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Fermentation of Palm Kernel Cake by *Marasmius sp* and Implication to Performnce Native Chicken

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Abstract: The palm kernel cake waste product has a high gross energy of 5088 kcal / kg, so it can be used as a source of energy for chicken and could be used to substitute corn meal in the preparation of local chicken ration. However, the use of this waste is still limited because the crude fiber content is quite high (17.18%) and its palatability is low. Efforts to improve is through the process of fermentation by using microorganisms namely Marasmius sp. Because this microbial can produce enzymes that are able to break down and dissolve the lignin contained in palm kernel cake and can degrade crude fiber into simpler bonds (polysaccharides), so its easily digested. The research was divided into two phase. Phase I was held to find out the best dosage and time of fermentation of palm kernel cake. Phase II was to find out the using level of fermentation palm kernel cake in diet native chicken. One hundred native chickens at two weeks of age were raised in cages until 12 weeks old. A Completely Randomized Design with five treatment palm kernel meal level in the diets , namely 0 % (R0), 10 % (R1), 20 % (R3), 30% (R4) and 40% (R5), replicated four times and where each replication consisted of five chickens, and the measured variables were feed consumption, body weight gain, and feed Conversion Statistical test performed by analysis of variance and differences between treatment effects were examined using Duncan's multiple range test. The experiment showed that nutrient containing of palm kernel meal fermentation were increased and treatment using palm kernel cake in native chicken diet was significant effect on feed consumption, body weigh gain, and feed conversion, Results showed that best dosage of inoculum was 7.5% and time of fermentation was three weeks and the diet used palm kernel cake fermentation until 30% had same effect on performance as control diet.

Key words: Palm kernel cake, fermentation, body weight gain, native chicken

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1. Introduction

Oil palm has a fruit that consists of three parts, namely flesh of fruit (mesocarp), shell and kernel. The palm kernel cake is a byproduct of the extraction process or the suppression of the palm kernel, has a high gross energy of 5088 kcal / kg, so it can be used as a source of energy for chicken and could be used to substitute corn meal in the preparation of local chicken ration (Widjastuti ,*et al*, 2005). However, the use of this waste is still limited because the crude fiber content is quite high (17.18%) and its palatability is low, which cause the nutrients so difficult to be digested by the digestive enzymes of chicken (Leeson and Summer 2008). The use of high crude fibers in addition to lowering the digestible components also leads to decreased activity of the enzyme-breaking of nutrients such as enzymes that help digest carbohydrates, proteins and fats. This is because only a portion of the crude fibers can be digested by microflora in caecum and colon (Tulung,1987). Efforts to improve is through the process of fermentation by using microorganisms namely *Marasmius* sp. The *Marasmius* is a genus of mushroom-forming fungi in the family *Marasmiaceae*. This fungi can produce enzymes that are able to break down and dissolve the lignin contained in palm kernel cake and can degrade crude fibre into simpler bonds (polysaccharides), so its easily digested. *Marasmius* sp has a characteristic of extracellulary enzyme phenoloxidase which is an enzyme involved in lignin biodegradation process and it can also produce glucosidase enzymes that can break glycosidic bonds so that crude fibre becomes embedded into simpler bonds such as simple sugars (polysaccharides), which are a source of energy for poultry (Musnandar , 2004).

Some researchers report a change in the composition of nutrients in the substrate through fermentation with fungi. Fermentation of palm kernel cake using Marasmius sp fungi at 7.5% inoculum dose and 3 week fermentation time real can decrease crude fiber content and increase crude protein. The research of fermentation cocoa shell with *marasmius* sp at 7.5% dose and one week of fermentation can decrease crude fiber, cellulose and lignin (Shermiyati, 2003). Rahayu research (2002) the use of fermented palm kernel meal products up to 25 percent in broiler ration had no effect on feed consumption and had a preference for eating the same and also did not cause differences in the performance of body weight. Widjastuti *et al* (2005), reported that fementation of palm kernel cake by *Marasmius* sp that nutrient containing, metabolizable energy and digestibility of palm kernel cake fermentation were increased, and the used palm kernel cake fermented product until 30 percent in the ration does not cause a negative effect on broiler performance. Hence, the objective of this study was to find out the best dosage and time of fermentation of palm kernel cake and implication on the performance native chicken.

2. Materials and Method

The Research Phase I Fermentation of Palm Kernel Meal

Microbial used was *Marasmius* sp and the main raw material was by product of the processing of palm oil is palm kernel cake. Fermentation processed had been conducted as procedure by Abun (2003). Palm Kernel cake as much as 100 grams put in plastic bags, plus 60 ml of water then steamed for one hour, cooled and added standard mineral solution. The substrate was then inoculated with an inoculum *Marasmius* dose of 2.5, 5.0, 7.5 and 10.0%, then incubated with room temperature for 2; 3 and 4 weeks. Palm kernel cake products was dried in an oven with a temperature of 600 ^{0}C for 24 hours, and then were analyzed for protein and crude fiber

The Research Phase II, Feeding Trial

One hundred native chickens at two weeks of age were raised in cages until 12 weeks old. A Completely Randomized Design with five treatment palm kernel cake fermented level in the diets, namely 0% (R0), 10 % (R1), 20 % (R3), 30% (R4) and 40% (R5), replicated four times and where each replication consisted of five chickens, and the measured variables were feed consumption, body weight gain and feed conversion. Statistical test performed by analysis of variance and differences between treatment effects were examined using Duncan's multiple range test.

3. Results and Discussions

Effect of Treatment Palm Kernel Cake Fermented on Crude Protein

Crude protein content of palm kernel cake before and after fermentation and its increase can be seen in Table 1.

Table 1. Mean Crude Protein Content in Palm kernel cake before and after Fermentation

Treatments	Before Fermentation (%)	After Fermentation (%)	Increase of Protein (%)
Dl.W1	14.25	14.47	3.58
Dl.W2	14.36	15.70	10.15
Dl.W3	14.47	16.74	17.45
D2.W1	14,25	15.09	5.08
D2.W2	14.36	18.33	27.62
D3.W3	14.47	18.04	25.65
D3W1	14.25	17.34	16.66
D3.W2	14.36	17.33	19.74
D3.W3	14.47	17.29	19.47

Description: d = *Marasmius* inoculum dose (2.5,5,7,5 and 10%), W = Processing time (2,3 and 4 weeks)

From Table 1. It is seen that fermentation of palm kernel cake using *Marasmius* sp can increase the crude protein content between 3.5% to 27.62%.

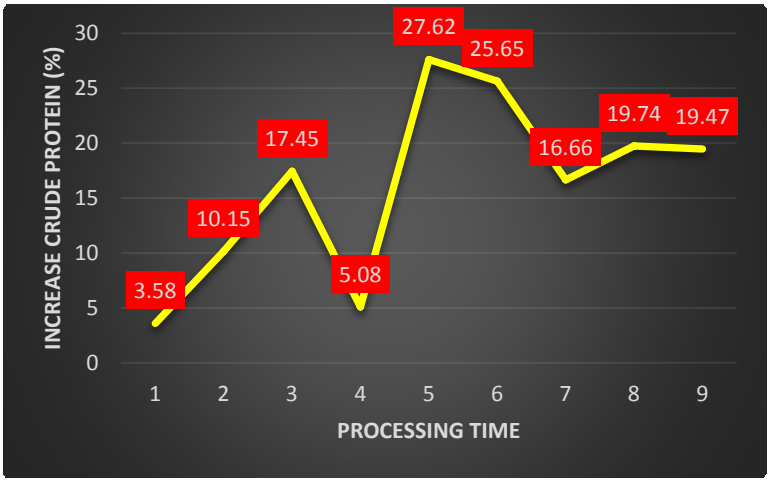

Fig.1. Increase Crude Protein (%)

The result of variance analysis showed that the dose and processing time had significant effect on the increase of crude protein content.

Table 2, Duncan Multiple Range Test Influence Treatment Dose and processing time Palm Kernel Cake to Increase in Protein Content

Dose	Processing Time		
	W1	W2	W3
	%	%	%
D1	3.58 aA	10.15 aB	17.45 aC
D2	5.08 aA	27.62 bB	25.65 bB
D3	16.66 bA	19.74 bA	19.47 bA

Note: The similar superscript in the same row and columns show no significant difference (P<0.05)

From Table 2. shows the treatment dose of 5,7.5 and 10 percent in processing time 2 weeks there was no significant difference to the increase in crude protein of palm kernel cake, at weeks 3 (W2) and 4 (W3) there was a significant increase of protein with various doses of inoculum *Marasmius* sp. Differences in protein content with fermentation duration were most likely to the level of microbial growth obtained in that time frame. Microbial growth can be divided into three phases: the “slow phase,” when cells undergo metabolic and physiological activities which prepare them for division; the “exponential phase,” a period of accelerated growth; and a stationary or resting phase (Battley and Edwin, 1987; Balia, 1993). The ability of microbes to

quickly multiply their numbers and produce functional enzymes which break down substrates affects the quality and quantity of the final processed product, and is directly reflected in the fermentation time. Furthermore, a higher dose of inoculum and longer fermentation time has been shown to create larger microbial populations and increased degradation of substrates (Aisjah, 1995, Widjastuti *et al.* 2005). Fermentation determines the amount of time needed to establish of microbial populations which is directly link to the development of enzymes which break down substrates and affect the final product. A longer fermentation allows for an increase in the microbial population enabling more substrate components to be overhauled. Microbes experiencing high growth rates continue to rise until they reach the stationary phase. In this phase, the easily revamped nutrient substance has been exhausted, consequently the microbe remodel lignin to meet its nutritional needs (Kuhad *et a*l, 1997). At dose of 7.5% (D2) with 3 weeks fermentation time (W2) was the best combination of increasing crude protein content of palm kernel cake (27.62%).

Effect of Treatment Palm Kernel Cake Fermented on Crude Fiber

Crude fiber content of palm kernel before and after fermentation and its reduction can be seen in Table 3. In Table 3 shows a decrease in crude fiber palm kernel fermented content starting from a low of 13.72% to a high of 40.77%. The decrease in crude fiber is affected by the dose of inoculum and the duration of fermentation.

Table 3. Mean Crude Fibre Content in Palm kernel Meal Before and After Fermentation

Treatments	Before Fermentation (%)	After Fermentation (%)	Reduction (%)
Dl.W1	25.23	22.63	13.72
Dl.W2	25.13	19.69	24.92
Dl.W3	24.64	16.78	36.04
D2.W1	25.23	21.55	14.25
D2.W2	25.13	15.43	38.59
D3.W3	24.64	15.43	16.08
D3W1	14.25	20.68	16.08
D3.W2	14.36	14.97	39.26
D3.W3	14.47	14.59	40.77

Description: d = *Marasmius* inoculum dose (2.5,5,7,5 and 10%), W = Processing time (2,3 and 4 weeks)

Fig.2. Reduction Crude Fiber

The result of statistic analysis showed that between dose of inoculum and processing time had significant effect on the decrease of crude fiber.

Tabel 4, The results of Duncan's Multiple Range Test between Doses and Processing time Palm Kernel Cake to Reduction of Crude Fiber

Dose	Processing Time		
	W1	W2	W3
	%	%	%
D1	13.72 aA	24.92 aB	36.04 aC
D2	14.25 aA	38.28 bB	38.59 aB
D3	16.09 aA	39.26 bB	40.77 aA

Note : The similar superscript in the same row and columns show no significant difference (P<0.05)

Table 4, shows the treatment dose of 5,7.5 and 10 percent in processing time 2 weeks there was no significant difference to the decrease in crude fiber of palm kernel cake. This is because at the time of micobe *Marasmius* sp has not been maximal in using rough fiber components in meeting the nutritional needs for growth. At week 3 (W3) and 4 (W3) there was a significant decrease with various doses of inoculum, this was because at that time the *Marasmius* sp had begun to degrade the crude fiber complex compounds such as lignin optimally. With the breaking of the lignin bond it will directly result in the decrease of the crude fiber of palm kernel cake. In Table 4, it showed that at each dose used for 4 weeks did not show any significant difference. This is because at the 4 th week of *Marasmius* sp is at the phase of death because the data of colonies shows

that at that time the number of colonies decreased. The test results showed that the effect of dose of 7.5% with 3 week fermentation time was the best combination for the decrease of crude palm kernel cake fiber.

Effect of Treatment Palm Kernel Meal Fermentation on Performance Native Chicken

The effect of palm kernel cake fermentation on feed consumption, body weigh gain, and feed conversion is shown in Table 5.

Table 5. Effect Treatment Palm Kernel cake Fermented on Performance Native Chicken

Variable	R0	R1	R2	R3	R4
Feed consumption (g)	3264.12 a	3200.56 a	3239.26 a	3241.28 a	2994.79 a
body weigh gain (g)	708.04 a	713.01 a	710.18 a	720.55 a	514.90 b
feed conversion	4.61 a	4.49 a	4.57 a	4.55 a	4,87 b

Note. The similar superscript in the same row show no significant different (P<0.05)

Feed Consumption

Table 5, shows that feed consumption trends to decrease proportional because to use of product fermented of palm kernel cake was increased in the ration. The results variance analysis showed that using of product fermented palm kernel cake in diet native chicken has no significant effect on feed consumption. This suggests that the palm kernel cake fermented product can improve palatability from ration (R1, R2, R3, and R4) more better so that the feed intake rate is not different from the control ration. According to Saptoningsih (2000) that the fermentation results will be more palatable when given to poultry, because during the fermentation process the enzymes are produced which can solve complex compounds into simpler molecules that are easily digested, altering the aroma and taste more better than the original material. In addition, the physical form of rations containing fermented products is lighter than the control ration.

Body Weight Gain

The body weight of each treatment is showed in Table 5. The average of body weight was 594.90 – 720.55 gram. Analysis of variance showed that by addition of product fermented kernel meal palm has significant effect on body weight gain native chicken. By adding 30 percent of fermented palm kernel products in native chicken rations still gave a good results. This means that rations containing fermented palm kernel products can be digested equally well with ration control. Its mean that the product of fermented palm kernel meal from 10 percent up until 30 percent in the ration did not influence palatability and native chicken appetite, so the body weight gain was increased. This is because, in the process fermentation of palm kernel meal with *Marasmius sp* there will be degradation of lignin compound with lignin peroxidase enzyme, which can break

the lignin bond with carbohydrate and lignin bond with protein. In line with the opinion of Saptoningsih (2000) and Abun (2008) which states that fermented food products are generally easier to digest than their origin products, because in the fermentation process there is a change of organic compound complex into compounds that are more simple and easy to digest, so the absorption of nutrients is better. In R4 treatment, 40% of palm kernel fermented products decreased body weight gain. This is because the amount of crude fiber donated in the ration is higher. High fiber content will affect the digestibility of other nutrients because crude fiber can not be degraded in the digestion of chicken so that nutrient needs grow chicken body is less fulfilled. According to Leeson and Summer (2008) that the main factors affecting digestion of nutrients in chicken are cellulose and lignin, where cellulose and lignin are part of crude fibers.

Feed Conversion

In Table 5. shows that the chicken conversion value ranges from 4.49 to 4.87. The result of variance analysis showed that the treatment by using fermented palm kernel flour product significantly affected the feed conversion. The conversion value of ration between Ro, R1, R2 and R3 treatment is better than R4 treatment (adding 40% fermented palm starch). Thus, rations containing fermented palm kernel products up to 30% are still efficiently equivalent to control rations, as each treatment provides the same physiological effect in utilizing the nutritional rations. It is supported that fermentation with *Marasmius* sp can break lignin bonds with carbohydrate and lignin bonds with palm kernel proteins that make fermented palm kernels more digestible so that their use in rations of up to 30% yields the same ration conversion value as control rations. In R4 treatment (40% palm kernel fermentation) resulted in higher ration conversion value when compared with treatment R0, R1, R2 and R3. This means that the contribution of crude fiber in R4 rations is much higher, leading to rapid feed flow leaving the gastrointestinal tract so that few nutrients can be absorbed by the livestock body.

4. Conclusions

It can be concluded that

1. A bioprocessing time of 3 weeks and doses 7.5 percent was optimum for degradation of palm kernel waste materials using *Marasmius* sp, as it produced the highest nutrient. At dose of 7.5% (D2) with 3 weeks fermentation time (W2) was the best combination of increasing crude protein content of palm kernel meal (27.62%) and the decrease of crude palm kernel fiber (38.59%).
2. By using the palm kernel meal fermented until 30 percent levels in the ration was still able to support a good result on performance native chicken.

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