System For Bio-Conversion Of Palm Kernel Cake In Production Of Fish Feed

MM Hanafi, MS Kamarudin, O Radziah and P Omar

Faculty of Agriculture
Faculty of Science and Environmental Studies
Universiti Putra Malaysia
43400 UPM, Serdang, Selangor
Malaysia

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Introduction

Previously, solid-state fermentation of palm kernel cake (PKC) with *Trichoderma longibrachiatum* was carried out in the plastic bags. However, it was impossible to achieve effective aeration and mixing due to no solid support of the plastic bag used. Therefore, the bioreactor was designed and prefabricated locally using Perspex. Various parameters were taken into consideration in designing of bioreactor for solid sate fermentation of PKC in production of fish feed. The parameters used were ease of agitation to ensure proper mixing of substrate and inoculums, positioning of air inlets for aeration, adequate allowance of headspace to ensure heat removal and lastly operating cost. These parameters determine the efficiency of solid substrate cultivation. Therefore, the objective of the study was to evaluate the fish feed quality derived from solid-state fermentation of PKC.

Materials and Methods

*Culture Conditions**Trichoderma longibrachiatum* inoculums was prepared by liquid solid cultivation. The compositions of the media are as follows: 0.6% KH_2PO4, 0.06% $MgSO4.7H_2O$, 1% $(NH_4)_2SO_4$, and 4% PKC. Solid-state fermentation was carried out in the bioreactor. Air inlet was passed through sterile saline solution.

*Analytical determinations*Protein content was calculated from the total nitrogen content as determined by the Kjeldahl method. Other determinations were amino acids, crude fibre, cellulose, hemi cellulose, ether extract, ash, and dry matter.

*Fish Feed*Isonitogenous and isocaloric feeds were formulated for tilapia using the least-cost linear programming software. Ingredients used include, fermented PKC (iPKC), fish meal, rice bran, soybean meal, palm oil, cod liver oil, mineral and vitamin premixes, threonine and histidine. Five different feeds with varying composition of iPKC including reference feed (no PKC) and ordinary PKC were prepared. The ingredients were manually mixed and passed through a pelleting machine. Each feed was oven-dried overnight at 60°C and the pellets were then crumbled in a blender to pass through a sieve size of 2 mm.

*Feeding trial*Red tilapia is the test fish used in the feeding trial. Their sizes ranged from 1.0 g to 5.0 g. Seven test feeds used were arranged in a completely randomized design (CRD) with three replications of each in the aquarium (20 litres capacity). The stocking density of the fish was at 1 fish /litre. Parameters monitored were survival, weight gain and feed digestibility after 8 weeks.

Results and Discussion

The solid-state fermentation of PKC (iPKC) increased crude protein content (from 18 to 31%) and a considerable decreased in the cellulose (28 to 13%) and hemi cellulose (37 to 12%) contents. The observed increase in lignin content of the fermented PKC might be due to the analytical method used based on the difference between the initial and the final weight after washing of cellulose and hemi cellulose. The difference in the initial and final weights of the fermented PKC, which contains small amount of cellulose and hemi celluloses resulted in a higher value in comparison with PKC, which contains higher amounts of cellulose and hemi cellulose. There were 18 types of amino acid detected in PKC. Most of essentials amino acids (10) required by fish were observed in the iPKC. All of these amino acids were significantly higher in the iPKC as compared to PKC. After five weeks of feeding trial, there has been no mortality, even though visual observation of an average weight gain appears to be lower than expected. Feed digestibility and actual weight gain will be estimated after the termination of the experiment, which will be on the 12th of November 2001.

Conclusions

Fermentation of PKC using bioreactor at specific conditions increased the crude protein content significantly compared to normal PKC. Most of essentials amino acids (10) required by fish were detected in iPKC. Proximate analysis of compounded feeds showed no significant different in the dry matter content of fish feed.

Benefits from the study

A general methodology has been established for solid- state fermentation of PKC using bioreactor at specific conditions in the laboratory. The patent for protein enhancement of PKC system in production of fish feed was filed and pending# (Hanafi and Kamarudin, 2001). Additional work on the scale up and pilot plant for economic evaluation needs further funding from MPKSN

Literature cited in the text

Hanafi, M.M. and M.S. Kamarudin. 2001. Protein enhancement of palm kernel cake. Malaysian Patent Pending No. PI 20012925)

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