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The Effect of Fermented Palm Kernel Cake Layer Quail Rations on Production Performance and Eggshell Thickness

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ABSTRACT

The purpose of the study was to evaluate how palm kernel cake fermented by *Sclerotium rolfsii* and supplemented with humic acid affected production performance and egg quality of quails. The animals used in this study were 200-layer quail (*Coturnix coturnix japonica*) at 14 weeks of age. Fermented palm kernel cake (FPKC) with rationed compositions of 0, 5, 10, 15 and 20% were utilized in the research treatment, which lasted for eight weeks. Also, this study used a randomized design with four replicates in each group. The results showed that feed intake, egg production, feed conversion, egg weight, and eggshell thickness of layer quail were not statistically significant (P>0.05). Conclusively, palm kernel cake fermented with *S. rolfsii* may be utilized in laying quail feed at a concentration of up to 20%.

Key words: Egg quality, Humic acid, Japanese quail, Palm kernel cake, *Sclerotium rolfsii*

INTRODUCTION

Palm kernel cake (PKC) is a by-product of palm oil processing, which can serve as a potential ingredient in poultry feed. Furthermore, its nutritional composition includes crude protein, crude fibre, crude fat, calcium, phosphorus at 16.07, 21.30, 8.23, 0.27, and 0.94%, respectively, as well as copper at 48.4 ppm. (Mirnawati et al. 2010). The crude protein content of PKC is relatively high, yet its use in poultry rations is still limited. PKC at a concentration of up to 10% can be used instead of 40% soybean meal in broiler diet due to the high β-Manan content in the coarse fibres, which may be undesirable since birds do not have fibre-breaking enzymes for manan in the digestive tract (Sundu et al. 2006). Therefore, PKC must first be processed to improve its quality with the aid of fermentation biotechnology that utilises cellulolytic and mannanolytic moulds (Meryandini et al. 2008; Mirnawati et al. 2018). Furthermore, this can reduce the content of crude fibre and manan while increasing the quality of palm kernel cake such that it can replace the soybean meal in poultry rations.

Sclerotium rolfsii is a cellulolytic and mannanolytic microorganism that can be used for the fermentation of palm kernel cake. According to Razak (2006), the mannanase enzyme activity of *S. rolfsii* is greater than that of *Aspergillus niger*. The fermentation of palm kernel cake with *S. rolfsii* yielded crude protein, retained nitrogen, crude fibre, and digestible crude fibre at 26.90, 54.86, 14.86, and 58.41%, respectively, as well as crude fat at 0.22% and 2557.6kcal/kg. However, the use of palm kernel cake in broiler diets is still restricted to 25% despite the rise in its nutritional content and quality.

Mirnawati et al. (2017) processed palm kernel cake mixed with humic acid through the fermentation process using *S. rolfsii*. The result of this study showed an increase in crude protein, nitrogen retention, and crude fibre digestibility at 27.43, 59.17, and 55.40%, respectively, as well as a decrease in crude fibre at 11.53%. After fermentation, the increased nutritional content of palm kernels enables its use as a quail feed ingredient. Therefore, it is necessary to conduct research in order to determine the effect of fermented palm kernel cake containing *S. rolfsii* in rations on the production performance and quality of laying quails.

MATERIALS AND METHODS

The samples used in this study were 200 quail laying hens aged about 14-weeks old, which were confined in individual cages of size 45×20×30 cm as ten laying birds

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per unit. The study used a fully randomized design (CRD) with five treatments containing 0, 5, 10, 15 and 20% compositions of FPKC, as well as four replicates each. The diets used included iso-protein and iso-caloric at 20% and 2700kcal/kg, respectively. Subsequently, Table 1 showed the diet formulation, nutritional and metabolizable energy levels of treatment diets. The diet formulation was made up of yellow corn, rice bran, meat meal, CP 126 concentrate feed (Charoen Pokphand Indonesia), top mix and FPKC. In addition, drinking water and experimental diet were provided *ad-libitum.*

The fermented palm kernel cake was made using a combination of PKC and rice bran at 80 and 20%, respectively, which were fermented with *S. rolfsii* and added to 200ppm humic acid. The inoculum dosage was 10% of the substrate, and the incubation period was seven days. After harvesting, the product is dried and milled before being incorporated into quail diets. Meanwhile, layer quail have a feeding period of two months or eight weeks. Table 1 showed the composition of the feeding or diet treatments.

Data Collection

The data collected during the study included feed conversion, egg mass production (g/head/day), egg weight (g/egg/head), feed intake (g/head/day), quail day egg production (%) and the eggshell thickness (mm) of laying quail, which were measured following Nuraini et al. (2012).

Data Analysis

All data were analyzed by analysis of variance based on a completely randomized design according to Steel and Torrie (1991).

RESULTS

There was no significant difference (P>0.05) in the feed intake of the laying quails based on the levels of FPKC in the diets since an increase in the level of FPKC did not reduce the feed consumption of the laying quails. Table 2 showed the feed intake, which ranged between 20.37-22.30g/head/day. Similarly, there was no significant difference (P>0.05) in the feed consumption of the laying quails based on the levels of FPKC in the diets. The effects of the amount of FPKC in the diet on the daily egg production of quails were not significant (P>0.05). However, increased amounts of FPKC in quail diets can sustain the egg production of laying quails. The egg production of laying quails in this experiment ranged between 70.80 to 72.05%, as shown in Table 2.

The quantity of FPKC in meals did not affect egg mass production of laying quails (P>0.05). During the trial, the egg mass output of laying quails ranged from 7.46 to 7.67g/head/day. Feed conversion is the ratio of feed intake to egg mass, and it was non-significant (P>0.05) when FPKC levels in diets ranged between 2.74-3.08. Different amounts of FPKC in diets had no effect (P>0.05) on the egg weight of laying quail, which ranged from 10.61 to 11.71g/egg/head. The amounts of FPKC in meals had no effect on the thickness of the eggshells from laying quails, which ranged from 0.27 to 0.29mm.

Table 1: Diet formulation (%), nutrient content (%) and metabolizable energy (kcal/kg).

Item	Treatment Ration				
	R1	R2	R3	R4	R5
Corn	45.5	45	44	43	43
Rice brand	20	18	16	13.5	11.5
Meat meal	6	6	6	6	6
CP 126 concentrate	26.5	24	22	20.5	17.5
FPKC	0	5	10	15	20
Mineral B12	1	1	1	1	1
Top mix	1	1	1	1	1
Total (%)	100	100	100	100	100
Crude protein	20.06	20.04	20.16	20.44	20.42
Crude fat	3.46	3.40	3.34	3.28	3.29
Crude fiber	6.13	6.17	6.23	6.27	6.50
Calcium	2.94	2.80	2.63	2.60	1.94
Phosphor	0.88	0.89	0.91	0.93	0.82
Metabolizable energy	2710	2708	2703	2706	2725

Table 2: The effect of dietary fermented palm kernel cake (FPKC) on laying quail feed intake, egg production, egg mass, feed conversion, egg weight, and eggshell thickness.

Variables	Treatment (%)					SEM
	R1	R2	R3	R4	R5	
Feed intake (g/head/day)	20.37	21.61	21.71	21.47	22.30	0.43
Egg production (%)	71.80	71.61	70.80	72.05	70.93	2.01
Egg mass (g/head/day)	7.67	7.58	7.46	7.57	7.54	0.20
Feed conversion ratio	2.74	2.98	3.01	2.99	3.08	0.08
Egg weight (g)	10.69	10.61	11.71	10.48	10.65	0.50
Eggshell thickness (mm)	0.29	0.29	0.28	0.29	0.27	2.49

Note: Inclusion FPKC in R1 to R5 was R1 (0%-Control), R2 (5%), R3 (10%), R4 (15%), and R5(20%). SEM: standard error of the mean.

DISCUSSION

The difference in feed consumption of laying quail rations between treatments R1 and R5 suggests that feeding FPKC with *S. rolfsii* to 20% (R5) has the same palatability. However, these FPKC-containing meals were discovered to have a higher quality and aroma than the original substrate. According to Mirnawati et al. (2018), the fermentation process can improve the physical and chemical characteristics such as aroma, taste, and texture compared to the original substrate. Furthermore, it was also observed that feed palatability, digestibility, and diet composition all affect the amount of feed eaten by birds (Mirnawati et al. 2019; Mirnawati et al. 2020; Ciptaan et al. 2020). In this study, parameters such as age, type, as well as energy and protein consumption were all relatively equal. Ciptaan et al. (2020) obtained a quail feed intake of about 22.14g/head/day by adding 25% palm oil sludge fermented with *Phanerochaeta chrysosporium* and *Neurospora crassa* in rations. Palm oil sludge is another promising by-product that can replace the ingredients of standard feed, such as yellow maize and soybean meal, in poultry diets. Previous research did not reveal a significant difference in the feed conversion ratio of broilers (Mirnawati et al. 2021).

The daily quail production was unaffected in treatments R1, R2, R3, R4, and R5 since fermented palm kernel cake provides enough nutrients needed for poultry production. Subsequently, fermentation can increase digestibility, which is in line with the hypothesis of Sukaryana et al. (2010) and Mirnawati et al. (2019) that fermented farm waste will have favorable nutritional

profiles. Meanwhile, there was no significant difference in the egg production of quails since it was associated with the consumption of rations. This is consistent with the study by Akbarillah et al. (2010) that egg production is controlled by the amount of food ingested, particularly nutrient consumption, as well as environmental variables. Consumption has improved the quantity and quality of egg production since a majority of the nutrients consumed will be transformed into eggs, in addition to the fundamental needs of the birds. These values obtained in this result is greater than what was obtained in the previous study by Ciptaan et al. (2020), which reported daily egg production of 60.21% using palm oil sludge fermented with *N. crassa* at a ration level of 12%. According to a study by Abbas et al. (2017), the rate of feed intake Japanese quails at seven weeks of age, supplemented with 15g/kg *Cucurbita moschata* seeds oil over a period of 1-3 weeks, was 135.5g.

According to Abou El-Ghar and Debes (2013) and Vercese et al. (2012), egg mass is related to egg weight and egg production pattern. This is comparable to the results obtained by Nuraini et al. (2012), who obtained an egg mass in the range of 6.85-7.20g/head/day by administering a mixture of sago pulp and tofu waste fermented with *N. crassa* at a 12% ration. According to Ciptaan et al. (2020), the quail egg mass was reduced by 6.11g/head/day when palm oil sludge fermented with *P. chrysosporium* and *N. crassa*, was incorporated to quail feed at a 25% ration level.

The FPKC treatment has no effect on feed consumption or egg mass, the ration conversion is also relatively the same. Table 1 shows that quails fed a ration containing up to 20% FPKC are similarly efficient in egg production to quails fed with the control ration (R1), which demonstrates that quails are equally efficient in FPKC-containing diets.

The result of this study is greater than that obtained by Nuraini et al. (2012), which utilized ration conversions ranging from 2.82 to 2.90 with a mixture of sago pulp and tofu pulp fermented with *N. crassa* 12% in rations. However, the results were more desirable than what was obtained from a mixture of 200-600mg/kg L-Carnitine and Japanese quail diet with a feed conversion ratio ranging between 5.8 to 7.7 (Mahmoud et al. 2020).

A minor variation in quail egg weight produced by the fermentation process might break down complex or low digestible components into simpler molecular structures, improving nutritional absorption and the quality of poultry products. Conversely, beneficial primary and secondary metabolites are secreted by microbes throughout the incubation process. Furthermore, Mirnawati et al. (2019) showed that fermented palm kernel meal has higher amino acid quality after fermentation. The egg weight obtained from this study was higher than previous results obtained by Nuraini et al. (2012) which were 9.57-9.64g/egg/head.

The eggshell thickness treatment of R1 to R5 showed that FPKC up to 20% in the diet still provides almost similar results because the inclusion of FPKC and humic acid as mineral sources increases the bioavailability of calcium and phosphorus, both of which play significant roles in the eggshell formation process. Korsakov et al. (2019) found that about 50-75mL of humic acid given through drinking water significantly affects the eggshell thickness, which was 0.35-0.36mm in laying hens. Ciptaan et al. (2020) measured the average thickness of quail eggshells to be 0.26-0.28mm.

Conclusions

Conclusively, palm kernel cake fermented with *Sclerotium rolfsii* can be utilized up to 20% in quail diets. The results showed that the feed intake, egg production, egg mass production, feed conversion, egg weight, and eggshell thickness were found to be 22.30g/head/day, 70.93%, 7.54g/head/day, 3.08, 10.65g/egg/head, and 0.27mm, respectively. Therefore, it is expected that palm kernel cake would be able to partially replace the current ingredients used in commercial feed in order to enhance the profitability of quail layer farming.

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Authors Contribution

Gita Ciptaan supervised the experiment and writing original manuscript. Mirnawati and Ferawati conducted the experiment and analyzed the data. Malik Makmur finalize manuscript.

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