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OPEN ACCESS International Journal of Poultry Science ISSN 1682-8356 DOI: 10.3923/ijps.2018.342.347 Research Article Utilization of Fermented Palm Kernel Cake with Sclerotium rolfsii in Broiler Ration Mirnawati, Ade Djulardi and Gita Ciptaan amyloliquefaciens and Humic Substances and Its Utilization as a Feed Ingredient for Broiler Chickens", Asian-Australasian Journal of Animal Sciences, 2014">Department of Animal Feed and Nutrition, Faculty of Animal Science, Andalas amyloliquefaciens and Humic Substances and Its Utilization as a Feed Ingredient for Broiler Chickens", Asian-Australasian Journal of Animal Sciences, 2014">University, Padang, West Sumatra, amyloliquefaciens and Humic Substances and Its Utilization as a Feed Ingredient for Broiler Chickens", Asian-Australasian Journal of Animal Sciences, 2014">Indonesia Abstract Background and Objective: Palm kernel cake (PKC) can potentially be used as feedstuff, especially for poultry. PKC needs to be processed in advance, by fermentation, with Sclerotium rolfsii. An experiment was conducted to evaluate the utilization of palm kernel cake fermented (PKCF) with Sclerotium rolfsii in the diet of broiler. Materials and Methods: Two hundred day-old chicks (DOC) were used in this study. The diet was arranged amyloliquefaciens and Humic Substances and Its Utilization as a Feed Ingredient for Broiler Chickens", Asian-Australasian Journal of Animal Sciences, 2014">based on the amyloliquefaciens and Humic Substances and Its Utilization as a Feed Ingredient for Broiler Chickens", Asian-Australasian Journal of Animal Sciences, 2014">equal amount of energy and protein, which were 3000 kcal kgG1 and 22%, respectively. The experiment used a completely randomized design (CRD) with 5 treatments and 4 replications. The treatments were

arranged as follows: (1) 10% PKCF (control diet), (2) 15% PKCF, (3) 20% PKCF, (4) 25% PKCF and (5) 30% PKCF in broiler diet. The parameters measured were feed consumption, body weight gain, feed conversion, body weight, carcass weight, crude fiber digestibility and nitrogen retention of broiler. Results: Feed consumption, body weight gain, feed conversion, body weight, carcass weight, crude fiber digestibility and nitrogen retention were highly significantly decreased ($p<0.01$) with any treatment. Conclusion: The palm kernel cake fermented (PKCF) with Sclerotium rolfsii can be used up to 25% in broiler ration. Key words: Utilization, fermentation, palm kernel cake, Sclerotium rolfsii, feedstuff, broiler, ration Received: February 27, 2018 Accepted: June 04, 2018 Published: June 15, 2018 Citation: Mirnawati, Ade Djulardi and Gita Ciptaan, 2018. Utilization of fermented palm kernel cake with Sclerotium rolfsii in broiler ration. Int. J. Poult. Sci., 17: 342-347. Corresponding Author: Mirnawati, amyloliquefaciens and Humic Substances and Its Utilization as a Feed Ingredient for Broiler Chickens", Asian-Australasian Journal of Animal Sciences, 2014">Department of Animal Feed and Nutrition, Faculty of Animal Science, Andalas amyloliquefaciens and Humic Substances and Its Utilization as a Feed Ingredient for Broiler Chickens", Asian-Australasian Journal of Animal Sciences, 2014">University, Padang, West Sumatra, amyloliquefaciens and Humic Substances and Its Utilization as a Feed Ingredient for Broiler Chickens", Asian-Australasian Journal of Animal Sciences, 2014">Indonesia Competing Interest: The authors have declared that no competing interest exists. Data Availability: All relevant data are within the paper and its supporting information files. INTRODUCTION Currently, Indonesia is the largest palm oil producer in the world, with crude palm oil (CPO) production as high as 30.948.931 t1. The continuing development of palm oil plantations produce waste in the form of palm kernel cake (PKC), which is produced at the rate of 45-46%2. Based on the data above, PKC can potentially be used as feedstuff, especially for poultry. Nutrient content of the PKC is as follows: 16.07% crude protein, 21.30% crude fiber, 8. 23% crude lipid, 0. 27% Ca, 0. 94% P and 48.4 ppm Cu3. Even with its high crude protein content, the use of PKC is still limited in poultry rations. According to Rizal4, PKC can be used to replace 10% or 40% of soybean meal in the broiler ration. PKC needs to be processed in advance due to its low quality content5,6. This is because of its high content of fiber in the form of $-mannan7 and broilers do not have the enzymes to break down fibers and mannan in its digestive tract. The prior processing of PKC, using cellulolytic and mannanolytic fungi, is necessary to improve the quality of biotechnological fermentation8-10, which will reduce the content of crude fiber and mannan and increase the quality of palm kernel cake, thus, it will be able to replace soybean meal in poultry rations. Mannanolytic and cellulolytic fungi that can be used for fermentation of palm kernel cake are Eupenicillium javanicum, Sclerotium rolfsii and Aspergillus niger.

Mirnawati et al.10 performed a PKC fermentation with mannanolytic and cellulolytic fungi (Eupenicillium javanicum, Sclerotium rolfsii and Aspergillus niger). In their study, Sclerotium rolfsii, with a fermentation time of 7 days, increased the nutrient content and quality of the fermented palm kernel cake (PKCF). The results obtained in this study were as follows: 26.90% crude protein, 14.86% nitrogen retention, 14.86% crude fiber, 58.41% crude fiber digestibility, 0.22% crude lipid and 2557.61 kcal kgG1 metabolizable energy. Based on the above results, it is expected that palm kernel cake fermented with Sclerotium rolfsii can be used as a feed ingredient for poultry, although the quality of the feed material needed to be tested biologically. Therefore, this study was conducted to determine the percentage of palm kernel cake fermented with S. rolfsii that can be used in broiler rations. MATERIALS AND METHODS Experimental animal and diet composition: Two hundred day old chicks (DOC) were obtained from the poultry shop for this experiment. The experiment was performed in a completely randomized design (CRD) with five treatments (10, 15, 20, 25 and 30% PKCF in diets) and four replications. There were six broilers per unit used in this experiment. These broilers were kept in cage boxes (80×70×60 cm). The diets were formulated in iso protein (22%) and iso caloric (3000 kcal kgG1) ration. Diet formulation, nutrient content and metabolizable energy content of treatment diets are shown in Table 1 and Table 2. Diet formulation consisted of yellow corn, rice bran, fish meal, soybean meal, PKCF, oil and topmix. Fermented diet and drinking water were provided ad-libitum. Procedure of preparing PKCF: Fermented palm kernel cake was the product of 80% PKC plus 20% rice bran that was fermented with Sclerotium rolfsii. The dose of Sclerotium rolfsii inoculum administered was 10% of the substrate, which was incubated for 7 days. After harvesting the product, PKCF was dried, milled and then mixed in broiler diets. Data collection: Collected data were feed consumption (g/head), body weight gain (g/head), feed conversion, body weight (g/head), carcass weight (g/head), crude fiber digestibility (%) and nitrogen retention (%) of broilers. Table 1: Composition of ration (%), nutrients (%) and metabolizable energy (kcal kgG1) of broiler by treatment Feedstuff R1 R2 R3 R4 R5 Corn 44.00 42.00 39.50 Rice Brand 3.00 2.00 1.50 Soybean Meal 23.00 21.00 19.00 Fish Meal 18.00 18.00 18.00 PKCF 10.00 15.00 20.00 Oil 1.50 1.50 1.50 Top mix 0.50 0.50 0.50 Total 100.00 100.00 100.00 EM (kkal kgG1) 3005.00 3013.85 3014.00 Protein (%) 22.03 22.04 22.05 Crude lipid (%) 3.45 3.43 3.43 Crude fiber (%) 4.80 4.96 5.17 Ca (%) 1.51 1.48 1.46 Phosphor (%) 0.67 0.71 0.75 Lisin 1.76 1.94 2.14 Methionine 0.56 0.64 0.73 39.00 2.00 19.00 18.00 25.00 1.50 0.50 100.00 3014.15 22.07 3.43 5.38 1.43 0.80 2.40 0.84 34.00 1.00 15.00 18.00 30.00 1.50 0.50 100.00 3005.60 22.10 3.43 5.63 1.41 0.84 2.63 0.92 Table 2: Average of feed consumption, body weight gain, feed conversion, body weight, carcass weight, crude fiber digestibility (DCSK) and nitrogen retention on broiler by treatment Treatments ---------- ---------- ---------- Parameters R1 R2 R3 R4 R5 Feed consumption (g) 2260.68a 2298.93a 2287.62a 2296.36a 2180.43b Body weight gain (g) 1219.66a 1238.27a 1224.62a 1235.83a

1165.12b Feed conversion 1.85b 1.85b 1.85b 1.86b 1.96a Body weight (g) 1203.25a 1184.75a 1183.50a 1288.50a 1099.50b Carcass weight (g) 799.750a 787.775a 781.675a 798.28a 676.15b Crude fiber digestibility (%) 54.62a 53.56a 54.45a 54.42a 52.49b Nitrogen retention (%) 57.50a 57.33a 57.14a 56.93a 55.86b Different superscript letters on the same line show highly significant effects ($p<0.01$) Data analysis: All the data were analyzed by one-way analysis of variance in a completely randomized design according to Steel and Torrie11. Duncan's multiple range test (DMRT) was performed for testing the difference among treatments ($p<0.05$)11. The ration composition, ingredient contents and metabolic energy of the treatments are presented in Table 1. RESULTS AND DISCUSSION The effect of treatments on the broiler performance (feed consumption, body weight gain, feed conversion, body weight, carcass weight, crude fiber digestibility and nitrogen retention) are illustrated in Table 2. Feed consumption: Based on the analysis of variance, the use of palm kernel cake fermented (PKCF) with Sclerotium rolfsi in the ration significantly decreased ($P<0.01$) the feed consumption of broiler. Based on DMRT, R1, R2, R3 and R4 treatments had no significant effect ($p>0.05$) but R5 significantly decreased ($p<0.01$) the feed consumption of broiler. The R1, R2, R3 and R4 treatments had no effect on feed consumption because the ration containing fermented palm kernel cake had the quality, taste and flavor preferred by broilers. Fermentation can also change the feed material to be easily digested, produce aroma and unique flavor and eliminate toxins from the original material12. Usually, materials that undergo the fermentation process have better quality, so they can improve the flavor and aroma, increase the digestibility of the ration and give a good influence on consumption. The results of this study are consistent with the previous studies conducted by Mirnawati et al.13, Rizal et al.14 and Sinurat et al.15, who found an increase in the use of fermented PKC in poultry rations. Treatment R5 decreased the consumption due to the use of 30% CCP in the ration, which provides a higher crude fiber content. The high fiber content in the diet lead to poor palatability and lower feed consumption, which was in accordance with Azizi et al.16, who stated that the factors affecting feed intake are the amount of consumption and the content of nutrients such as energy, protein and fiber. Body weight gain: Based on the analysis of variance, the use of palm kernel cake fermented (PKCF) with Sclerotium rolfsii in the ration significantly decreased ($p<0.01$) the body weight gain of broilers. Based on DMRT, the treatment rations of R1, R2, R3 and R4 had no significant effect ($p>0.05$) but R5 had a highly significant effect ($p<0.05$). This finding indicates that the use of palm kernel cake fermented with Sclerotium rolfsii, up to 25%, resulted in an equal weight gain compared to broilers receiving control diets. Body weight gain in the treatment rations of R1, R2, R3 and R4 had no significant effect because the fermentation of palm kernel cake had good nutrient quality. Fermentation can improve digestibility, as noted by Sukaryana et al.12 and Dairo and Fasuyi17, because materials that undergo the fermentation process will have better nutrient quality. In this study, palm kernel cake fermented with Sclerotium rolfsii can be used up to 25% in broiler rations. The results of this study were higher than

those of Mirnawati et al.13, who statedthat palm kernel cake fermented with Aspergillus niger could only be given up to the level of 17% due to the higher mannanase activity of Sclerotium rolfsii than Aspergillus niger10. Feed conversion: Statistical analysis showed that the use of palm kernel cake fermented with Sclerotium rolfsii in the broiler ration significantly decreased ($p<0.05$) feed conversion. DMRT showed that palm kernel cake fermented with Sclerotium rolfsi in the treatment rations of R1, R2, R3 and R4 showed no significant effect ($p>0.05$) but R5 showed a highly significant decrease ($p<0.05$). The non-significant effect of the treatment rations of R1, R2, R3 and R4 was due to non-significant result between weight gain, feed consumption and feed conversion. Feed conversion is the ratio of the amount of feed consumed and body weight gain in a given time period. The average feed conversion of broiler for 5 weeks of the study was 1.86. This result is lower than that of Ezhieshi and Olomu6, who obtained 1.89-2.33 and that of Ugwu et al.18, who obtained 2.61-3.46. Body weight: The analysis of variance showed that palm kernel cake fermented with Sclerotium rolfsii up to the level of 30% in the ration significantly decreased ($p<0.01$) body weight gain. Duncan's multiple range test showed that the treatment rations of R1, R2, R3 and R4 had no significant effect ($p>0.05$) but R5 significantly decreased ($p<0.05$) body weight gain. The quality of ration is one of the factors that influence the final body weight of broiler. Genetic and environmental factors also affect the growth rate of body composition that includes the distribution of weight, chemical composition and carcass components. The non-significant effect of the treatment rations of R1, R2, R3 and R4 on the body weight of broiler resulted in good nutritional quality of fermented palm kernel cake as fermentation process can improve the digestibility of a product. The high digestibility of broiler chickens was due to the high activity of the mannanase enzyme of Sclerotium rolfsii that can degrade fiber. Mirnawati et al.10 reported that Sclerotium rolfsii has higher cellulose and mannanase activity than A. niger and E. javanicum. Sundu and Dingle19 reported that mannanase is effective in improving the nutritional value of PKC. Carcass weight: The analysis of variance showed that palm kernel cake fermented with Sclerotium rolfsii up to 30% in the ration significantly decreased ($p<0.01$) carcass weight. Duncan's multiple range test showed that the treatment rations of R1, R2, R3 and R4 showed no significant effect ($p<0.05$) but R5 showed significant decreases in carcass weight. The non-significant effect of carcass weight in treatment rations of R1, R2, R3 and R4 was caused by the non-significant effect of body weight ($p>0.05$). This is in accordance with the opinion of Nahashon et al. 20 that carcass weight was directly related to body weight. Additionally, the lack of differences of carcass weight was due to the equal quality of ration in each treatment, the balance of the food substance contents in the feed material and the similar amount of feed consumed. This finding was in accordance with the opinion of Haroen21 who reported that diets containing similar nutrient utilization processes showed the same carcass weight. Nahashon et al.20 described the factors affecting broiler's carcass weight are genetic, sex, physiology, age, body weight and nutrition in ration. The results of this study were higher than the average carcass weight obtained by Priabudiman and

Sukaryana22 with the use of fermented palm kernel cake. Digestibility of crude fiber: The analysis of variance showed that the use of PKC fermented with Sclerotium rolfsii significantly decreased ($p<0.01$) the digestibility of crude fiber. DMRT showed that the treatment rations of R1, R2, R3 and R4 showed no significant effect ($p>0.05$) but were significantly decreased ($p<0.01$) compared to treatment R5. The non-significant effect of crude fiber digestibility in treatment rations of R1, R2, R3, R4 suggesting that the use of PKC fermented with Sclerotium rolfsii up to 25% would still give the same crude fiber digestibility. This fermentation product has better quality, high digestibility and a complete amino acid digestibility of crude fiber so that it will be easily digested. Crude fiber in the fermented PKC was degraded by cellulose and mannanase enzyme produced by Sclerotium rolfsii. Mirnawati et al.10 stated that Sclerotium rolfsii has cellulose and mannanase activity higher than A. niger and E. javanicum. Sundu and Dingle19 reported that mannanase is effective for improving the nutritional value of PKC. The decrease in the digestibility of the fiber in treatment R5 was due to the high content of crude fiber in the ration. PKCF was further enhanced with the higher crude fiber contained in the ration. The high crude fiber in ration can reduce digestible components that will also determine the activity of enzymes that aid digestion. Despal23 found that crude fiber has a negative correlation with digestibility, the higher the crude fiber was, the lower the digestibility of the crude fiber. In this study, PKC fermented with Sclerotium rolfsii was used up to 25% in broiler rations. The results of this study were higher than those of Mirnawati et al. 10, who stated that the PKC fermented with Aspergillus niger may only be used in broiler chicken rations as much as 17%. This was due to the higher activity of mannanase enzyme of Sclerotium rolfsii than Aspergillus niger17. Nitrogen retention: The results of analysis of variance showed that use of PKC fermented with Sclerotium rolfsii significantly decreased ($p<0.01$) nitrogen retention in the broiler. DMRT showed that treatment rations of R1, R2, R3 and R4 showed no significant effect ($p>0.05$) but significantly decreased ($p<0. 01$) compared to treatment R5. The non-significant effect of nitrogen retention in treatment rations of R1, R2, R3 and R4 were due to the use of PKC fermented with Sclerotium rolfsii. This fermentation product had better quality and complete amino acid content. According to Dairo and Fasuyi17, the fermentation process improved the amino acid profile, which was observed as increased nitrogen retention. This is consistent with the findings of Mirnawati et al.24, 25. The increased use of PKCF to 30% in the ration is expected to decrease nitrogen retention while increasing the crude fiber content, thus reducing the quality of rations. In the opinion of Siri et al.26, high crude fiber would bind other substances, such as protein and absorb water in the intestine, making it difficult to digest nutrient content in the rations26. SIGNIFICANCE STATEMENT This study discovered that PKC fermented with Sclerotium rolfsii increase the quality and nutrient content of palm kernel cake which can be beneficial as a raw material for the preparation of poultry feed. This study will help researchers to uncover new method in preparing feedstuff for poultry ration using by-product of palm oil and fermentation with Sclerotium rolfsii, that have previously not been

explored. Thus, these results present new insights regarding the appropriate level of PKC fermented with Sclerotium rolfsii as formulation of broiler ration. CONCLUSION Based on the results of this study, PKC fermented with Sclerotium rolfsii can be utilized up to 25% in broiler ration to achieve 1235.83 g/head body weight gain with feed consumption of 2296.36 g/head resulting in a feed conversion of 1.86, with final body weight of 1288.50 g/head, 798.28 gram/head carcass weight, 54.42% of crude fiber digestibility and 56.93% of nitrogen retention. ACKNOWLEDGMENT The authors would like to thank the Directorate General of Higher Education, Ministry of Research, Technology and Higher Education, Republic of Indonesia, for funding this study vide grant No. 020/SP2H/LT/DRPM/II/2016.
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