ABSTRACT

A study was conducted to evaluate the chemical composition and antinutritional qualities of fungi (Aspergillus 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 antinutrients 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-Tintore 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 antinutritional 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 Martínez – Herrera et al. (2006) also used chemical such NaHCO₃, 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 antinutritional 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
Composition of biologically treated *Jatropha curcas* kernel cake

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°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°C at 15 lbs per square inch for 15 minutes. It was allowed to cool to about 45°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.

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

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Treatment A</th>
<th>Treatment B</th>
<th>Treatment C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry matter</td>
<td>65.2</td>
<td>66.5</td>
<td>90.8</td>
</tr>
<tr>
<td>Ether extract</td>
<td>30.0</td>
<td>29.3</td>
<td>42.7</td>
</tr>
<tr>
<td>Ash content</td>
<td>16.0</td>
<td>12.5</td>
<td>13.7</td>
</tr>
<tr>
<td>Crude fibre</td>
<td>9.02</td>
<td>4.70</td>
<td>4.25</td>
</tr>
<tr>
<td>Crude protein</td>
<td>44.4</td>
<td>52.9</td>
<td>50.8</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Treatment A</th>
<th>Treatment B</th>
<th>Treatment C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phytate</td>
<td>6.67</td>
<td>5.92</td>
<td>6.26</td>
</tr>
<tr>
<td>Cyanide</td>
<td>1.35</td>
<td>1.04</td>
<td>0.68</td>
</tr>
<tr>
<td>Oxalate</td>
<td>1.49</td>
<td>0.93</td>
<td>0.61</td>
</tr>
<tr>
<td>Tannin</td>
<td>0.59</td>
<td>0.37</td>
<td>0.42</td>
</tr>
<tr>
<td>Saponin</td>
<td>2.13</td>
<td>0.48</td>
<td>0.35</td>
</tr>
</tbody>
</table>

+ 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,
CONCLUSION
It could be concluded from this study that incubation of Jatropha curcas seed cake with A. niger and M. mucida 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.

REFERENCES


