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Archives of Applied Science Research, 2010, 2 (4): 255-261

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ISSN 0975-508X
CODEN (USA) AASRC9

Response of Goat to Fungi (*Rhizopus oligosporus, Rhizopus nigrican*) treated *Jatropha curcas* kernel cake

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ABSTRACT

A study was conducted to compare the effect of fungi (Rhizopus oligosporus and Rhizopus nigrican) based diet on the performance characteristics of West African dwarf goat (n=15). The goats (n= 15) were randomized against the experimental diets in a completely randomized design model for a 56 day period. The diets consisted of soybean cake based diet A (control), diet B (50% Rhizopus oligosporus treated Jatropha curcas kernel cake + 50% Soybean cake), diet C (50% Rhizopus nigricans treated Jatropha curcas kernel cake + 50% Soybean cake), D (100% Rhizopus oligosporus treated Jatropha curcas kernel cake) and E (100% Rhizopus nigricans treated Jatropha curcas kernel cake). The animals were fed and watered ad-libitum. The results showed a numerical increase in the crude protein and ether extract contents of the fungi treated (50%) Jatropha curcas kernel cake. There were improvement in the consumption of crude protein, ether extract, ash and nitrogen free extract in diet B compared to other diets. The digestibility coefficient of most nutrients (crude protein, crude fiber, nitrogen free extract) in diet B was significantly higher than other diets. Diet B proved promising as there was no mortality recorded for animals on this diet and diet A (control). Additionally, the packed cell volume, red blood cell, haemoglobin and neutrophil contents of the blood of animals on diet B was similar to that of diet A. It was concluded that growing goats can be fed a diet consisting of 50% Soybean cake + 50% Rhizopus oligosporus treated Jatropha curcas kernel cake under confinement and obtained adequate dry matter and other nutrients.

Key words: Feed intake, digestibility coefficient, proximate composition, haematological indices.

INTRODUCTION

Food and nutrition security resulting in healthy population has been the most challenges to Nigerian Government. Hence, various policies and programmes (Green revolution, Operation feed the Nation and many more) were formulated and implemented since independence. It was reported that about 1.02 billion people worldwide are hungry [1]. Additionally, almost 16000 children die from hunger related causes-one child every 5 second [2]. Nigeria was rated as the 154th poorest nation with about 40 million people believed to be hungry [3].

The most vulnerable groups are the children, pregnant women and the aged. It is interesting to note that malnutrition could be related to poor animal production. It was noted that an integrated intervention for mother and children tighter, not in isolation from each other is crucial to breaking the various vicious circle of malnutrition in the life cycle. In other to solve the problem, researchers have been searching for alternative feed ingredients in livestock diet so as to alleviate hunger in Africa. Among the alternative feed ingredients are Mucuna seed, Adansonia seed and Jatropha seed.

Jatropha curcas L. which is native to tropical America is now found in many tropical regions. The plant also grows in semi-arid and arid zones [4, 5].The seed which is very rich in crude protein also contains toxic thermostable lipo-soluble phorbolester which was identified as the major toxic principle. Phorbolesters are bioactive diterpene derivatives that have a multitude of effects in cells. Other antinutrients include trypsin inhibitor, lectin (curcin) tannins, saponins and phytate. These antinutrients must be removed /or lowered to level that do not elicit toxic response for livestock animals.

While other nutrients can be removed by either chemical, mechanical /or physical methods, phorbolester which is the major antinutrient could not be removed. However, *Belewu and Ogunsola* [6] reported on the biological treatment of the kernel with encouraging results. It was noted that fungal treatment enhanced digestion of the mesophyll tissue and improved access for ruminal microbes by collapsing the vascular bundles. Hence, this study investigates fungi (*Rhizopus oligosporus*, *Rhizopus nigrican*) treatment of *Jatropha curcas* kernel cake on the intake, digestibility coefficient and blood parameters of West African dwarf goat.

MATERIALS AND METHODS

Collection and Preparation of Seed and kernel Cake

Mature seeds of *Jatropha curcas* were collected during the dry season (October – February, 2010). The seeds were cleaned and cracked individually to remove the kernel in readiness for its use in the preparation of kernel cake.

Detoxification of *jatropha curcas* kernel cake

The kernel was milled using mechanical grinder and then defatted using hydraulic press. The defatted kernel cake was kept in polythene bags for autoclaving at 121^{o}C for 30 minutes so as to get rid of any microbes that could be present in the cake.

Fungi used

Rhizopus oligosporus and *Rhizopus nigricans* used for the study were collected from Institute of Agricultural Research and Training (IITA) Ibadan and maintained on potato dextrose agar (PDA) containing in petri dishes.

Inoculation and incubation of the substrate

The autoclaved *Jatropha curcas* kernel cake was inoculated with the spores of *Rhizopus oligosporus* and *Rhizopus nigricans* respectively in different sterilized bowls. The inoculated *Jatropha curcas* kernel cake was incubated at room temperature so as to stimulate the fungi growth. In about six days the fungi had enveloped the substrate. The growth was later terminated by oven drying at 70^{o}C for 24 hours.

Diets formulation

The spent substrate was later used in the formulation of diet for West African dwarf goats at the inclusion levels of 50% and 100% in replacement of Soybean cake (Table 1). Other ingredients are of fixed proportions in the formulated diet.

Experimental animals and management

Fifteen West African dwarf goats used for the experiment were bought from a local market in Ilorin metropolis, kwara State, Nigeria. Prior, to the starting of the experiment, the pens were cleaned, washed and disinfected using detergent for washing while *Dettol and Morigad* were used as disinfectants. The animals were treated against ecto and endo parasite using IVOMEC and L oxytetracycline was used against pneumonia and cold.

The animals were group into three (3) and later randomized against five dietary treatments. Feeding and watering were supplied *ad-libitum* throughout the 56 days experimental period. The goats were weighed at the beginning and end of the experimental period to determine the average weight gain / loss.

Digestibility trial

Digestibility study was carried out during the last two weeks of the experiment. The animals were kept in metabolic cages made of slatted floor covered with fine wire netting that allows the passage of urine while the faeces was collected in the tray under the cage. Total faeces voided by individual animal was weighed daily and only 20% of it was taken for dry matter determination at 100^{o}C for 24 hours and the remaining faeces was dry at 70^{o}C for 24 hours for proximate analysis determination.

Blood collection

Blood was collected from the jugular vein of the experimental animals fortnightly and various blood parameters were determined using the method of Jain [7].

Analysis

The proximate composition of the fungi treated and untreated diet and the fecal samples were determined following the method of AOAC [8].

All data collected were subjected to ANOVA of a completely randomized design model while treatment means were separated using Duncan [9] multiple range test.

RESULTS AND DISCUSSION

The dry matter content (Table 2) of the fungi treated experimental diets seems consistent with numerous reports in literature [10, 11]. The crude protein (CP) (Table 1) content of the fungi treated experimental diets varied between 7.5 and 11.00% and this was higher than the value reported in literature. The crude fiber (Table 1) was slightly lower in the fungi treated Jatropha based diets compared to the control, diet A. The lower crude fiber content of the Jatropha fungi based diet could be due to the action of the fungi on the crude fiber content of Jatropha kernel cake. The fungi could have used the fiber content for their own growth.

The ether extract was highest in diet B followed closely by diets C, A, E and D in that order. Additionally, the ash content followed similar trend.
The dry matter intake (Table 2) varied significantly ($P< 0.05$) among the diets. The highest dry matter intake was reported for diets A and B and the least was diet C. This result was consistent with numerous results reported elsewhere [11]. The highest crude protein intake recorded for diet B might be due probably to the higher crude protein content of the diet. This shows that fungi treated Jatropha kernel cake could be used to complement the crude protein content of soybean cake and this could have stimulated microbial growth leading to production of microbial protein. While the least crude protein intake was noted for diet C. The low crude fiber consumption of the fungi treated diets could be due to the utilization of the fiber content by the fungi for their own growth. The observation confirmed the report of Jacquline and Visser[12]. The various enzymes (cellulase, xylanase, xylosidases, hemicellulase, amylases ,beta glycosidase, proteinases, pectinases, alpha-galactosidae etc)) secreted by the fungi could have helped in digesting various fiber fractions of the *Jatropha curcas* kernel cake.

Table 1: Composition of the Experimental Diets

Ingredients (%)	Diet A(Control)	Diet B	Diet C	Diet C	Diet D
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	0.00	0.00
Fungi Treated *Jatropha* kernel cake	0.00	2.00[a]	2.00[b]	4.00[a]	4.00[b]
Vitamin –Mineral premix	1.00	1.00	1.00	1.00	1.00
Salt	1.00	1.00	1.00	1.00	1.00
Total	100.00	100.00	100.00	100.00	100.00

a = Rhizopus oligosporus treated Jatropha curcas Kernel cake
b = Rhizopus nigricans treated Jatropha curcas kernel cake

Table 2: Proximate Composition of the Experimental Diets

Parameters (%)	Diet A	Diet B	Diet C	Diet D	Diet D
Dry matter	90.56	90.07	92.92	93.44	93.86
Crude Protein	8.93	10.93	9.18	8.43	7.46
Crude fiber	34.23	29.53	29.38	21.83	26.85
Ether extract	8.58	10.09	8.97	5.89	6.55
Ash	12.62	15.23	13.13	10.79	11.49

The ether extract intake of diet B might be due to its high content in the diet. The ash content which is an indicator of the mineral content shows the superiority of the diet compared to other diets. However, the least ash content was noted in diet D.

Generally, the fungi might have played a vital synergistic role in detoxifying the cake. This allows the ruminal microbes free access to the feedstuff and the digestible portion of the feedstuff.

Table 3: Feed intake of the Experimental diets

Parameters(g/d)	Diet A	Diet B	Diet C	Diet D	Diet E	±SEM
Dry matter	715.00^{a}	712.00^{a}	520.00^{b}	393.00^{d}	441.00^{c}	0.85*
Crude Protein	63.85b	77.82a	47.74c	33.13d	32.90d	4.69*
Crude fiber	244.75a	210.25b	152.78c	85.79	118.41	15.57*
Ether extract	61.35b	71.84a	46.64c	13.15e	28.89d	5.68*
Ash	90.23^{b}	108.45^{a}	68.28^{c}	42.41^{e}	50.67^{d}	6.65*

Means along the row with similar superscripts are not significantly different (p>0.05)

Table 4: Digestibility Coefficient and Weight gain of the Experimental Diets

Parameters (%)	Diet A (Control)	Diet B	Diet C	Diet D	Diet E	±SEM
Dry matter	94.78	92.99	91.67	95.29	95.10	0.37
Crude Protein	71.09^{b}	74.76^{a}	61.02^{c}	48.66^{e}	58.12^{d}	2.50*
Crude fiber	94.34^{a}	94.23^{a}	91.89^{b}	88.85c	90.04^{b}	0.63*
Ether extract	90.09^{a}	86.09^{b}	79.98^{c}	78.01^{c}	80.76^{c}	1.21*
Weight gain	1.23^{a}	1.23^{a}	0.33^{b}	0.13^{d}	0.23^{c}	0.48*

Means along the row with different superscripts are significantly differently (p<0.05).

Table 5: Haematological Indices of the experimental Animals

Parameters	Diet A(Control)	Diet B	Diet C	Diet D	Diet E	±SEM
Packed cell volume (%)	29.33^{a}	29.66^{a}	23.00^{b}	20.33^{b}	21.33^{b}	4.46*
Red Blood cell(10^{9L-1})	2.06^{a}	2.25^{a}	1.39^{b}	1.38^{b}	1.28^{c}	0.27*
Haemoglobin	10.97^{a}	11.45^{a}	9.72^{b}	8.49^{b}	11.05^{a}	0.99*
White Blood cell(10^{9L-1})	9.57^{a}	7.93^{c}	8.67^{b}	8.90^{b}	7.47^{c}	0.63*
Neutrophil	72.67^{b}	76.67^{a}	75.33^{a}	72.67^{b}	78.33^{a}	2.29*
Lymphocyte(10^{9L-1})	23.00^{b}	20.33^{c}	22.00^{b}	25.33^{a}	20.33^{c}	2.83*
Monocyte (10^{9L-1})	0.33^{c}	0.67^{b}	2.33^{a}	0.30^{c}	0.67^{b}	0.04*
Eosinophil	1.33^{c}	2.67^{a}	0.00^{e}	2.00^{b}	0.67^{d}	1.14*

Means along the row with different superscripts are significantly differently (p<0.05).

Digestibility trial

The digestibility of feedstuff is the major determinant of the quality of the feed. The highest crude protein digestibility was noted for diet B followed closely by diet A and the least was diet D. The high crude protein digestibility could be due to the high content of protein in this diet as well as high consumption of it. There was no significant difference in the crude fiber digestibility of all the diets. However, lower ether extract digestibility was found for diets B, C, D, and E compared to diet A. Generally, it was noted that the digestibility coefficients of the nutrients decreased when 100% of the *Jatropha* kernel cake was included in the total diet. Additionally, there was no significant difference in the weight gain of animals fed diets A and B. This

indicates that nutrients contained in these diets are well digested and utilized by goat than other diets. While animals on diets C, D and E recorded poor weight gains.

Haematological indices

Haematological data were used as an indication of the health status of the experimental animals. Value of the white blood cell reported in this study was consistent with the reported values in literature [11, 13]. Fungi treatment of the Jatropha kernel cake could be another reason for lack of adverse effect on the haematological content. The value reported herein was higher than the values reported by Belewu *et al*.[11] and this shows that the blood of these animals is richer in oxygen. The variation between the two studies could be due probably to the variation in the age of animals (goats). The packed cell volume (PVC) reported in this study fell within the range of values reported by Tambuwal *et al*. [13] and Belewu *et al*. [11]. Hence, the PCV reported could be due to Compensatory Accelerated Production (CAP) of PVC which returns PCV to its normal value.

The white blood cell was consistent with the reported values of Tambuwal *et al*. [13] and Belewu *et al*. [11]. This explains the protective system of the animals. The Red blood cell (RBC) noted for animals in this study was higher than the value reported elsewhere [11]. The high RBC indicates that the animals are not anaemic.

The neutrophil value noted in this study was similar to the value of Belewu *et al*. [11]. This shows that the cellular digestion was more in these experimental animals. The eosinophil content was consistent with the value of *Belewu et al.* [11]. High eosinophil count might induce immunological and cytotoxic processes. Additionally, high eosinophil could indicate lower pulmonary function test (PFT) hence, eosinophil was found to be vital for pulmonary function impairment which is associated with the changes of different flow rates [14].

CONCLUSION

Based on this study, it can be concluded that fungi treated *Jatropha curcas* kernel cake is highly recommended for dry season feeding.

- Biomass production from the *Jatropha* plant could provides the potential of the crop as the harvesting time coincides with the harsh dry season period when many natural feeds are either limited /unavailable.
- The high protein content coupled with high intake proved Jatropha cake as an excellent feedstuff and a supplement in livestock nutrition. This new approach of fungi treated (Biotechnology) *Jatropha* kernel cake needs to be implemented as a strategic dry season feeding in a sustainable livestock production system

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