ISSN 2228-6...

International Journal of

AgriScience

International Academic Journal

International Journal of AgriScience Vol. 3(7): 584-591, July 2013
ISSN: 2228-6322© International Academic Journals

Effects of velvet bean (*Mucina pruriens*) as diet inclusion on performance and digestibility by West African dwarf rams

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Received April 2013; accepted in revised form June 2013

ABSTRACT
This study was designed to evaluate the performance of West African dwarf rams subjected to varying degree of treated velvet bean for a period of 12 weeks. The impact of roasted velvet bean (RVB) on the performance by ram and digestibility of the feed was evaluated. In a randomized complete block design, twelve rams aged 12 and 18 months old with initial weight of 13.67-14.25kg were randomly allotted into 3 treatments on diets A (0% RVB), B (25% RVB) and C (50% RVB). Weight gain, feed intake and feed conversion were measured. Similarly, in the digestibility trial, 3 animals per treatment were placed in metabolic cages for 14 days of stabilization and 5 days of collection. Treatment effects as affected by varying levels of velvet bean was significant for final live weight gain with values varying from 29.86kg(diet B) to 34.20kg (diet C). Also, the mean live weight gain follows the same trend with the highest mean live weight gain obtained for animals on diet C and the least mean live weight for diet B. The result obtained showed a direct relationship between total feed intake and final live weight gain. Since *Mucuna pruriens* is available in the dry season therefore, utilization at such period will meet dietary requirement of the sheep.

Keywords: *WAD rams, Growth, "Mucuna pruriens", Performance, Digestibility.*

INTRODUCTION
In tropical areas, ruminant livestock production is based on seasonal production. In those systems, pastures are abundant during the rainy season but inadequate in quality and quantity during the dry season (Perez – Hermandez et al. 2003). One of the constraints to ruminant production in Nigeria is perennial insufficient protein for ruminant animals during the dry season (Heady 1994). To overcome this problem supplementation of animal nutrition during critical periods is a practical alternative. The adverse effects of low protein can be alleviated by judicious feeding of ruminants with nitrogen rich supplements. Sources of such supplements include plants proteins (cotton-seed meal and soya bean meal). Unfortunately, these conventional commercial protein supplements are either unavailable or too expensive.

Due to the limited availability of conventional protein sources, various studies are focusing on the utilization of alternative protein sources in ruminant production. A promising example is the seed of velvet beans (*Mucuna pruriens*). Velvet bean (*Mucuna pruriens*) is a flourishing cover

crop and soil improver (Osei-Bonsu et al. 1993). Velvet bean is an annual legume that grows readily in tropical and subtropical regions (Duke 1981). It has potential as a feed and can be used as a protein supplement to improve the nutritional value of poor quality roughage (Daka et al. 1996). The foliage is frequently fed to grazing animals and the seed is sometimes eaten by monogastric animals such as pigs and chickens (Iyayi et al. 2006). Velvet bean is a prolific plant, producing high amounts of husk and forage (CIDICCO 1999).

In the early 20th century, the pods and forage were commonly used for feeding pigs and ruminants in the southern United States of America (USA) (Eilitta and Sollenberger 2002). Like many other grain legumes, velvet bean contains many anti-nutritional factors; it also contains L-Dopa which has a number of anti-physiological effects (Ravindran and Ravindran 1988; Siddhuraju et al. 2000). The adoption of velvet bean could be promoted through increased animal consumption of the processed seeds and foliage. Though, velvet bean's soil improving qualities clearly fostered its adoption, it has been suggested that its use as feed was more important (Buckles 1995). Velvet bean has been used as feed in a number of countries. For animal feed, both beans and foliage have been utilized. Also, as feed it has been tested and proven on large scale, especially in southern USA during the first half of the last century (Eilitta and Sollenberger 2002). Velvet bean and husks have good nutritional characteristics (Ayala Burgos et al. 2003) with which to supplement ruminant livestock in critical periods. It is particularly valuable for the smallholders keeping ruminants in their backyard. However, the use of Velvet beans as an animal feed has been restricted by the anti-nutrients in the grain (Perez-Hernandez et al. 2003). The objective of this study was to determine the effect of roasted velvet bean on the performance and nutrient digestibility of WAD ram lambs.

MATERIAL AND METHODS

Two studies were conducted. In study 1, intake and weight gain of twelve rams' were evaluated at three levels of roasted velvet bean supplementation (0%, 25% and 50%) of a diet based on forage. In study 2, *in-vivo* digestibility of nutrients was evaluated with nine rams.

Experimental animals and management

Twelve West African dwarf rams with weight ranging from 13.6 to 14.20kg were randomly allotted to three treatments with four replicates in a randomized complete block design for 12 weeks. On arrival, the animals were kept in the pens for proper routine management. All the rams were given antibiotic injection (Oxytetracycline L/A) while Ivomec injection was administered to control both the endo and ecto parasites. Concentrate feed and Guinea grass was fed to the rams during this period of adaptation. Clean water was made available *ad libitum*.

Preparation of diets

Processing of velvet bean was by weighing the seeds into a circular pan over fire at 100^0C for between 15 and 20 minutes. The beans in the pan were stirred from time to time to maintain uniform heating. Roasting was considered adequate when the seed coat was broken and had a brownish colour. Diets supplemented with velvet bean were ground in a hammer mill. The chemical composition of velvet bean used in the study is presented in Table 1.

Experimental diets

Guinea grass (*Panicum maximum*) was fed as basal diet to the rams after wilting and chopping while wheat offal (WO), soyabean meal (SBM), roasted velvet bean (RVB) were formulated as diets:

A – 68% WO 30% SBM + 2% salt

B – 68% WO + 22.5% SBM + 7.5% RVB + 2% salt

C – 68% WO + 15% SBM + 15% RVB + 2% salt

Growth Trial

In an 84-day trial, twelve WAD rams were randomly allotted into the experimental diets with four replicates per diet. Animals were kept in individual pen. Initial weights of the animals were taken and recorded before the commencement of the experiment. Animals were fed at 5% of their body weights. Remnant was measured to determine the quantity consumed. Animals were weighed weekly to determine differences in weight.

Digestibility Study

Faeces and urine of all twelve animals was collected at the last five days after seven days adjustment period in the metabolic cages. Weight of animal feed intake, total faecal output, urine output and digestibility were measured and calculated. Aliquot sample of faeces and urine were preserved for analysis

Chemical Analysis

Samples of all diets and faeces were taken and oven dried at 105^0C to obtain dry matter, while crude protein, fibre fractions (Acid detergent fibre, nitrogen detergent fibre and Acid detergent lignin) were analysed as described by AOAC (1990). Dry matter (DM) intake of the forage, supplement and the faeces were recorded for each animal on a daily basis. DM digestibility was calculated for each animal within diets according to standard procedures (McDonald et al. 1995).

Statistical Analysis

Data were subjected to statistical analysis using SAS (1999) where statistical significance were observed, means were compared using Duncan Multiple Range test of the same package.

RESULTS AND DISCUSSION

Table 1 shows the chemical composition of raw and roasted velvet bean seeds. The DM content for raw and roasted bean was 88.41% and 91.89% respectively. It was observed that the heat applied to raw beans removed some moisture from the seeds thereby improving the DM content of roasted beans. However, the value is similar to the value of 90.1% DM reported by Aletor and Aladetimi (1989). The crude protein values were 30.41% and 28.86% for raw and roasted velvet bean. Roasting reduced the CP of velvet bean. A similar trend was reported by Mugendi and Njagi (2010) where roasting significantly reduced ($P<0.05$) the CP of velvet bean.

The crude fibre (CF) values were 8.18% and 7.26% for raw and roasted velvet bean. The relative decrease in the value of CF of roasted beans is consistent with those reported by Aletor and Ojo (1989) where cooking, roasting and autoclaving processing methods generally reduced the CF level in legumes. Duke (1981) showed that low fibre content makes the beans a good potential source of feed for monogastric farm animals.

The ash contents of 3.42% and 4.36% for raw and roasted beans and ether extract values for raw and roasted velvet beans were 0.58% and 0.63% respectively. The increase in the values for both ash and ether extract in roasted beans may be the result of roasting process that occurred in crude oil of the seed. However, Mugendi and Njagi (2010) reported that roasting increased the amount of L – Dopa, while phytic acid and total phenols reduced considerably in the roasted velvet bean. Shown in Table 2 are feed intake, weight gain and feed conversion ratio of rams fed roasted velvet bean. The average feed intake ranged from 660g/day

(diet A) to 750g/day (diet C). Animals on diet C had the highest average feed intake of 750g/day and highest total feed intake of 42kg compared to those on diets A and B which had 660g/day and 600g/day respectively. From Table 2, the inclusion of 50% roasted velvet beans (diet C) increased feed intake and weight gain of WAD rams. The slightly high feed intake of diet C could be due to the roasting of velvet bean which made the nutrients more available and the diets more palatable, thus enhancing more feed intake. It could also be due to the slightly lower energy content of the diet which allowed the animals to eat more in order to satisfy their energy requirement (Taiwo et al. 2006).

Table 1. Chemical composition of raw and roasted velvet bean seeds

Parameter	Raw	Roasted
DM	88.41	91.89
CP	30.41	28.86
CF	8.18	7.26
EE	0.58	0.63
Ash	3.42	4.36
NFE	51.82	44.53

DM = Dry Matter; CP = Crude Protein; CF = Crude Fibre; EE = Ether Extract; NFE = Nitrogen free extract

Table 2: Live Weight Gain (LWG) of WAD rams fed roasted velvet bean based diet

Parameter	0%RVB	25%RVB	50%RVB	SEM
Total Feed intake(kg)	36.90	38.08	42.00	0.25
Average feed intake (glday)	660^{0}	680	750	0.46
Initial Live weight (kg)	14.20	14.05	14.35	0.79
Final Live weight (kg)	32.35^{a}	29.86^{b}	34.20^{a}	0.15
Mean Live weight gain (kg)	18.15^{a}	15.81^{b}	19.85	0.54
Average daily weight gain(g)	216.01^{a}	188.21^{b}	236.31	0.55
Metabolic Live weight gain (0.75)	162.01	144.16^{b}	177.23	0.12
Feed Conversion Ratio	2.04	2.41	2.12	0.10

a,b, means in the same row with different superscripts are significantly different (P<0.05)

The mean live weight gain was 31.14kg, 26.91kg and 33.32kg for diets A, B and C respectively. The highest mean live weight gain was recorded in diet C (33.32kg) and the lowest in diet B (26.91kg). However, significant differences (P<0.05) were observed in WAD rams in diet C when compared with diets A and B. Furthermore, increase in average daily weight gain was observed on WAD rams on diet C. The average daily weight gain was 556.2g, 480.50g and 595.05g for diet A (0%RVB), diet B (25%RVB) and diet C (50%RVB) respectively. The increase in average daily weight gain and live weight gain could be due to increase in L- Dopa content of the feed. L – Dopa is noted for the muscle building effect in athletes (Landauer. 2013). However, the non-significant increase in the weight gain in WAD rams fed the diet A (0% RVB) could be due to the effect of roasted velvet bean not present in the diet. This could have imparted negative effect on utilization of that particular protein (Mosely and Griffith. 1979).

Nevertheless, animals on diet A recorded the best fed conversion ratio of 2.14 compared with those on diets A (3.16) and C (3.12). However, there was no significant difference in the FCR values between diet B (25%RVB) and diet C (50% RVB). Similarly, Table 3 shows the nutrient digestibility of WAD rams fed velvet based diets. Dry matter (DM) digestibility

increased with increasing levels of roasted velvet beans in the diet with 69.9% in diet A (0% RVB) to 81.2% in diet C (50% RVB). There were significant differences (P<0.05) observed for all the diets. The digestibility coefficients were comparable to 78-79% and 78-80% DM digestibility observed by Hadjipanayiotou (1990) respectively for sheep and goats fed hay supplement with concentrates as well as those reported by Murphy et al. (1994) who fed concentrate at restricted intakes to lamb in complete diets. In the same trend, the CP digestibility ranged from 82.04% for diet A to 84.81% in diet C. This observation is consistent with the speculation of Quellet et al. (2002). Giri et al. (1997) and Aregheore (2002) reported that digestibility of nutrient varies with nutrient composition. However, the values obtained were higher than the values of Waghorn et al. (1990) who fed sheep with roughage and concentrate.

Table 3: Live Weight Gain (LWG) of WAD

Parameter %	A (Control)	B (25%)	C (50%)	SEM
DM	69.90^{b}	72.9^{c}	81.20^{a}	0.20
CP	82.04^{c}	84.02^{ab}	84.81^{a}	0.16
NDF	57.21^{b}	58.39^{a}	59.23^{b}	0.24
ADF	44.18^{a}	42.60^{a}	42.25^{a}	0.23
ADL	12.10^{a}	12.37^{a}	12.83^{a}	0.22
EE	90.05^{a}	92.61^{a}	96.72^{b}	0.28
ASH	80.37^{c}	81.74^{c}	83.04^{a}	0.81
NFE	73.84^{c}	75.62^{c}	78.31^{a}	0.20

a.b.c means in the same row both different superscript are significantly different (P<0.05)
DM = Dry Matter; CP = Crude Protein; NDF = Neutral Detergent Fibre; ADF = Acid Detergent Fibre; EE = Ether Extract; NFE = Nitrogen Free Extract; ADL = Acid Detergent Lignin

NDF degradability ranged from 57.21% in diet A to 59.23% in diet C. Significant differences (P<0.5) were observed between diet A and diet C. The highest NDF digestibility was observed in rams on diet C. The observation could be due to longer retention of the feed in the GIT, hence, the higher digestibility obtained. This may be related to changes in the rate of passage of digesta from the rumen (Badamana 1992). Slow rate of degradation might have exerted a beneficial effect on fibrolytic activity in the rumen. The reduction of time spent by concentrate in the rumen due to protein source would reduce protein degradation in the rumen (Tamminga 1982).

The ether extract digestibility was significantly different (P<0.05) with increasing levels of roasted velvet beans in the diet while the NFE digestibility increased with the increasing levels of roasted velvet beans in the diet, however, significant differences (P<0.05) were observed in diet C.

CONCLUSION

Roasting of raw velvet bean increased the CP, while, L- Dopa, phytic acid and total phenols reduced considerably. Animals fed diet C (50% RVB) had comparable weight gain to the control diet fed a compliment of wheat offal and soybean based diet. No mortality was recorded during the study; this is an indication that roasted velvet bean diets did not have any deleterious effect on the experimental animals. However, there were significant differences (P<0.05) in weight gain of rams fed roasted velvet beans at 50% inclusion rate. It can be concluded that roasted velvet beans supplementation can substitute the use of conventional supplements for WAD rams without a significant reduction in feed digestibility.

ACKNOWLEDGEMENT

The authors are grateful to University of Ibadan for funding this research.

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