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Full Length Research Paper

Biological upgrading of the nutritional quality of *Jatropha curcas* kernel cake: effect on performance characteristics of goat

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This study was conducted to evaluate the feeding value of fungi treated *Jatropha curcas* kernel cake on feed intake, weight gain /loss , digestibility coefficient and blood parameters of West African dwarf goat. Five diets were formulated with diet A (control, without *Jatropha curcas* kernel cake); B (50% *Penicillium* treated *Jatropha curcas* kernel cake +50% Soybean cake), C (50% *Aspergillus niger* treated *Jatropha curcas* kernel cake + 50% Soybean cake), D (100%*Penicillium* treated *Jatropha curcas* kernel cake) and E (100% *Aspergillus niger* treated *Jatropha curcas* kernel cake). The animals (n=15) were randomized against the experimental diets in a completely randomized design model for a 56 day period. The results revealed highest crude protein intake for diet A and the least for diet E. The ether extract (EE) and crude fibre (CF) consumption were significantly higher for the control diet (A) compared to the fungi treated based diets. The crude protein digestibility was highest in diet A and least in diet C. The serum and haematological values are within the normal range for goat. It was concluded that West African dwarf goat can be fed a diet consisting of 50% *Aspergillus niger* treated Jatropha curcas kernel cake /or 50% *Penicillium treated Jatropha curcas* kernel cake in a mixed ration.

Keywords: *Aspergillus niger, Penicillum sp*, feed intake, digestibility coefficient, blood parameters

INTRODUCTION

The most complex limiting factor in animal production in the tropical and sub tropical environment include nutrition and feed supplies. Animal feeds accounts for between 40 and 60% of the total cost of production, due probably to the competition between man and his livestock. However, ruminant animals are opportunity feeder due to their ability to consume all manner of feedstuffs which ranges from agricultural wastes, browse plants and shrubs and some weeds that contain some anti-nutrients. But it was noted (Belewu, 2008, Belewu et al.,2010) that goat and rat could not tolerate the consumption of untreated Jatropha curcas seed cake.

Jatropha curcas plant is a multipurpose drought resistant large shrub or small tree which is a native of tropical America. The plant was found to thrive very well throughout Africa and Asia countries. Unfortunately, the plant is not browsed for its leaves and stem due to the presence of some anti-nutrients like tannin, saponin , lectin , protease inhibitors phytate and phorbolester. Phorbolester which was identified as a major toxic content in Jatropha plant are bioactive deterpene derivatives with multitude effect on rat (Belewu, 2008).

Phorbolester was found to be responsible for purgative skin irritant effect and tumor promotion due to its stimulating effect on kinase C which is involved in transduction and development processes (Makkar and Becker, 1997)

The seed formed a large proportion of the fruit while the kernel formed a large part of the seed. The seed could be stored for a long period of time due probably to the low moisture content of the kernel (<6%) and shell (<10%). Additionally, the presence of antinutrient is also likely enhanced the shelf life of the seed. The shell/ seed coat was reported to composed mainly of fibre (>83% NDF, >45% ADL with low protein <5%) (Makkar and Becker 1997). The chemical composition of the seed and the kernel composed mainly of lipid and protein with little

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Table 1. Composition of the Experimental Diets

Parameters (%)	Diet A	Diet B	Diet C	Diet D	Diet E
Cassava waste	63.00	63.00	63.00	63.00	63.00
Rice husk	31.00	31.00	31.00	31.00	31.00
Soybean cake	4.00	2.00	2.00	----------	--------
Jatropha curcas kernel cake	-------	2.00a	2.00b	4.00a	4.00b
salt	1.00	1.00	1.00	1.00	1.00
Vitamin –mineral premix	1.00	1.00	1.00	1.00	1.00

Note a= *Penicillium* sp, b= *Aspergillus niger*

amount of moisture and ash. The crude protein content of the untreated Jatropha curcas kernel cake was 50.80% while the crude fibre was given as 7.01% and the ash 4.45% (Belewu et al., 2010).

The NPN content of Jatropha seed meal was between 21 and 35% compared to 2.9-8.0% of soybean meal, 50% sunflower and 6.9% rape seed meal. This suggested that Jatropha meal has a significant amount of rumen bypass protein which will be available to animal at post rumen for production purposes (Aderibigbe et al., 1997).

Various) detoxification methods (chemical and physical) (Makkar and Becker, 1997) are well documented in literature with no encouraging results. Apart from the high cost of chemicals, it is interesting to note that chemical could also caused chemical load in the animal. Recently, the biological method of detoxification which is well documented gave promising results (Belewu et al 2010). Thus, the thrust of this study was to evaluate the nutritional value of fungi (Aspergillus niger and Penicillium sp) treated *Jatropha curcas* kernel cake by goat.

MATERIALS AND METHODS

Location of the experiment

The study was carried out at the Animal Pavilion of the University of Ilorin, Nigeria. University of Ilorin is located in the central zone of Nigeria.

Animal and Housing

Fifteen growing West African dwarf goats bought from a local market in Ilorin, Nigeria were treated against ecto and endo parasites using IVOMEc and L-oxytetracycline against cold and pneumonia before the initiation of the experiment. The animals were fed ad-libitum throughout the experimental period (56 days).

Inoculation and Incubation of *Jatropha* kernel cake

Jatropha curcas kernel cake was milled and later autoclaved at 121^{0C} for 15 minutes so as to get rid of any microbes that may be present. The kernel cake was later cool and inoculated with the different microbes (10^6-10^9 spores of the different fungi). The whole content was incubated at 37^{oc} till the fungi enveloped the substrate in about 7 days. At the end the growth of the fungi was terminated by oven drying 70^{oc} for 48 days. The spent substrate was later used in the formulation of diet as shown in Table 1.

Treatment and Design

The experimental animals were allocated to five treatments in a completely randomized design model. The five diets consist of a control (Diet A) which was a soybean cake based diet, Diet B (50% soybean cake + 50% Penicillium treated Jatropha Kernel cake) , C (50% soybean cake +50% Aspergillus niger treated Jatropha kernel cake) , D (100% Penicilliun treated Jatropha kernel cake) and E (100% Aspergillus niger treated Jatropha kernel cake).Other ingredients are of fixed proportions in the diets.

Measurements

Measurement data of feed given and residue was obtained daily. Digestibility coefficient was determined during the last week of the experiment in which each goat was individually kept in a metabolic cage which allowed for separation collection of faeces and urine. About 10% of the faeces from each goat was taken daily and kept in a deep freezer at 0^{0C} until the end of the experimental period. The faeces were later thoroughly mixed and representative samples taken and dried at 70^{oc} for 24hours. Dried samples were milled and various proximate composition were determined (AOAC, 1990).

Analyses

All data collected were subjected to analysis of variance of a completely randomized design model while means were separated using Duncan (1955) multiple range test.

RESULTS AND DISCUSSION

Chemical composition

Data on proximate composition is as shown in Table 2. There was wide variation in the nutritive value of the diets (A-E). Generally, the control diet had the highest crude

Table 2. Proximate composition of the Experimental diets

Parameters (%)	Diet A	Diet B	Diet C	Diet D	Diet E
Dry matter	95.70	95.20	94.90	98.40	92.00
Crude Protein	8.00	6.89	6.68	6.23	7.37
Crude fibre	32.39	27.94	28.77	20.73	27.39
Ether extract	11.28	9.66	12.12	7.83	12.28
Ash	13.06	12.29	11.17	9.86	8.80

Table 3. Feed intake and Digestibility coefficient of the Animal fed the experimental diets

Parameters	Diet A	Diet B	Diet C	Diet D	Diet E
Dry matter intake	607.01a	473.36b	368.97c	535.06b	294.90d
Dry matter digestibility	86.50	92.00	86.00	87.60	86.40NS
Crude protein intake	48.56a	32.65b	24.78c	33.14b	21.74c
Crude protein digestibility	73.40a	53.40b	33.70c	46.20b	45.70b
Ether extract intake	68.47a	45.79b	44.94b	41.66b	36.23b
Ether extract digestibility	94.90	98.30	96.00	95.80	96.50NS
Crude fibre intake	196.60a	132.44b	106.74c	110.28c	80.80
Crude fibre digestibility	90.20	93.10	90.00	87.50	91.90
Ash intake	79.27	58.25	41.44	52.46	25.96

Means along the same row with similar superscripts are not significant different ($p>0.05$) NS= Not significant at $p>0.05$, Significant at $p<0.05$

protein (CP), crude fibre (CF) and ether extract (EE) and less of nitrogen free extract (NFE). This was consistent with the work of Belewu (2008) and Belewu et al. (2010).

Feed Consumption and Digestibility Coefficient

The dry matter consumption of goats fed the control diet (diet A) was significantly higher than the fungi treated based diets (Table 3). This observation was similar to the report of Belewu (2008) who reported higher feed intake for rats fed soybean cake based diet. The crude protein, crude fibre and ether extract consumption followed similar trend. The crude protein intake was a major determinant of dry matter intake hence, the importance of crude protein intake as the determinant of performance in ruminant has been strongly emphasized by Preston and Leng (1987). Hence similar observation was noted in this study.

Results of the apparent digestibility coefficient of ether extract and crude fibre did not show any significant difference among diets. In contrast the dry matter digestibility was numerically higher for diet B followed by diets D, A, E in the order and the least was diet C ($p>0.05$).

Blood Parameters

Table 4 shows the blood parameters of the experimental animals. The value of the Packed cell volume (PCV) reported herein fell within the normal value reported by Tambuwal et al.(2002) and Belewu et al. (2010).This shows that fungi treatment of Jatropha curcas kernel cake had no effect on the PCV.The value noted for Red blood cell (RBC) was lower than the reported results of Tambuwal et al.(2002).However, the reported value herein was similar to the value reported by Belewu et al . (2008).The variation could be due probably to the type of diet fed to the animal.

The haemoglobin (Hb) value recorded in this study fell within the normal range of value (7-15) reported by Tambuwal et al. (2002).However, the value noted in this study was higher than the value reported by Belewu et al. (2010).

There was no significantly difference in the white blood cell count among the diets; however, the value was higher than that of Belewu et al. (2010) but fell within the normal range of values (6.8-20.1) reported by Tambuwal et al .(2002). Additionally, the value was similar to the normal range reported by Tambuwal et al. (2002) for goat. This shows that the animals are not infected by any

Table 4. Mean hematological and serum parameters

parameters	Diet A	Diet B	Diet C	Diet D	Diet E	±SEM
PVC (%)	28.30	30.70	25.30	25.00	21.90	0.34
RBC$10^{12/L}$	2.06a	2.14a	1.40b	1.47b	1.10c	0.21*
Hb (g/dl)	11.50ab	12.00ab	11.00c	9.40d	9.70d	0.59*
WBC ($10^{9/L}$	10.40a	9.20b	10.50a	9.80b	9.90b	0.79*
Neutrophil(%)	73.30	73.00	77.00	76.70	74.70	3.19*
Lymphocytes(%)	26.30b	75.30a	22.33b	22.00	23.00b	8.33*
Monocytes(%)	0.33	0.33	0.33	0.33	0.67	0.42*
Eosinophil(%)	0.00	1.33	0.33	1.00	1.67	0.64*

Means along the same row with similar superscripts are not significant different ($p>0.05$) NS= Not significant at $p>0.05$, Significant at $p<0.05$

disease.The lymphocyte value was lower than the value noted by Belewu et al. (2010). The value of 75.3% reported for diet B fell within the range of value reported by Tambuwal et al. (2002). The monocytes count which is responsible for breaking down foreign particle for lymphocyte's action was found to be of low value in this study.The low value indicates that the animals were not affected by any surgical trauma/ disease (Kahenbuhl et al., 1998).

Eosinohpil value reported in this study fell within the value reported in literature (http://web2.Girmail.net/lithman/blood_cell).The low value shows that the diets are not dusty hence the animal had no respiratory impairment (cough, wheezing, chest tightness, eye and nasal irritation, itching, sneezing and skin rashes) (Chattopadhyay et al., 2007). High level of eosinophil could results in destructive type of pulmonary dysfunction (Chattopadhyay et al., 2007).There are few papers to our knowledge, that investigated the use of fungi treatment on Jatropha curcas kernel cake except that of Belewu (2008) , Belewu et al .(2010).

Conclusion and Application

The results of this study indicate that:

1. Fungi treated *Jatropha curcas* kernel cake can partially replace soybean cake for growing goat by as much as 50%.
2. Inclusion of fungi treated *Jatropha curcas* kernel cake is encouraging due to its nutritional improvement.
3. This simple technology would be a promising feed source for goat

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