The effect of feed containing fish hydrolysate to the feed quality improvement and the produced egg quality

A Sjaifullah

Universitas Jember, Jl. Kalimantan 37 Jember

Corresponding author: sjaiful.fmipa@unej.ac.id

Abstract. Addition of 1-2% of fish hydrolysate into the standard feed of laying hens has been reported to reduce total nitrogen content and the total water content in the excreta. The reduction in total nitrogen content in the excreta is one of the simple indications of improved digestion and the better quality of feed given. This paper reports the effect of fish hydrolysate addition to the standard feed at various concentration on improving feed quality and egg quality of laying hens. A population of 114 laying hens of ± 86 weeks old were divided into three treatment groups. Each group consisted of 38 individual hens, and each group performed three replications. The chickens are kept in a battery cage by treating standard feed mixed with fish hydrolysates with varying fish hydrolysate concentrations (0; 1; and 2%). To investigate the effect of fish hydrolysate addition to standard feed on the feed quality, the total weight of the excreta produced by each chicken was measured, and the beta carotene content in the yolk of the egg is determined. The results showed that the total weight of excreta produced was significantly affected (sig <0.05) by the addition of fish hydrolysate to the standard feed. The weight of the excreta gradually decreases from the first day of the feeding treatment until the fifth day, and the weight reduction of the excreta has a similar tendency to the decrease of the total nitrogen in the excreta that has been reported. Therefore, the reduction in weight of the excreta can also be considered as better digestion due to the increased quality of feed given. The increase in feed quality, which results in an improved digestion process, also led to an increase in egg quality characterized by a 250% increase of carotenoids content in egg yolk compared to chicken eggs fed with standard feed. The conclusion is the mixing of 1- 2% fish hydrolysate in standard feed can improve feed quality which is characterized by a decrease in the total weight of excreta and also increase the egg quality characterized by an increase in total carotenoid in the yolk.

1. Introduction

Chicken farming is one of the dynamic businesses in Indonesia that absorbs a great number of workers, from household scale to large companies. The development of chicken farms is also aimed at fulfilling human needs for nutritious food. Demand for livestock commodities is increasing with the growth and rise in population, income and public awareness for improving family nutrition [1]. Chicken farms in East Java are the largest producers of chicken eggs in Indonesia. The population of laying hens in East Java increases every year; the latest data in 2015 reached 43,221,466, which is the largest population after broiler [2].

Almost all laying hens farming mainly focus on producing as many eggs as possible without regard to their quality[3], although there are many studies on how to improve the quality of eggs [4] [5] [6] [7]. Since eggs are considered as nutritious food, its quality parameters are often associated with

nutrients or other parameters that affect the quality of these nutrients. The parameters used to determine the quality of an egg are measured based on several aspects such as the density of the egg shell [8], its omega-3 content, mineral content, protein content, cholesterol content, carotenoid content [9] ,and other nutrients parameters. In many scientific reports, increasing egg quality is done by modifying the feed given to chickens by mixing additives or modifying the composition of feed ingredients in standard feed. For example, one of the most reported nutritional parameters is the total carotenoid content in eggs. As a group of lipid compounds, carotenoids in egg yolk consist of several compounds such as Lutein and zeaxanthin which are believed to be compounds that help protect the eyes against radiation damage [9]. Adding 70 g of carrots into the standard feed is reportedly able to increase the carotenoid content in egg yolks up to 150% higher than that which is only given standard feed ([4]. The effect of adding rapeseed cake rich in certain amino acids into standard chicken feed mixtures has also been reported to improve egg quality and increase total carotenoid content in eggs [5]. In addition, the effect of feed on egg quality was seen from the thickness of their eggshell. The thickness of the eggshell, which affects its resistance to damage, is an important issue affecting the economic benefits of egg production. Świątkiewicz et al., (2018) examined the effect of giving feed additives on egg performance and eggshell quality. The results showed that in 69-week-old chickens, food supplementation with chitosan increased eggshell thickness to 5 μm, while the addition of herbal extracts increased eggshell thickness to 13 μm.

The addition of fish hydrolysates into standard feed has been reported to improve chicken digestion, which is characterized by a decrease in nitrogen levels and moisture content in the produced excreta [10]. These effects are also characterized by the reduced odor of chicken manure and reduced flies that come on the chicken farms, resulting in a farm that is more environmentally friendly. Fish hydrolysates obtained by liquefying fresh fish in a hydrolysis process have high-quality short-chain proteins because it contains complete amino acids, perfect nutrition and is easy for digestion [11]. Adding fish hydrolysate in chicken feed is expected to affect the life of good bacteria in the digestive tract, so it can help the digestion process and absorption of feed nutrients in the digestion tract of a chicken. In chicken farms, increasing feed efficiency can be observed by through several indicators, such as the amount of animal feed consumption, livestock body weight gain, egg weight and egg quality, number of eggs, and excreta quality. Observation on the quality of animal feed by looking at the quality of excreta can be done easily and with a relatively short time. Previously reported by Yusrizal et al (2012), the addition of synbiotics in the form of fermented palm kernel meal powder in feed can reduce ammonia in chicken manure. [12] also reported that the use of fermented palm sludge added with critical amino acids (methionine, lysine and triptopan) can reduce odor. Decreasing nitrogen compounds in feces show that absorption of feed nutrients is improving. Improved digestive quality due to the presence of fish hydrolysates in the feed mixture is also expected to boost the quality of chicken farm products. This paper will explain the effect of fish hydrolysates added to the feed on the weight of the excreta produced and the quality of the eggs produced by measuring the total carotenoid content.

2. Materials and methods

In this study, a number of 114 chickens aged ± 86 weeks were divided into three treatment groups, namely the chicken group treated with standard feed (P1), the group treated with standard feed mixed with fish hydrolysate in a concentration of 1.0% (P2), and the group with standard feed mixed with 2.0% of fish hydrolysate (P3). The fish hydrolysate was prepared according to the research report by Sjaifullah, A. (2009), i.e. proteolytic digestion of sardinella fish by protease contained in tuna intestine. The chemicals composition of the fish hydrolysates is resembled to the chemicals composition of the whole sardinella fish, which is contain carotenoid less then 0,35 ppm. The total nitrogen content in the feed, P1, P2 and P3 was obtained through the Kjeldahl's method. The standard feed is a mixture of CP124P type of chicken concentrates from Pokphan, corn and rice bran with composition as in Table 1. Each chicken in the treatment group was given feed of the same weight of 55.50 grams twice per day during 15 days of the feeding experiment. The weight of the excreta produced by each chicken is collected every day (24 hourly) and determined its weight on days 0, 1, 2, 3, 4, 5, 7 and 9. The amount of carotenoid content on eggs produced on days 0, 1, 2, 3, 4, 5, 7 and 9 in the three treatment groups

was determined based on the widely used spectrophotometry method [3]; [13]. The method begins by extracting 0.50 g of egg yolk with 25 mL of acetone. This process is performed twice in which the extraction result is then filtered through Whatman paper No. 4 or its equivalent. The volume of the results obtained throughout this process is then adjusted to reach 50.00 mL by adding acetone. The carotenoids absorbance of the sample was measured on a spectrophotometer at 450 nm wavelength and its concentration was calibrated towards the standard solution of β-carotene.

3. Results and discussion

3.1. Feed composition

The composition and nutrient content of feed given to laying hens has met the national standard of feed quality. The feed composition is made according to proximate analysis reported previously [12] as shown in Table 1.

Table 1. Standard feed composition

Feed ingredients (%)	
Concentrate	30
Corn	44
Rice bran	26
Nutrition content	
Protein (%)	18,67[1)]
Metabolite energy (ME) (Kcal/Kg)	2.754,20
Fiber (%)	4,54
Fat (%)	4,37
Potassium (%)	3,83
Phosphorus %)	0,74[4]

[1)] From proximate calculation

The fish hydrolysate used in this paper is an enzymatically liquefied fish based on a research report [14] and has a nitrogen content of 2.78% as determined by Kjeldahl's method. The nitrogen levels in standard feed, P1, is 2.51%, while the nitrogen content of P2 with the addition of 1% of fish hydrolysate into its standard feed is 2.52% and the nitrogen content in P3 is 2.52%. From Kejldahl's analysis, it was found that mixing 1% and 2% of fish hydrolysate into standard feed nearly did not affect the total nitrogen levels in P2 or P3 feed, so that nitrogen levels in feed P1, P2 and P3 could be said to be equal.

3.2. Daily weight of excreta and total carotenoid levels in egg yolk.

Table 2 shows the daily weight of excreta and carotenoid content during feeding experiment.

Table 2. Daily weight of excreta and carotenoid content during feeding experiment

Observation Day	Feeding treatment					
	P1, 0% fish hydrolysate		P2, 1% fish hydrolysate		P3, 2% fish hydrolysate	
	WED, g	CC, ppm	WED, g	CC, ppm	WED, g	CC, ppm
(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
0	88.22	6.01	88.01	6.40	87.98	6.10
1	87.80	6.10	86.44	7.82	85.12	8.12
2	88.00	6.12	82.10	8.90	81.40	11.14
3	88.10	6.00	80.00	11.12	79.00	14.00
5	87.90	6.20	78.70	14.00	77.68	15.98
7	88.12	5.98	77.62	14.15	77.42	15.80
9	88.10	6.08	77.52	14.21	77.40	16.01

WED = average daily weight of excreta produced by each chicken in gram
CC = Carotenoid content in yolk egg in ppm

In observation day 0, all chicken in all groups of feeding experiment were fed with standard feed, feed without fish hydrolysate addition. From the average daily weight of excreta produced by each chicken in column (2), and carotenoid content in column (3) and also on the observation in day 0, Table 1 shows that the chicken group in all samples can be said to be homogeneous. All chicken samples show no significant differences based on the weight of the produced excreta and the carotenoids content in their egg yolk during feeding treatment in very reasonable deviation. Changes in daily weight of excreta during the feeding experiment in Table 2 can also be depicted as in Figure 1.

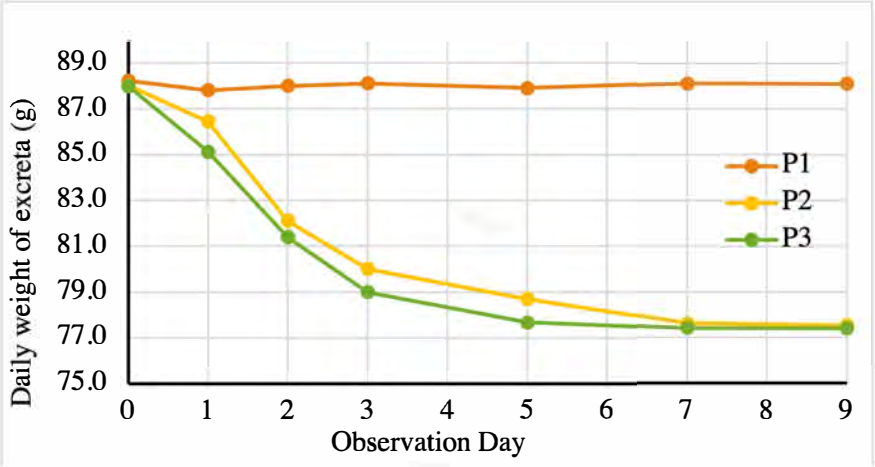

Figure 1. daily weight of excreta during the feeding experiment

Figure 1 shows that the weight of produced daily excreta of treatment groups fed with 1% fish hydrolysate, P1, gradually decreases from day one to day 5 and becomes constant on day 7 and so on. While for the group of chickens fed with standard feed containing 2% of fish hydrolysates, P2, the constant weight of produced daily excreta was achieved quicker as it became constant on day 5. However, the maximum weight reduction of produced daily excreta was not affected by the percentage of fish hydrolysate contained in the feed. The maximum reduction of daily weight of produced excreta is about 14% in both trial groups of chicken. The reduction of daily weight excreta produced is associated to the reduction of water content and nitrogen content of the excreta as previously reported [10]. Therefore, the reduction of produced daily weight excreta is one indication of the improvement in digestion process and may also be an indication of better feed quality.

Since the reduction in daily weight of produced excreta can be seen as an indication of a better feed quality, it is also expected to be followed by the quality improvement of chicken farming products such as egg production and egg quality. One of the parameters that is associated to the quality of eggs is the carotenoids content in the yolk as it is considered as one of the most important nutrients of an egg. The carotenoids content in egg yolks during the feeding experiment in Table 2 can also be described as shown in Figure 2.

Figure 2 shows that the egg quality indicated by the carotenoid content remains constant at about 6.00 ppm during the feeding experiment of the chicken treatment group P1. The concentration of carotenoid in the yolk of normal eggs obtained is in accordance to value reported anywhere which is at around 5 ppm [4]. The same value was also observed in both P2 and P3 before they were fed with standard feed without fish hydrolysates, i.e. at observation day 0. This indicates that all chicken population in all treatment groups are homogenous. On the other hand, the addition of fish hydrolysate to the standard feed may improve feed quality as indicated by the reduction of produced daily weight of excreta as shown in Figure 1 and also improve the egg quality as seen in chicken group P2 and P3 in Figure 2.

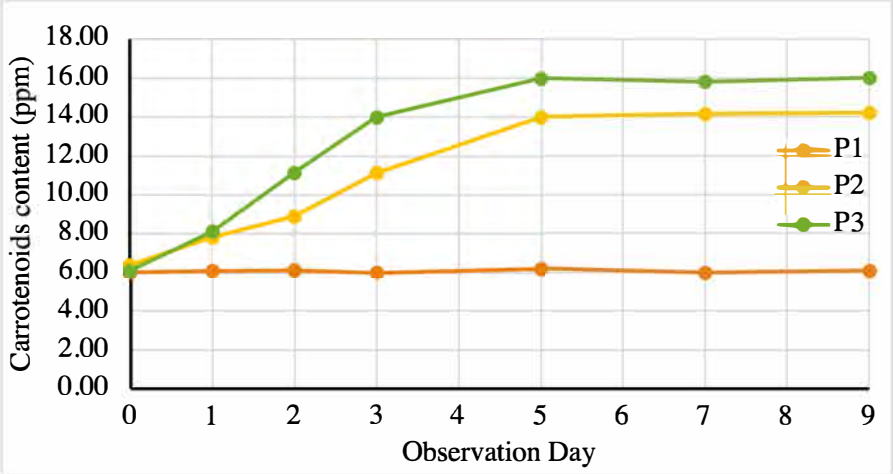

Figure 2. Carotenoids content in the egg yolk

The carotenoid content of the egg yolk in chicken group of P3 is higher than in chicken group of P2. This is because that the P3 chicken group was fed with standard feed which contained higher fish hydrolysate (2%) than the group of P2 which only contains 1% of fish hydrolysates. For both experiment groups with added fish hydrolysate of 1 and 2% into the standard feed, the carotenoid content showed an increase up to 250 %, from about 6.00 ppm to around 16.00 ppm. This can be ascertained that the increase is due to an improved digestive process in the chicken intestine as an outcome of a better quality of feed due to addition of fish hydrolysates, since the carotenoid content in fish hydrolysate is also small, i.e. 0,35 ppm. The increasing of carotenoid in the yolk, which is about 2,5 fold, obtained in this experiment is comparable with other report on the addition of 10% of dry weight of micro algae which able to increase carotenoid content in the yolk by 3.6 fold [15].

4. Conclusion

The addition of fish hydrolysate into the standard feed of laying hens can reduce the daily weight of excreta produced, and at the same time may improve the quality of produced egg which is indicated by the higher content of carotenoid.

References

[1] Ibrahim S and A 2012 *Jurnal Agripet* **12** 47–51
[2] Dinas Peternakan Provinsi Jawa Timur 2017 *Statistik Populasi Ternak* (Surabaya: Dinas Peternakan Provinsi Jawa Timur)
[3] Islam K M S, Amin M R and Schweigert F J 2017 *Int. J. Poult. Sci.* **16** 228–32
[4] Hammershøj M, Kidmose U and Steenfeldt S 2010 *J. Sci. Food Agric.* **90** 1163–71
[5] Świa¸tkiewicz S, Koreleski J and Arczewska-Wlosek A 2010 *Agric. Food Sci.* **19** 233–9
[6] Skøivanová V, Englmaierová M, Bendová M and Skřivan M 2017 *Czech J. Anim. Sci.* **62** 323–30
[7] Abou-Elkhair R, Selim S and Hussein E 2018 *Anim. Nutr.* **4** 394–400
[8] Świątkiewicz S, Arczewska-Włosek A, Krawczyk J, Szczurek W, Puchała M and Józefiak D 2018 *Ann. Anim. Sci.* **18** 167–83
[9] Zaheer K 2017 *CYTA - J. Food* **15** 474–87
[10] Sjaifullah A 2018 *Press*
[11] Kristinsson H G and Rasco B A 2000 *J. Agric. Food Chem.* **48** 657–66
[12] Fenita, Y., U. Santoso dan F 2011 *Seminar Nasional Teknologi Peternakan dan Veteriner* pp 725–31
[13] AOAC 1973 *J. Assoc. Off. Anal. Chem.* **56** 272–272

[14] Sjaifullah A 2009 *Optimalisasi Hidrolisis Ikan Lemuru menggunakan Enzim Protease dari Usus Ikan Tuna*
[15] Fredriksson S, Elwinger K and Pickova J 2006 *Food Chem.* **99** 530–7