Improving the nutritive value of palm kernel cake through treatment with *Aspergillus niger.*

Alimon, AR., Swe KH, M.D. Jaafar, A. Norhani

Faculty of Agriculture
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

Telephone Number of Corresponding Author: 03-89466891
E-mail of Corresponding Authorralimon@agri.upm.edu.my

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Introduction

Palm kernel cake (PKC) is a by-product of the oil palm industry. Malaysia produces about 2.0 million tones of PKC yearly, but little is used as feed for poultry. This is because of the high content of insoluble carbohydrates that limits intake. Studies have shown that through fermentation with fungi, such as *Aspergillus spp.* the nutritive value of PKC can be enhanced. Current studies have shown that fermentation increased crude protein content by 20-30 % and reduced NDF content by 50 %, hence, suggesting that fermented PKC can be used for poultry if properly treated. The nature of the substrate is important for the success of the fermentation process. Rice bran and wheat bran are good substrate for *Aspergillus spp* fermentation and enzyme production. The solid substrate used and its preparation can significantly affect the production of enzymes and subsequently, the success of fermentation.. Palm kernel cake (PKC) contains mainly linear mannans, moderate amounts of cellulose and small amount of other polysaccharides. The objective of present study is to examine the effect of different groups of substrate on the final nutrient content of PKC and products of SSF using *Aspergillus niger.*

Materials and Methods

Experiments were conducted to examine the effect of solid state fermentation (SSF) of palm kernel cake (PKC) using *Aspergillus niger* as the fermentative microorganisms. A mixture of PKC (70%) and rice bran (30%) were used as the substrate. The fermentation was carried out for 8 days and samples of the fermented PKC were taken at 0, Palm kernel cake (PKC) was inoculated with *Aspergillus niger* The second part of this experiment dealt with PKC + rice bran as substrates. A mixture of different proportions of PKC and rice bran were used as substrates for this experiment. The substrates tested were : PKC 70% + rice bran, 30% (Treatment A); PKC 80% + rice bran, 20% (Treatment B); PKC 90% + rice bran 10% (Treatment C); and PKC 100% (Treatment D). *Aspergillus niger* spore suspension was used to inoculate the substrate. Fermentation time for each treatment group was carried out for 8 days. After the fermentation, proximate analysis of fermented PKC, enzyme activity and biomass production of fungus were determined. Proximate analysis (DM, CP, NDF, ADF) was conducted according to standard procedures, mannanase enzyme activity by the method of Araujo and Ward (3) and fungal biomass was measured indirectly by determination of glucosamine content.

Results and Discussion

The results show that after the fermentation, NDF of fermented product (FPKC) was reduced by 42 % when compared with unfermented PKC, but were not significantly different between substrate groups ($P>0.05$). NDF content of FPKC was decreased by 66.8 to78.9%. Degradation of NDF during fermentation was mainly due to the action of mannanase enzyme produced by *Aspergillus. niger.* However, enzyme activities among different treatment groups were not significantly different ($P>0.05$). ADF content of FPKC in Treatment A (24.3%) was significantly lower than that of FPKC in other treatment groups ($P<0.05$). It was probably due to the higher proportion of rice bran which had lower ADF content than PKC. *Aspergillus niger* can produce as many as 21 types of enzyme, including cellulase. CP of fermented PKC between different substrate groups were not significantly different although crude protein content of FPKC in Treatment D was increased by 26.5%. Filamentous fungi have received increasing attention particularly for the enrichment of protein in starchy substrates such as cassava. According to the results, the differences of ether extract% among different treatment groups were not significant. After fermentation, ether extract% of FPKC was appreciably reduced by 2% when compared with unfermented PKC (5 - 15%). It might be because the macromolecules from solid substrates usually provide the carbon and energy for microbial growth. Lipid reserve and carbon are used for the germination of many fungal spores. Because of these reasons, ether extract% of fermented product was reduced when compared with that of PKC. Biomass is a fundamental parameter in the characterization of microbial growth. Direct determination of biomass in SSF is very difficult due to problems with separation of the micro-organism from the substrate. In this study, glucosamine contents of fungus among different treatment groups were not affected by different substrates.

Conclusions

It can be concluded that fermentation with *Aspergillus niger* improved protein content and significantly reduced the fibre components (ADF, NDF) However, the different substrate groups used for solid state fermentation by *Aspergillus niger,* did not significantly affect the final nutrient contents of substrate and fermentation products different. Further research is needed to

determine toxin level produced by *Aspergillus niger*, because the production of toxin is related to the composition of the substrates.

Benefits from the study

This study relates to the solid state fermentation and the results add new information to the optimum conditions required for the fermentation. It is noteworthy that substrates like rice bran and wheta bran can play a role in the production of enzymes in this type of fermentation using Aspergillus niger. *Aspergillus spp.* are sometimes difficult to harness if substrates used are not suitable. Furhermore the optimum time to stop the fermentation and harvest the fermented product is also critical to achieve products that are safe and not contaminated by toxins produced by this organism.

Patent(s), if applicable:

Nil

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Nil

Project Publications in Refereed Journals:

Nil

Project Publications in Conference Proceedings

1. Swe, K.H., **AR Alimon**, D. Mohd Jaafar and A. Norhani (2003). The nutrient contents of palm kernel cake with graded levels of rice bran after solid state fermentation using *Aspergillus niger*. International Conference on Animal Nutrition (ICAN 2003) 3-5 March 2003, Marriot Hotel Putrajaya Malaysia. Abstract No.1

2. **Alimon AR**, KH Swe, D. Mohd Jaafar and N. Abdullah (2002) Improving the nutritive value of palm kernel cake through solid state fermentation using *Aspergillus niger*. Proc. Of the MSTC Conference (Life Sciences), 12-14 th December 2002, Kuching, Sarawak

3. Swe KH, **AR Alimon**, D Mohd Jaafar, N. Abdullah and S. Noraini (2002). The addition of alcohol in the fermentation of PKC by Aspergillus niger and its effect on the fibre content of PKC. Proc. 24th MSAP Conf. 19-23 May 2002 Penang, Malaysia pp 78-79.

Graduate Research

Name of Graduate	Research Topic	Field of Expertise	Degree Awarded	Graduation Year
Khin Hnin Swe	Improving the nutritive value of PKC through solid state fermentation using *Aspergillus niger*.	Poultry Nutrition	(Ph.D.)	

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