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ARTICLE

Effect of Fermented Shrimp Waste Level in Feed on Biological Value on Native Chicken

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ABSTRACT

The purpose of the study was to determine the effect and obtain the level of use of fermented shrimp waste in the feed that produces the best biological value in native chickens. The study used 125 one-day-old chickens (DOC) placed in 25 cages randomly, containing five chickens reared for eight weeks. The study used experimental methods, and the experimental design used was a completely randomized design with five types of treatment, namely, feed without the use of fermented shrimp waste (R0), feed containing 5% fermented shrimp waste (R1), feed containing 10% fermented shrimp waste (R2), feed containing 15% fermented shrimp waste (R3), and feed containing 20% fermented shrimp waste (R4), each treatment was repeated five times. The observed variables were absorbed nitrogen, nitrogen stored in the body, and biological value. Data were analysed using ANOVA and Duncan's Multiple Distance Test. The results showed that the use of fermented shrimp waste at a level of 20% in feed resulted in the best biological value in native chickens.

1. Introduction

The success of native chicken farming is influenced by several factors such as environmental conditions, maintenance management, cage management, and feed. Feed is an essential factor in raising native chickens. A good feed is a feed that contains good quality protein because protein is the main component in the feed that is needed by chickens to support their growth so that an essential factor that must be considered in preparing chicken feed is protein content that must be met in addition to paying attention to the energy content of the feed [1,2].

The limited availability of protein source feed ingredients such as fish meal due to high prices impacts increasing feed prices. Therefore, it is necessary to choose the right alternative feed ingredients to produce feed that has the quality and can meet the needs of livestock with high feed use efficiency and reduce production costs. One of them is utilizing local alternative feed ingredients that are cheap, easy to obtain, sustainable availability, and have a reasonably high nutrient content, namely shrimp waste. Shrimp waste is one of the fisheries wastes whose number

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is increasing from year to year. In Indonesia, the volume of shrimp head and shell waste produced reaches 203,403-325,000 tons per year [2,3].

Shrimp waste has the advantage of having a low price, is widely available, and has a relatively high protein content of 41.5%, almost equal to fish meal [3-7]5 % FM substitute with SHWF (R1. However, it has obstacles, one of which is having a limiting factor in the form of chitin which binds to proteins and minerals [8,9]. It is necessary to carry out a processing process to improve the quality, especially the protein from shrimp waste, which is to process it through a fermentation process by adding *Bacillus licheniformis*, *Lactobacillus* sp., and *Saccharomyces cerevisiae* gradually. *B. licheniformis* produces proteases and chitinases that will liberate some nitrogen or protein from chitin bonds [8-10]. *Lactobacillus* sp. functions to break down glucose, sucrose, maltose, and lactose so that mineral deposits occur [11,12]. Rogosa, and Sharpe (MRS. *S. cerevisiae* is a yeast that produces amylase, lipase, proteases, and other enzymes that can help digest food substances in the digestive organs [13,14].

Shrimp waste fermentation technology is an inexpensive alternative to increase the nutrient value of shrimp waste so that it affects the quality of feed. Increasing the nutritional value of fermented shrimp waste will improve the quality of protein in the feed to increase the quality of feed in native chickens [15,16]. One way that can be used to assess the quality of feed protein is to calculate the biological value [17]. Biological value is a method used to determine the quality of feed protein by looking at how much protein is stored in the body from the absorbed protein [18]n = 6. Good biological value can be seen from high body weight gain from consuming feed with high protein quality. It is interpreted as the amount of nitrogen that is absorbed and utilized by the body in producing body weight gain with high feed efficiency.

2. Materials and Methods

The livestock used in the study were 125 native chickens of Sentul type with the age of 1 day (DOC) obtained from the Poultry Livestock Breeding Development Center, Jatiwangi, Majalengka, Indonesia. Chickens are reared from 1 day to 8 weeks of age. The average coefficient of variation in body weight is 7.53%. The cage used in this study used 25 units of cage made of bamboo, wood, and wire with a length of 0.7 m, width 0.5 m, and height of 0.7 m. Each cage unit is filled with five chicks and is equipped with a feed and drinking water container made of plastic and a 15-watt incandescent lamp. Feeding and drinking water is provided on an ad-libitum basis.

The experimental method used in this study was experimentally using a completely randomized design with five treatments and five replications. The composition of the feed is based on a crude protein content of 15% and metabolizable energy of 2750 kcal/kg. The design of the experimental feed in the study was as follows:

Treatment R0 = Feed without the use of fermented shrimp waste

Treatment R1 = Feed containing 5% fermented shrimp waste

Treatment R2 = Feed containing 10% fermented shrimp waste

Treatment R3 = Feed containing 15% fermented shrimp waste

Treatment R4 = Feed containing 20% fermented shrimp waste

The nutrient and energy content of the feed ingredients that make up native chicken feed can be seen in Table 1. The composition of the experimental feed used is shown in Table 2. Based on the design of the feed, the nutrient and energy content of each experimental feed is shown in Table 3.

Table 1. Nutrient Content and Metabolizable Energy of Feed Ingredients for Ration

Feed Ingredients	ME**)	CP**)	EE**)	CF**)	Ca**)	P**)	Lys**)	Meth**)
	(kcal/kg)	....	....	....	%	....	....	....
FSW*)	2614	39.29	7.03	7.79	6.81	2.83	3.04	1.46
Rice bran	1630	12.00	13.00	12.00	0.12	0.21	0.71	0.27
Yellow corn	3370	8.60	3.90	2.00	0.02	0.10	0.20	0.18
Soybean meal	2240	44.00	0.90	6.00	0.32	0.29	2.90	0.65
Fish meal	2970	58.00	9.00	1.00	7.70	3.90	6.50	1.80
Bone meal	0	0	0	0	23,3	18.0	0	0
CaCO3	0	0	0	0	40.0	0	0	0

*)FSW, fermented shrimp waste

**)ME, metabolizable energy; CP, crude protein; EE, extract enter; Ca, calcium; P, phosphorus; Lys, lysine; Meth, methionine

R0 = Ration without the use of fermented shrimp waste
R1 = The ration contains 5% fermented shrimp waste
R2 = Ration contains 10% fermented shrimp waste
R3 = Ration contains 15% fermented shrimp waste
R4 = Ration contains 20% fermented shrimp waste

The observed variables include:

(1) Nitrogen absorbed (g) = Nitrogen consumption (g) × % Nitrogen digestibility

Nitrogen consumption (g) = Feed consumption (g) × Feed nitrogen content (%)

(2) Nitrogen stored in the body (g) = Carcass nitrogen (g) + Feathers nitrogen (g)

Carcass nitrogen (g) = Weight Gain (g) × % Carcass nitrogen content

Feather nitrogen (g) = Weight Gain (g) × % Feather of weight × % Feather nitrogen content

(3) Biological value (BV) = (Nitrogen stored in the body (g) / Nitrogen absorbed (g)) × 100%

Table 2. Arrangement of Experimental Ration

Feed Ingredients	R0	R1	R2	R3	R4
	……………………………….%............................				
FSW[*)]	0.00	5.00	10.00	15.00	20.00
Rice bran	28.00	26.75	24.75	23.00	18.00
Yellow corn	58.00	58.00	58.00	58.00	60.00
Soybean meal	4.75	2.50	2.25	1.50	0.00
Fish meal	8.00	6.50	3.75	1.25	0.00
Bone meal	0.75	0.75	0.75	0.75	1.00
CaCO3	0.50	0.50	0.50	0.50	1.00
Amount	100	100	100	100	100

[*)]FSW, fermented shrimp waste

Table 3. Nutrient Content and Metabolizable Energy of Experimental Ration

Nutrient Content	R0	R1	R2	R3	R4	Necessity
Metabolizable energy (kkal/kg)	2,755	2,770	2,781	2,792	2,838	2,750
Crude protein (%)	15.08	15.03	15.05	15.03	15.18	15
Extract ether (%)	6.66	6.70	6.54	6.43	6.09	4.0-7.0
Crude fibre (%)	4.89	4.97	5.08	5.19	4.92	3.0-6.0
Calcium (%)	1.05	1.27	1.39	1.54	2.03	0.9-1.1
Phosphor (%)	0.58	0.65	0.68	0.72	0.84	0.7-0.9
Lysin (%)	0.97	0.95	0.90	0.86	0.86	0.8-1.0
Methionine (%)	0.35	0.38	0.40	0.42	0.45	0.38-0.42

3. Results and Discussion

The average results of the study consisting of absorbed nitrogen, nitrogen stored in the body, and biological value for each treatment for each free-range chicken are presented in Table 4.

Table 4. Average Research Results

Variable	Treatment				
	R0	R1	R2	R3	R4
Nitrogen absorbed (g)	31.34^{a}	33.80^{a}	30.71^{a}	30.20^{a}	29.94^{a}
Nitrogen stored in the body (g)	20.59^{bc}	22.06^{c}	20.64^{bc}	18.33^{ab}	17.89^{a}
Biological value (%)	65.66^{a}	65.28^{a}	67.66^{a}	61.36^{a}	60.98^{a}

Effect of Treatment on Absorbed Nitrogen

Based on the analysis results, fermented shrimp waste 0%, 5%, 10%, 15%, and 20% in the feed had no significant effect (P>0.05) on the nitrogen absorbed. This means that the use of fermented shrimp waste in the feed up to a level of 20% did not show a significant difference in the nitrogen absorbed in chickens. There was no significant difference (P> 0.05) in the nitrogen absorbed between treatments due to the chitin content contained in the feed, which was still within the tolerance limit so that it did not affect the amount of nitrogen absorbed by the chickens. There was no significant difference (P>0.05) between treatments on the nitrogen absorbed was influenced by nitrogen consumption and nitrogen digestibility, the results of which were not significantly different (P>0.05). According to the opinion [19], the use of various levels of fermented shrimp waste in feed did not show a significant difference in the digestibility value of crude protein. This means that nitrogen digestibility fed by fermented shrimp waste up to 20% has the same effect as feed without fermented shrimp waste (R0). This could be caused by the nitrogen content of the treated feed, which was not different and due to the degradation of protein from chitin in shrimp waste by the activity of bacteria and moulds in the fermentation process into easily digestible components, namely peptides and amino acids to improve the quality of digestibility in [2,20,21].

In addition to the value of nitrogen digestibility which was not significantly different (P>0.05) between treatments, the amount of nitrogen consumed by chickens produced an amount that was not significantly different (P>0,0,5). The nitrogen consumption is determined by the amount of feed consumption and the nitrogen content in the feed. The nitrogen consumption was not significantly different because the nitrogen content between the treatments used was not different, and the amount of feed consumption was not significantly different (P> 0.05), causing nitrogen consumption between treatments to produce values that were not significantly different (P> 0.05). According to research results [4,22], that the use of various levels of fermented shrimp waste in feed was not found to have a significant effect on feed consumption. It was stated by [23] that the mixture of feed fed with fermented shrimp waste flour produced no significant effect on feed consumption in chickens. This can be due to an increase in palatability due to the fermentation process in shrimp waste. Feed using fermented shrimp waste is as palatable as feed without fermented shrimp waste [8].

In addition, there is an increase in the quality of nutrients in fermented shrimp waste, namely by decreasing the chitin content in fermented shrimp waste. The decrease in chitin content from the fermentation process of shrimp waste with the help of Bacillus licheniformis bacteria, which frees some protein in the form of N-Acetyl-D-glucosamine monomer and acetylamino from chitin [3,24,25], as well as the fermentation process by *S. cerevisiae*, which helps the digestion of food substances in the digestive organs [26-28]. This causes an increase in palatability of the feed so that there is no difference in the amount of nitrogen consumption in the treatment of feed using fermented shrimp waste with feed without the use of fermented shrimp waste, which at the same time has no significant effect on the nitrogen value absorbed by chickens. According to the opinion [29,30] that fermented shrimp waste with *B. licheniformis*, *Lactobacillus* sp., and *S. cerevisiae* will improve its quality and palatability, which provides an aroma and flavour that is preferred by livestock.

Effect of Treatment on Nitrogen Stored in the Body

Based on the variance results, the use of fermented shrimp waste at levels of 0%, 5%, 10%, 15%, and 20% in the feed had a significant effect (P<0.05) on nitrogen stored in the body. The highest value of nitrogen stored in the body was produced by treatment feed using 5% fermented shrimp waste (R1 = 22.06 g) which had a significantly different effect (P<0.05) with feed treatment containing 15% fermented shrimp waste (R3 = 18.33 g) and feed treatment containing 20% fermented shrimp waste (R4 = 17.89 g) while had no significant effect (P>0.05) with feed treatment without the use of fermented shrimp waste (R0 = 20.59 g) and feed treatment containing 10% fermented shrimp waste (R2 = 20.64 g). The treatment that gave the lowest value of nitrogen stored in the body was the treatment of feed containing 20% fermented shrimp waste (R4 = 17.89 g) and had a significantly different effect (P<0.05) with feed treatment without the addition of fermented shrimp waste. (R0 = 20.59 g), feed treatment with the addition of 5% fermented shrimp waste (R1 = 22.06 g), and feed treatment containing 10% fermented shrimp waste (R2 = 20.64 g) but not significantly different (P> 0.05) with feed treatment containing 15% fermented shrimp waste (R3 = 18.33 g). It can be seen that from the amount of nitrogen stored in the body, the use of fermented shrimp wastes up to a level of 10% in feed did not decrease the amount of nitrogen stored in the body, and there was a decrease when giving fermented shrimp waste starting at the 15% level.

The existence of a significantly different effect of the five treatment feeds on nitrogen stored in the body could be caused by the chicken's body metabolism to keep the absorbed nitrogen. Metabolic processes are strongly influenced by the balance of amino acids and are also closely related to the balance of calcium and phosphorus in the feed. By the opinion [31-33] , that calcium and phosphorus are closely related in metabolic processes, especially in bone formation, body growth, and amino acid metabolism. This indicates that the balance of calcium and phosphorus in the treatment feed up to the use level of 10% fermented shrimp waste is in the best balance to produce the nitrogen value stored in the body in the feed treatment with the addition of 5% fermented shrimp waste the highest and not significantly different from the feed. Treatment without the use of fermented shrimp waste (R0) and feed with the help of 10% fermented shrimp waste (R2), which was in the balance between 1.81:1 and 2.04:1 (Table 3). In line with the opinion [2,34], for growing chicks, the best balance of calcium and phosphorus is between 1.5:1 and 2:1.

There was no significant difference (P>0.05) in feed treatment using 5% fermented shrimp waste (R1) with feed treatment without the use of fermented shrimp waste (R0) and feed treatment using 10% fermented shrimp waste (R2) on stored nitrogen. The body also indicates that the amino acid balance of the feed treatment is up to the level of use of 10% fermented shrimp waste in the best amino acid balance in the feed (Table 3) so that the absorbed nitrogen is stored optimally in the chicken body. By the opinion [35-37] , that to meet protein needs as perfectly as possible, essential amino acids must be provided in the right amount and sufficient balance so that it can produce additional protein. Optimal body weight. The best balance of amino acids and assisted by the optimum balance of calcium and phosphorus in the feed is beneficial in the metabolic process of the chicken body in carrying out its role so that the value of nitrogen stored in the body is obtained with high yields in feed treatment with the use of 5% fermented shrimp waste (R1) and 10% fermented shrimp waste (R2).

The feed containing 20% fermented shrimp waste (R4) gave the lowest value of nitrogen stored in the body. It was not significantly different (P>0.05) from the treatment of feed containing 15% fermented shrimp waste

(R3) but significantly different (P<0.05) was lower than feed treatment without the use of fermented shrimp waste (R0), feed with the addition of 5% (R1) and 10% (R2) fermented shrimp waste. The feed with the addition of 15% fermented shrimp waste (R3) was significantly different (P<0.05) lower than the treatment feed with the addition of 5% fermented shrimp waste (R1). This indicates that there is an imbalance of amino acids as well as calcium and phosphorus in the R3 (15%) and R4 (20%) treated feed so that a lot of nitrogen is wasted.

Effect of Treatment on Biological Value

Based on the analysis results, it was found that the treatment of feed without the use of fermented shrimp waste, feed containing 5%, 10%, 15% and 20% of fermented shrimp waste, had no significant effect (P>0.05) on the biological value. There was no significant difference (P>0.05); the biological value up to a level of 20% using fermented shrimp waste indicated that the protein quality of the treated feed was as good as that of the feed without the use of fermented shrimp waste (R0). In addition, it indicated that the amino acid balance of the five treatment feeds was still within normal limits. In line with the opinion [35,38], the protein quality is determined by the type and proportion of amino acids it contains and feeds with protein containing various kinds of essential amino acids in appropriate proportions for growth purposes will produce protein. Feed with high biological value or high quality. Proteins in the diet containing optimal amounts and ratios of all essential amino acids and containing sufficient quantities of nonessential amino acids will have high biological value [39,40].

It was proven that shrimp waste fermented with bacteria *B. licheniformis*, *Lactobacillus* sp., and *S. cerevisiae* had a good effect, which could improve digestibility and protein quality of feed. Furthermore, the completeness of amino acids is still in an average balance. The nitrogen of fermented shrimp waste in feed can be optimally digested and stored in the body and, in turn, produces the same biological value as feed without the use of fermented shrimp waste (R0).

4. Conclusions

From the results of research and discussion, it can be concluded that feed containing fermented shrimp waste at a level of 20% produces the best biological value in native chickens.

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