PROTEIN EFFICIENCY IN JAPANESE QUAIL (*Coturnix-coturnix Japonica*) FED FERMENTED PALM KERNEL CAKE BY (*Aspergillus niger*)

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ABSTRACT

This study was conducted to determine the efficiency of protein in quails fed fermented palm kernel cake by *Aspergillus niger* (FPKC). Ninety six three-weeks-old female quails were raised in 16 cages with 60 x 60 x 40 in size of each and 6 quails each. Diets were formulated by yellow corn, rice bran, soybean meal, coconut meal, fish meal, bone meal, premix, palm kernel cake and fermented palm kernel cake by *Aspergillus niger*. This study used a randomized block design with 4 treatments and 4 blocks as replications. The treatments were R0 = basal diet as a control diet, R1 = basal diet + 15 % FPKC, R2 = basal diet + 20 % FPKC, R3 = basal diet + 25 % FPKC. The observed variables were feed consumption, body weight gain, protein consumption and protein efficiency. The results from this study showed that quail fed fermented palm kernel cake by *Aspergilus niger* had no significantly different on their performance ; feed intake, body weight gain, protein consumption and protein efficiency. It can be concluded that using palm kernel cake by *Aspergillus niger* up to 25% in the ratio had no adverse effect on quail performance and protein efficiency.

Keywords: Aspergillus niger, fermented palm kernel cake, protein efficiency, quail

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كفاءة البروتين في تغذية طائر السمان *Coturnix–coturnix Japonica* بنوى التمرالمخمر ب *Aspergillus niger*

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المستخلص

أجريت هذه الدراسة لتحديد كفاءة البروتين في السمان التي تغذيها كعكة النواة المخمرة من قبل *Aspergillus niger* (FBKC) وقد تم وضع تسع وستون طير من الإناث في 16 قفصاً بحجم 60 × 60 × 40 في كل منها 6 طير . تم تحضير العليقة من الذرة الصفراء ونخالة الأرز وفول الصويا وجوز الهند وعلف السمك و العظم والبريميكس وكعكة نواة النخيل وكعكة نواة متخمرة من نواة .Aspergillus niger . استعملت في هذه الدراسة تصميم القطاعات الكاملة المعشاة ، بأربعة مكررات في كل مكرر اربعة بلوكات. كانت المعالجات R0 معاملة المقارنة و R1 علف المقارنة + 15٪ FPKC و R2 علف المقارنة + 20٪ FPKC و = R3علف المقارنة + 25٪ FPKC. . أظهرت النتائج أن السمان التي تغذت على كعكة النواة المخمّرة من قبل Aspergilus niger للم تختلف معنويا في استهلاك العلف ، زيادة وزن الجسم ، استهلاك البروتين وكفاءة البروتين. يمكن الاستنتاج أن استعمال كعكة نواة النخيل بواسطة Aspergillus niger لغاية 25٪ ليس له أي تأثيرعلى أداء السمان وكفاءة البروتين.

كلمات البحث Aspergillus :النيجر ، كعكة نواة النخيل المخمرة ، كفاءة البروتين ، السمان

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INTRODUCTION

In the current situation, utilization of local and unconventional feedstuff as alternative feed for the animals are carrying out and trending topic to be determined. It is due to the local feedstuffs are easy to obtain, cheap, more production and have not been utilized optimally. Most of them are also still have potential nutrient. One of local feedstuffs in Jambi, Indonesia which is derived from agricultural and plantation industry is palm kernel cake (PKC). Palm kernel cake is one of by-products from oil palm (*Elaeis guineensis* (*Jacq.*) production where the main commercial products are palm oil and palm kernel oil. Palm kernel cake and palm kernel meal are produced depend on the processing method of palm kernel oil production (19). PKC is produced by 45% - 46% of palm kernel and is obtained from the palm kernel seed through mechanical processing included cleaning, grinding, flaking, stem conditioning and screw pressing (29). Oil palm area of plantation and production in Indonesia increases 6.18 % and 7.72 % per year from 2011 – 2016, respectively (9). It means the palm kernel cake production also increases. It is very potential to use as animal feed. Besides its availability, palm kernel cake contains higher protein content than that of other plantation industry by products that are around 14 – 21 % and gross energy 4,998 kcal/kg (27). However, efforts to use it as local feedstuff were still obstacles due to high content of crude fiber (14 %), unbalanced amino acid and the presence of anti-nutritional substances such as mannan oligosaccharide (9). (27) who stated that the crude protein content of fermented PKC was 11.30% - 17.00% however the fat content and crude fiber are quite high, about 4.50% -17.00% and 16% - 23%, respectively. High content of fat might cause rancidity and decrease shelf life of feed, while high crude fiber would decrease feed digestibility because the feedstuff were more difficult to digest by livestock (12). Use of PKC in the poultry diet is limited due to the high content of crude fibre content in PKC (28), reach 15% (22) and the component is dominated by mannan, reach 56,4% (7) that can not be digested. Besides, it also has antinutrients such as galactomannan, xylan and arabinoxylan. According to (6), more than 60% of PKC is cell wall components; 58% mannan, 12% cellulose and 4% xylan. Therefore non-ruminants have less ability on fiber digestion of PKC and it was recommended to use less than 20% for poultry of the total ration (22).Due to its limitation, PKC must be pre-treated before offer to the non-ruminant especially poultry (chicken) to improve feed efficiency such as physical, chemical, and biology or its combinations (fermentation) processing. Fermentation could decrease crude fiber content and reduce antinutrition factors but increase crude protein content. In general, end products of fermentation were simpler and easier to digest than the original products. Hence, fermentation technology is an alternative solution to utilize local feedstuff optimally, such as using *Aspergillus niger*. Fermented PKC by *Aspergillus niger* had better nutrient content than PKC; dry matter 42.38% vs 87.30%, crude protein 23.30% vs 16.07%, crude fibre 10.59% vs 21.30% (15, 15). Increased nutrient content due to *Aspergillus niger* can produce Laccases form the largest subgroup within the Multicopper oxidases (MCOs) family that have activties on degradation of lignocellulose material (2) and oxidation of antibiotics produced by microorganisms (27) and lignin, cellulose or starch (16). This fact means *Aspergillus niger* might be used to degrade cellulose in PKC and at the end product of fermentation can increase protein and decrease crude fibre content in PKC. Fermentation PKC with *Aspergillus niger* could be done to improve PKC quality and might be used in poultry ration to improve feed efficiency especially protein efficiency. However, report its effects on protein efficiency in quail is still lack documented. Therefore this study was conducted to determine the efficiency of protein in quails fed fermented palm kernel cake by *Aspergillus niger*. It is hoped that offering feed contain fermented palm kernel cake by *Aspergillus niger* can improve protein efficiency in Japanese quail.

MATERIALS AND METHODS

Ethical statements : This study was carried out with approved by the ethics committee in the Animal Health Study Program, Faculty of

Animal Science, Universitas Jambi and as per the laws in force during the study and at the time of sending this paper for publication.

Experimental animals

Total ninety six 3-weeks-old female quails were used in this study, offered diet according to quail diet recommended by Nutrient Research Council (16) to meet nutrients requirement of quails and kept for 5 weeks in 16 colony cages (each 25 x 39 x 40 cm in size), 6 quail each. Diets as treatments were consisting yellow maize , rice bran, soybean meal, fish meal, bone meal and premix, palm kernel cake (PKC) and fermented palm kernel cake by *Aspergillus niger* (FPKC) as shown on Table 1.

Tabel 1. The composition of Treatment Diets

Feedstuffs	Treatment			
	R0	R1	R2	R3
Yellow maize	45	40	40	45
Rice bran	8	6	6	6
Fish meal	8	7	7	7
Soybean meal	12	10	10	15
Bone meal	1,5	1,5	1,5	1,5
PKC	25	20	15	0
FPKC	0	15	20	25
Premix	0,5	0,5	0,5	0,5
Total	100	100	100	100
Nutrients (%)				
Crude protein	22.21	21.76	21.92	21.70
Ether extract	4.74	4.31	4.16	3.96
Crude fiber	5.34	8.42	9.46	10.42
Calcium	1.95	1.81	1.69	1.57
Total phosphorus	0.55	0.56	0.57	0.58
ME (kcal/kg)	3049.05	3086.93	3101.78	3114.45

PKC = palm kernel cake, FPKC = fermented palm kernel cake, Premix produced by TMC contained Vitamin A 200 000 IU, Vitamin D 40 000 IU, Vitamin E 100 mg, Calcium 150 000 mg, Phosphorus 50 000 mg, Magnesium 25 000 mg, Cobalt 5 mg, Copper 250 mg, Selenium 10 mg, Sulphur 50 000 mg, Zinc 4 000 mg.

Experimental design and procedure

This study was designed in Block Randomized Design with 4 treatment diets and 4 body weight groups as block. R0 = basal diet (control, without FPKC), R1 = Diet contained 15% FPKC, R2 = Diet contained 20% FPKC, R3 = Diet contained 25% FPKC. Fermented palm kernel cake was made of palm kernel cake (PKC) that has separated from its shell, added 600 ml water per kg PKC, soaked for 30 minutes, drained and steamed for 30 minutes. Thereafter, they were cooled until temperature around 40^{o}C, mixed with 70 g complete mineral per kg of feedstuff. Then, mixed them thoroughly with 10g/kg *Aspergillus niger*, and continued by anaerobically incubation for 3 days in room temperature and then aerobic incubation in 2 days. Therafter, harvested it, dried and milled before mixing with other feedstuffs and giving to the birds according to the treatment.

Statistical analysis

The observed variables were feed consumption, body weight, body weight gain, protein consumption and protein efficiency, were analyzed by ANOVA and Duncan's Multiple Range Test for the significant effect with a 5% level of significance. All analyses were performed in Analyse-it® Four Edition in Microsoft Excel (https://analyse-it.com/).

RESULTS AND DISCUSSION

Effect of the treatment diets on feed consumption, body weight, protein consumption and protein efficiency of Japanesse quail during the study are shows in Table 2.

Feed Consumption

In this study, quails consumed feed in range between 136.97-149.45 g/bird/wk and was not significantly different among treatment groups. There was no different effect of fermented palm kernel cake on feed consumption due to the feed quality and metabolisable energy among the treatment diets were similar (isoprotein and isoenergy) and still in ranged of quail requirement, 20-24% for protein and 2650-2900 kcal/kg for metabolizable energy under tropical condition (17, 22). It showed that all treatment diets had similar palatability even though the fermentation already changed texture and aroma of diet and also altered unfavoured

flavor become more favourable. It could be due to quails like other birds have limited sense of taste and smell. The current study found that feed consumption was similar to other previous reports (3, 11) but lower than report who found that feed consumption of quail reared in different group size in range 25,86-28,74 g/bird/day . The differences might be caused by Japanese Quails require variable nutrients depend on the age of the birds, growth, egg laying and purpose of production (1).

Table 2. Effect of treatments on all observed variables during the experimental periods

Parameters	Treatments			
	R0	R1	R2	R3
Feed consumption (g/bird/wk)	136.97±14.37	149.45±22.47	141.36±10.70	137.89±10.80
Body weight gain (g/bird/wk)	24.03±1.51	22.87±0.97	23.40±0.89	24.62±0.94
Protein consumption (g/bird/wk)	31.07±4.97	32.88±4.94	31.10±2.36	31.03±4.39
Protein efficiency ratio	0.78±0.07	0.70±0.10	0.76±0.08	0.79±0.02

Body weight gain

Analysis of variance showed that fermentation of PKC did not significantly affect body weight gain. This was in correlation to feed consumption which was not significant different. Amount of feed consumed indicates the amount of food substances that can be digested by the body, absorbed and used to form muscle, meat or other tissues. In this study, body weight of quail among the treatment groups insignificantly increased, 24.03 in control group and 24.62 in quail group fed diet contained 25 % of FPKC. It might be due to the protein content among treatment diets (R0, R1, R2 and R3) were quite similar, 22.21, 21.76., 21.92 and 21.70. respectively. It means that fermented PKC might be used up to 25 % in diet without any adverse effect to the body weight and their gain tended to increase even though was not significance. Similar results were reported by the previous studies on poultry (5 ,15), goat (21) and fish (10, 26). Animals were offered fermented palm kernel cake resulted good growth performance. In contrary was reported by Marini, et al. (13) who found that rat lost their body weight after feeding fermented palm kernel cake.

Protein consumption

Potein consumption among treatment groups were not significant different (P>0.05) in line with feed consumption due to protein content in treatment diets were similar around 21.70 – 22.21 % in dry matter basis (Table 1). It means that feeding FPKC up to 25 % in diet of Japanese Quails did not influence protein palatability. Protein consumption in this study was around 31.03 – 32.88 g/bird/week or equal to 4.43-4.68 g/bird/day and might be due to the nutrient content in diet especially crude protein and energy content. Higher crude protein content in diet, more possibility that will be consumed by the birds. Thus, more protein will be digested, absorbed and utilized by the quail to produce body weight and eggs. This study was also line with resulting body weight of quails that is also similar among treatment groups. This results were similar to the results of previous authors (4, 18 , 20 , 24 , 25) who found that crude protein and energy content in diet of poultry affected feed consumption and it is in line with protein consumption and nutrient digestibility. Higher protein content in diet might caused higher protein consumption, higher could be digested. The next effect was increasing body weight. However, this result was lower than that of Hikmawati (8) who found protein consumption of Japanese quail is equal to 7.96 – 8.64 g/bird/d.

Protein efficiency ratio

Protein efficiency ratio (PER) describes the comparison between the body weight produced with protein content in diet. The increase value of PER means more efficient the animals use protein consumed. Analysis of variance showed that fermentation palm kernel cake in diet up to 25 % did not significant (P>0.05) effect on PER. It is in line with the results of body weight among the treatment groups. It might be due to the quails were on the early days of laying, thus some consumed protein was used for becoming of yolks.

Besides, protein consumption was influenced directly by feed consumption and phase of life or physiological condition of bird, while protein efficiency ratio was related directly to the increasing body weight and protein consumption. Protein efficiency ratio in this study similar to previous observed (29, 31) was not affected significantly by crude protein content in diet. It can be concluded that fermented palm kernel cake by *Aspergillus niger* up to 25% in the ration had no adverse effect on quail performance and protein efficiency. It is recommended to conduct further research with organic acid supplementation in the feed contains fermented palm kernel cake by *Aspergillus niger* and its effect on egg production and quality especially cholesterol and protein content in egg.

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