Efficacy of Mucor and Abisidia Treated *Jatropha curcas* kernel cake on Performance Characteristics of Goat

***Belewu, M.A., [1] Odebisi, M.B., [2] Esan, O.T, [2]Abdulsalam, K.O., [2]Arise, A.K., Badmos, A.H.A., Liadi, M.T., Lawal, R.A., Ugbamaja, E.R and Adebayo, A.M.**

Microbial Biotechnology and Dairy Science Laboratory
Department of Animal Production, University of Ilorin,
[1]Department of Microbiology
[2]Department of Home Economics and Food Science
E-mail: milkyinka@yahoo.com,
Tel: 234-8035817941/234-8020594079
*Corresponding author.

ABSTRACT

The study evaluates the efficiency of *Mucor indicus* and *Absidia corymbifera* treated *Jatropha curcas* kernel cake on the performance characteristics of weaner West African dwarf goats (average BW= 6.25kg). The goats (n=25) were randomly allocated to five dietary Treatments A, B, C,D and E in a Completely Randomised design model for a 56 day period. Treatments A (Control, contained Groundnut cake as protein source); Treatment B (contained 50% Groundnut cake plus 50% *Mucor indicus* treated *Jatropha curcas* kernel cake), Treatment C (contained 50% Groundnut cake plus 50% *Absidia corymbifera* treated *Jatropha curcas* kernel cake) , Treatment D (contained 25% Groundnut cake plus 75% *Mucor indicus* treated *Jatropha curcas* kernel cake) and Treatment E (contained 25% Groundnut cake plus 75% *Absidia corymbifera* treated *Jatropha curcas* kernel cake). The results revealed higher crude protein and ether extract contents for the fungi treated *Jatropha curcas* kernel cake compared to the untreated cake. Conversely, the crude fibre content of the fungi treated *Jatropha*

curcas kernel cake was lower than the untreated cake. Additionally, the crude fibre content of the fungi treated *Jatropha curcas* kernel cake was reduced between 20% (*Mucor indicus) and* 28% (*Abisidia corymbifera)* compared *to* the untreated cake.

Similarly, the dry matter, crude protein, ether extract and ash contents of the fungi treated Treatments B, C, D and E were numerically higher (P> 0.05) compared to the Control (Treatment A). Conversely, the Crude fibre content of Treatments B, C, D and E was lower compared to Treatment A (Control). The dry matter intake of Treatments B and E compared favourably with that of the Control (Treatment A) but significantly higher than Treatments C and D. The crude protein, ash and nitrogen free extract intakes followed similar trend. The crude fibre intake of Treatments A and E were similar but significantly higher than other Treatments. Animals on Treatments B and E had similar weight gain to that of the Control (Treatment A). With the exception of dry matter digestibility of Treatment A which was significantly higher than other Treatments, other nutrient digestibility (crude protein, ether extract and nitrogen free extract) were similar($p>0.05$). The Crude fibre digestibility was lower for the fungi treated Treatments compared to the Control. It could be concluded that inclusion of 50% *Mucor indicus* treated *Jatropha curcas* kernel cake and 75% *Absidia corymbifera* treated *Jatropha curcas* kernel cake could be used to supplement for high cost of groundnut cake in the diet of goat.

……

Key words*: Jatropha curcas, Mucor indicus, Absidia corymbifera*, feed intake, weight gain, digestibility coefficient, goat

INTRODUCTION

The most vital factor affecting the survival, dominance, growth and development of livestock is nutrition. Nutrition also, exerts a very large influence on flock reproduction, milk production, and lamb and kid growth. Hence, formulation and feeding of well balance feed is paramount in livestock farming. Interesting to note that feed accounts for about 60% or more of the total cost of production of livestock therefore, caution must be taken to formulate a least cost ration without compromising the quality of such feed. The increasing cost of conventional feedstuffs, low availability and increasing competition between man, livestock and industries for these conventional feedstuffs stimulated animal nutritionist to pay more attention to exploring the use of unconventional feedstuffs like *Jatropha curcas.*

Jatropha curcas which is a non-edible oil crop of the family Euphorbiaceae is a typical example of such novel feedstuff. The feedstuff which has a crude protein content of between 40 and 60% is readily available and cheap but has some anti-nutrients (tannin, saponin, lectin, trypsin inhibitor, phorbol ester) that hindered its utilization by livestock animals (Makkar and Becker, 1997). Numerous workers (Makkkar and Becker,1997., Annongu *et al.,* 2010) have used different methods (physical and chemical) of detoxifying the cake with no positive result. However, Belewu and Adeniyi (2001); Belewu and Ogunsola (2010) used solids state fermentation method with a positive response. Solids State fermentation method was reported by various researchers (Broerse and Visser, 1996., Sabu et al., 2005,) as enhancing the protein , total lipids and fatty acids contents of the substrates as well as helps in detoxifying some toxins. Various microorganisms secret different enzymes thus : Mucor secrets enzymes like amylase, lipase, protease and pectinase while Absidia secrets enzymes like lipase, caseinase and alpha-galactosidase (Calhoun *et al,* 1985). It is noteworthy that untreated Jatropha kernel cake is presently a low value by-product but treatment of the cake will improve its suitability as livestock feed; enhance its market value equivalent to that of soybean. Therefore, the thrust of this study was to evaluate the dietary effect of fungi (*Mucor indicus and Absidia corymbifera)* treated *Jatropha curcas* cake on the feed intake, weight gain and digestibility coefficient of West African dwarf goat.

MATERIALS AND METHODS

Collection and Preparation of *Jatropha curcas* seeds

Sun dried *Jatropha curcas* fruits were picked from Osogbo, Osun State and Kwara State. The pericarps were removed to obtain the seeds, which were later de-husked manually to attain the kernels. The kernel was pressed with hydraulic pressing machine so as to get rid of the oil and obtained the cake for further processing.

Preparation, Inoculation and Incubation of the Cake

The cake from the pressing machine was later milled and autoclaved at 121^{0C} for 15 minutes so as to get rid of any possible microbes in the cake.. The substrate was allowed to be cooled before inoculation with fungi.

Fungi Used

The fungi used were obtained from the Department of Microbiology, University of Ilorin, Nigeria. Each of the fungus was maintained on potato dextrose agar containing in petri dishes and incubated for 7 days at room temperature so as to enhance the growth.

The substrate was packed in already autoclaved transparent polythene bags. Each polythene bag (2kg) was inoculated with 5ml of either *Mucor indicus or Absidia corymbifera* separately. The spore suspension contained 10 spores per ml. The inoculated substrate was covered with black polythene sheet and left for 14 days during when the fungi could have enveloped the substrate. At the end of the incubation period the substrate was oven dried at 70^{oC} to terminate the fungal growth.

Preparation of the Experimental Diets

The fungi treated substrate was used in the formulation of diets for the experimental animals thus:

Treatment Protocol

Treatment A = Control diet (without fungi treated substrate)

Treatment B = 50% *Mucor indicus* treated Jatropha kernel cake + 50% Groundnut cake

Treatment C = 50% *Absidia corymbifera* treated Jatropha kernel cake + 50% Groundnut cake

Treatment D = 75% *Mucor indicus* treated Jatropha kernel cake + 25% Groundnut cake

Treatment E = 75% *Absidia corymbifera* treated Jatropha kernel cake + 25% Groundnut cake

Table 1: Composition of the Experimental Diets

Ingredients (%)	Treatment A	Treatment B	Treatment C	Treatment D	Treatment E
Cassava wastes	63.00	63.00	63.00	63.00	63.00
Rice husk	31.00	31.00	31.00	31.00	31.00
Groundnut cake	4.00	2.00	2.00	1.00	1.00
Fungi treated Jatropha kernel cake	0.00	2.00[a]	2.00[b]	3.00[a]	3.00[b]
Vitamin-mineral premix	1.00	1.00	1.00	1.00	10..
Salt	1.00	1.00	1.00	1.00	1.00
Total	100.00	100.00	100.00	100.00	100.00

a = Mucor *indicus* treated Jatropha Kernel cake. b = *Absidia corymbifera* treated Jatropha kernel cake

Experimental Animal and Management

Prior to the start of the experiment the pens were washed and dis-infected using detergent and Izal . While twenty five West African dwarf goats (average weight = 6.0kg) used for the experiment were bought from a local market in Ilorin metropolis, Nigeria and treated against ecto and edo- parasite using Ivomec. They were later randomized against the experimental diets while feeding and watering were supplied *ad-libitum* throughout a 56 day period. The animals were weighed before the commencement of the experiment and at weekly interval to determine the average weight gain/loss.

Feed intake was determined by subtracting the orts from the feed supplied daily while digestibility was determined during the last two weeks of the experiment. During digestibility trial the animals were kept in metabolic cages while the total feacal output were collected and digestibility coefficient was determined thus:

$$= \frac{\text{Feed intake} - \text{Feacal output}}{\text{Feed intake}} \times 100$$

Chemical Analysis

The proximate composition of untreated cake, fungi treated cake, experimental diets and, feaces were determined according to the procedure of AOAC (1990) method.

Statistical Analysis

All data collected were subjected to Analysis of Variance of a Completely Randomised design model (Steel and Torrie , 1990) while treatment means were separated using Duncan (1955) Multiple range test.

RESULTS

Table 2 : Proximate Composition of the Experimental Diets

Parameters	Untreated Jatropha Kernel cake	*Mucor indicus* treated Jatropha kernel cake	*Absidia corymbifera* treated Jatropha kernel cake
Dry matter	888.88	86.67	87.66
Crude Protein	335.68	41.78	41.34
Crude fibre	34.28	27.44	24.79
Ether Extract	1.78	2.00	2.20
Ash	9.32	3.90	4.44
Nitrogen Free Extract	7.82	11.55	14.89

Table 2 shows the proximate composition of Untreated and fungi treated Jatropha kernel cake. The protein content of the treated Jatropha kernel cake increased by 17% (B, Mucor treated sample,) and 16% (C, Absidia treated sample,) compared to the untreated cake while the ether extract content also increased by 12.36% (B, Mucor treated sample) and 2.4% (C, Absidia treated sample). Conversely, the Crude fibre content and the Ash content were greater for the untreated sample than the fungi treated samples.

Table 3: Proximate composition of the Experimental Diets

Parameters	Treatment A	Treatment B	Treatment C	Treatment D	Treatment E
Dry matter	88.89	91.90	91.06	89.17	90.57
Crude Protein	6.68	7.84	7.97	7.61	6.94
Crude fibre	42.28	40.02	38.80	42.10	41.92
Ether extract	3.78	4.82	4.10	4.24	4.75
Ash	10.32	10.81	10.64	10.30	10.62

The crude protein content of the experimental diets (Table 3) increased for Treatments B, C, D and E compared to Treatment A (Control). The ether extract content followed similar trend. Decreasing Crude fibre content was recorded for Treatments B, C, D and E compared to Treatment A (Control). With the exception of Crude fibre content of Treatment D, other Treatments (B , C and E) were numerically lower than Treatment A (Control).

Table 4: Feed intake and Weight gain of the Experimental Animals

Parameters/ diets	A	B	C	D	E	±SEM
Dry Matter	388.93[a]	327.50[a]	221.79[b]	123.57[c]	388.57[a]	11.70
Crude Protein	26.56[a]	25.87[a]	17.53[b]	9.13[c]	27.07[a]	0.58
Ether Extract	13.88[a]	15.91[a]	9.02[a]	5.09[b]	18.53[c]	0.91
Crude Fibre	222.26[a]	102.40[b]	74.71[c]	52.75[d]	181.97[a]	11.32
Ash	39.94[a]	35.67[a]	23.41[b]	12.36[c]	41.42[a]	1.07
Weight Gain	4.76[a]	4.76[a]	1.19[b]	0.20[c]	4.76[a]	0.26

Table 4 shows the feed intake, digestibility coefficient and weight gain of the experimental animals. The dry matter intake of Treatments A, B and E are similar but significantly different from Treatments C and D. The Crude protein was greater for Treatments A, B and E and least for D. The ether extract was 13.88 (A), 15.91 (B), 9.02 (C), 5.09 (D) and 18.53 (E), The Crude fibre was greater for A> E > B > C >D in that order.

The ash intake followed similar trend. The highest weight gain was recorded for animals on Treatments A , B and E and least for animals on Treatment D. With the exception of the dry matter digestibility and crude fibre digestibility, other parameters showed no significant difference ($p>0.05$). The dry matter digestibility of Treatment A was significantly higher than other Treatments (B, C, D and E). Additionally the crude fibre digestibility was greater for Treatments A > E > B >C > D in that order.

Table 5: Digestibility Coefficient of the Experimental Animals (%)

PARAMETERS	A	B	C	D	E	±SEM	REMARKS
DM	90.48[a]	74.48[b]	73.27[b]	61.18[b]	70.47[b]	2.53	SD
CP	94.50	91.73	89.73	72.62	87.51	0.66	NSD
EE	90.25	96.77	85.14	91.36	97.41	1.16	NSD
CF	93.06[a]	71.27[b]	66.11[b]	58.71[c]	75.74[b]	3.08	SD

DISCUSSION

The increased Crude Protein content of the fungi treated samples (Table 2) could be due probably to the addition of microbial protein synthesized by the fungi . This assertion corroborates the submission of Broerse and Visser, 1996) and Belewu and Popoola (2007). It is enough to also note that the increment in the ether extract of the fungi treated sample could be accounted for by the production of various enzymes. This was in agreement with the report of Sabu *et al*. (2005). The low crude fibre content of the fungi treated sample confirmed the degradation and upgrading of the nutrient values of agricultural by products by fungi (Broerse and Visser, 1996).

The increase in the Crude protein content of the fungi treated Treatments B –E (Table 3) was similar to the work of Martinez-Herrera *et al* .(2006) and Belewu and Ogunsola (2010) who fed Aspergillus treated *Jatropha curcas* seed cake to goat. Another point of consequence was the increasing ether extract of the fungi treated Treatments B –E indicating lipogenic ability of the fungi. The decreasing Crude fibre found in Treatments B-D was similar to the report of Belewu and Popoola (2007). The low Crude fibre content after fermentation could be due to the utilization of the fibre content by the fungi for their growth (Broerse and Visser, 1996).

The significantly dry matter intake of Treatments A, B and E could be accounted for by a better interaction between metabolic and nutritional factors and /or a result of the synergistic effect of the different chemical composition which emanated from the combination of the Jatropha kernel cake and Groundnut cake.

The dry matter digestibility which decreased from Treatments A-E was similar to the work of Chivand *et al* . (2006) and Belewu (2008) who observed similar trends in pigs and rats respectively. The lower digestibility of Crude fibre may be due to the action of various enzymes (xylase, pectinase, amylase, lipase, cellulose, hemicellulase) sectered by fungi during fermentation process. The low fibre digestion confirmed the report of Broerse and Visser (1996). The numerically higher ether extract digestibility of Treatments B, D and E compared to Treatments A and C was similar to the work of Sabu *et al*. (2005).

The higher weight gain recorded for animals on Treatments B and E revealed better utilization of the diet compared to other Treatments.

CONCLUSION AND IMPLICATIONS

The result from this study demonstrates that fungi treatment of Jatropha kernel cake holds a very promising value as an effective method of detoxifying the kernel cake due to the improved performance of the animals. This biological method could be used to replace the complicated and expensive chemical and physical methods. Hence, it could be concluded that 50% inclusion of *Mucor indicus* treated Jatropha kernel cake and 50% Groundnut

cake or 75% *Absidia corymbifera* and 25% Groundnut cake should be encouraged among livestock farmers.

REFERENCES

SabuA. Kiran , G.S. and Panda, A. (2005). Purification and Characterization of tannin acylhydrolase from A . niger ATCC 16620. Food Technol. Biotechnol. 42 (2) :133-138.

Annongu A.A., Belewu M.A., P Joseph J.K., (2010). Potentials of Jatropha seeds as Substitute Protein in Poultry. Res. J. Animal Sci., 4 (1) 1-4.

A.O.A.C. (1990).Association of Analytical Chemists. Official Methods of Analyses 15th edn. Washington D.C.

Belewu, M.A. (2008). Replacement of Fungus treated Jatropha curcas seed meal for Soybean meal in the diet of Rat. Green Farming Journal Vol 2 (3) :154-157

Belewu, M.A. and Adeniyi, A.O. (2001). Apparent digestibility of solid state fermentation of cotton waste withfungus (PleurotusSaiorCaju) using WAD goat. NISEB Journal 1 (2) 123-128.

Belewu, M.A. and Ogunsola, F.O. (2010). Haematology and Serum Indices of Goat fed Fungi treated and Untreated Jatropha curcas Kernel cake in a Mixed Ration. J . Agriculture, Biology and Sustainable Development Vol 2 (3) :35-38

Belewu, M.A. and Popoola, M.A. (2007).Performance characteristics of African dwarf goats fed Rhizopus treated Sawdust. Scientific Research Essay. 2 (9) 496-498.

Broerse J. E.W and Visser, B. (1996).Assessing the potential in Biotechnology: Building on Farmers knowledge. Edited by Joske Bunders, BertusHaverkot and WimmHiemstra.Macmillan edu.Ltd. London and

Basingstoke.

Calhoun, D.H, Bishop, D.F., Bernstein, H.S., Quinn M. HantzopoulosP., Desnick, R.J. (1985). Fabry disease:Isolation of a cDNA clone encoding humanalpha-galactosidae A. proc.Natl.acad.sci.U.S.A. 82(21):7364-8.

Chivandi, E., Erlwanger, K.H., Makuza, S.M., Read, J., and Mtimuni, J.P. (2006). Effect of dietary *Jatropha curcas*meal on percent packed cell volume, serum glucose cholesterol, triglyceride concentration and alphaamylase activity of weaned fattening pig. Research Animal and Veterinary Science 1(1): 18-24.

Duncan, D.B. (1995). Multiple Range and Multiple F-test. A Biometric Approach.Pp 1-42.

Makkar, H.P.S. and Becker, K. (1997). Potential of J. curcasseed meal as Protein.Supplement to Livestock Feed,Constraints to its Utilization and Possible Strategy to Overcome Constraints. In G. M. Gubitz, M.

Mittelbach and M. trabi Eds. Biofuel and Industrial Products from Jatrophacurcas, Proceedings of theSymposium "Jatropha 97" held in Managua, Nicaragua, Feb 23 – 27, 1997.

Martinez-herrera, J., Siddhuraju, P., Francis G., Davila Ortiz, G., and Becker, K. (2006). Chemical composition,Toxic/anti-metabolic constituent and effects of different treatment on their levels in four provenances of J.curcas from Mexico. Food chem. 96:80-89.

Steel, R.G.D. and Torrie, J.H. (1990).Principles and Procedures of Statistics; A Biometric Approach.2nd edition,McGraw Hill Book Co., New York, USA. Pg 63