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The Role of Humic Acid in Palm Kernel Cake Fermented by *Aspergillus niger* for Poultry Ration

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Abstract: An experiment was conducted to improve the nutrient content of palm kernel cake through fermentation by *Aspergillus niger* with combination humid acid dosage and fermented time. The experiment used Complete Randomize Design (CRD) with 3 x 3 factorial and twice replication. The first factor was humic acid dosage: (1) 0 ppm, (2) 100 ppm and (3) 200 ppm. The second factor was fermented time: (1) 5 day, (2) 7 day and (3) 9 day. The parameters were dry matter, crude protein and crude fiber. The result of study showed that there was no significantly ($p>0.05$) interaction between humic acid dosage and fermented time to dry matter, but against crude protein and crude fiber, there were highly significant interaction ($p<0.01$). Humic acid dosage were not ($p>0.05$) effected to dry matter, but against crude protein and crude fiber, there were significant ($p<0.01$) effect. Fermented time showed that there were highly significant ($p<0.01$) effect to dry matter, crude protein and crude fiber. The conclusion was palm kernel cake which was fermented by *Aspergillus niger* showed that humic acid 100 ppm and fermented time 7 day had a better content. This condition can be seen in crude protein 23,20%, crude fiber 10,59% and dry matter 42.38%.

Key words: Fermentation, *Aspergillus niger*, palm kernel cake and humic acid

INTRODUCTION

One of the potential wastes to be used is waste of oil palm processing such as Palm Kernel Cake (PKC). PKC is the side result of oil palm production that can be used as feedstuff for poultry. Palm Kernel Cake (PKC), the major agroindustrial by product of the palm oil industry in Malaysia, Indonesia and Thailand is another good source of energy and protein for ruminants (Setthapukdee *et al*., 1991) and poultry diets (Ezhieshi and Olomu, 2008).

Even though the crude protein contain of PKC is quite high but the usage of it is still low in poultry ration. It is around 10% in duck ration (Yeong *et al*., 1981). It is caused by the low quality (Garcia *et al*., 1999; Perez *et al*., 2000; Odunsei *et al*., 2002). To increase the use value of PKC, there has been done a research by using the fermentation method to use the microorganism of cellulose characteristic such *Aspergillus niger*. Supriyati *et al*. (1998) got the result of the research about the processing of PKC by *Aspergillus niger* gave the improvement of protein that high enough as much as 52,04% and the decreasing crude fiber around 42,03%, but still limited to use in poultry ration.

So in this research, it will introduce the role of humic acid in processing of PKC, in order to get the optimum condition to improve the quality of PKC. Humic acid is one of compound which consisted in "Humic Substance" as the result of decomposition organic substance, especially concerning plants which located young coal, peat moss oil, compost (Senn and Kingman, 1973). Humic acid is also effective in fasten micro substance, such as Cu, Zn and Mn (Tan, 1998, but in animal husbandry especially in processing and woof material biotechnology are still rare to use. The manufacturing through the soaking with humic acid will give the best result and new thing. Besides, humic acid also provides the component such as N, P and S into land and energy for microorganism activity (Stevonson, 1994). By adding of Kucukersan *et al*. (2005) that the usage of humic acid in livestock feed gives some advantages for health and livestock growth, for example, humic acid has ability in carbohydrate metabolism and protein through out catalytic. This theory can be used in PKC fermentation process because the fermentation process also activated the microorganism growth which is expected, so the processing PKC has better quality and expected to replace the soybean meal (Dairo and Fasuyi, 2008). So that the ration cost can be pressed and the breeder income increase.

Therefore, the objective of this study was to determine the effect of humid acid dosage and fermented time to improve the nutrient content of palm kernel cake through fermentation by *Aspergillus niger*.

MATERIALS AND METHODS

This research was conducted to determine various of concentration of humic acid and fermentation time to raise the quality of Palm Kernel Cake (PKC). It will be

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fermented with *Aspergilllus niger*. Materials that are used on this research are: 1). The oil palm tree seeds from PT. Incasi Raya Jl. Baypass Padang, 2). *Aspergilllus niger* from the center of applied research LIPI. 3). Humic acid from the soil. 4). The Media: PDA/Potato Dextrose Agar from Diffo-Becton Dickinson. 5). 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. 6). Substrate is the mix of PKC and Chicken fesses with the comparison 80% BIS and + 20% chicken fesses.

This research was using a completely randomized design with 3 x 3 factorial and twice repetition. The first factor was three kinds of humic acid dosage: (1) 0 ppm, (2) 100 ppm and (3) 200 ppm. The second factor was fermented time: (1) 5 day, (2) 7 day and (3) 9 day. The data is analyzed by using variation of investigation. If there is an effect of the treatment, so the differences on treatments are determined by Duncan's Double test (Steel and Torrie, 1991).

The parameters were dry matter, crude protein and crude fibe of Palm kernel cake fermentation by *Aspergilllus niger*.

RESULTS

The aim of the research was to determine the condition of fermentation which is suitable to combine the Humic Acid dosage and the fermentation time. So it produces a high quality product Palm Kernel Cake Fermentation (PKC) can be seen in dry matter, crude protein and crude fiber.

Dry Matter (DM): The average value of dry matter content of fermented Palm Kernel Cake (PKC) by *Aspergillus niger* at the interaction between humic acid dosage and fermented time is shown in Table 1. At Table 1 can be showed that the average dry matter fermented of PKC about 37.26-44.36% (DM).

The result of statistic analysis shows that there was no interaction ($p>0.05$) among A and B. The factor A were no significant ($p>0.05$) but the factor B were highly significant ($p<0.01$) effect to dry matter content of PKC.

Crude Protein (CP): The average value of crude protein content of fermented Palm Kernel Cake (PKC) by *Aspergillus niger* at the interaction between humic acid dosage and fermented time is shown in Table 2. At Table 2 can be showed that the average crude protein fermented of PKC about 16.40-23.20% (CP).

The result of statistic analysis shows that there is interaction ($p<0.01$) effect among A and B than the factor A and B every were highly significant ($p<0.01$) effect to crude protein content of PKC by *Aspergillus niger*.

Crude Fiber (CF): The average value of crude fiber content of fermented Palm Kernel Cake (PKC) by *Aspergillus niger* at the interaction between humic acid dosage and fermented time is shown in Table 3. At Table 3 can be showed that the average crude protein fermented of PKC about 10.59-12,50% (CF).

The result of statistic analysis shows that there is interaction ($p<0.01$) effect among A and B than the factor A and B every were highly significant ($p<0.01$) effect to crude fiber content of PKC by *Aspergillus niger*.

Table 1: The average value of dry matter content of fermented PKC by *Aspergillus niger* at the interaction between humic acid dosage and fermented time

	Fermented time			
Humic acid dosage	B1 (5 days)	B2 (7 days)	B3 (9 days)	Average
A1 (0 ppm)	43.38	41.89	39.28	41.52
A2 (100 ppm)	44.63	42.38	37.26	41.42
A3 (200 ppm)	44.34	41.84	39.25	41.81
Rataan	44.12^{A}	42.0491^{B}	38.60^{A}	

Keterangan: Different capital letter on the same row indicated highly significant ($p<0.01$)

Table 2: The average value of crude protein of fermented PKC by *Aspergillus niger* at the interaction between humic acid dosage and fermented time

	Fermented time			
Humic acid dosage	B1 (5 days)	B2 (7 days)	B3 (9 days)	Average
A1 (0 ppm)	19.76^{d}	19.90^{d}	21.32^{c}	20.33
A2 (100 ppm)	19.90^{d}	23.20^{a}	19.09^{e}	20.73
A3 (200 ppm)	21.00^{c}	22.32^{e}	16.40^{f}	19.91
Rataan	20.22	21.81	18.97	

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

Table 3: The average value of crude fiber content of fermented PKC by *Aspergillus niger* at the interaction between humic acid dosage and fermented time

	Fermented time			
Dosis asam humat	B1 (5 hari)	B2 (7 hari)	B3 (9 hari)	Rataan
A1 (0 ppm)	12.51^{a}	12.02^{cd}	12.30^{b}	12.28^{A}
A2 (100 ppm)	11.70^{e}	10.59^{g}	12.22^{bc}	11.50^{C}
A3 (200 ppm)	12.21^{bc}	10.81^{f}	11.93^{d}	15.60^{B}
Rataan	12.14^{A}	11.14^{B}	12.15^{A}	

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

DISCUSSION

Dry Matter (DM): Lack of interaction between humic acid dosage and fermented time caused by the low range of humic acid dosage and range of fermented time made it still not yet to show the real difference of interaction.

Based on the test of DMRT towards fermented time (factor B) shows that the treatment of B1 is real difference ($p<0.01$) rather than B2 but the same with B3. The treatment of dry matter B2 was decrease than B1 and B3. It is caused by the degree of water. The higher

of water degree for treatment of B2 relates to microorganism growth activity. Because the growth of mold is more active than the other. A lot of mold which stimulated a mount of food essence are changed to be dry matter. The growth and development of mold so in the last fermentation of water degree increase which caused the decrease of dry material degree.

The increasing of development mold is caused by humic acid given. It is based on Kucukersan *et al.* (2005) stated that Humat Acid is able to do metabolism carbohydrate and protein by catalytic. Added by Kompiang (2006) that Humic acid can stimulate the microorganism growth in intestines. So this fermentation actives the growth of mold It could be seen for decrease of dry matter after adding Humic acid 100 ppm. But in adding until 200 ppm doesn't show the difference result, because pH not suitable to growth of mold.

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. Fardias (1988) explained that the microorganism used carbohydrate as energy source which proceed from glucose. The degradation of glucose was done through the glycolisis 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.

At B3 treatment there was an improvement of dry matter than B2 treatment. This caused by the growth and propagation of mold experienced a reduction because the nutrient available in substrate was decreasing, so the water retained in metabolism process was less than B2 treatment. Because of the low water retained, the water content of product decrease and increase the dry matter of product.

Crude Protein (CP): The test of DMRT for interaction between A and B shows that treatment combination A2B2, was highly significant (p<0,01) with other. Then the higher of crude protein for A2B2 compared by other are caused by *Aspergillus niger* 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 enzym in which the enzym is also a protein.

The height of crude protein at A2B2 treatment caused by humic acid dosage given 100 ppm which was able to reach the rught condition for the growth of mold, while humic acid available with constituent and energy which really needed in mold growth At the 7 day of fermentation, mold reach the optimum growth and grow more than usual, so the protein from substrate increase. According to Stevonson (1994) that humic acid supplied constituent and energy for the growth of microorganism in soil. Sukara and Atmowidjojo (1980) have a notion that the better growth and development of mold will change more media component composer into a mass cell, so the protein of mold formed and will increase crude protein of material. The low improvement of crude protein content at A3B3 treatment than other treatment caused by 2 possibilities. The first is because humic acid dosage was too high that made the atmosphere become too sour in which this situation is not suitable for the growth of mold. It relates to addition of humic acid with 100 ppm will give growth of mold which is better than adding 200 ppm humic acid. It has relation with pH of fermentation process. A good pH is a round 4-5 and Humic Acid pH is around 4-5. The second is because the nutrient content in substrate was decreasing. Because of these 2 things above, the growth of mold experienced the decreasing. The lower of mold, the lower of crude protein content. Appropriate with the opinion from Moeljoharjo (1979) that the growth of microbe was affected by the sufficiency of food source.

Crude Fiber (CF): The test of DMRT for interaction between A and B shows that treatment combination A2B2, was highly significant (p<0,01) with other. The low of crude fiber for A2B2 compared by other are caused by *Aspergillus niger* growth activity was better than other.

From the DMRT experiment against the interaction between factor A and B turn out that the combination A2B2 treatment was real difference (p<0.01) than other combination treatment. From the result above we can see the possibility of reduction along with the improvement of Humic Acid content and fermented time. The best treatment is the combination of A2B2 treatment with humic acid dosage 100 ppm and fermented time 7 days which give the lowest crude fiber content of palm kernel cake fermented with *Aspergillus niger*.

The low content of crude fiber at A2B2 treatment is caused by the addition of humic acid 100 ppm and fermented time 7 days. At 7 days fermented time, mold grows better than other fermented time. The more mold grow, the more cellulose enzyme will retained to tear down cellulose, so at the end of fermentation, the crude fiber decrease. Appropriate with the opinion of Sulaiman (1988) that the longer fermented time given, the longer time to tear down food material, so at the end of fermentation the decreasing of crude fiber.

The low content of crude fiber at A2B2 treatment is caused by the addition of humic acid 100 ppm because humic acid can activate microorganism growth wanted. Appropriate with Kucukersan *et al.* (2005) that the function of humic acid in ration gave an amount of profit for health and growth of livestock, for example humic acid had an ability to metabolic carbohydrate and protein

through catalytic. The higher microorganism activity, the higher retained enzym produced by mold to tear down cellulose, so at the end of fermentation, the crude fiber decrease.

Conclusion: The conclusion was palm kernel cake which was fermented by *Aspergillus niger* showed that humic acid 100 ppm and fermented time 7 day had a better content. This condition can be seen in crude protein 23,20%, crude fiber 10,59% and dry matter 42.38%.

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