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EFFECTIVENESS OF FISH FEED FORMULATION WITH CHICKEN FEATHER MEAL BASED ON SNI STANDARDS FOR NILE TILAPIA

Efektivitas Formulasi Komposisi Pakan Ikan Dengan Tepung Bulu Ayam Berdasarkan Standar Sni Pada Ikan Nila

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ABSTRACT

This study evaluated the use of chicken feather meal as an alternative ingredient in Nile tilapia (*Oreochromis niloticus*) feed formulation, based on the Indonesian National Standard (SNI). The formulation was conducted using the Pearson Square method, combining chicken feather meal, soybean meal, wheat flour, fish oil, vitamin mix, and probiotics. Laboratory results showed that protein content (32.31%), fat (9.13%), ash (7.11%), moisture (6.05%), and crude fiber (5.12%) met SNI standards, with water stability reaching 87.25%. The feed was free from Salmonella contamination and antibiotic residues, but cadmium (1.5 mg/kg) and mercury (1.69 mg/kg) exceeded safe limits. Chicken feather meal demonstrates potential as an economical and eco-friendly feed ingredient, with enhanced heavy metal control needed to ensure feed safety.

Keywords: Alternative Feed, Chicken Feather Meal, Feed Quality, Indonesian National Standard (SNI), Nile Tilapia

ABSTRAK

Penelitian ini mengevaluasi penggunaan tepung bulu ayam sebagai bahan baku alternatif dalam formulasi pakan ikan Nila (*Oreochromis niloticus*) sesuai Standar Nasional Indonesia (SNI). Formulasi dilakukan menggunakan metode Pearson Square dengan campuran tepung bulu ayam, tepung kedelai, tepung terigu, minyak ikan, vitamin mix, dan probiotik. Hasil pengujian menunjukkan kadar protein (32,31%), lemak (9,13%), abu (7,11%), air (6,05%), dan serat kasar (5,12%) memenuhi standar SNI, serta kestabilan dalam air mencapai 87,25%. Pakan bebas kontaminasi Salmonella dan residu antibiotik, namun kadar logam berat kadmium (1,5 mg/kg) dan merkuri (1,69 mg/kg) melebihi batas aman. Tepung bulu ayam berpotensi menjadi bahan baku pakan alternatif yang ekonomis dan ramah lingkungan, dengan catatan kontrol logam berat perlu ditingkatkan untuk memastikan keamanan pakan.

Kata Kunci: Ikan Nila, Kualitas Pakan, Pakan Alternatif, Standar Nasional Indonesia (SNI), Tepung Bulu Ayam

INTRODUCTION

Tilapia (*Oreochromis niloticus*) is one of the important fishery commodities in Indonesia, with a high level of consumption in both domestic and international markets. Increasing tilapia production is highly dependent on the quality of feed given, because feed is the main component in fish farming that affects the growth, health, and quality of the fish produced (Iskandar & Elrifadah, 2015). One of the main challenges in feed formulation is finding a source of high-quality, affordable, and easily available protein (Fitriana *et al.,* 2024).

Fishmeal is often used as the main source of protein in fish feed because of its complete essential amino acid content. However, the availability of fishmeal is increasingly limited, and its increasing price is putting economic pressure on the aquaculture industry (Fauzi & Sari, 2018). Therefore, it is necessary to find alternative protein sources that can replace some or all of the role of fishmeal in fish feed formulation. One potential alternative is chicken feather meal, which is a waste from the livestock industry and has a high protein content (Rahayu *et al.,* 2014).

Chicken feather meal contains around 85-90% protein, mostly in the form of keratin, which is a protein that is difficult for fish to digest without certain treatments (Andriani *et al.,* 2024). However, through the hydrolysis or fermentation process, the digestibility of protein in chicken feather meal can be increased, so that it can be used as an effective fish feed ingredient (Mulia *et al.,* 2016).

To ensure that tilapia fish feed formulated with chicken feather meal meets quality standards, testing needs to be carried out based on the Indonesian National Standard for fish feed. Indonesian National Standard stipulates several parameters that must be met by fish feed, including ash content, water content, fat content, protein content, crude fiber content, and microbiological safety such as Salmonella tests and the presence of contaminants such as heavy metals and antibiotics (National Standardization Agency, 2024). This testing is important to ensure that the feed produced not only provides sufficient nutrition for fish but is also safe for human consumption as a final product (Setyono *et al.,* 2020).

This study aims to evaluate the effectiveness of the use of chicken feather meal in the formulation of tilapia fish feed, with reference to the standards set by Indonesian National Standard. Thus, it is expected that this study can provide a significant contribution to the development of fish feed that is more economical, environmentally friendly, and still meets the quality standards required by the aquaculture industry in Indonesia.

RESEARCH METHODS

Time and Place

This research was conducted in the fish feed laboratory of PT Tirta Lestari, Indonesia, during June to August 2024. This location was chosen because of its facilities that support a comprehensive feed quality analysis process according to research standards. This research reached the testing of fish feed in the laboratory.

Research Design

This study used an experimental design with a quantitative approach to evaluate the quality of tilapia feed formulated with chicken feather meal as an alternative protein source. The feed was formulated by mixing chicken feather meal with other raw materials such as fish meal, bran, and fish oil in predetermined proportions, following standard formulation procedures (Koch *et al.,* 2016). The method used to determine the formulation of ingredients

used the Pearsons Square method which has been used in various previous studies (Fitriana *et al.,* 2024). This method allows the grouping of raw materials based on their protein content into basal feed ingredients (protein <20%) and supplementary feed ingredients (protein> 20%).

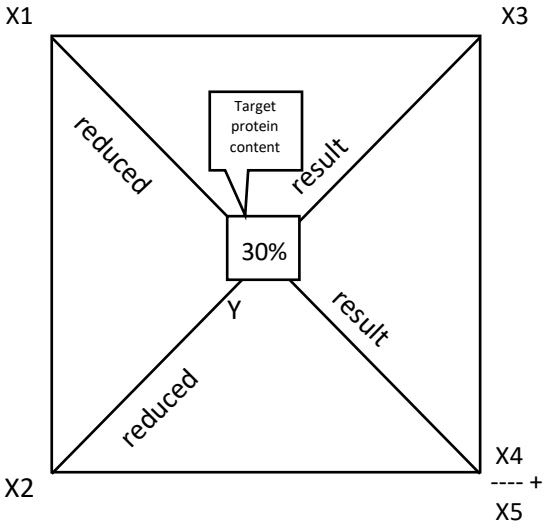

Figure 1. Square Method in determining the amount of feed ingredients

Image Description Pearson Square Method:
Y = % desired feed protein
X1 =% basal protein
X2 = % supplementary protein
X3 = X2 – Y
X4 = Y – X1
X5 = X3 + X4

The next step is to calculate the composition of each raw material that has been arranged in the following manner:

$$\text{Basal protein} = \frac{X3}{X5} \text{ x } 100\% \quad (1)$$

$$\text{Protein supplements} = \frac{X4}{X5} \text{ x } 100\% \quad (2)$$

The stages of feed formulation are as follows:

a) Selection of Raw Materials: The raw materials used in this study included chicken feather meal as a source of supplementary protein and corn flour as a basal feed ingredient.
b) Grouping of Raw Materials: These materials were grouped based on their protein content, with chicken feather meal included in the supplementary protein category and corn flour in the basal protein category.
c) Calculation of Protein Content: Calculating the average protein content of the basal and supplementary feed ingredients using the Pearsons Square method.

The feed formulation process is carried out by following these steps:

a) Preparation of Tools and Materials: Prepare all the necessary tools and materials, including a grinding machine, pellet molding machine, and sieve. The materials used include chicken feather meal, corn flour, fish oil, and vitamin mix.
b) Making Fish Feed: The process begins by measuring the weight of each raw material, mixing it evenly, and forming a homogeneous dough. Fish oil and warm water are added gradually until the dough reaches the desired consistency. The dough is then

molded into pellets with a size of 2-3 mm and dried until the water content is less than or equal to 12%.

Table 1. Research Tools and Materials

Tool	FUNCTION
Machine Grinder	Smoothing material
Machine Print Pellets	Make fish food according to size
Filter	Sorting feed according to size
Plastic Packaging	Packaging feed
Scales	Weigh material according to composition

Material	Type of material
Chicken Feather Meal	Supplement raw materials
Soybean Flour	Supplement raw materials
Flour	Basalt raw material
Pollard Flour	Basalt raw material
Fish oil	Additional materials

Data Analysis

Data from the research results were analyzed using the Indonesian National Standard for fish feed, including tests of protein content, crude fiber, fat, ash, water, free nitrogen, and stability in water, as well as antibiotic residue tests (chloramphenicol, nitrofuran, oxytetracycline) and heavy metal content (Pb, Cd, Hg). Testing was carried out with three repetitions for each parameter. The test results were compared with the Indonesian National Standard to determine the quality of the formulated tilapia feed (Sugiyono, 2010).

RESULT

Information regarding raw materials and their nutritional content can be seen in Table 2.

Table 2. Composition of tilapia fish feed protein 30-32%

Material name	Composition	Ingredients
Chicken feather meal	23-25 %	SNI feed standards: ash 26.2%, protein 50.1%, fat 2.83%
Soybean flour	22-25 %	Protein content up to 40-50 percent
Flour	25-27 %	protein content, vitamins B1, B2, folic acid, iron, zinc and vitamins A, D, E, K.
Fish oil	1.5%	Fish Oil Animal Feed Grade A
Vitamin mix	0.5%	Vitamins and supplements used as a mixture of fish feed containing multi-vitamins, amino acids and minerals.
Probiotics	0.5%	Contains Lactobacilus Bacteria

Laboratory testing was conducted on the formulation of tilapia feed using chicken feather meal. The results of this laboratory test indicate that the formulation meets most of the standards set by the Indonesian National Standard, as shown in Table 3.

Table 3. Laboratory Test Results of Tilapia Fish Feed with Chicken Feather Meal

No	Test Type	Indonesian National Standard	Test results Tilapia Fish Feed
1	Ash Content	Max 12%	7.11%
2	Water content	Max 12%	6.05%
3	Fat content	Min. 5%	9.13%
4	Protein Content	Min. 30%	32.31%
5	Fiber content rough	Max 8%	5.12%
6	Salmonella Test	Negative	Negative
7	Chloramphenicol Antibiotic	Not detected	Not detected
8	Nitrofuran Antibiotics	Not detected	Not detected
9	Antibiotics Oxytetracycline	100 µg/kg	100 µg/kg
10	Lead (Pb)	Max 5.0 mg/kg	1.01 mg/kg
11	Cadmium (Cd)	Max 1.0 mg/kg	1.5 mg/kg
12	Mercury (Hg)	Max 0.5 mg/kg	1.69 mg/kg
13	Stability in water	Min. 85%/15 Minutes	87.25%
14	Free Nitrogen	Max 0.20%	<0.01%

DISCUSSION

Information on raw materials and their nutritional content can be seen in Table 2, which shows the composition of tilapia feed with a protein content of 30-32%. Chicken feather flour as one of the main ingredients has a very high protein content, reaching 65.46%, which contributes significantly to the protein requirements in this feed formulation. Soybeans and wheat flour also provide additional protein and other nutrients such as vitamins and minerals (Nurulaisyah *et al.,* 2021).

The ash content in tilapia feed with chicken feather flour reached 7.11%, which is still below the maximum limit of 12% set by SNI (National Standardization Agency, 2024). This ash content value shows that the use of chicken feather flour does not increase excessive mineral content, so it is safe for fish and in accordance with the nutritional standards required for optimal growth (Akbarurrasyid *et al.,* 2024). The water content in the feed was recorded at 6.05%, far below the maximum limit of 12% permitted according to SNI (National Standardization Agency, 2024). This low water content is important to prevent the growth of microorganisms that can damage the feed during storage, so that it can extend the shelf life of the feed and maintain its quality (Zaenuri *et al.,* 2014). This chicken feather meal feed has a fat content of 9.13%, which exceeds the minimum standard of 5% set by SNI (National Standardization Agency, 2024). High fat content is a good indicator for providing the energy needed by fish, which is important to support the growth and daily activities of tilapia (Nasution *et al.,* 2017). However, control is needed to prevent excessive increases in fat content. The protein content in the feed reached 32.31%, which exceeds the minimum standard of 30% according to SNI. This shows that chicken feather meal as a protein raw material has great potential to support the protein needs of tilapia, which is essential for the growth and development of the fish's body (Ispitasari & Haryanti, 2022; Rosadi *et al.,* 2012). The crude fiber content in the feed was recorded at 5.12%, still within the maximum limit of 8% set by SNI (National Standardization Agency, 2024). Crude fiber is quite important to support the digestive process in the fish's body, but it should not exceed the limit that can interfere with nutrient absorption (Sayuti *et al.,* 2022).

Laboratory test results show that this feed is negative for Salmonella, indicating that this feed is free from contamination by pathogenic bacteria that can endanger the health of fish and humans. This is in accordance with the requirements of SNI which prioritizes food safety in

feed products (National Standardization Agency, 2024). This feed was not detected to contain antibiotic residues such as chloramphenicol, nitrofuran, and oxytetracycline. This is very important because antibiotic residues can cause bacterial resistance that is harmful to human and animal health (Hakimah *et al.,* 2019). Feed that is free from antibiotics shows compliance with regulations and feed safety.

The heavy metal content in the feed shows that the lead (Pb) level is 1.01 mg/kg, cadmium (Cd) is 1.5 mg/kg, and mercury (Hg) is 1.69 mg/kg. Although lead is still below the safe limit, cadmium and mercury exceed the limits recommended by SNI (National Standardization Agency, 2024). This shows the need for more attention in the selection of raw materials to avoid heavy metal contamination that can endanger the health of fish and consumers (Daşbaşi *et al.,* 2015).

The stability of the feed in water was recorded at 87.25%, which is higher than the minimum limit of 85% set by SNI. This stability shows that the feed can last a long time in water without experiencing excessive dissolution, so that fish can utilize it optimally (Zaman *et al.,* 2018). This feed shows a very low free nitrogen content, which is <0.01%, far below the maximum limit of 0.20% permitted by SNI. The low free nitrogen content indicates that this feed is of good quality and does not contain nitrogen compounds that are potentially harmful to fish.

CONCLUSION

This study shows that the formulation of tilapia fish feed using chicken feather meal as one of the main raw materials mostly meets the standards set by SNI. Laboratory test results show that this feed has high protein (32.31%) and fat (9.13%) content, which play an important role in supporting optimal tilapia growth. In addition, the ash content (7.11%), water content (6.05%), and crude fiber content (5.12%) are also within the permitted limits, indicating that this feed has a balanced composition and good quality.

This feed is also free from Salmonella contamination and does not contain hazardous antibiotic residues such as chloramphenicol, nitrofuran, and oxytetracycline, making it safe for fish consumption. However, special attention needs to be paid to the content of heavy metals, especially cadmium (1.5 mg/kg) and mercury (1.69 mg/kg), which exceed the limits recommended by SNI. Although the lead content (1.01 mg/kg) is still within the safe limit, stricter control is needed to ensure the safety and quality of the feed.

Overall, this feed formulation with chicken feather meal has good potential for use in Tilapia fish farming. However, efforts to improve quality, especially in terms of controlling heavy metal contamination, must be a priority to ensure the safety of feed for fish and consumers.

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