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Manufacture of Lele Dumbo (*Clarias Gariepinus*) Feed by Utilizing Industrial Waste of Fish, Cassava and Paddy

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Abstract

A feed is one of the components that supports a cultivation business activity, fish feed must have good nutrition, especially a source of protein. Sources of protein for fish feed ingredients are generally imported, such as peanut meal and fish meal. Utilization of fishery and industrial waste as fish clothing is an effort to overcome the relatively high cost of feed. This study aims to determine the effect of adding formulations on the chemical properties of industrial waste-based catfish feed. The results showed that the more fish meal formulations that were added could increase the protein content in a range of 22.90% -39.90%, fat 5% -7.70%, and ash 5.79% -11.36%. The carbohydrate content decreased with a value range of 33.87% -57.08% and water 7.14% -12%. Fish feed formulations that are close to the SNI for catfish feed are found in treatment P1 with 39.90% protein content test results; water 7,18%; fat 7,7%; Ash 11.36% and carbohydrates 33.87%.

Introduction

Catfish is a widely cultivated fish because of its economic value and ease to cultivate. Based on (Central Statistics Agency (BPS), 2015), catfish production in Jember Regency reaches 3,297.90 tons per year. The development of quality catfish farming requires feed intake that meets the nutritional needs of catfish. According to (Indonesian National Standard (SNI), 2006), African catfish feed must contain nutrients such as protein> 30%, fat> 5%, carbohydrates <40%, ash <13%, water <12%, vitamins, minerals, and energy in sufficient quantities so that it can support fish growth well.

The feed is one of the components that support a fishery cultivation business activity. According to (Ardiwijoyo et al., 2018), the feed has a vital role in the reproduction and growth of aquaculture. The availability of feed is one of the main factors for maximum cultivation production. Good feed is a feed that has high nutritional value, is easy to obtain, easy to process, easy to digest, relatively inexpensive, and does not contain toxins. Fish growth is influenced by the composition of the nutritional content in fish feed, one of which is protein. Protein content in feed affects fish growth because fish need protein as energy for body development and survival. The problem faced by fish cultivators is the high costs of providing feed, which reaches 60-70% of production costs (Emma, 2006).

An alternative that can be done to reduce production costs is to make a feed. Feed making can be done using simple techniques and utilizing local raw materials, including utilizing waste from fishery and agricultural industries in the form of fishbone and fin waste, bran and cassava skin as an alternative source of protein and carbohydrates the feed. Utilization of waste maximally can provide significant results because the nutrient content in the waste still can be utilized.

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Skipjack tuna is a sea fish that has very high nutritional content and is suitable for consumption. The portion of skipjack fish consumed is only the fish of the fish, while the parts of the fish that are discarded are the head, tail, fins, and bones, which generally cause 35% of fishery waste. Fahrizal & Ratna, (2018) state that skipjack tuna waste has a protein content of 32.27%, 8% fat, 35.15% ash, 17.63% carbohydrates, and water content 6.95%. Skipjack tuna waste can be developed into raw material for making feed because it has reasonably good nutritional content.

The waste that can be used to meet the fish feed's nutritional content is cassava peel and rice bran. Cassava peel is the result of stripping waste in the processing of cassava-based food products such as tape, tapioca flour, cassava flour, and chips. The percentage of cassava peels in each cassava reaches approximately 20% of the cassava's weight (Salim, 2011). Based on (Central Statistics Agency (BPS), 2016) cassava production in Jember Regency reaches 1712.2 tons, meaning that the potential for cassava peels in Jember Regency reaches 342.44 tons. The availability of cassava peels in Jember Regency can be used as raw material for making fish feed as a binder and a source of carbohydrates. Rice milling waste is usually in the form of husks (15-20%), bran (8-15%), and groats (± 5%). Based on BPS Jember Regency (2016), rice production in Jember Regency reaches 98,665.3 tons, meaning that the potential for rice bran in Jember Regency reaches 7,885,224 tons - 11,827,836 tons. The abundant availability of rice bran can be used as an alternative energy source in making fish feed. This study aims to determine the effect of adding skipjack tuna waste meal to a fish feed's nutritional content.

Methods

Research Design

The method used in this research is the experimental method. This study's environmental design was a Complete Randomized Design (CRD) Duplo 3 times repeat. The materials used in fish feed formulations are skipjack fish waste flour, cassava skin waste flour, and bran. The dumbo catfish used is 11 days to 20 days old. The formulation of the experimental design can be seen in Table 1.

Table 1. Experimental Design Formulations

Materials	Treatment					
	P0 (control)	**P1**	**P2**	**P3**	**P4**	**P5**
Bran (F1)	-	20 g	30 g	40 g	50 g	60 g
Skipjack fish waste flour (F2)	-	60 g	50 g	40 g	30 g	20 g
Cassava skin waste flour	-	20 g	20 g	20 g	20 g	20 g
Total	-	100 g	100 g	100 g	100 g	100 g

Note: P0 (Control) using fish feed Hi pro vite 781-1

Research Stages

Making Waste Flour Cakalang Fish

Fish meal is made by drying the bones and fins of skipjack fish with sunlight for 1-2 days until the water content is 8.27%. The bones and fins of dried calories are ground until smooth and sifted with 80 mesh sieves to obtain a uniform particle size.

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Cassava Skin Flour Making

Cassava skin flour is made by peeling the outer skin, then done shrinking cassava skin size. Cassava skin is washed with running water and soaked for 48 hours. Water in the soaking process is replaced every 24 hours to remove impurities attached to cassava skin. Also, it aims to reduce the content of HCN on cassava skin. Cassava skin is drained and then dried with sunlight for 1-2 days until the moisture content in cassava skin becomes <10% and reduces the content of HCN in cassava skin. Cassava skin is smoothed and sifted to uniformize the size with a sieve of 80 mesh.

Fish Feed Making

Making fish feed begins by preparing fish feed raw materials such as fish meal, cassava skin flour, bran, and water. The raw materials are weighed according to the predetermined formulation. All ingredients are mixed manually until the dough is evenly distributed. The dough is printed with a diameter of 3 mm and a ± of 1 cm, aiming to reduce the size of fish feed. The printed dough is dried with the oven at 50-60^{o}C for 24 hours. Drying is carried out to reduce the moisture content of the feed. After dried, a physicochemical test is carried out to find out the best formulation on catfish feed.

Analysis Procedure

The nutrient content test is used to determine the protein, fat, carbohydrates, ash, and water content of fish feed produced. Analysis of protein content with Kjehdahl method, carbohydrates by difference method, fat by soxhlet method, ash by fertilization method, and moisture content with gravimetry method. Data from physical and chemical testing of fish feed were analyzed using a variety of fingerprints at the test level of 5% to determine the effect of treatment on the parameters measured, if there is a real difference between the average treatment continued with the DNMRT test (*Duncan New Multiple Range Test*), then presented in the form of a graph. Data obtained using SPSS (*Statistical Product and Service Solutions*) application.

Results and Discussion

The nutrient content test is a method used to determine the content of protein, carbohydrates, fats, ash, and water content in fish feed. Based on the analysis of the nutritional content carried out in several different formulations, the results of the content of feed nutrients as in Table 2.

Table 2. Nutritional content of Fish Feed

Treatment	Protein (%)	Water (%)	Fat (%)	Abu (%)	Carbohydrates (%)
SNI***	>30	<12	>5	<13	<30
P0 (Control)**	33	12	5	7	43
P1*	39,90	7,18	7,70	11,36	33,87
P2*	36,21	7,41	7,43	9,75	39,20
P3*	31,45	7,55	7,10	8,80	45,85
P4*	27,74	7,77	6,74	7,20	50,55
P5*	22,90	7,94	6,30	5,79	57,08

Source: * = Processed Data (2019), PT. Central Food Earth, ***= SNI 4078.1:2006

Protein is a significant factor that fish desperately need to grow, repair, and build body tissues, the formation of enzymes, hormones, and antibodies in the body. Protein is a complex molecule consisting of essential and non-essential amino acids. Essential amino acids should

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be administered outside the fish's body through feed because the fish's body cannot synthesize itself, while the fish body can synthesize non-essential amino acids. The content of both amino acids will support fish's growth to the maximum (Millamena *et al*, 2002). The value of catfish feed protein content can be seen in Figure 1.

Based on the quality requirements determined by SNI 4087.1:2006, the requirement of dumbo catfish feed protein content is at least 30%. The data of the analysis resulted in protein content values ranging from 22.90% - 39.90%, which means that the treatment of P4 and P5 does not meet the quality requirements determined by SNI because it has protein levels below 30%, but the treatment of P0, P1, P2, and P3 has met the quality requirements of dumbo catfish feed. Fulfillment of protein needs in fish feed has an impact on fish growth because the function of protein is as a catalyst, as a carrier and storage of other molecules such as oxygen, mechanically support the immune system (immunity) of the body, move the body, as transmitters of nerve movements, control growth, and development (Katili, 2009).

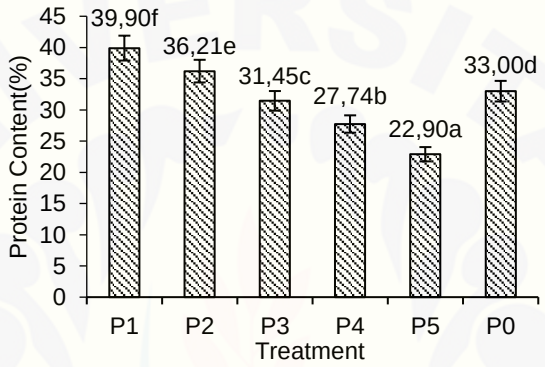

Figure 1. Protein content of catfish feed

The results of the fingerprint with a whole level (α) 0.05 showed that there is a real influence ($p<0.05$) of commercial feed and artificial feed on the protein content of catfish feed. Based on the results of multiple distance tests, Duncan showed that each treatment showed a very noticeable difference and the highest protein content is in the P1 treatment, namely fish feed with the formulation of adding 60% cauline waste flour and 20% bran.

Water content is a characteristic that is very influential on feed, especially on appearance and texture. High water content results in bacteria, type, and khamir quickly growing, affecting the quality and shelf life of the feed (Hafez, 2010). The water content value of catfish feed can be seen in Figure 2.

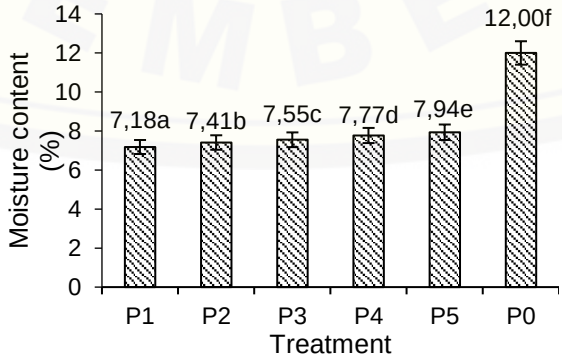

Figure 2. Water content of catfish feed

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Based on the quality requirements determined by SNI 4087.1:2006, the water content requirement in dumbo catfish feed is a maximum of 12%. The analysis data produced water content values ranging from 7.18% - 12%, which means that all treatments meet the quality requirements of dumbo catfish feed determined by SNI because it has a water content below 12%. The appropriate moisture content will cause the fish feed to have a maximum feed shelf life and is not easily damaged by microbes. The maximum water content limit is 12% (Zaenuri, 2014). This statement is by Ketaren (2010), which states that the less moisture content of the feed, the better.

The results of the fingerprint with a whole level (α) 0.05 showed that there is a real influence ($p<0.05$) of commercial feed and artificial feed on the water content of catfish feed. Duncan's multiple distance test results showed that each treatment showed a very noticeable difference. Treatment with the lowest water content is found in the P1 treatment with the formulation of skipjack fish waste flour 60%, bran 20%, and cassava skin flour 20%, which is 7.18%.

Fat is one of the essential macronutrients for fish as an energy source, it also provides essential fatty acids that the fish body cannot synthesize. As the primary source of energy, fats' ability to produce energy is much greater than carbohydrates and proteins. However, because fish have an excellent ability to consume protein, fat as an energy source occupies the second position after protein (Afrianto & Liviawaty, 2005). The value of fat content in fish feed can be seen in Figure 3.

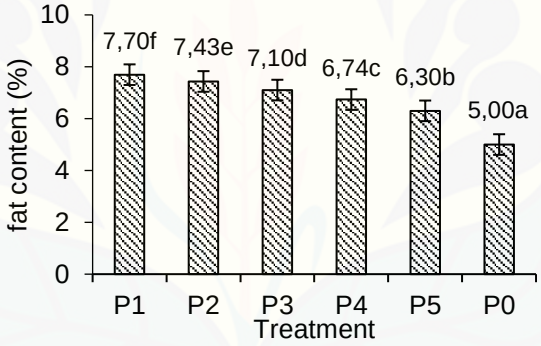

Figure 3. Fat content of catfish feed

Based on the quality requirements determined by SNI 4087.1:2006, the fat content requirement in dumbo catfish feed is at least 5%. The analysis data produced a fat content value ranging from 5%-7.70%, which means that all treatments meet the quality requirements of dumbo catfish feed determined by SNI because it has fat content above 5%. According to Dani *et al* (2005), the presence of fat in feed affects the taste and texture of feed. Fat content should be optimum but not excessive; if there is excess fat content, it will cause the feed will quickly oxidize (*easily rancid*), resulting in the accumulation of fat in the intestines of fish, days or kidneys so that the fish become too fat and appetite is reduced.

The results of fingerprints with a whole level (α) 0.05 showed that the real influence ($p<0.05$) of commercial feed and artificial feed on the fat content of catfish feed. Duncan's multiple distance test results showed that each treatment showed a very noticeable difference. Treatment with the highest fat content is A1 treatment with the formulation of skipjack fish waste flour 60%, bran 20%, and cassava skin flour 20% that is 7.70%, and the lowest fat content is found in the P0 treatment (*control*) of 5%. According to Darsudi *et al* (2008), the big difference in fat content in fish feed is the varying quality of ingredients, depending on the type of fish and the manufacturing process.

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Ash is an inorganic mineral element that is not volatile and is left behind after being burned or incandescent until it is free of carbon and water. Ash content in the feed is determined by weighing the remaining minerals due to burning organic matter. The level of ash contained in a feed indicates the level of purity of the feed. This level of purity depends mostly on its composition and mineral content. The ash content value of fish feed can be seen in Figure 4.

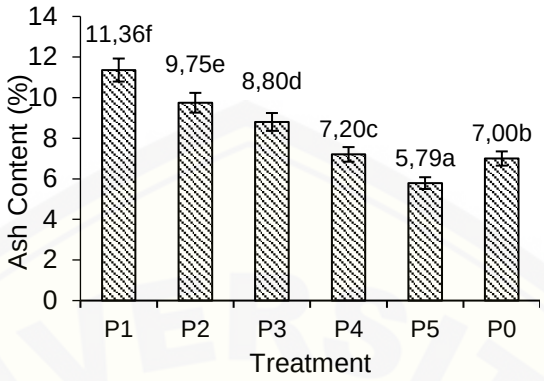

Figure 4. Ash content of catfish feed

Based on the quality requirements determined by SNI 4087.1:2006, the requirement of ash content in dumbo catfish feed is a maximum of 13%. The analysis data produced ash content values ranging from 5.79% - 11.36%, which means that all treatments meet the quality requirements of dumbo catfish feed determined by SNI because it has ash content below 13%. Based on the test results, it can be concluded that acceptable ash levels are present in the P1 treatment because it has enough minerals or organic matter and is suitable for the growth of body tissues. By the opinion of Setyono (2012), good fish feed should have an ash content of less than 13% because ash affects fish veins and fish growth.

The results of the prints with a whole level (α) 0.05 showed that the real influence ($p<0.05$) of commercial feed and artificial feed on the ash content of catfish feed. Duncan's multiple distance test results showed that each treatment showed a very noticeable difference. Treatment with the lowest ash content is found in the P5 treatment with the formulation of skipjack fish waste flour 20%, bran 60%, and cassava skin flour 20%, which is 5.79%.

Carbohydrates are a cheap source of energy and can replace expensive energy sources of protein. The protein-sparing effect of carbohydrates becomes an economical source of energy, many carbohydrates can be digested, used in the formulation of fish feed. Sources of carbohydrates such as starch can be used as adhesives in fish feed to increase feed resistance in water (Millamena *et al*, 2002). The value of carbohydrate content can be seen in Figure 5.

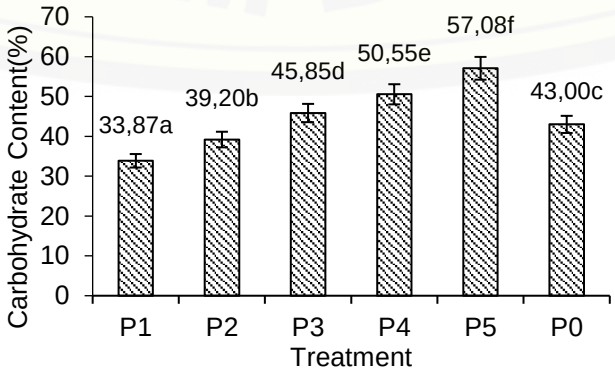

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Figure 5. Carbohydrate content of catfish feed

Based on the quality requirements determined by SNI 4087.1:2006, the requirement of the carbohydrate content in dumbo catfish feed is a maximum of 40%. The analysis data produced the value of carbohydrate content ranging from 33.87% - 57.08%, which means that P1 and P2 meet the quality requirements of dumbo catfish feed determined by SNI because it has carbohydrate levels below 40%. The P0, P1, and P3 treatments have a carbohydrate value of <45%, and those values are also excellent for omnivorous fish types. This is because omnivorous fish need carbohydrate content in feed ranging from 10-50%. This is by Afrianto & Liviawaty (2005) statement, which states that the level of carbohydrate needs reaches 10-50% for omnivorous fish.

The results of the fingerprint with a whole level (α) 0.05 showed that there is a real influence ($p<0.05$) of commercial feed and artificial feed on the carbohydrate content of catfish feed. Duncan's multiple distance test results showed that each treatment showed a very noticeable difference. Treatment with the highest carbohydrate content there is a P5 treatment with the formulation of skipjack fish waste flour 20%, bran 60%, and cassava skin flour 20% that is 57.08% and the lowest carbohydrate content is found in the P1 treatment with the formulation of skipjack fish waste flour 60%, bran 20% and cassava skin flour 20% is 33.87%. The higher the formulation of bran addition, the higher the carbohydrate content in the feed. This is because bran contains high carbohydrates, so that it can increase carbohydrates in the feed. Bran contains 49.4% carbohydrates (Rao, 2000). While the skipjack fish meal only has a carbohydrate content of 17.63% (Fahrizal & Ratna., 2018) According to Rukmini (2012), carbohydrate levels in feed range from 0-50%, the ability of fish to utilize carbohydrates depends on their ability to produce amylase enzymes (carbohydrate breakers).

Conclusion

Based on the research that has been done, the addition of formulations of fish meal and bran to the chemical properties of fish feed can be concluded that the more formulations of fish meal added can increase protein levels with a range of 22.90%-39.90%, fat 5%-7.70%, and ash 5.79%-11.36%. Carbohydrate content decreased with a value range of 33.87%-57.08% and water 7.14%-12%. Formulations close to SNI catfish feed are found in the P1 treatment with a test result of 39.90% protein content; water 7.18%; fat 7.7%; Ash 11.36%, and carbohydrates 33.87%.

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