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Performance and blood indices of West African dwarf goats fed graded levels of malted sorghum sprout with enzyme supplementation

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Abstract

Malted sorghum sprout (MSP) is an agro-industrial by-products rich in organic nitrogen and amino acids which can be used to enhance ruminant nutrition. A study was conducted to assess the nutritive value of MSP as supplementary on the performance characteristics and blood profile of West African dwarf (WAD) goats. MSP was collected, air-dried and then incorporated at different inclusion levels of 0, 10, 20 and 30% to formulate four dietary treatments T_1, T_2, T_3 and T_4, respectively, with T_2- T_4 being supplemented with Roxazyme G2 enzyme at 0.5g/kg. Twelve WAD bucks with an average weight of 7±0.5kg were assigned into four dietary treatments with three bucks per treatment in a completely randomized design over a period of 84 days. Data were obtained on performance characteristics, haematological and serum biochemical indices. Performance characteristics showed that average concentrate consumed (229.04g/day) and average daily weight gain (44.44 g/day) of WAD goats were significantly (P<0.05) higher in goats fed 20% MSP with enzyme supplementation. Dietary MSP with enzyme supplementation significantly (P<0.05) influenced the total protein (TP), aspartate amino transferase (AST), alanine amino transferase (ALT), white blood cells (WBC) and red blood cells (RBC) across the treatments. TP (7.05g/dL) and WBC (7.88 x 10^3/mm^3) were significantly (P<0.05) higher in goats fed 20% MSP while globulin values increased significantly (P<0.05) across the dietary treatments (3.94 – 5.05g/dL) and is within the normal levels expected of healthy goats. It is concluded that dietary MSP with enzyme supplementation at 20% improved the performance, hematological and serum biochemical indicess of WAD goats without any adverse effects.

Keywords: Malted sorghum sprouts, Enzyme, Performance, Hematology and Serum.

Introduction

The major problems of ruminant production in the developing countries today are the poor nutritive value of some post-harvest crop residues, rapid quality decline, and inadequacy of natural pasture during the dry season from the roadside and communal grazing land (Adegbola, 2002). However, the cost of ingredients required to formulate diets for goats has risen greatly due to the competition between humans and livestock. Efforts to reduce the high cost of feeds have concentrated on using feeds formulated from available and cheap alternative or unconventional feedstuffs of no nutritional value in human diets. Agro-industrial by-products are wastes with high nutrient content to sustain ruminant animals despite their high fibre level (Paggot, 1992) but when left unutilized often cause environmental pollution and hazard. One of such example is malted sorghum sprout. Malted sorghum sprout (MSP) is a non-conventional feedstuff, a by-product of the sorghum malting process. It is the separated

roots and shoots left after malt extraction from young germinating sorghum seedlings (Aletor *et al*., 1998). It is rich in organic nitrogen (Ikediobi, 1989) and also reported to contain a considerable number of amino acids with a low level of methionine, lysine, and threonine (Aning *et al*., 1998). Recently conducted experiments have demonstrated the beneficial effects of supplementing ruminant diets with exogenous enzymes, more specifically, exogenous fibrolytic enzymes to improve fiber digestibility and, consequently, the efficiency of feed utilization by ruminants (Arriola *et al.,* 2011). Roxazyme G2 is a specific blend of beta-glucanase, cellulose, and xylanases, which improves the efficiency of energy utilization and digestibility of feed, thereby encouraging the nutrient absorption (Acamovic, 2001). Meanwhile, several researchers reported no significant differences in growth parameters of animals fed diet enzyme supplementation (Miller *et al.,* 2008). However, in the use of these non-conventional feed ingredients, it is important to assess the animals' health status. A readily available and fast means of assessing the animals' clinical nutritional health status on feeding trials may be by the use of blood analysis (Olabijin *et al.,* 2007). This study is therefore designed to evaluate the performance characteristics, haematological and serum biochemical indices of West African dwarf goats fed dietary MSP supplemented with enzyme.

Materials and methods

The experiment was conducted at the Teaching and Research Farm of the Federal College of Animal Health and Production Technology, Moor Plantation, Ibadan, South- Western part of Nigeria. The area lies within the rain forest ecological zone, and falls within longitude and latitude 7^0 27'N and $3^0$25'E, respectively at altitude 200-300m above the sea level with an annual rainfall of about 1250 mm. The temperatures and relative humidity ranged from 30-35^{0}C and 76-84% respectively. The experiment was conducted in the dry season.

Source and processing of malted sorghum sprout

The malted sorghum sprout was sourced from Life –care Nigeria Limited, Sango, Otta, Ogun state. The malted sorghum sprout was air- dried to prevent it from growing mouldy and later kept in a jute bag in preparation for feed formulation with other ingredients.

Source of enzyme

Roxazyme G2 enzyme was purchased from O. M Simons Nigeria limited, Ibadan, Oyo State and it consists of beta-glucanase, cellulases and xylanase.

Experimental animals and their management

A total number of twelve (12) West African dwarf (WAD) goats buck aged 5-6 months with an average live weight of 7.00±0.5kg of 6.5±7 .5kg were used for this study. The animals were housed intensively in well ventilated individual pens disinfected with morigad solution before their arrival. To ensure good condition of the goats, they were given prophylactic treatments which included intramuscular application of oxytetracycline LA and vitamin B complex at a dosage of 1mL/10kg body weight of the animal. They were also dewormed with 1mL/10kg body weight of Albendazole® and treated against ectoparasites with 0.5mL/10kg body weight of Ivomec®. The animals were allowed an adaptation period of two weeks during which they were maintained on *Panicum maximum* and maize sievate. Fresh water was also supplied *ad libitum*. After the adaptation period, the animals were divided into four treatment groups of three animals each, after balancing them for body weight. Each group of animals was randomly assigned to one of the four different experimental concentrate diets.

Experimental diets

Four experimental concentrate diets (T_1, T_2, T_3 and T_4) were formulated to contain varying levels of malted sorghum sprout at 0, 10, 20 and 30% respectively, with T_2- T_4 being supplemented with Roxazyme G2 enzyme at 0.5g/kg. Other ingredients in the diets were constant such as bone meal, Maize bran, dried brewers grain, premix and salt (Table 1).

Table 1: Percentage (%) composition of the experimental concentrate diet

Ingredients (%)	MSP inclusion levels			
	T_1 (0%)	T_2 (10%)	T_3 (20%)	T_4 (30%)
Wheat offal	50.00	40.00	30.00	20.00
Malted Sorghum Sprout	-	10.00	20.00	30.00
Maize bran	39.59	39.59	39.59	39.59
Brewer dried grain	7.00	7.00	7.00	7.00
Bone meal	3.00	3.00	3.00	3.00
Premix	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25
Enzyme	-	+	+	+
Total	100.00	100.00	100.00	100.00
Determined Analysis (%)				
Dry matter	90.14	90.03	89.72	89.65
Crude Protein	12.87	13.15	13.49	12.98
Crude fibre	19.87	20.79	20.68	21.44
Metabolizable Energy (MJ/Kg DM)	8.58	9.98	7.07	8.66
Ether extract	3.57	3.48	3.64	3.53
Nitrogen free extract	48.98	45.32	44.24	45.21
Neutral Detergent fibre	51.36	52.57	51.95	53.74
Acid detergent fibre	39.66	40.28	39.87	41.39
Acid Detergent lignin	9.85	11.74	10.88	12.13
Cellulose	29.81	28.54	39.99	29.26
Hemicellulose	11.70	12.29	12.08	12.35

Positive sign (+) indicates with enzyme supplementation at the rate of 0.5g/kg
Negative sign (-) indicate without enzyme supplementation MSP – Malted Sorghum Sprout
BDG – Brewers Dried Grain

Experimental design

The experimental design was completely randomized design. The animals were divided randomly into four groups containing three replicates each, after balancing them for weight. The feeding trial lasted for 84 days. Animals were fed at 5% body weight while clean water was provided *ad-libitum.*

Data collection

Feed intake and live weight changes

The growth of the animals in response to the experimental treatments was monitored by taking their pre-experimental body weights, followed by weighing on a weekly basis prior to feeding. Feeds offered daily per animal were recorded and refusals were weighed and recorded to compute feed intake on daily basis. Feed conversion ratio (FCR) was also calculated.

Collection of blood samples

At the end of the trial, 5mL of blood sample was collected before feeding from three goats per treatment via jugular vein, using hypodermic needle and syringes. 2.5mL of blood sample collected was released into labeled sample bottles containing ethylene diamine tetra acetic acid (anticoagulant) and the bottle was rocked gently to ensure easy mixing of the blood with the

anticoagulant for hematological parameters analysis, while the remaining 2.5mL of blood sample were released into plain sample bottles for serum biochemical parameters analysis

Chemical analysis

Aliquot of daily feed samples (Concentrate and *Panicum maximum)* were collected, oven-dried, ground and sieved through a 2-mm sieve and stored in airtight containers for proximate (AOAC, 2007) and fibre (Van Soest *et al.,* 1991) analyses. Cellulose was taken as the difference between ADF and lignin while hemicellulose was also taken as the difference between NDF and ADF.

Statistical analysis

The data obtained from the study were subjected to one-way analysis of variance in a Completely Randomized Design (SAS, 2002). Means for treatments showing significant differences in the Analysis of variance were compared using the Duncan's multiple range test, (Duncan, 1955).

Results and discussion

Chemical composition of Malted sorghum sprout (MSP) and Panicum maximum (PM)

Table 2 shows the chemical composition of Malted sorghum sprout and *Panicum maximum* used in the experiment. The crude protein (22.93%) value of malted sorghum sprout recorded in this study was in line with the value (22.60%) reported by Oduguwa *et al.* (2006). The high crude protein observed in this study could be as a result of fermentation. The crude fibre and dry matter percentage reported here were similar with the observation of Oduguwa *et al*. (2006) and Akinola (2002). However, the ash and nitrogen free extract values obtained (7.16% and 53.24%) were lower than the values (5.83% and 64.70%) reported by Oduguwa *et al*. (2006) and Akinola (2002) respectively. The variations observed might be due to the differences in geographical location, age of the plant and time of harvesting. The crude protein value of *Panicum maximum* confirms the report of Agishi (1985) that tropical pasture grasses are frequently low in protein and cannot support high levels of ruminant production. The higher crude protein content of malted sorghum sprout compared with *Panicum maximum* should be expected as most agro-industrial by-product wastes contain higher nitrogen contents than grasses. Thus, this suggests that Malted sorghum sprout could as well serve as protein supplement to poor quality grasses.

Table 2: Chemical composition of malted sorghum sprout and *Panicum maximum*

Parameters (%)	MSP	Panicum maximum
Dry matter	92.84	90.87
Crude fibre	6.85	8.67
Crude Protein	22.93	31.28
Ether extract	2.36	2.46
Ash	3.68	7.16
Nitrogen free extract	53.24	38.59
Neutral detergent fibre	21.97	61.38
Acid detergent lignin	1.38	9.67
Hemicellulose	10.75	14.59
Cellulose	9.84	37.12

Hemicellulose = %NDF - %ADF, Cellulose = %ADF-%ADL, MSP = Malted Sorghum Sprout

Performance characteristics of West African dwarf goats fed malted sorghum sprout with enzyme supplementation

Presented in Table 3 is the effect of malted sorghum sprout supplemented with enzyme on performance characteristics of West African dwarf goats. The weight gain ranged from 3.10 – 4.00kg while daily weight gain ranged from 37.22 – 44.44g/d. Goats on 20% MSP inclusion levels supplemented with enzyme had the highest weight gain values (4.00kg) and the least feed conversion ratio (13.11) compared to the control (13.87) but not significantly ($P<0.05$) different from other treatments. The variation in weight gain and average daily intake observed across the treatments may be due to the differences in the age of the breed of animals. The performance result was consistent with the report of Oduguwa *et al.* (2001). Also, the result of this study indicates that the use of enzyme in the concentrate feed when feeding poor quality forage had a positive effect on weight gain which was in line with report that fibrolytic enzymes increases weight gain in steers (Zarrodini *et al*., 2004).

Table 3: Performance characteristics of West African dwarf goats fed graded levels of malted sorghum sprout with enzyme supplementation

Parameters	Inclusion levels of MSP				
	T_1(0%)	T_2(10%)	T_3(20%)	T_4(30%)	SEM
Initial body weight (kg)	8.00	8.20	8.27	7.73	0.44
Final body weight (Kg)	11.35	11.63	12.27	10.83	0.45
Total weight gain (kg)	3.35^{bc}	3.45^{b}	4.00^{a}	3.10^{c}	0.11
Average daily weight gain (g/d)	37.22^{bc}	38.15^{b}	44.44^{a}	34.44^{c}	1.18
Concentrate daily intake (g/d)	220.11^{ab}	243.37^{ab}	229.04^{ab}	202.04^{b}	6.38
Forage daily intake (g/d)	294.24	321.70	352.67	298.04	11.19
Total daily intake (g/d)	514.35bc	565.07^{ab}	581.70^{a}	500.07^{c}	12.42
FCR	13.87	14.83	13.11	14.74	0.34

abc: means on the same row with different superscripts are significantly ($P < 0.05$) different
SEM – Standard Error of mean FCR – Feed Conversion Ratio

Effects of levels of malted sorghum sprout with enzyme supplementation on haematological indices

Table 4 shows the effects of malted sorghum sprout inclusion levels supplemented with enzyme on the haematological indices of West African dwarf (WAD) goats. Among the haematological parameters measured, packed cell volume, haemoglobin, red blood cells, white blood cells, eosinophils, mean corpuscular haemoglobin and mean corpuscular volume were significantly ($P>0.05$) influenced by the dietary treatments except the neutrophil, monocyte and mean corpuscular haemoglobin concentration. Haematological indices can simply referred to as mechanism indicating a reflection of dietary treatment's effects on the animals in terms of type of diet, quality and amount of feed ingested and the amount of feed that were available for the animals to meet its physiological, biochemical and metabolic necessities. Mean packed cell volume values obtained in this study were within the range of values (21 – 35%) reported by Opara *et al.* (2010). In contrast to this, Taiwo and Ogunsanmi (2003) reported higher values of 36.9% and 35.5% for clinically healthy West African dwarf goats. The haemoglobin range in this study fell within the range of 9.50 -10.80g/dL as reported by Daramola *et al*. (2005) but higher than the values of 5 – 6g/dL obtained by Belewu and Ogunsola (2010) for goats fed fungi treated Jatropha curcus kernel cake rations. The red blood cell count reported in this study were within the range

of values 10.59 -11.48 (x10^6/ul) reported by Tambuwal *et al*. (2002). The reduced red blood cell counts recorded for goats at 10% MSP inclusion level supplemented with enzyme present a likely susceptibility to anaemia related disease conditions of these goats. The white blood cell counts fell within the normal range as reported by Daramola *et al*. (2005). These values are suggestive of well-developed immune system in the WAD goats with such number of immune cells to proffer good health.

Table 4: Haematological parameters of West African dwarf goats fed graded levels of malted sorghum sprout with enzyme supplementation

Parameters	Inclusion levels of MSP				
	T_1(0%)	T_2(10%)	T_3(20%)	T_4(30%)	SEM
Packed cell volume (%)	30.50^{bc}	28.50^{c}	33.00^{a}	31.00^{ab}	0.56
Haemoglobin (g/dL)	9.60^{b}	9.50^{b}	10.80^{b}	10.10^{ab}	0.19
Red blood cell (× 10^6/µL)	10.83^{ab}	10.59^{b}	11.13^{ab}	11.48^{a}	0.13
White blood cell (× 10^3/µL)	4.13^{c}	3.95^{c}	7.88^{a}	5.75^{b}	0.48
Lymphocytes (%)	41.50	49.50	47.00	33.00	5.18
Neutrophil (%)	52.00	46.00	46.50	61.00	5.19
Monocytes (%)	2.00	2.00	3.00	2.00	0.22
Eosinophil (%)	4.50^{a}	2.50^{b}	5.50^{ab}	4.00^{ab}	0.33
MCV (fl)	28.17^{ab}	26.95^{b}	29.71^{a}	27.03^{b}	0.46
MCHC (g/dL)	31.41	23.41	37.72	32.58	0.33
MCH (pg)	8.85^{b}	8.98^{ab}	9.73^{a}	8.85^{b}	0.15

^{abc} : means on the same row with different superscripts are significantly (P < 0.05) different.
MCH – Mean Corpuscular hemoglobin MCHC – Mean Corpuscular Hemoglobin Concentration MCV – Mean Corpuscular Volume SEM – Standard Error of mean

Effects of malted sorghum sprout inclusion levels supplemented with enzyme on serum biochemical parameters

Indicated in Table 5 is the effect of malted sorghum sprout inclusion levels with enzyme supplementation on the serum biochemical parameters. The serum and enzyme parameters of West African dwarf goats fed graded levels containing malted sorghum sprout with enzyme supplementation, total protein, globulin, urea, aspartate amino transferase, alanine amino transferase were significantly different (P<0.05) while albumin, creatinine, glucose and cholesterol were not significantly different (P>0.05). The urea concentration in this study was consistent with the report of Tambuwal *et al.* (2001). The urea at the end of chain reactions breaks down amino acids that make up the proteins. These amino acids are metabolized and converted in the liver to ammonia, Co_2, water and energy. The liver converts the ammonia to non- toxic compound, urea, which can then be safely transported in the blood to the kidneys, where it is eliminated. The aspartate amino transfersase and alanine amino transferase ranged from 0.96 – 3.56LU/I and 941.74 – 92.061LU/I, respectively. The aspartate amino transferase and alaninine amino transferase was consistent with the report of Fafiolu *et al.* (2016).

Table 5: Serum biochemical parameters of West African dwarf goats fed graded level of malted sorghum sprout with enzyme supplementation

Parameters	Inclusion levels of MSP				
	T_1(0%)	T_2(10%)	T_3(20%)	T_4(30%)	SEM
Total Protein (g/dL)	6.53^{c}	6.71^{bc}	7.05^{ab}	7.43^{ab}	0.11
Albumin (g/dL)	2.60	2.72	2.71	2.38	0.77
Globulin (g/dL)	3.94^{b}	3.99^{b}	4.34^{b}	5.05^{a}	0.18
Urea (mg/dL)	48.82^{b}	60.38^{a}	47.90^{b}	56.50^{ab}	1.96
Glucose (mg/dL)	58.90	51.10	49.70	55.83	1.98
Cholesterol (mg/dL)	45.54	67.85	51.33	56.20	4.31
AST (iu/L)	54.23^{ab}	41.74^{b}	92.06^{a}	82.76^{a}	7.80
ALT (iu/L)	0.96^{b}	3.56^{a}	3.52^{a}	4.56^{a}	0.47

^{abc} : means on the same row with different superscripts are significantly ($P < 0.05$) different.
AST – Aspartate amino transferase, ALT – Alanine amino transferase

Conclusion

Based on the results of this study, it can be concluded that a dietary Malted Sorghum Sprout (MSP) at 20% with enzyme supplementation improved the performance of West African dwarf goats (WAD) in terms of feed conversion ratio and had no deleterious effects on haematological and serum biochemical parameters. Thus, MSP can be utilized to a good advantage for goats in replacement for grass during dry season.

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