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Nutritional Status of Palm Kernel Meal Inoculated With *Trichoderma Harzanium*

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Target audience: Feedmillers, farmers, and research institutions

Abstract

The ability of *Trichoderma harzanium* to improve the nutritional status of palm kernel meal (P K M) was assessed over forty days of fermentation. Fermentation within this time period induced various changes in the proximate and mineral analysis of the palm kernel meal. Comparatively, the highest crude protein and ether extract of 33.03% and 8.65% respectively were obtained at 20 days of biodegradation by Trichoderma *harzanium*. As the fermentation period increases there was reduction in the crude fibre content of palm kernel meal from 14.45% at day 0 to 7.74 at day 10. There was increase in the quality of Ca (0.016%) potassium (0.170%) at day 10 and phosphorus (0.00073%) at day 20 when compared with the control.

Keywords: Nutritional status of PKM *Trichoderma harzanium*

Description of Problems

Palm kernel meal is a by-product of palm oil extraction and is abundant in the tropics. Fetuga *et.al.*, (1974) Panigrahi and Powel (1991) reported various crude protein, metabolisable energy and Ether extract values of palm kernel meal. Onwudike (1986) equally reported the amino acid composition of palm kernel meal.

Climatic factors, differences in species of oil palm and the efficiency of extraction are some of the resulting differences in the proximate composition of palm kernel meal.

The utilization of palm kernel meal in the diet of monogastric animal especially poultry has not been favourable (Yeong *et. al.*, 1981; Olutoye 1986 and Ogbonna *et. al.*, 1988). This is highly unfortunate since economic resources of energy for poultry are in short supply. The Gritty nature of palm kernel meal, the crystalline (1 – 4) – D mannan, cellulose and branched galactomannans along with the lignifield shells which contain xylans have been implicated as the reasons for the inability of non-ruminants and man digestive enzymes to break it down efficiently (David and Jevis 1992).

According to Bogner (1961) poultry as well as other monogastric can utilize mannose but the efficiency can be improved upon when enzyme depolymerization of some of these polysaccharides like mannan into mannose and galactose is

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attempted with the possible degradation of cellulose by cellulases at the same time. David and Jevis (1992) attempt to improve the nutritional quality of palm kernel meal by treating with wide range of commercial enzymes, even those enzymes active in depolymerization of B (1,4) – D mannas in solution were used after pretreatment with sodium hydroxide little or no degradation of mannan was observed.

The work of Alang *et. al.* (1988) however highlighted the possibility of enzymatic degradation of oil palm seed. Enzyme preparations from fungi like *Rhizopus oryzae, penicillium* and *Trichoderma* spp cultured on wet palm kernel meal have the potential for large-scale improvement of palm kernel meal for non-ruminant nutrition.

Hui (1991) found Trichoderma species as the most successful fungi that can degrade cellulose embedded in lignin. This then explain the reason for the fungi of choice in this study, which intends to investigate the effect of biodegrading palm kernel meal with *Trichoderma harzanium* over a period of time on the proximate and some minerals composition of palm kernel meal.

Materials And Methods

Supply of Feedstuffs and fungal species:

The palm kernel meal used in this study was supplied by Adom Feedstuff, Orogun, Ibadan, Nigeria. This was milled, sieved with 3mm-pore size sieve and stored in polythene bags.

The Trichoderma specie used in the experiment was from Department of Botany and Microbiology University of Ibadan. It was preserved on potato dextrose agar slants and stored at 4°C.

Inoculation Procedure:

Thirty samples (100g each) of palm kernel meal were sterilized by autoclaving at 121°C for 15 minutes. They were arranged and labeled in such as to give six replicates for each of the periods used in the experiment (0, 10, 20, 30 and 40 days). These samples were then watered with 3-ml water to 10grams of samples.

A 6mm-cork borer was used to punch a luxuriant culture of the *Trichoderma harzanium* and aseptically introduced into the PKM for the target time period. Five of such inoculations were introduced into each sample and the samples were properly mixed and duely labeled. All samples were arranged based on days of fermentation and stirred every 3 days to ensure even degradation and aeration. Incubation was done at room temperature. At the end of each experimental period, the respective samples were oven dried at 80°C for 24hours and subjected to further analysis.

Proximate analysis

The samples of palm kernel meal were subjected to analysis of proximate composition according to the standard methods of A.O.A.C (1980) while Nitrogen free extract (N.F.E) was estimated by the difference of the summation of the crude protein value, Ether extract crude fibre and ash minus 100.

Mineral Analysis

The wet oxidation procedure of A.O.A.C (1980) was applied in the preparation of the digest for the mineral analysis. Suitable preparations of the digest were read on flame photometer for the respective minerals namely calcium, sodium and potassium.

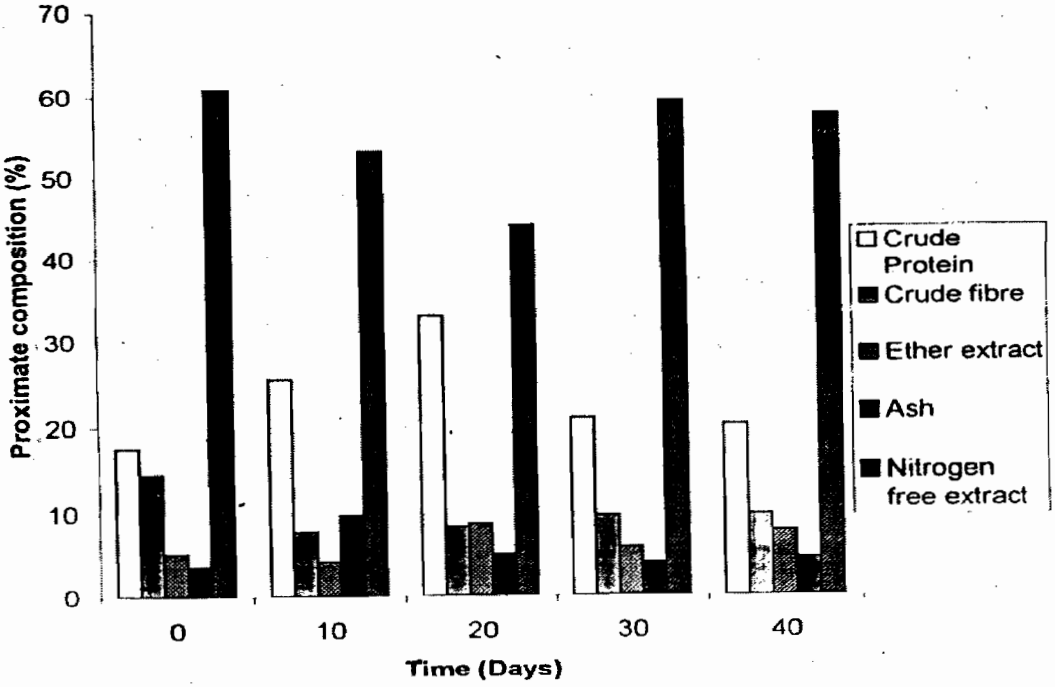
Results

The crude protein and Ether extract value of the biodegraded samples increased over the period of time (fig.1). The highest crude protein and ether extract (33.03% and 8.65% respectively) was obtained at 20 days of biodegradation by *Trichoderma harzanium.* Although there was an initial fall in the ether extract composition from day 0 to day 10 but this was later increased with increases in fermentation period.

The ash content of the samples were higher than the value obtained for day zero. As the fermentation period increases there was reduction in the value of the crude Fibre content of palm kernel meal from 14.45% at day 0 to 7.74% at day 10 when compared to the control, after which increases was observed over time.

The Nitrogen free extract content of the degraded samples were lower than that of the control (Fig.1).

Fig. 1: Effect of Trichoderma specie on proximate composition of biodegraded palm kernel cake.



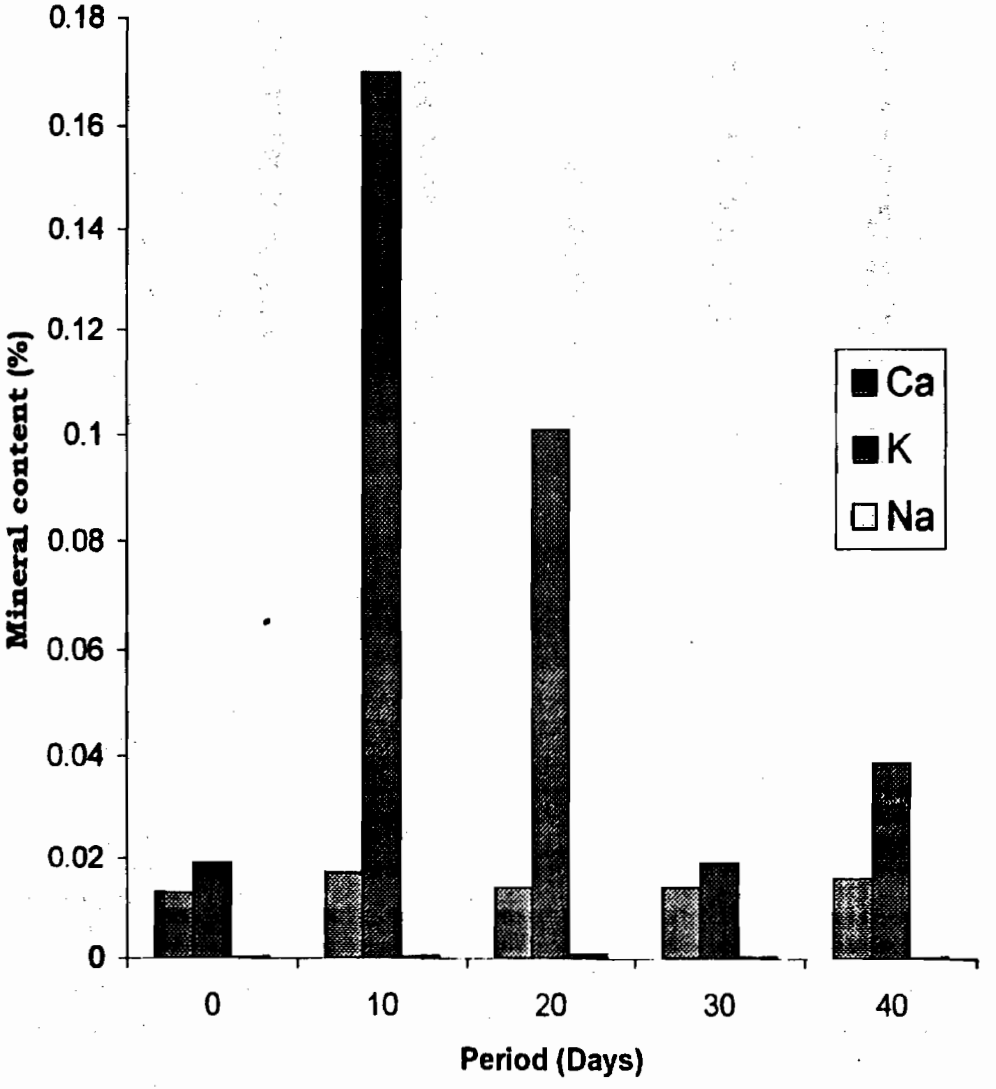
The effect of inoculation of *Trichoderma harzanium* resulted in improvement in the mineral content of the degraded palm kernel meal.
It was observed that there was increase in the quantity of Ca (0.016%) potassium (0.170%) at day 10 and phosphorus (0.00073%) at day 20 when compared with the control (Fig.2).

Discussion

The use of microbial enzymes to cleave the B (1 – 4) carbohydrates bond can also be used to improve the nutritional value of animal feeds. This is vivid in the result of proximate and mineral analysis obtained in these studies. The increase in protein content of the substrates after degradation must have resulted from the ability of microbes to convert large molecular substrate to lower molecules. This may also be as a result of proliferation of the microbes and increase in microbial mass.

Other researchers that had obtained increase in protein content as a result of fungi degradation include Belewu and Okhawere (1998) using *Trichoderma harzanium* on rice husk, and Smits *et. al.*, (1996) when inoculated wheat offal with *Trichoderma reesei*. The efficacy of the Trichoderma species at increasing the crude protein content of fibrous feedstuffs was equally attested to in the work of Onilude (1994) when Trichoderma species gave the highest protein content among seventeen other fungi tested. The possibility of ether extract serving as source of energy for the microbes in the process of solid state fermentation (Nishimura and Beevers 1979) coupled with the fact that the Trichoderma species have hydrolytic enzymes might be responsible for the rate of improvement

Fig. 2: Effect of Trichoderma Specie on some minerals content of Biodegraded palm kernel cake



of the ether extract. The mineral contents of fibrous feedstuffs are known to be bound by fibre and phytate (Reinhold *et. al.*, 1976; Davies *et. al.*, 1977). Other antinutritional factors in the mineral binding are oxalates and tannins (Harldan, 1989). Mod *et. al.*, (1982) opined that the release of nutrients from fibrous feedstuff is possible in-vitro and should be available for re-absorption in-vivo. This is evident equally in this study. Improvement in ash content has been reported by Yang *et. al.*, (1993) during protein enrichment of sweet potato residue with mono or co-culture of different fungi in solid state fermentation. Although he obtained some slight fall as biodegradation progresses. Smits *et. al.*, (1996) on the other hand obtained a non significant increase in ash content of wheat offal.

The reduction in the crude fibre content of the substrate in this study is due to the activities of the fungal enzyme, which degrade the non-cellulosic cell wall polysaccharides. The level of hydrolysis obtained is a function of the fibre composition and the nutritional requirement of the microbe. The approach is the disruption of large molecular weight substrates, reduction of viscosity and encapsulation (White *et. al.*, 1983; Campbell *et. al.*, 1993).

Other authors that obtained decrease in crude fibre content of fibrous feedstuffs include Smits *et. al.*, (1996) and Enruvbertine and Adegboyega (1996). Mod *et. al.*, (1982) opined that the bioavalability of essential minerals is affected by the body need for the minerals, digestibility of the food that supplies the minerals and the interaction of the minerals with other dietary components. The property of fibre to act as a cation exchange resin could produce undesirable effects such as reducing the absorption of several mineral elements (Branch *et. al.*, 1975; James *et. al.*, 1978). The above fact led to the treatment of high fibrous feedstuffs with dietary enzymes to release some of the minerals bound. Other possible treatment that could lead to release of minerals is the effect of pH. The released minerals would then be available for re-absorption in-vivo.

With increase in period of degradation, the amount of calcium, potassium and sodium made available increased as a result of degradation of the fibre component. Increase in sodium content of substrate after biodegradation is in line with the findings of Macedo and Makata (1987), during cheese ripening. Dietary phytate is known to reduce the availability of calcium, zinc, magnesium, iron, manganese and copper among others (Davies and Nightingale 1975). Since the degradation of phytic acid decrease over time with the introduction of dietary enzymes, then the mineral content will definitely increase. The work of Thompson and Weber (1981) however state that a fibre source may either have beneficial or detrimental effect on the mineral status of the animal. It is equally worth nothing that fibre-binding minerals are more common in divalent metals than with univalent minerals.

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