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CHEMICAL COMPOSITION OF BIOLOGICALLY TREATED *Jatropha curcas* KERNEL CAKE

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ABSTRACT
A study was conducted to evaluate the chemical composition and antinutritional qualities of fungi (*Aspegillus niger* and *Mucor mucedo)* treated *Jatropha curcas* seed cake. The experiment consist of three treatments thus A (Control, without fungi treatment) B (*A. niger* treated samples) and C (*M. mucedo* treated sample). The results revealed reduction in the level of the antinutients after fermentation with the microorganisms. Phytate was reduced from 6.67 to 5.92 in *A. niger* treated *J. curcas* seed cake and 6.26 in *M. mucedo* treated sample. Saponin content also reduced from 2.13 to 0.48 in *A. niger* and 0.35 in *M. mucedo* treated samples. Reductions were also observed in the cyanide, tannin and oxalate contents of the fungi treated *J. curcas* seed cakes. This reduction in the toxins of *J. curcas* seed cake indicates that fermentation may be a good method for the detoxification of toxic seed oils and subsequent uses as a source of feed for livestock. However, further works is required to ascertain the effect of this method on the level of phorbol ester (the main antinutritional factor of *J. curcas* seed) in the seed cake.

KEYWORDS: *Jatropha curcas, Aspergillus niger, Mucor mucedo*, fermentation, antinutritional factors.

INTRODUCTION

Jatropha curcas, commonly known as physic nut, belongs to the *Euphorbiaceae* family. It grows quickly and survives in poor stony soils, it is resistant to drought and diseases, reaches a height of 3 – 8 m, and can be grown on wastelands or barren and marginal agricultural lands where no irrigation facility is available. It does not compete with conventional food or feed crops for land and water, and thus it could be an ideal choice to make use of vast land resources that are presently underutilized. In tropical countries it is well known for its medicinal properties and as an oilseed. It is also used as a live hedge (Makkar *et al*., 1997; Gallegos-Tintoré *et al*., 2010).

Recently, *J. curcas* has attracted attention of various research organizations, governments, public and international developmental agencies and industries in the tropics and subtropics due to its adaptability to semi arid marginal sites, the possibility of using its oil as a diesel fuel substitute and its role in erosion control (Martinez-Herrera *et al*., 2010). The defatted meal has been found to contain a high amount of protein, which ranged between 50% and 62%. Except for lysine, all other essential amino acids in *J. curcas* meal protein have been reported to be in higher concentrations than those of the FAO reference pattern suggested for pre-school children (Makkar *et al*., 1998). Although the seed cake meal of *J. curcas* is rich in protein, it is toxic to rats, mice, ruminants and humans due to the presence of antinutrional factors such as phorbol esters, curcin, trypsin inhibitors, lectin etc, (Makkar *et al*., 1997; Makkar and Becker, 1997; Aregheore *et al*., 2003; Makkar *et al*., 2008; Abou-Arab and Abu-Salem, 2010). Because of its richness in protein, several works has been carried out on the *J. curcas* seed so that it can be used as a source of protein in animal feed. For example Oladele and Oshodi (2008) attempted the detoxification of the seeds using local fermentation process while Martı´nez – Herrera *et al*. (2006) also used chemical such $NaHCO_3$, ethanol as well as irradiation as a method of detoxification. However, Aregheore *et al* (2003) reported that Heat and chemical (ethanol) treatments was able to reduced the antinutrient factors in *J. curcas* seed to a tolerable minimum, while solid state fermentation employed by Belewu & Sam (2010) was able to detoxified and inactivate almost 100 % of the antinutrient contents of *Aspergillus niger* treated sample of *Jatropha* kernel cake to a tolerable level. The residual protein-rich seed cake, remaining after extraction of the oil, could form a protein-rich ingredient in feeds for poultry, pigs, cattle and even fish if it could be detoxified. The plant itself is very sturdy and can be an excellent candidate for re – greening of eroded zones, and for those lands that are not suitable for culture of more sensitive and demanding crops, (Martinez-Herrera *et al*., 2006). In view of these, the present research was designed to study the effects of biological treatment (*Aspergillus niger* and *Mucor mucedo*) to inactivate the antinutrional factors in defatted Jatropha kernel meal.

MATERIALS AND METHODS

Preparation of seed cake

The seeds were obtained from ripe fruits harvested from different locations in Osogbo, Osun State, Nigeria. The seeds were dehulled and milled with magnetic blender (SHB – 515) model, made by Sorex Company Limited, Seoul, Japan). Standard Official and Tentative Method of

Oil Chemists Society procedure was used to defat the seed cake (AOAC, 1990). The defatted seed cake was dried and kept for analysis.

Biological treatment

The cake was autoclaved using an autoclaving machine set at a temperature of 121^{0}C for 30 minutes in the laboratory of the Department of Biochemistry University of Ilorin, Ilorin.

Preparation and sub- culturing of the Fungi

The fungi (*Mucor mucedo* and *Aspergillus niger*) were obtained from the laboratory of the Department of Microbiology, University of Ilorin, Ilorin.

A paste of Potato Dextrose Agar (PDA) was prepared by weighing 10 g of PDA in 250 ml of distilled water; it was then autoclaved (Autoclave machine model YSQ-LS-/00SII) at 121^{0}C at 15 lbs per square inch for 15 minutes. It was allowed to cool to about 45^{0}C and streptomycin injection was added to prevent bacteria growth. The mixture was then poured into a sterile plate and allowed to set (solidify), after setting, the required organism was inoculated on the plate and incubated at room temperature for 72 hours. A pointed needle was used to pick the organism from the stock and stab the centre of the plate.

Inoculation and Incubation of *Jatropha curcas* kernel cake

The autoclaved cake was divided into three portions, a portion was inoculated with *Aspergillus niger* (Treatment B) another *Mucor mucedo* (Treatment C) while the third was left untreated (Treatment A). All the treatments were inoculated at ambient temperature in the laboratory. The fungal growth was terminated after 10 days by oven drying the spent substrates in an air draught oven at 70^{0}C for 24 hours in the laboratory of the Department of Animal Production, Faculty of Agriculture, University of Ilorin.

Analyses

The proximate compositions of the fermented and unfermented samples were analyzed using the method of AOAC (1990). All data were analyzed using ANOVA of a completely randomized design model.

RESULTS AND DISCUSSION

It has been reported that fungi treated samples of *J. curcas* seed cake had appreciable reduction in trypsin inhibitors and other toxins (Belewu and Sam 2010). The proximate composition of the fungi treated *J. curcas* seed cake is presented in Table 1.

TABLE 1: Proximate composition of the fungi treated and untreated *Jatropha curcas* seed cake$^+$

Parameter	Treatment A	Treatment B	Treatment C
Dry matter	65.2	66.5	90.8
Ether extract	30.0	29.3	42.7
Ash content	16.0	12.5	13.7
Crude fibre	9.02	4.70	4.25
Crude protein	44.4	52.9	50.8

Key: + means of three determinations

The results presented in Table 1 indicates that the fungi treatment increases the dry matter content of *Jatropha curcas* seed cake, this was in agreement of earlier report of Belewu *et al* (2010) and Belewu & Sam (2010). On the other hand *A. niger* treatment reduces the ether extract while there was an increase in the *M. mucedo* treated sample, the lowest value of 29.3 % was found in *A. niger* treated sample. Both the *A. niger* and *M. mucedo* treatments reduced the ash content of the *J. curcas* seed cake with 12.5 % and 13.7 % ash content respectively. This was consistent with the work of Belewu (2008). A slight decrease was also observed for the crude fibre content of *J. curcas* seed cake with 4.70% in *A. niger* treated sample and 4.25 % in *M. mucedo* treated sample in comparison to the untreated sample with value of 9.02 % The slightly lower content of the crude fiber might be due to the action of various enzymes (cellulase, xynalase, pectinase, chitin, amylase, hemicellulase, lipase etc) secreted by the fungi during fermentation process. The low fibre content confirmed the assertion of Jacqueline and Visser (1996) and Belewu and Popoola (2007).

The crude protein content of the fungi treated samples was higher than the untreated sample. The higher crude protein content of the fungi treated samples could be due to the addition of microbial protein during fermentation process.

TABLE 2: The antinutritional components of treated and untreated *Jatropha curcas* seed cake$^+$

Parameter	Treatment A	Treatment B	Treatment C
Phytate	6.67	5.92	6.26
Cyanide	1.35	1.04	0.68
Oxalate	1.49	0.93	0.61
Tannin	0.59	0.37	0.42
Saponin	2.13	0.48	0.35

+ Means of three determination

An interesting consequence of the fungi treatment used was the appreciable reduction in the antinutrient contents of *J. curcas* seed cake, Table 2. The lowest phytate and tannin contents were noted in the *A. niger* treated sample, the decrease in the various toxins levels could be due to the production of various enzymes during the vegetative and reproductive phases of the fungi (Jacqueline and Visser 1996). The various enzymes secreted during incubation period include cellulose, xylanase, xylosidases,

hemicellulase, amylases beta glycosidase, proteinases, pectinases, alphagalactosidase etc and these could have contributed to the detoxification of the cake (Belewu & Sam 2010). These findings agreed with the earlier works of Jacqueline & Visser, (1996) and Belewu & Popoola (2007).

CONCLUSION

It could be concluded from this study that incubation of *Jatropha curcas* seed cake with *A. niger* and *M. mucedo* cocktail of fungi is a promising method of minimizing to tolerable level if not removed completely, as it reduced the anti-nutrient contents of *Jatropha curcas* seed cake significantly. Consequently, an additional source of renewable feedstuff for livestock animals can be achieved.

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