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Improving the Quality of Palm Kernel Cake Through Fermentation by *Eupenicillium javanicum* as Poultry Ration

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Abstract: An experiment was conducted to improve the nutrient content of palm kernel cake through fermentation by *Eupenicillium javanicum* with combination inoculums dosage and fermented time. The experiment used complete randomized design (CRD) with 3x3 factorial and twice replication. The first factor was inoculums dosage: (1) 4, (2) 7 and (3) 10%. The second factor was fermented time: (1) 7 days, (2) 11 days and (3) 15 days. The parameters were dry matter, crude protein, crude fiber and fat of palm kernel cake fermented. The result of study showed that there was highly significant ($p<0.01$) interaction between inoculums dosage and fermented time to dry matter, crude protein and crude fiber but crude fat was no interaction ($p>0.05$). Each factor, inoculums dosage and fermented time were significantly ($p<0.05$) affected to dry matter, crude protein, crude fiber and crude fat. It is concluded that palm kernel cake fermented by *Eupenicillium javanicum* showed inoculums dosage 10% and fermented time 11 days had a better nutrient content. This condition can be seen in dry matter (42.21%), crude protein 26.27% and crude fiber 11.37% of palm kernel cake fermented.

Key words: Fermentation, *Eupenicillium javanicum*, palm kernel cake and inoculum

INTRODUCTION

Palm Kernel Cake (PKC) is a waste of the palm oil processing. At the moment, Indonesia is the largest palm oil producer in the world with a production of 23 million tones in 2012. West Sumatra is the largest oil producing region with a total production of 953.937 tones of CPO (www.deptan.go.id). The continued development of oil palm plantations is certainly going to produce waste in the form of palm kernel cake which is quite high as 45-46% of palm oil is in the form of palm kernel cake.

Nutrient content of palm kernel cake were 16.07% crude protein, 21.30% crude fiber, crude fat 8.23%, 0.27% Ca and 0.94% P and 48.4 ppm Cu (Mirnawati *et al*., 2008) so that it can be used as feed livestock. Although crude protein content is high enough, but using it in poultry ration is still limited. According to Rizal *et al*. (2000) palm kernel cake can be replace 10 or 40% as replace of soybean meal in broiler rations.

On the other hand the use of PKC in the poultry ration need processing because its low quality (Garcia *et al*., 1999; Perez *et al*., 2000; Odunsei *et al*., 2002; Ezhieshi and Olomu, 2008). That's because of the high crude fiber in the form of β-manan content (Daud and Jarvis, 1992; Dusterhoft *et al*., 1993; Purwadaria and Haryati, 2003), while poultry do not have fiber and manan enzyme in digestive tract. It is necessary for processing prior to improve the quality palm kernel cake is through biotechnology and fermentation by cellulolytic and mananolitik of fungi (Meryandini *et al*., 2008; Purwadaria and Haryati, 2003) will be able to decrease of crude fiber and manan content so quality of palm kernel cake will increased that it can replace soybean meal in poultry rations.

Eupenicilium javanicum and *A. niger* is a mold which have manannolitic and cellulolytic enzyme that can be used to improve the quality of palm kernel cake. Mirnawati (2012) stated that the results of research to get that the activity of cellulase and mananas enzyme of palm kernel cake fermented with *A. niger* is cellulase activity 22.84 U/mL and mananas activities 20.65 U/mL. According to Purwadaria and Sari (2004) that *Eupenicillium javanicum* can produce β-manannase on locust bean gum substrate 1% with the highest activity is 49 U/ml and also produce β-manannase with higher activity when grown on coconut cake.

Based on the above needs to be done with the fermentation of palm kernel cake using mold *Eupenicillium javanicum* to improve the quality of palm kernel cake so that it can be used as a substitute for local feed ingredients imported feed ingredients in poultry rations. In fermentation there are several factors that must be considered include inoculum dose and time of fermentation. The more inoculum dose given more and more microbes that grow and the longer time given the more nutrients that can be reformed so that the combination of both will be able to improve the quality of palm kernel cake.

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It is necessary for a study to know at the combination of optimum inoculum dosage and fermentation time can be increase the nutrient content of palm kernel cake fermented with mold *Eupenicillium javanicum*

MATERIALS AND METHODS

This research was conducted to determine various of inoculum dosage and fermentation time to increase the quality of Palm kernel cake (PKC). It will be fermented with *Eupenicilium javanicum*. Materials that are used on this research are: (1). The oil palm tree seeds from PT. Incasi Raya Jl. Baypass Padang, (2). *Eupenicilium javanicum* from the center of applied research LIPI. (3). The Media: PDA/Potato Dextrose Agar from Diffo-Becton Dickinson. (4). Aquades and mineral brooks which consist of $MgSO_4$ $7H_2O$, $FeSO_4$ $7H_2O$, $ZnSO_4$ $7H_2O$, $MnSO_4$ $7H_2O$, KH_2PO_4 and Thiamin hydrochloride. (5). Substrate is the mix of PKC and with the comparison 80% PKC+20% rice brand (Mirnawati *et al*., 2012).

This research was using a completely randomized design with 3x3 factorial and twice replication. The first factor was 3 of inoculum dose : (1) 4%, (2) 7% and (3) 10% The second factor was fermented time was (1) 4 days, (2) 11 days and (3) 15 days. The parameters were dry matter, crude protein and crude fiber of palm kernel cake fermentation by *Eupenicilium javanicum*. The data was analyzed by using analysis of Variance (ANOVA), the differences of treatments are determined by Duncan's Multiple Range Test (DMRT) (Steel and Torrie, 1991).

RESULTS

This experiment aims to determine the inoculum dose and the optimum fermentation time which can improve the quality of fermented of palm kernel cake (PKCF). The average content of dry matter, crude protein and crude fiber of palm kernel cake fermented with *Eupenicilium javanicum*.

Results of analysis of variance showed that there was an interaction ($p<0.01$) between A factor (inoculums dose) and B factor (fermentation time), each factors (A and B) also showed a significant ($p<0.05$) affected on dry matter, crude protein and crude fiber of palm kernel cake fermented with *Eupenicilium javanicum*. More detail can be seen in Table 1.

DISCUSSION

Dry matter (DM): Based on DMRT test, there was an interaction between A factor (inoculum dose) with B factor (fermentation time) to the dry matter, that more and more doses of inoculum were given a trend of decrease in dry matter, especially in fermentation 11 days (A3B2) highly significant ($p<0.01$) is lower than other treatments. The low dry matter in A3B2 treatment caused by mold grow more lush and more visible number of spores that much also, the more mold grows, the more enzyme is also produced to break down food substances. the more microbes grow the more the metabolic process occurs in which metabolic processes will result in the water the more water is produced, the lower the dry ingredients at the end of fermentation (Mirnawati *et al*., 2010)

While the metabolism process was on, the energy retained from carbohydrate (glucose) will produce energy, water (H_2O) and CO_2. The water retained will increase the water content of product which make the dry matter content of product decrease. Fardiaz (1988) explained that the microorganism used carbohydrate as energy source which proceed from glucose. The degradation of glucose was done through the glycolysis stripe until the energy, water (H_2O) and CO_2 retained. The water obtained will increase the water content of product which made the dry matter content of product decrease after fermentation

Crude protein (CP): Test of DMRT for interaction between A and B shows that treatment combination A3B2, was highly significant ($p<0.01$) with other. The higher of crude protein for A3B2 treatment compared by other are caused by *Eupenicilium javanicum* growth activity was better than other. A lot of mold will contribute more protein because the body of mold consists of single cell protein. Based on Saono (1974) that around 31-50% mold contains of protein and fermentation produces enzyme in which the enzyme is also a protein. The increase of crude protein on A3B2 treatment cause by mold grows increasingly fertile mold growth because the higher the protein the body molds it is a single cell protein sources. The more the growth of mold the more the enzymes are produced so that the more loss of dry matter during fermentation. This is in accordance with the opinion of Supriyati *et al*. (1998) which states that the fermentation technology can increase the protein content in PKC. Sukara and Atmowidjojo (1980) fertile mold growth will transform the substrate into cell mass, whereas the cell, including proteins that causes the protein increased after fermentation. Increase in the crude protein content is also due to a lower dry matter during fermentation.

Crude fiber (CF): Based on DMRT test, there was an interaction between A factor (inoculums dose) with B factor (fermentation time) of the crude fiber. From the data above shows a decrease in crude fiber with increasing doses of inoculum and fermentation time 7 days, 11 days, or 15 days. While, at each inoculum dose decreased crude fiber on day 11, but at day 15 increased. The more a given inoculum dose there was decline in crude fiber, especially on a long fermentation 11 days (A3B2) highly significant ($p<0.01$) higher than other treatments.

The low crude fiber in treatment A3B2 with 10% inoculum dose and fermentation time 11 days, caused by mold to grow more and more fertile, so many

Table 1: Average of dry matter, crude protein and crude fiber content of fermented PKC by *Eupenicilium javanicum*

Parameters	Inoculum dose (A)	Fermentation time (B)			Average
		B1 (7 days)	B2 (11 days)	B3 (15 days)	
Dry Matter (%)	A1 (4%)	44.20^{aA}	42.21^{aA}	41.12^{aA}	42.51
	A2 (7%)	42.99^{aA}	40.80^{bA}	40.25^{bA}	41.35
	A3 (10%)	42.87^{aA}	38.48^{cB}	41.93^{aA}	41.09
	Average	43.35	40.5	41.1	
Crude Protein (%)	A1 (4%)	24.30^{aB}	23.78^{aB}	23.49^{aB}	23.85
	A2 (7%)	24.10^{aB}	24.22^{aB}	24.14^{aB}	24.15
	A3 (10%)	25.34^{aA}	26.27^{aA}	24.52^{aB}	25.38
	Average	24.58	24.75	24.05	
Crude Fiber (%)	A1 (4%)	16.35^{aA}	14.09^{cA}	15.18^{bA}	15.21
	A2 (7%)	15.04^{aB}	13.00^{cB}	14.87^{bA}	14.30
	A3 (10%)	13.08^{bC}	11.37^{cC}	15.23^{aA}	13.22
	Average	11.12	9.61	11.3	

Note: Capital and small letters are different on the same row and column indicated highly significant ($p<0.01$)

enzymes produced to break down cellulose into glucose. Accordance with the opinion of Moore and Landecker (1982) that cellulase enzymes can break down cellulose into glucose contained in the substrate to produce energy so crude fiber content decreased. The more mold that grows the more the enzymes are produced. This is in accordance with the opinion of Kassim *et al.* (1985) that there is a positive relationship between growth and the production of cellulase enzymes during fermentation, is supported by the nutrient content suitable for mold growth. This is supported by suitable conditions for mold growth (Mirnawati *et al*., 2012).

Conclusion: Palm kernel cake which was fermented by *Eupenicilium javanicum* showed that inoculums dosage 10% and fermented time 11 day had a better content. This condition can be seen in crude protein 26.27%, crude fiber 11.37% and dry matter 42.21%.

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