Proximate Composition of Some Common Fish Feed Flour Substitute

Arrum Nurjannah Herdiyanti [1*], Happy Nursyam[2], Arning Wilujeng Ekawati[2]

[1]Master Program of Aquaculture, Faculty of Fisheries and Marine Sciences, University of Brawijaya, Malang, Indonesia
[2]Faculty of Fisheries and Marine Sciences, University of Brawijaya, Malang, Indonesia

Abstract

Indonesia has very large territorial water, so it supports the development of the economy in the field of fisheries, one of which is through aquaculture. Recently, fish meal has become the most expensive protein ingredient in aquaculture feeds. We aim to proximately analyse of some common alternative flour as fish feed ingredient i.e. fish flour, shrimp head flour, soybean flour, and bran flour to get best-recommended flour for the type of cultured fish. Fish flour, shrimp head flour, soybean flour, and bran flour was purchased from the fish farmer in Malang who use alternative fish feed flour for their aquaculture. Proximate analysis carried out by protein content, moisture content, fat and fiber. Proximate analysis was conducted in the Laboratory of Fishery Products Engineering, University of Brawijaya on April 2018. The results showed that shrimp head flour had higher protein content than others flour that is about 48.71%, fat and carbohydrate content about 7.99%, and 18.34% respectively. Soybean flour contains protein, fat and carbohydrate about 31.29%, 20.75%, and 30.45% respectively. Carnivorous fish culture can use high protein flour as an alternative ingredient for feed such as fish flour and shrimp head flour; balance proximate composition for omnivorous fish cultures such as soy flour, and high carbo flour such as bran flour for herbivorous fish culture.

Keywords: Bran flour, proximate analysis, shrimp head flour, soybean flour.

INTRODUCTION

Indonesia has very large territorial waters, thus it supports the development of the economy in the field of fisheries, e.g. aquaculture. In aquaculture activities, the feed is a major factor that greatly affects fisheries production. In this case, the availability of nutrients for fish growth [1].

Commercial fish feed commonly used in aquaculture activities. High prices are one of the main problems for fish farmers. One of the causes of high feed prices is due to the availability of expensive ingredients, such as protein from fish which is needed as one of the main composition of feed production.

For commercial culture of fish, the formulation of low-cost balanced diet using locally available agro-industry byproducts is needed. Recently, fish meal has become the most expensive protein ingredient in aquaculture feeds. Many studies have shown considerable success in partially replacing fishmeal with soybean meal and other soybean products in the diet for various fish species [2-4]. Shrimp head waste silage has been reported as a protein source to formulate the feed of African catfish (*Clarias gariepinus*) [5]. Bran flour and fish meal have also been reported to be alternative fish feed formulations [6].

Based on the previous description, it is necessary to do a proximate test of some of these materials. Thus, we will know the suitability of the need for fish feed formulations with nutritional content which includes protein, fat, carbohydrate, ash, and crude fiber content in each ingredient. We aims to proximately analyse some common alternative flour as fish feed ingredient, i.e. fish flour, shrimp head flour, soybean flour, and bran flour to get best recommended flour, based on the type of cultured fish.

MATERIAL AND METHOD

Material Preparation

Fish flour, shrimp head flour, soybean flour, and bran flour was purchased from fish farmer in Malang who use alternative fish feed flour for their aquaculture.

Proximate Analysis

Proximate analysis consisted of crude protein content, ash content, crude fat content, moisture content, and crude fiber according to AOAC [7]. Explained as follows :

Protein and Ash Content Analysis

Protein content analysis was carried out by the Kjeldahl methods described in Chang [8].

* Correspondence address:
Arrum Nurjannah Herdiyanti
Email : arumherdiyanti@yahoo.com
Address : Faculty of Fisheries and Marine Science, Brawijaya University

ISSN. 2087-2852
E-ISSN. 2338-1655

Moisture Content Analysis

This analysis uses a weigh bottle that has been oven at 105°C for 4 hours, and cooled in a desiccator for 30 minutes, before being weighed. In the weighing bottle, 2 grams of selected flour was added and re-ovened at 105°C for 4 hours. Then cooled again in the desiccator for 30 minutes, and then weighed. Repeat this treatment for all selected flours, until you find the desired fixed weight. Moisture content can be calculated using the following formula:

$$Moisture\ Content = \frac{Fresh\ Weight\ (g) - Dry\ Weigh\ (g)}{Fresh\ Weight\ (g)} \times 100\%$$

Fat Content Analysis

The filter paper that has been provided is cut to a length of 10 cm and a width of 8 cm, then oven at a temperature of 105°C for 12 hours. The filter paper is weighed (a) and weighs 0.5 grams of sample (b). The sample is wrapped in filter paper and put into soxhlet. 150 mL of ether petroleum was put into soxhlet flask for extraction at 40-60°C for 5-6 hours, then the sample was put in oven at 105°C for 12 hours, and cooled in a desiccator for 30 minutes before being re-weighed (c). Fat content is calculated using the following formula:

$$Fat\ Content = \frac{Weight\ of\ Extracted\ fat\ (a+b) - c}{dryweight\ (b)} \times 100\%$$

Fiber Content Analysis

Dry the tools and ingredients by oven, then the tool is put in a desiccator and weighed. As much as 2.5 - 5 grams of dried sample wrapped in filter paper. The sample was extracted with diethyl ether for 6 hours using soxhlet. The sample was put into a 600 mL erlenmeyer, added to the sample 200 mL of boiling H_2SO_4 solution, and then boiled again for 30 minutes. The suspension obtained is filtered with filter paper and the residue left in the erlenmeyer or on the filter paper is washed with boiling water.

The residue was washed again with 200 mL of NaOH solution with the same treatment as the treatment of H_2SO_4 solution. The residue was filtered again with known weight filter paper, and washed with 10% K_2SO_4 solution, boiling water, and then using 95% alcohol. Filter paper used was oven at 110°C, and cooled in a desiccator then weighed. The weight of the residue is the weight of the crude fiber. Coarse fiber is calculated using the following formula:

$$Fiber\ Content = \frac{Crude\ fiberweight}{Initial\ Sample\ Weight} \times 100\%$$

RESULT AND DISCUSSION

The results of the analysis obtained the proximate content of the fish meal, shrimp head flour, soybean flour, and bran flour showed in Table 1. The highest protein content other than the fish meal is shrimp flour which is 48.71% and the lowest is bran flour 10.01%. Protein is important for the fish body because on average 65-75% of the fish's dry body weight is protein [3]. So that fish with protein eat can maintain body cells and can reproduce. The need for protein in freshwater pomfret that have ranged from 25-37% [9].

Base on figure 1, the highest fat content was found in soybean flour 20.75% and the lowest in the fish meal was 2.99%. Fat plays a very important role as a source of energy in fish feed [10]. The levels of fat present in the feed are generally in the range of 6.89% [11]. Fat content in shrimp head flour, soy flour, and bran flour, has been able to meet the standard fat requirements for fish growth.

The highest fiber content in Figure 1 is on soy flour by 12.22% and the lowest in shrimp flour head is 6.10%. The high percentage of coarse fiber causes the fish difficult to digest food [12]. High crude fiber content is less utilized by fish, especially for omnivorous fish but more carnivorous tendencies such as catfish, thus less effectively digesting polysaccharides than species that tend to herbivores such as tilapia [13-15]. Digestive functions of some carnivorous fish less able to digest carbohydrates. This is because of α-amylase levels on carnivorous fish are very low [16].

Ash is a residue produced by the combustion of organic matter in the form of inorganic materials in the form of oxides, salts, and minerals. Based on the results of the proximate analysis in Table 1, the highest content of ash content was the fish flour of 21.26% and the lowest of soybean flour by 5.28%. Mineral content or ash content is very important for teething and scales [17]. However, the high content of ash cannot be used as feed ingredients. The ash content in the feed represented the mineral content of the feed, with corresponding rate was 3-7% [18]. Based on the table, fish flour and shrimp flour have ash content that exceeds the needs of fish while bran meal and soy flour are still in the range of fish needs.

ISSN. 2087-2852
E-ISSN. 2338-1655

Table 1. Proximate Analysis of Fish flour, Shrimp Head Flour, Soybean Flour, and Bran flour

Material	Protein (%)	Fat (%)	Fiber (%)	Ash (%)	Carbo (%)
Fish Flour	55.78 ± 1.4	2.99 ± 1.2	9.38 ± 2.0	21.26 ± 1.3	10.55 ± 1.4
Shrimp Head Flour	48.71 ± 0.8	7.99 ± 1.7	6.10 ± 2.2	18.84 ± 0.5	18.34 ± 2.1
Soy Flour	31.29 ± 2.1	20.75 ± 2.2	12.22 ± 1.4	5.28 ± 0.8	30.45 ± 2.5
Bran Flour	10.01 ± 1.9	11.00 ± 1.3	8.88 ± 0.7	7.16 ± 1.6	62.92 ± 0.9

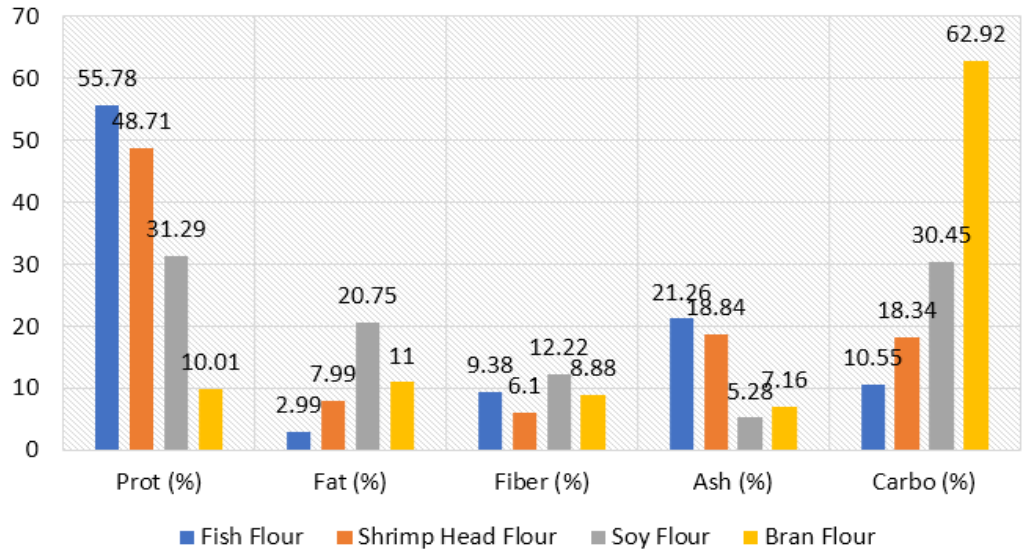

Figure 1. Proximate analysis of Fish Flour, Shrimp Head Flour, Soybean Flour, and Bran Flour

Carbohydrates in the fish feed are present in the form of crude fiber and Free-Nitrogen extract (FNE), but crude fiber has low nutritional value [19]. Fish used up to 45% carbohydrate feed for growth [20]. The highest BETN content was found in bran flour of 62.92% and the lowest in fish flour of 10.55%. The need for carbohydrate feed content is varied to each group of fish in sizes and species [21]. The comparison between carbohydrates and proteins in feed affects the protein utilization for fish tissue formation [22]. If the carbohydrate content is not sufficient as a source of energy, fish will use protein as a source of energy for tissue formation and as a driving force for the body. Digestive functions capable of hydrolyzing a greater variety of carbohydrate-containing feedstuffs have developed in herbivorous and omnivorous fish, which in contrast to carnivorous fish [23].

The fish use energy for growth, daily metabolism, and life-keeping activities. Energy requirements for fish are usually associated with protein requirements. The high protein content of feed is good for fish. The habit of eating freshwater pomfret belongs to the omnivorous fish group, but it is also mentioned that this fish tends to be a carnivore that is visible from its sharp teeth which, while still seed-sized, likes plankton and aquatic plants. So that can be said this pomfret can utilize protein, fat, and carbohydrate for their energy needs.

CONCLUSION

Shrimp head flour had contents of protein, fat, and carbohydrate about 48.71%±0.8, 7.99%±1.7, and 18.34%±2.1, respectively. Soybean flour contains protein, fats, and carbohydrates about 31.29%±2.1, 20.75%±2.2, 30.45%±2.5, respectively. Fish flour had contents of protein, fat, and carbohydrate about 55.78%±1.4, 2.99%±1.2, 10.55%±1.4, respectively. Carnivorous fish culture can use high protein flour as an alternative ingredient for feed such as fish flour and shrimp head flour. Balance proximate composition is for omnivorous fish culture such as soy flour, and high carbo flour such as bran flour for herbivorous fish culture.

REFERENCES

[1] Pandey, G. 2013. Feed formulation and feeding technology for fishes. *Int. Res. J. Pharm.* 4(3). 23-30.

[2] Boonyaratpalin, M., P. Suraneiranat, T. Tunpibal. 1998. Replacement of fish meal with various types of soybean products in diets for Asian seabass, *Lates calcarifer*. *Aquaculture.* 161. 67-78.

[3] Quartararo, N., G.L. Allan, J.D. Bell. 1998. Replacement of fish meal in diets for

Australian snapper, *Pagrus auratus*. *Aquaculture.* 166. 279-295.

[4] Hernandez, M.D., F.J. Martinez, M. Jover, B. Garcia. 2007. Effects of partial replacement of fish meal by soybean meal in sharpsnout seabream (*Diplodus puntazzo*) diet. *Aquaculture.* 263. 159-167.

[5] Nwanna, L.C. 2003. Nutritional value and digestibility of fermented shrimp head waste by African Catfish *Clarius gariepinus*. *Pak. J. Nutr.* 2(6). 339-345.

[6] Lestari, S.F., S. Yuniarti, Z. Abidin. 2013. Pengaruh formulasi pakan berbahan baku tepung ikan, tepung jagung, dedak halus dan ampas tahu terhadap pertumbuhan Ikan Nila (*Oreochromis* sp). *Jurnal Kelautan.* 6(1). 36-46.

[7] AOAC. 1995. Official methods of analysis, 12th Ed. Association of Official Analytical Chemists. Washington DC.

[8] Chang, S.K.C. 2003. Protein analysis. In: Nielsen, S.S. (Ed). Food Analysis. Kluwer Academic Plenum Publisher. New York.

[9] Halver, J.E. 1989. Fish nutrition, 3rd Ed. Academic Press. United States of America.

[10] Hernandez, M., T. Takeuchi, T. Watanabe. 1995. Effect of dietary energy sources on the utiliz eation of protein by *Colossoma macropomum* fingerlings. *Fish. Sci.* 61. 507-511.

[11] Marzuqi, M., N.W.W. Astuti, K. Suwirya. 2012. Pengaruh kadar protein dan rasio pemberian pakan terhadap pertumbuhan Ikan Kerapu Macan (*Epinephelus fuscoguttatus*). *Jurnal Ilmu dan Teknologi KelautanTropis.* 5(2). 55-65.

[12] Darsudi, N.P.A. Arsini, N.P.A. Kenak. 2008. Analisis kandungan proksimat bahan baku dan pakan buatan/pellet untuk Kepiting Bakau (Scylla paramamosain). *Buletin Teknik Litkayasa Akuakultur.* 7(1). 41-45.

[13] Sutriana, A. 2007. The use of cassava leaves as a dietary component for African catfish fry. *Jurnal Kedokteran Hewan.* 1(2). 59-65.

[14] Hadadi, A. 2002. Pengaruh kadar karbohidrat pada pakan berbeda terhadap pertumbuhan dan efesiensi pakan ikan gurami (*Osphronemus gouramy lacepeda*) ukuran 70-80 g. Master Thesis. Graduate School, Bogor Agricultural University. Bogor.

[15] Yuwono, E. 2008. Fisiologi hewan air. Jenderal Soedirman University Press. Purwokerto.

[16] Hidalgo, M.C., E. Urea, A. Sanz. 1999. Comparative study of digestive enzymes in fish with different nutritional habits. Proteolytic and amylase activities. *Aquaculture.* 170. 267-283.

[17] Bernard, T., W. Wiryanta, S.P. Sunaryo, S.P. Astuti, M.B. Kurniawan. 2010. Budidaya dan bisnis ikan nila. Agromedia Pustaka Publisher. Yogyakarta.

[18] Agbabiaka, A.L., A.S. Amadi, M.O.G. Oyinloye, I.I. Adedokun, A.C. Ekeocha. 2011. Growth response of African catfish (*Clarias gariepinus*, Burchell 1822) to dried rumen digesta as a dietary supplement. *J. Nutr.* 10(6). 564-567.

[19] Sutikno, E. 2011. Pembuatan pakan buatan ikan bandeng. Directorate General of Aquaculture Center for Development of Brackish Water Cultivation. Jepara.

[20] Winarno. 1997. Kimia pangan dan gizi. Gramedia Pustaka. Jakarta.

[21] Zonneveld, N., E.A. Huisman, J.H. Boon. 1991. Prinsip-prinsip budidaya ikan. Gramedia Pustaka Utama. Jakarta.

[22] Shimeno, S., T. Ruchimat, M. Matsumoto, M. Ukawa. 1997. Inclusion of full-fat soybean meal in diet for fingerling yellowtail. *Nippon Suisan Gakkaishi.* 63. 70-76.

[23] Krogdahl, A., G.I. Hemre, T.P. Mommsen. 2005. Carbohydrates in fish nutrition: digestion and absorption in postlarval stages. *Aquac. Nutr.* 11(2). 103-122.

ISSN. 2087-2852
E-ISSN. 2338-1655