

Chicken Feather Silage Meal As A Fish Meal Protein Source Replacement in Feed Formula of Pomfret (*Colossoma Macropomum*)

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ABSTRACT

The research was conducted to know the effect and to determine the best utilization of the chicken feather silage meal as a substitute for fish meal protein source in the feed formula of *Colossoma macropomum*. This study used experimental method based on Completely Randomized Design (CRD) with 5 treatments and 3 replications. Five diets (33% isoprotein and 3.85 kcal/g diet isoenergetic) were formulated with substitution of the chicken feather silage meal to fishmeal protein. These substituted 0, 25, 50, 75 and 100 % (A, B, C, D and E respectively) of the fishmeal protein. Parameters observed and analysed were: survival rate, specific growth rate, feed conversion ratio, protein efficiency ratio, protein retention and protein digestibility. The results showed that the treatment had no effect on survival rate, specific growth rate, feed conversion ratio, protein efficiency ratio, and protein retention but the effect on protein digestibility. Based on these results, it can be concluded that fishmeal protein can be substituted with the chicken feather silage meal up to 100% in the feed formula of *Colossoma macropomum*.

Keyword: Chicken feather silage meal, protein retention, protein digestibility, *Colossoma macropomum*.

INTRODUCTION

In Indonesia, the development of aquaculture has been growing rapidly. Aquaculture strongly supports the fulfillment of foodstuffs, especially fish commodities. One is pomfret freshwater (*Colossoma*

macropomum) which has several advantages such as resistance to disease, can live in poor water quality, the market price is high and can be used as ornamental fish. Moreover, the relatively rapid growth and flavor of the meat is tasty, and cultivation is not too difficult (Utami, *et al.*, 2012). Significant increase in production is still having some problems. The main obstacle in cultivation of freshwater pomfret (*C. macropomum*) is the higher feed prices. This is because the raw materials used are imported materials, so the price is expensive. Such materials include fish meal. Intensive fish farmers spend 60-80% of the costs for the procurement of feed (Boer *et al.*, 2007). One way to lower feed prices are higher is seeking a replacement material with the same nutritional value. One of the materials that can be used as an alternative material is chicken feathers that have high protein by 80-90%, and continuous availability. It is supported by the rapid growth of industrial chicken slaughterhouse (RPA), it also increases the waste generated mainly chicken feathers (Erlita and Waridin, 2010). Chicken waste contains a high enough risk of the spread of chicken origin because of the occurrence of microbial contamination of the environment (Risris *et al.*, 2011).

There are four methods of processing of chicken feathers that physically with the pressure and temperature, chemically with acids, bases or carbonation, enzymatic and microbiological examination. Chicken feathers can be processed into silage using the addition of strong acids such as HCl (Puastuti, 2007).

The use of chicken feathers as a substitute for fish feed had been given to the Chinook Salmon *Onchorhynchus tshawytscha* (Fowler, 1990), Fish Rainbow Trout *Oncorhynchus mykiss* (Pfeffer et al., 1994), Groupers Mouse *Cromileptes altivelis* (Shapawi et al., 2007), Fish African catfish *Clarias gariepinus* (Chor et al., 2013), and Tilapia *Oreochromis niloticus* (Suloma et al., 2014). Based on this, it is necessary to research on the utilization of waste chicken feathers silage meal as a substitute for fish meal in fish feed formula pomfret (*C. macropomum*).

METHODS

Material Research

This study used 15 aquariums size of 30x30x30 cm³, blower, aeration stone, aeration hose, DO meter, pH meter, digital scales, basin, feed mill, pan, mortar and pestle. The research material used Freshwater pomfret (*C. macropomum*) weight 3,50 ± 0,30 grams from farmers in Kediri. Stocking density 36 individuals per aquarium. Feed formula content 33% isoprotein and 3.85 kcal/g isoenergetic. Proximate of feed ingredient and feed formula presented in Table 1, 2 and 3.

Table 1. Proximate of Feed Ingredients

Ingredients	Moisture (%)*	Protein (%)*	Fat (%)*	Crude Fiber (%)*	Ash (%)*	NFE (%)**
Fish meal	9,26	57,75	12,00	5,09	14,00	11,16
MBM	8,00	54,25	7,00	9,60	20,00	9,15
Chicken feathers silage meal	16,23	89,69	1,00	0,70	0,90	7,71
Soybean meal	10,00	47,90	15,00	9,80	4,00	23,30
Wheat flour	10,75	13,20	11,00	8,70	10,00	57,10
Brand flour	13,00	16,76	1,00	0,60	0,00	81,64
Tapioca	12,58	0,00	1,00	0,10	0,00	98,90

* The results of Fish Nutrition Laboratory of Fisheries and Marine Science Faculty, University of Brawijaya.

** NFE = 100 - (protein + fat + crude fiber + ash).

Table 2. Feed Formula

Ingredients	TREATMENTS				
	A	B	C	D	E
Fish meal (%)	21,60	16,20	10,80	5,40	0,00
MBM (%)	9,85	9,85	9,85	9,85	9,85
Chicken feathers silage meal (%)	0,00	3,48	6,95	10,43	13,91
Soybean meal (%)	17,43	17,43	17,43	17,43	17,43
Wheat flour (%)	27,17	27,17	27,17	27,17	27,17
Brand flour (%)	17,25	17,25	17,25	17,25	17,25
Tapioca (%)	2,55	4,17	5,80	7,42	9,04
Premix (Vitamin Mineral mix)	2,00	2,00	2,00	2,00	2,00
NaCl	1,50	1,50	1,50	1,50	1,50
Cr ₂ O ₃	0,50	0,50	0,50	0,50	0,50
CMC	0,14	0,44	0,74	1,05	1,35
Total	100,00	100,00	100,00	100,00	100,00

Table 3. Feed Proximate

	Feed Proximate *				
Moisture (%)	6,50	7,00	7,70	8,00	9,00
Protein%	32,61	32,57	32,42	32,40	32,50
Crude Fat (%)	8,50	8,30	8,00	7,50	6,00
Crude Fiber (%)	6,00	5,70	5,40	5,33	4,90
NFE (%)	43,02	43,67	45,34	46,19	48,19
Ash (%)	9,87	9,76	8,84	8,58	8,41

* The results of Fish Nutrition Laboratory of Fisheries and Marine Science Faculty, University of Brawijaya.

Research Methods

The research design used experimental method based on Completely Randomized Design (CRD) with 5 treatments and 3 replications. Five diets (33% isoprotein and 3.85 kcal/g diet isoenergetic) were formulated with substitution of shrimp heads waste silage meal protein to fishmeal protein. These substituted 0, 25, 50, 75 and 100 % (A, B, C, D and E respectively) of the fishmeal protein. Maintenance is carried out for 30 days. The main parameters measured were survival rate, specific growth rate, feed conversion ratio, protein efficiency ratio, protein retention and protein digestibility. Water quality as supporting parameter measured consists of temperature, DO, pH and ammonia.

Various data collected during the study further were statistically analyzed using

analysis of variance (ANOVA), according with a design that is used is completely randomized design (CRD) with SPSS (Statistical Package for the Social Sciences) ver. 17 for windows.

RESULTS AND DISCUSSION

Data of survival rate, specific growth rate, feed conversion ratio, protein efficiency ratio, protein retention and protein digestibility can be seen in Table 4. Data in Table 4 showed that the survival rate of freshwater pomfret (*C. macropomum*) in each treatment was not significantly different, but the survival in each treatment produces excellent survival level is above 97.22%. Based on research conducted by Widodo *et al.* (2010), the survival rate above 90% classified as a good range in fish farming.

Table 4. Survival rate, specific growth rate, feed conversion ratio, protein efficiency ratio, protein retention and protein digestibility on pomfret (*C. macropomum*).

Parameters	Treatments				
	A (0%)	B (25%)	C (50%)	D (75%)	E (100%)
Survival Rate (%)	100 ± 0,00 ^a	99,44 ± 0,96 ^a	100 ± 0,00 ^a	99,44 ± 0,96 ^a	97,22 ± 3,47 ^a
Specific growth rate (%BW/Day)	1,35 ± 0,10 ^a	1,19 ± 0,08 ^a	1,15 ± 0,05 ^a	1,12 ± 0,04 ^a	1,12 ± 0,15 ^a
Feed Conversion Ratio	2,16 ± 0,14 ^a	2,35 ± 0,19 ^a	2,48 ± 0,07 ^a	2,47 ± 0,11 ^a	2,52 ± 0,41 ^a
Protein Efficiency Ratio	1,52 ± 0,10 ^a	1,41 ± 0,12 ^a	1,35 ± 0,04 ^a	1,36 ± 0,06 ^a	1,37 ± 0,25 ^a

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Parameters	Treatments				
	A (0%)	B (25%)	C (50%)	D (75%)	E (100%)
Protein Retention (%)	15,33 ± 0,61 ^a	13,85 ± 1,18 ^a	9,76 ± 2,17 ^a	13,27 ± 1,92 ^a	13,64 ± 3,11 ^a
Protein Digestibility (%)	83,26 ± 1,05 ^c	80,77 ± 0,58 ^b	78,38 ± 1,40 ^a	78,09 ± 0,48 ^a	76,90 ± 1,13 ^a

This is presumably because the silage flour chicken feathers not toxic when used as fish feed, so as not to cause death serious. The content of keratin as antinutrisi on chicken feathers have undergone a chain breaking disulfide. According to Moritz and Latshaw (2001), during hydrolysis, sulfide bonds in keratin be volatile and even disappear, so that the keratin structure becomes damaged. In addition, chicken feathers silage allegedly has not contain harmful microbes making it safe for living organisms, especially fish. This is supported by Puastuti (2007), that in the light of security, silage chicken feathers have been free of Salmonella and avian influenza virus. Salmonella bacteria could live well at a temperature of 8-45 °C and pH 4-8 while bird flu virus can not live in acidic conditions. The use of acid below pH 4 causing Salmonella and avian influenza virus is not active and even death. Average of life shows above 90%. This shows that the survival rate of freshwater pomfret (*C. macropomum*) during the maintenance is quite good, as the opinion Yulianti (2007), that the survival of freshwater pomfret (*C. macropomum*) between 95.41 to 99.07% is fair.

Table 4 shows that substitution treatment chicken feather protein silage meal did not affect the specific growth rate of freshwater pomfret (*C. macropomum*) ($p > 0.05$). This is presumably because the fish can utilize energy sources and fairly so that energy is not excessive and not stored as fat. According to Afrianto and Liviawaty (2005), the energy obtained from the overhaul of chemical bonding through the process of

oxidation of the feed components, which are proteins, fats, and carbohydrates. During the process of metabolism, these three components will be reformed into simpler compounds (amino acids, fatty acids and glucose) so that it can be absorbed by the body to be used or stored.

Lack of energy may result in weight loss because the fish can not eat enough feed to meet their energy needs, while if the excess energy can lead to high fat deposition and interfere with growth (Halver and Hardy, 2002). Freshwater pomfret itself has energy needs (DE) of 385 kcal/100 grams (Keshavanath *et al.*, 2012).

Decrease SGR up to 100% substitution treatment allegedly caused by keratin in the quill is not degraded completely. There might be a mixing of HCl is less prevalent. According Puastuti *et al.* (2004), the number of chicken feathers dissolved fraction after hydrolysis, indicating the increasing number of bonds being broken and reflects how much the chicken feathers can be digested. Another possibility is that the feathers have an amino acid composition that is less complete. According Suloma *et al.* (2014), chicken feathers silage and cystine rich in protein but low in essential amino acids, namely 3 methionine, lysine and histidine. This leads to decreased growth of up to 100% substitution.

SGR range indicates normal values despite decreased with the increasing number of protein substitution. This is supported by the results of Nwanna (2008), SGR with unfermented feed is of $1.05 \pm 0.19\%$ BW/day. Based on the research results Oishi

(2010), freshwater pomfret (*C. macropomum*) fed with protein content of 35% resulted SGR $0.90 + 0.01\%$ BW/day.

Weight gain or growth is limited by the levels of protein and energy feed protein. The addition of body weight indicates growth. This is due to the energy content in feed has been meeting the needs of maintenance of fish (Adelina, 1999). It is also similar to the opinion of Utami *et al.* (2012), that the average weight gain pomfret freshwater seed indicates the feed has been meeting the needs of maintenance (maintenance).

Suloma *et al.* (2014) say that current research on the use of silage chicken feathers as a partial substitution of the fish meal did not have a negative effect on the growth of the fish. Research Shapawi *et al.* (2007), using chicken farm waste are of high quality to replace fish meal protein can be carried out up to 100% without lowering the growth of *C. altivelis* fish, while Gunben *et al.* (2014) using the same materials but the fish do *Ephinephelus fuscoguttatus* substitution of up to 50%.

Feed conversion ratio (Table 4) it is important to know the value of feed quality. These results indicate that treatment substitution chicken feather silage meal protein had no effect on feed conversion ratio of freshwater pomfret (*C. macropomum*) ($p > 0.05$). This is presumably because the amount of feed given to each treatment is the same, namely 3% of body weight. In addition, body weight gain is also almost the same so that the feed conversion ratio freshwater pomfret (*C. macropomum*) in this study was relatively the same. According to Handajani (2006), the level of feed efficiency in fish is determined by the growth and the amount of feed given. The size of the feed conversion ratio is influenced by the quality and quantity of feed, species, size and quality of the water. Effendi (2004)

adds that the feed conversion depends on the species of fish seen in the eating habits and body size of fish, water quality and quality of feed given. Thus, as long as the size and feeding habits of the fish are relatively common and water quality conditions can still be tolerated freshwater pomfret (*C. macropomum*) then it will not affect the value of FCR.

Feed conversion value in this study still showed a lower number than the research Haetami *et al.* (2005), feed conversion freshwater pomfret (*C. macropomum*) was 2.6 ± 0.6 . Keshavanath *et al.* (2012) in his research to the basic feed formulation similar to this study that the feed conversion ratio of commercial feed is of 2.35 ± 0.12 . Figures low FCR indicates the quality of the feed, the better. Calvalho *et al.* (2014) found *C. macropomum* as omnivorous fish, has the characteristics to utilize various sources of nutrients and for high adaptive capacity, enzymatic, these fish can utilize the nutrients ingested according to its quality.

Substitution treatment of chicken feather silage meal protein had no effect on protein efficiency ratio freshwater pomfret (*C. macropomum*) ($p > 0.05$). This is presumably because the resulting body weight during the study are relatively similar, as well as protein feed that is almost the same anyway (isoprotein). According to Dani *et al.* (2005), the use of protein for fish growth is influenced by several factors, including the size of the fish, fish age, quality protein feed, the energy content of the feed water temperature and the frequency of feeding. So that the protein efficiency ratio will be relatively the same as the factors that influence it is also relatively common.

Protein efficiency ratio in this study is quite good compared to research Oishi (2010), which uses 35% protein feed to produce protein efficiency ratio amounted to

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1.87 ±0.20. The lower the protein efficiency ratio protein are used to produce the body weight, the better. This could depress the price of feed is more expensive, where according to Giri *et al.* (2007), the protein content of feed is affecting the price of feed for most of the feed components are proteins, as well as most protein comes from fish meal. Much research has been done to suppress the use of fish meal as the main protein source in feed. One alternative used in this study is silage chicken feathers. The use of alternative feed ingredients on a regular basis can reduce the price of feed.

Retention of proteins in protein substitution of chicken feathers silage meal

to fish meal protein with different percentages shows the results were not significantly different. This suggests that the need for protein as an energy source of freshwater pomfret (*C. macropomum*) in all treatments have been met. A protein that exceed the needs of the fish's body and stored as body fat. Fat content can be stored or used as a source of energy.

Supported by a body protein accretion feed ration and balance of essential amino acids contained in the feed is already meeting the needs of the fish. In the given research feed silage waste chicken feathers with a percentage of 0%, 25%, 50%, 75% and 100% have a different amino acid (Table 5).

Table 5. Essential amino acids of feed*

Essential amino acid (%)	Feed Trial				
	A	B	C	D	E
Arginin	0,78	1,12	1,09	1,20	1,38
Histidin	0,38	0,35	0,36	0,37	0,41
Isoleusin	0,52	0,55	0,60	0,66	0,71
Leusin	0,76	0,80	0,86	0,93	0,98
Lysine	0,36	0,34	0,28	0,31	0,31
Methionine	0,28	0,28	0,30	0,20	0,19
Phenylalanine	0,68	0,72	0,77	0,84	0,90
Threonine	0,48	0,59	0,52	0,57	0,74
Tryptophan	0,30	0,33	0,38	0,34	0,41
Valine	0,66	0,71	0,78	0,82	0,94

*Analysis by Laboratory of Animal Research Center, Bogor

Results of research conducted Mazukiwicz (2009), showed that the protein retention is a parameter to indicate the contribution of protein consumed in the diet on body protein accretion. Protein retention needs attention specifically to see the contribution of protein consumed in the diet to increase the fish's body (Giri *et al.*, 2007). Protein retention value also shows the quality of protein in the diet, the higher the value retention of the protein feed is getting better. The relationship between the value

retention of the protein and the specific growth rate of freshwater pomfret (*C. macropomum*) in this study were correlated positively.

Protein digestibility on Pomfret with control diet treatment still has the highest value. Treatment substitution of fish meal with a chicken feather meal of 50-100% has a value equal protein digestibility. The higher the percentage of starch in the feed silage quill the lower the protein digestibility on freshwater pomfret.

Maximum absorption of proteins that are not caused by keratin from chicken feathers that have not degraded during the process of silage. Disulfide bonds in keratin causes the protein digestibility of feather meal is low. Keratin is a fibrous protein, consisting of long-chain peptides, insoluble in water and difficult to be digested by the digestive system (Van der Poel *et al.*, 1990). Keratin is also difficult to dissolve by heating alkali and insoluble by gastrointestinal enzymes as stated by Aderibigbe and Church (1983), that the disulfide bonds formed between cysteine amino acids cause a protein is difficult to digest by proteolytic enzymes in the digestive tract of fish. How that is done for a decision is made chicken feather keratin bond can be processed using four methods, including physical, chemical, and physical, chemical, and microbiological (Sari *et al.*, 2015). Types of processing systems significantly affect the quality of the feather protein (Wang and Parsons,

1997).

Value protein digestibility on freshwater pomfret with control diet was higher than the digestibility of protein from freshwater pomfret with other feed. On the other hand, research done by Arunlertaree and Rakyuttithamkul (2006) showed that chicken feather silage meal can replace 25% of fish meal in fish feed of catfish hybrid (*Clarias macrocephalus* x *Clarias gariepinus*). Furthermore, a higher percentage is 50% chicken feather silage meal can replace fishmeal in fish tilapia (*Oreochromis niloticus*) (Kumari and Sundarabarathy, 2011). In general, protein digestibility of all treatments in this study are in the range of 76.90 to 83.26% and is still within the range of normal protein digestibility of fish in general by 75-95%. The results of water quality measurements of maintenance media in general are presented in Table 6.

Table 6. Water Quality of Research Media

Treatments	Parameters			
	Temperature (°C)	DO (mg/l)	pH	TAN (mg/l)
A	30,91 ± 0,88 ^a	6,77 ± 0,13 ^a	7,00 ± 0,01 ^a	0,005 ± 0,001 ^a
B	30,00 ± 0,49 ^a	6,79 ± 0,10 ^a	6,98 ± 0,01 ^a	0,005 ± 0,001 ^a
C	30,87 ± 0,71 ^a	6,72 ± 0,08 ^a	6,97 ± 0,01 ^a	0,004 ± 0,002 ^a
D	30,50 ± 0,08 ^a	6,62 ± 0,03 ^a	6,98 ± 0,01 ^a	0,007 ± 0,000 ^a
E	30,82 ± 0,26 ^a	6,63 ± 0,05 ^a	6,98 ± 0,01 ^a	0,006 ± 0,001 ^a

Water quality data obtained in the form of water temperature maintenance seed freshwater pomfret (*C. macropomum*) during maintenance (Table 6). Temperature fluctuations during the study showed that is not too high for their aquarium heater can be regulated temperature. Daily fluctuations in temperature around 1-2 ° C are not harmful. Calvalho *et al.* (2014), states that the ideal temperature for fish

growth is 25-30 °C. Freshwater pomfret (*C. macropomum*) can tolerate higher temperatures. Dissolved oxygen during the study (Table 6) show that the dissolved oxygen requirements for freshwater pomfret (*C. macropomum*) have been met. According Bezzera (2002), *C. macropomum* can tolerate the dissolved oxygen level is very low up to 0.5 mg / l. However, it would

be optimal if the dissolved oxygen ranges from 4-7 mg / l.

Results of pH measurement during the study (Table 6) still showed a neutral value and worth to the maintenance of freshwater pomfret (*C. macropomum*). Campos-Read and Kohler (2005), states that the optimal pH range for freshwater pomfret life (*C. macropomum*) in their natural habitat is 6-7. Results of pH measurement in this study indicates optimal results despite being in the range slightly higher lebih nearing 8. As in research Bezzera (2002), the pH value on the maintenance of freshwater pomfret (*C. macropomum*) ranges between 6.9 - 7.8.

Total ammonia nitrogen is a by product of the metabolism of fish such as fish excrement and food are not digested and absorbed by fish that are toxic (Asminatun, 2010). The content of TAN in the maintenance environment is still within the range that is able to tolerate freshwater pomfret (*C. macropomum*). The content of TAN during the study was not to exceed the maximum limit as do water changes every day so as not to cause a buildup of food remains and feces. Utami *et al.* (2012), states that the content of ammonia dissolved in water ranging from 0.008 to 0.034 mg / l is still in a decent range.

CONCLUSION

Based on these results it can be concluded that:

- a. Utilization of chicken feathers silage meal in the feed formula had no effect on survival, specific growth rate, feed conversion ratio and protein efficiency ratio, but the effect on protein digestibility freshwater pomfret (*C. macropomum*).
- b. Utilization of chicken feathers silage meal in the feed formula for freshwater pomfret (*C. macropomum*) can be used

as a substitute for fish meal protein up to 100%.

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