The effect of fish hydrolysate addition to the standard feed and its storage duration to the total content of nitrogen in the excreta of laying chicken

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Submitted: 13 September 2018, Accepted: 11 October 2019

ABSTRACT: The aim of this study is to determine the effect of the addition of fish hydrolyzate with variuos concentration to the standard feed and feed storage duration towards the decrease of odor by observing total nitrogen content in the excreta of laying chicken. 108 laying chicken aged forty-six weeks were divided into 12 (twelve) treatment combination. Each treatment consists of 9 (nine) laying chickens. All the laying chickens were kept in a battery cage and were fed with commercial standard feed which was added with fish hydrolysate in three different concentrations (0; 1; and 2%) during the 5-day feeding treatment period. Each standard feed which was added with different concentrations of fish hydrolysate were stored for a number of different day variations (0; 5; 10; and 15 days) before being fed to the laying chickens . The variables analyzed were water content and total nitrogen content in the excreta. Results showed that the total nitrogen content in the excreta was not affected ($\text{sig} > 0.05$) by the duration of feed storage but was significantly affected ($\text{sig} < 0.05$) by the addition of fish hydrolyzate with different concentration. The use of fish hydrolyzate in 1-2% concentration reduce the levels of water content and total nitrogen content of laying chicken excreta.

Keywords: laying chicken; fish hydrolyzate; laying chicken excreta.

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INTRODUCTION

Chicken farm is a vital activity in an attempt to fulfill human needs towards nutritional food and also to fulfill the demand of livestock product which is increasing along with the increase/growth of population, income, and public awareness on the importance of family nutrition improvement (Ibrahim, 2012). Chicken farming in East Java is the largest producer of chicken eggs in Indonesia with an increasing number of laying chicken population each year. Latest data of 2015 recorded a number of 43.221.466 laying chicken population which is the most after broiler chickens (Data Statistik Peternakan, 2017).

The main environmental problem that commonly arises from chicken farms around the world is the waste it produces (Qian, Song, Hu, & Ying, 2018). Chicken manure in a chicken farm creates an unpleasant pungent odor and can cause flies, raising environmental problems that are troubling the community, especially if the location of the farm is close to settlements area (Linggotu, L. O., Paputungan, 2016). Therefore, efforts to reduce the environmental impact of chicken farms is one of the many research topics conducted in recent times (Maheshwari, 2013). Reported attempts to reduce the environmental impact from chicken manure in the chicken farms can be achieved by regulating the feed mixture which can help in reducing the odor produced from the waste (Dunlop, M. W, 2016) . Other reported attempts include arranging mechanical cleaning system, or treating chicken waste chemically and biologically to reduce its odor (Malomo, G. A, 2018).

Ammonia is one of the main gases that cause chicken manure to have pungent smell. The amount of ammonia produced due to the enzymatic degradation process of chicken manure depends on the total nitrogen content in the manure. Ammonia gas is formed from the degradation of

nitrogen compounds contained in chicken manure which consists of uric acid and undigested protein which was not absorbed by the body and was excreted in the excreta (Koerkamp, 1994). The higher the level of nitrogen compound in the excreta, the greater the ammonia gas produced and the stronger the odor it causes. {Formatting Citation}

In chicken farms, improvement of feed efficiency can be observed through several indicators, such as the amount of feed consumption, body weight gain, weight and quality of egg, quantity of eggs, and the quality of the excreta. Observation of feed quality through chicken excreta can easily be carried out in a relatively short time. As previously reported by Yusrizal, *et al* (2012), the addition of synbiotics in the form of fermented palm kernel cake powder in chicken feed can reduce the amount of ammonia in chicken manure. Fenita, Santoso, and Fauziah. (2011) also reported that the use of fermented palm sludge in critical amino acids (methionine, lysine, and triptocyclone) may reduce the smell. Decreased nitrogen compounds in chicken manure indicates a better absorption of feed nutrients. Fish hydrolysate (FH) has a high-quality short chain protein as it contains complete amino acids, perfect nutrition, and is easy to digest (Kristinsson and Rasco, 2000). The addition of FH in chicken feed is expected to affect the life of good bacteria in the gastrointestinal tract, supporting a better feed absorption process in a chicken's digestion.

This paper will explain the effect of concentration variation of FH added to chicken feed and the effect of storage duration/time of feed mixed with FH towards the total amount of nitrogen level in laying chicken excreta. Results from this research are expected to provide information on the variation of the addition of fish hydrolysate to the laying chicken feed which can produce excreta with low level of nitrogen content. Outcome of this

research also includes information on the effect of storage duration of feed mixed with fish hydrolysate towards the total amount of nitrogen level in laying chicken manure as an attempt to create a more environmental-friendly laying chicken farm.

MATERIALS AND METHODS

The number of laying hens sampled were 108 chickens, aged $\pm$ 46 weeks, from a farms in the area of Sukorambi, Jember, East Java. The cage used was a bamboo battery cage. All of the cages is located in a cage construction with tile roofs. Each cage is equipped with a place for feed and drink made from paralon pipes which are placed seperately. Chemical analysis of total nitrogen content in chicken excreta is conducted in the chemistry laboratory The University of Jember.

Feed composition

There were 12 types of feed (P1 – P12) given to the laying hens during the feeding treatments. These feed are a mixture of commercial feed which was composed by KLK 36 laying chicken concentrate manufactured by Japfa Comfeed Indonesia, corn and rice bran (basal feed). The following is the composition of each feed type:

- P1 = standard feed + without FH and 0-day storage;
- P2 = standard feed + without FH and 5-day storage;
- P3 = standard feed + without FH and 10-day storage;
- P4 = standard feed + without FH and 15-day storage;
- P5 = standard feed + 1% FH and 0-day storage;
- P6 = standard feed + 1% FH and 5-day storage;
- P7 = standard feed + 1% FH and 10-day storage;
- P8 = standard feed + 1% FH and 15-day storage;
- P9 = standard feed + 2% FH and 0-day storage;

P10 = standard feed + 2% FH and 5-day storage;

P11 = standard feed + 2% FH and 10-day storage;

P12 = standard feed + 2% FH and 15-day storage.

The predetermined concentrate is then mixed with corn and bran with a composition as seen in Table 1. Each chicken in all treatment was given the same amount of each feed type of 55.55 grams per day for 5 consecutive days. On day 0, chickens in all groups still receive the same feed of standard feed without the addition of fish hydrolysate (FH).

Chicken excreta was sampled starting on day 0, 3, and 5 and was in the form of fresh excreta (less than one hour), so it is expected that the enzymatic decomposition has not yet produced ammonia gas. The total nitrogen levels in the chicken excreta was determined by using the Kjeldahl method. The total nitrogen levels in the feed are also determined to be used as reference. The data obtained is then further analyzed through T- test using the SPSS application to know the difference and effect of each treatment.

RESULTS AND DISCUSSION

The composition and nutritional content of the feed given to laying hens has fulfilled the national standard of feed quality. The composition of the feed is made according to the proximate analysis conducted by several researchers as stated in Table 1.

The effect of adding fish hydrolysate to the standard feed towards protein levels, which is represented in the form of total nitrogen levels, has been observed. The addition of fish hydrolysate slightly change the total nitrogen levels in the standard feed (Table 2) and was not significant. The results of this measurement will later be compared with total nitrogen levels in chicken excreta so that the effect of adding fish hydrolysate to the digestive system of

chickens can be observed. Addition of fish hydrolysate in feed is expected to improve the digestive system of chickens. Good digestion can increase the absorption of feed nutrients. The more feed nutrients that are digested, the less total nitrogen content are excreted in the feces. The less amount of nitrogen level in the excreta will reduce the amount of nitrogen compounds that are

decomposed by microorganisms, reducing the production of ammonia gas and thus the reduction of odor. Excreta of chickens fed without the addition of fish hydrolysate (0%) has a constant level of water content which applies the same in all chicken population used during the feeding experiment, both in control group and treatment groups.

Table 1. Composition and Content of Feed

Feed Composition (%)	
Concentrate	30
Corn	44
Rice bran	26
Total	100
Nutritional Composition	
Crude Protein (%)	18.67 ¹
Metabolic Energy (ME) (Kkal/Kg)	2.754,20 ²
Crude Fiber (%)	4.54 ³
Fat (%)	4.37 ³
Calcium (%)	3.83 ³
Phosphor (%)	0.74 ⁴

Note: ¹ calculation result. ² obtained by Fenita, Y., U. Santoso, and Fauziah (2011). ³ Yusrizal, et al (2011).⁴

Table 2. Total Nitrogen Level in Feed

Treatment		N level (%)	SD
FH concentration* (%)	Storage duration (Days)		
0	0	2.51	0.02
	5	2.51	0.01
	10	2.51	0.01
	15	2.51	0.01
1	0	2.52	0.02
	5	2.52	0.02
	10	2.52	0.02
	15	2.52	0.01
2	0	2.53	0.04
	5	2.52	0.04
	10	2.53	0.02
	15	2.52	0.03

*FH: Fish Hydrolysate

This indicates the uniformity of the chicken population and the feed mixture used during research while also indicating the absence of differences in experimental conditions during the study. On the other hand, the excreta of chicken which were given standard feed mixed with 1% and 2% fish hydrolysate shows a decreasing level of

water content from day 0, day 3, and day 5 (Fig. 1)

Water Content in Laying Chicken Excreta

Water content in chicken excreta of all group of chicken during 5 days feeding experiment is expressed in weight percentage are presented in figure 1.

Figure 1. Moisture content of chicken excreta in all chicken group during 5 days feeding treatment with standard feed mixed with fish hydrolysate at storage duration, (a) 0 day; (b) 5 days; (c) 10 days; (d) 15 days

Figure 1 shows water content in chicken excreta at day 0, in which all chicken are fed only with standard feed, have very similar moisture content at about 79.3%. The moisture content in the excreta of all chicken group 0% during feeding experiment, i.e. chicken that are fed by standard feed without fish hydrolysate addition, are always the same at about 79.3%. This indicate that all chicken in all group are similar. The impact of the addition of fish hydrolysate at different concentration to the standard feed in chicken group 1% and 2% is significantly different in the reduction of water content in their excreta. Figure 1 shows moisture content of chicken excreta in chicken group 2% is lower than in chicken group 1% at the

same day of treatment. On the other hand, storage duration of the mixture of standard feed with fish hydrolysate has the same tendency of (a), (b), (c), and (d). The duration of feed storage has no significant effect on water content in chicken excreta as indicated by t-test statistical analysis obtained by SPSS presented in table 3.

Providing additional ingredients to the feed that has an impact on reducing water content in chicken excreta has also been reported (Francesch and Brufau, 2004). Standard feed supplemented with a certain enzyme is one method to control the moisture content of chicken excreta (Nahm, 2007) and in the case of an additional ingredient used in the feed was fermented palm kernel cake powder was also been

reported (Yusrizal et al, 2012). Water has an important role in helping the metabolic functions and the growth of microorganisms. Transfer of nutrients from the outside into cells in the microorganisms is easier when in the form of solution (L. Waluyo, 2004). Decreased water content in chicken excreta indicates that water utilization in the chicken's digestive system is increasing. The addition of fish hydrolysate which contains simple peptides becomes additional nutrients for microbes in digestion. The need for water to help

metabolic and microbial growth functions as well as in the process of feed absorption, is increasing. Therefore, the remaining water released in the stool decreases. Water content in the chicken excreta also contributes to the speed of degradation of compounds in the chicken manure which produces pungent gases such as ammonia and hydrogen sulfide. Observations during the experiment showed that reduction in the smell of chicken manure whose feed was mixed with fish hydrolysate, was noticeable since the day after feeding.

Table 3. t-test evaluation of moisture content

Model		Coefficients ^a				
		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	79.218	.586		135.247	.000
	Storage duration	-.002	.051	-.005	-.036	.971
	Concentration	-1.515	.346	-.606	-4.379	.000

a. Dependent Variable: Moisture content (%)

Total Nitrogen Levels in Chicken Excreta

The addition of fish hydrolysate to the standard feed affects the total nitrogen levels in laying chicken excreta during feeding experiment. Chickens that are fed with standard feed without the addition of fish hydrolysate has a stable and constant total amount of nitrogen level in its excreta throughout the experiment as it is presented in figure 2. On the other hand, chickens that were fed with standard feed mixed with fish hydrolysate showed a decrease in the total nitrogen amount in the excreta during 5 days feeding experiment. The more fish hydrolysate is added, the smaller the total nitrogen level in its excreta. The addition of 2% hydrolysate has a greater effect in decreasing the total nitrogen content compared to the addition of 1% fish hydrolysate during the five days of feeding experiment. The reduction in total nitrogen

levels in chicken excreta between the chickens fed with standard feed without mixed fish hydrolysate and chickens with addition of fish hydrolysate, differs significantly ($\text{sig} < 0.05$). Total nitrogen levels of chicken excreta also decreased from day 0, day 3, and day 5. Therefore, the longer it is fed with fish hydrolysate, the greater the reduction of total nitrogen levels in chicken excreta (Fig. 2) during the 5 days feeding experiment.

The length or duration of feed storage did not affect the total N levels in laying chicken excreta as it is presented in Figure 2. There was no significant change in the total N level in the excreta of chickens who were fed with standard feed mixed with the same concentration of fish hydrolysate which are stored for 0, 5, 10, and 15 days as indicated by T-test evaluation as presented in table 4.

Figure 2. Total nitrogen content of chicken excreta in all chicken group during 5 days feeding treatment with standard feed mixed with fish hydrolysate at storage duration, (a) 0 day; (b) 5 days; (c) 10 days; (d) 15 days

Table 4. T-test on the evaluation of nitrogen content different

Coefficients ^a					
Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
1 (Constant)	.890	.040		22.300	.000
Concentration	-.105	.024	-.611	-4.437	.000
Storage duration	-4.444E-5	.003	-.002	-.013	.990

a. Dependent Variable: Nitrogen content (%)

A decrease in the total N levels in chicken excreta will also lead to a decrease in the amount of ammonia gas produced. This is due to the degradation of nitrogen compounds in the excreta, namely uric acid and remaining undigested proteins which were not absorbed during digestion. Odor in excreta arises due to the decomposition process of uric acid into ammonia. Uric acid is the biggest contributor of nitrogen (70%) in chicken manure (Koerkamp, 1994).

Fenita, Y., U. Santoso, and Fauziah (2011) reported that chicken feed with the addition of fermented palm sludge and critical amino acids (methionine, lysine and triptocyclone) may reduce the smell of chicken manure. Fish hydrolysate is rich in simple peptides, which are composed of amino acid units. Therefore, the addition of fish hydrolysate in chicken feed in this study is thought to be similar to the addition of these critical amino acids.

The affect also appears to be the same, which is the reduction of total nitrogen level in chicken manure. The addition of fish hydrolysate in feed reduces the odor of chicken manure due to the decrease in total nitrogen level in chicken excreta. The reduction in total nitrogen levels in manure of chickens fed with mixed fish hydrolyate is also very similar to the results found in administration of feed formula mixed with enzymes and or the critical amino acids (Nahm, 2007). Experiments conducted in this research experienced a decrease of nitrogen level up to 45% compared to nitrogen levels in chicken excreta without fish hydrolyate.

Kristinsson and Rascco (2000) stated that "enzymatic protein hydrolysis may increase or modify the physicochemical properties, functional and natural (visual) appearance of proteins without reducing the nutritional value of food and can also increase the absorption of protein." The presence of fish hydrolysate in chicken feed can likely increase the absorption of feed in the body of the chicken so that the remaining feed excreted in the form of residual proteins in the manure decreases. In addition, the microbial bowel microbes require a simple balanced sugar and peptide for their optimistic growth (Lei et al., 2012). The activity of digestive enzymes is affected by microbes. Fish hydrolysate consists of a simple peptide so that it can be used as a source of nutrients for microorganisms in chicken digestion. Digestive enzymes activity is increased, resulting in a better metabolic process among the chickens. The feed will be better digested and the metabolic result, i.e. uric acid production is decreased, so that the smell of chicken manure due to the decomposition of uric acid is reduced. An improvement in the quality of digestion of chickens due to the addition of fish hydrolysate in chicken feed is also indicated by the increasing quality of chicken farming products, e.g.

CONCLUSION

The addition of fish hydrolysate to the standard feed of laying chickens can lower the water content, and the total N levels of laying chicken excreta. This indicates that the fish hydrolysate can increase the efficiency of feed absorption in the digestive system of chickens and can reduce the adverse impact on the environment due to the pungent smell of chicken manure.

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