tilapia fish flour with specific percentage was resulted in the improvement on the percentage of protein, fat, and water

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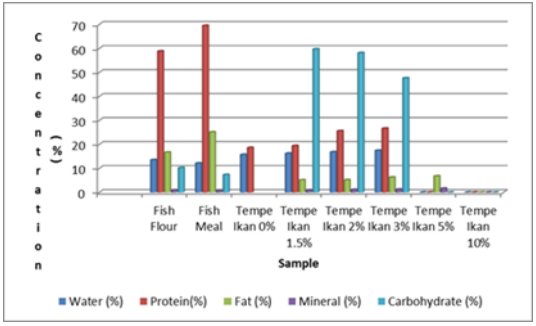
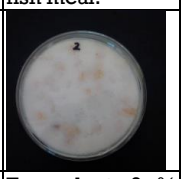
Table 1. Data of Tilapia Tempeh Proximate Analysis

Sample	Percentage of (%)				
	Water	Protein	Fat	Ash	Carbohydrate
Tilapia Fish Flour	13,5	58,78	16,64	0,89	10,19
Residue of Tilapia Fish Flour	12,1	69,44	25,10	0,67	7,31
Tilapia Tempeh					
0%	15,7	18,6	5,1	0,9	59,7
1,5%	16,2	19,39	5,20	1,1	58,11
2%	16,80	25,55	6,27	1,2	50,18
3%	17,4	26,62	6,78	1,6	47,6
5%	-	-	-	-	-
10%	-	-	-	-	-



In the 5 % and 10 % addition of tilapia fish flour, the proximate analysis was not conducted because on the first day when the tempeh was produced, the black color and soft texture could already be seen from the tempeh. Therefore, it was assumed that the tempeh with 5 % and 10 % addition of Tilapia fish flour could not process to the following experiment.

Table 2. Data Performace of Fish Flour, Fish Meal, and Tempeh Ikan in Difference Concentrations of Added Fish Flour

 Tilapia fish flour	 Tilapia fish meal (the residue of fish flour	Tilapia fish flour: made with the tempehrature of 70 °C. Fish meal: The residue of the process of making fish flour. 1 kg Tilapia fish (fresh) can b made into 254 gram fish flour and 105 gram fish meal.
 Tempeh without fish flour, day 1	 Tempeh + 1,5 % fish flour, day 1	 Tempeh + 2 % fish flour, day 1
 Tempeh + 3 % fish flour, day 1	 Tempeh + 5% fish flour, day 1	 Tempeh + 10% fish flour, day 1

Conclusion

The conclusions of the study were: Tilapia Fish can be used as a animal protein source in tempeh fermentation. The concentration of 3 % fish flour is the best concentration for making fish tempeh (tempeh ikan), the contents of water, protein, fat, ash, and carbohydrate in fish tempeh were 17.4%, 26,62%, 6,78%, 1,6%, and 47,6% respectively.

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