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Research Article

Performance Characteristics and Oxidative Status of West African Dwarf Rams Fed Basal Diet Supplemented with Graded Energy Levels of Concentrate Mix

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Abstract

The experiment was conducted to determine the performance characteristics and oxidative status of West African Dwarf rams fed basal diet (*Pennisetum purpureum*) supplemented with graded energy levels of concentrate mix. The concentrate mix compounded at 2600kcal/kg, 2400kcal/kg, 2200kcal/kg, 2000kcal/kg and 1800kcal/kg energy levels as treatment 1, 2, 3, 4 and 5 respectively. A total number of Twenty-Five (25) West African Dwarf Rams weighing (15 ± 0.2kg) were allotted into five dietary treatments in a completely randomized design. Parameters determined for performance characteristics included initial weight, final weight, weight gain, daily weight gain metabolic weight gain and feed conversion ratio. Blood samples were collected at the end of the feeding trial to determine the oxidative status of the rams. Results showed that the total body weight gain of the animals were significantly ($p < 0.05$) lower than in the control group. The highest weight gain (6.54kg) was obtained in rams fed 2600kcal/kg of concentrate mix. Average daily intake was not significantly different ($p < 0.05$) but increased as the energy level of concentrate increases. The feed conversion ratio were significantly different ($p < 0.05$) with increase in the energy level of concentrate which ranged from 7.38 – 12.86. TBARS (ThioBarburitic Acid Reactive Substance), SOD (Super Oxide Dismatase), GPx (Glutathion Peroxidase) and THIOL and catalase as the oxidative biomarkers for the samples at the laboratory. There were no significant difference ($p < 0.05$) on Thiobarbuturic Acid Reactive Substance (TBARS), Glutathion Peroxidase (GPx) and THIOL Catalase but there were significant difference ($p < 0.05$) in the Superoxide dismutate). It can be concluded that the basal diet (*Pennisetum purpureum*) could be supplemented with concentrate mix at 2600kcal/kg metabolisable energy level for better growth performance without oxidative stress to the West African Dwarf rams..

Keywords: Basal; Oxidative; Stress; Dismutase; Rams; Super Oxide; Concentrate; Biomarker

Introduction

Ruminant livestock plays an important role in the economic development of Nigeria in terms of feeding the steadily growing population and providing the investible resources for the nation [1]. The harsh environmental conditions of the tropics which the animals are exposed to are further aggravated by the seasonal fluctuations in quantity and quality of most of these feed resources which they depend on. The effect of these imbalances may enhance, aggravate or have negative consequences on the overall wellbeing of the animal. The evaluation of oxidative stress (the imbalance between the production of free radicals and the efficiency of antioxidant defense systems in the body has become increasingly important in ruminant health and animal production as complementary tools in evaluation of the nutritional and metabolic status of the animals [2].

Oxidative stress results from increased production of free radicals and reactive oxygen species, and a decrease in antioxidant defense [3,4]. External factors such as oxygen exposure resuscitation [5], heat, trauma, ultrasound, infections, radiations and toxins can lead to increased free radicals and other ROS and may lead to oxidative stress [6].

The limitations in the quality of quality of forages most especially during dry season and increasing in the demands for animal products require supplementing their diet with adequate and balance concentrate [7]. It becomes necessary to research on the optimum graded energy levels that will promote performance characteristics without oxidative stress to West African Dwarf rams.

Materials and Methods

The study was conducted at the small ruminant unit of the Federal College of Animal Health and Production Technology, Moor Plantation, Ibadan. The unit is located in the southwestern part of Nigeria. The area lies within the rain forest ecological zone and fall within longitude and latitude 7°-27°N and 3°-25°E respectively and altitude of 220-300m above sea level with the average rainfall of about 1250mm.The experiment was conducted in line with the Animal Welfare Ethics Laws Federal College of Animal Health and Production Technology, Ibadan Nigeria.

The experimental animals were twenty-five (25) growing West African Dwarf rams weighing 15.00 ± 0.2kg, which were purchased from a reputable market in Ibadan, Oyo state. The animals were housed intensively in well-ventilated pens. Before the arrival of the animals, the pens were washed thoroughly and disinfected with Morigad solution to ensure good hygienic condition of the pens for the conveniences of the rams. They were also given prophylactic treatment, dewormed and treated against ecto-parasites and vaccinated against rinderpest disease. The animals were acclimatized for 2 weeks during which they were fed elephant grass (*Pennisetum purpureum*) and graded energy levels of concentrate mix. Fresh water was supplied to the animals *ad libitum.* After acclimatization period they were balanced for body weight and randomly allotted into five treatments at five animals per treatment. The experiment lasted for (16) weeks equivalent to (4) months fresh grass of *Pennisetum purpureum* was harvested from the college and its environment. It was air-dried for a day before serving and the ingredients for concentrate were sourced from a reputable feed mill, formulated as shown in table 1.

The experiment was carried out using a Completely Randomized Design (CRD). Performance parameters are live weight (g), feed intake (g), weight gain (g) and mortality (%) and feed conversion ratio (FCR) were determined. Blood sample approximately 5ml of blood was via their jugular vein into EDTA (Ethylenediamine tetraacetic acid) bottles and were later packed/kept in an ice pack to prevent coagulation using TBARS (ThioBarburitic Acid Reactive Substance), SOD (Super Oxide Dismutase), GPx (Gluthathion Peroxidase) and THIOL and Catalase as the oxidative biomarkers for the samples at the laboratory.

Statistical analysis

Data obtained were subjected to one-way analysis of variance (ANOVA) and means were separated using Duncan Multiple Range Test.

	2600	2400	2200	2000	1800
Ingredient (%)	**T1**	**T2**	**T3**	**T4**	**T5**
Maize	10.00	6.00	2.00	0.00	0.00
Corn bran	8.00	8.00	10.00	10.00	10.00
Palm kernel cake	20.00	20.00	19.00	20.00	21.00
Groundnut cake	10.00	12.00	13.00	14.00	15.00
Molasses	10.00	10.00	10.00	10.00	10.00
Cowpea husk	5.00	5.00	5.00	5.00	5.00
Soya bean husk	10.00	10.00	10.00	10.00	10.00
Rice bran	20.00	22.00	24.00	24.00	22.00
Limestone	4.00	4.00	4.00	4.00	4.00
Bone meal	2.00	2.00	2.00	2.00	2.00
Salt	0.50	0.50	0.50	0.50	0.50
Grower premix	0.50	0.50	0.50	0.50	0.50
Total Calculated analysis	100.00	100.00	100.00	100.00	100.00
Matabolizable energy (kcal/kg)	2600	2400	2200	2000	1800
Crude protein (%)	15.20	15.22	15.24	15.21	15.22

Table 1: Gross composition of graded energy levels of concentrate mix supplemented to basal diet for West African Dwarf rams (kcal/kg).

Metabolizable energy.

Results and Discussion

Results

The performance characteristics of West African Dwarf (WAD) rams fed basal diet supplemented with concentrate mix of different energy levels is presented in table 2. There was no significant difference ($p > 0.05$) in the initial weight and final weight measured. The initial weight obtained was similar which ranged from 14.92to 15.01kg. Although, there were no significant difference ($p > 0.05$) observed but rams fed with (2600kcal/kg) basal diet supplemented with concentrate mix had higher final weight values (21.49kg) compared with other treatments. Supplementation of basal diet (*Pennisetum purpureum*) to the diets of West African dwarf rams had positive influence ($p < 0.05$) on the daily weight gain, daily grass intake and daily concentrate intake but no significant difference observed ($p > 0.05$) in the total feed intake parameter. The highest daily weight gain (77.86g/day) was obtained at (2600kcal/kg) basal diet supplemented with concentrate mix while the lowest daily weight gain value (49.13g/day) was observed at (1800kcal/kg) basal diet supplemented with concentrate mix of different energy level. However, the daily grass intake observed in this experiment ranged from 247.85to 355.10g/day and daily concentrate intake ranged from 247.85to 306.37g/day which were significantly affected ($p < 0.05$) basal diet supplemented with concentrate mix of different energy level. Though no significant difference, the best feed conversion ratio (FCR) with 7.38was observed with the rams fed diets containing 2600% basal diet supplemented with concentrate mix of different energy level. The metabolizable energy ranged from 2.89 to 4.08.

	2600	2400	2200	2000	1800	
Parameter	**A**	**B**	**C**	**D**	**E**	**SEM±**
Initial weight (kg)	14.95	14.92	14.98	15.01	5.19	0.918
Final weight (kg)	21.49	20.79	19.92	19.49	19.31	0.393
Weight gain (kg)	6.54^{a}	5..86^{ab}	4.94^{bc}	4..49^{c}	4.13^{c}	0.124
Daily weight gain (g/day)	77.86^{a}	69.82^{ab}	58..85b^{c}	53.41^{c}	49.13^{c}	0.124
Metabolic weight (W 0.75kg)	4.08^{a}	3.77^{ab}	3.32^{bc}	3.081^{c}	2.89^{c}	0.103
Dry matter grass intake (g/day)	247.85^{a}	355.10	345.74	332.67	324.85	0.657
Dry matter concentrate (g/day)	247.85	263.63	296.81	278.38	306.37	0.178
Total Dry Matter Intake (g/day)	570.98	618.74	642.56	611.04	631.22	0.411
Feed conversion ratio	7.38^{c}	8.91^{bc}	10.91^{ab}	11.63^{ab}	12.86^{a}	0.333

Table 2: Performance characteristics of West African dwarf ram fed basal diet supplemented with concentrate mix of different energy levels.

Metabolizable energy (kcal/kg)

Table 3 shows the effect of *Pennisetum purpureum* on oxidative status of West African Dwarf (WAD) rams. There were significant differences ($p < 0.05$) on (SOD), but there were no significant differences ($p > 0.05$) on the Thiobabituric acid Reactive Substance (TBARS), Superoxide dismutase (THIOL), Glutathione peroxidase (*GPx*). The Superoxide Dismutase (SOD) ranged from (24.64-48.37mol/l) which was significantly ($p < 0.05$) affected by the graded energy intake. The Glutathione Peroxidase (*GPx*) ranged from (28.32-31.22 mg/ ml). Thiobabituric acid Reactive Substance (TBARS) ranged from (1.08-2.14mol/l). Even though, there was no significant difference ($p > 0.05$) in THIOL having the result ranged from (227.31 to 244.68mol/l). The highest THIOL was recorded at rams fed basal diet supplemented with concentrate mix of 2200kcal/kg energy level which wasn't significantly different ($p < 0.05$) influenced by energy intake.

Discussion

The daily concentrate intake (g/day) for rams in this present study were in consistent with the finding of [8]who reported a range of 150- 350g/day when investigating the feed intake, digestibility of fat tailed hair sheep fed hay supplemented with two levels of concentrates. The increase in the daily concentrate intake might due to the positive effects of bioactive constituents of *Pennisetum purpureum* on the diets' palatability. In contrast with negative effects of tannin as one of the major bioactive constituents of *Pennisetum purpureum* leaves explained by [9] in reducing feed palat-

Parameters	A	B	C	D	E	SEM±
TBARS	1.08	1.65	2.14	1.12	1.53	0.17
GPx	35.19	32.52	31.22	34.17	28.32	2.72
THIOL	244.68	227.31	240.80	234.12	233.12	5.22
SOD	30.26[b]	48.37[a]	24.64[b]	31.39[b]	28.67[b]	2.14

Table 3: Oxidative status of West African dwarf rams fed basal diet supplemented with concentrate mix of different energy levels.

Footnote:

Glutathion Peroxidase (GPx)

Thiobarburitic Acid Reactive Substance (TBARS)

Super Oxide Dismutase (SOD)

ability, slowing down of digestion and development of conditioned aversions in reducing voluntary feed intake. That may lead to rejection of browses, feeds by small ruminants and wild browsers. [10] reported that reduction in intake of dry matter and crude protein when sheep were fed with browse diets containing tannins. [11] reported that stimulation of digestive secretions e.g., saliva, bile and mucus and enhanced enzyme activity are their core mode of nutritional action.

The potential of *Pennisetum purpureum* due to its pungency to increase dry matter intake by changing the intake pattern has been demonstrated by [13]. Similar reports of plant extract pungency also demonstrated by [12] showed that dry matter intake (DMI) was increased by a blend of cinnamal-dehyde and eugenol in the diets of primiparous cows and growing ewes respectively. The total daily dry matter intake values of experimental animals fed diets containing *Pennisetum purpureum* obtained in this study is in agreement with the range for total feed intake (601.87 to 628.56g/day) obtained by [14] on the evaluation of *Piliostigma reticulum* pod meal on sokoto bucks. It is also in line with the finding of [15] who reported a range of 610- 678g/day for Washera rams fed on natural pasture hay as basal diet. However, there was a shortfall as compared to the values obtained by [16] who reported average total dry matter intake of 528.21 and 534.68g/day for West African dwarf lambs fed diets containing varying levels of broiler litters respectively. All the observed values of feed intake were within the recommended daily feed intake of ruminants (3-4%DM body weight) according to [17]. This finding corroborates with earlier reports by researchers [18] who reported a range of 3.28 to 3.78% for rams fed mixtures of roughages and concentrates of the body weigh [19] reported a range of 3.25 to 3.67% for lambs fed diets containing *Foenicum vulgare*as additive. [20] conclusion on the average daily matter intake of the two genetic groups (Malpura and cross-bred lambs) were 754 and 755g/day amounting to 3.5% of their body weight. [21] reported that dry matter intake is an important factor in the utilization of feed by ruminants and is a critical determinant of energy utilization and performance in small ruminants. [22] also indicated that feed intake is an important factor in the utilization of feed by livestock. The result obtained for total daily feed intake in this present study agreed with the report of [23] who observed that feed intake by small ruminants depend on the palatability and fibre content of the diets.

Concentrate diets do not cause rumen fill because diets with less roughage like concentrate may increase the animal dry matter intake as explained by [24]. However, in the current study, rams fed diets containing 2600kcal/kg *Pennisetum purpureum* consumed more concentrate DM. Higher proportions of concentrates in the diets elevates DM intake in 2600g *Pennisetum purpureum* as a result of the increased rate of passage in addition to providing higher energy intake. [25] observed that increasing the amount of concentrates in the diets improved daily weight gain in rams. The differences in the daily weight gain observed in this study as a result of increase in the inclusion levels of *Pennisetum purpureum* is an attribute of higher crude protein and metabolizable energy intake that allows more microbial population growth and therefore promoting digestion, making nutrients available to increase weight gain in rams. This finding was in agreement with [26] who reported higher daily weight for sheep supplemented with 350g/day concentrate than those supplemented with 1.5% body weight. [27] also reported higher daily weight gain in goats supplemented with concentrates 1.5% BW compared with those consumed 1.0% body weight. The forage consumption in the control diet higher significantly compared with other treatments is in line with the finding of [28] who evaluated energy levels and forage types in lamb diets and observed that gastro intestinal tracts (GIT) was heavier in the

animals which consumed diets with the higher forage level than in those which received higher energy levels. [29] also studied four concentrates levels in lamb diets and observed heavier GIT in the animals fed diets containing 700g of forage per kilogram of dry matter (DM).

Oxidative stress is an active field of research in veterinary medicine and has been implicated in numerous disease and conditions including sepsis, mastitis, acidosis, respiratory and joint diseases. Compared to human medicine, only a limited number of conditions have been investigated with regards to the effect of oxidative stress in ruminant [30]. At the commencement of the study, Gluthathione peroxidase, thiol and thiobarburitic (TBARS) obtained for the oxidative biomarkers were not statistically affected by the inclusion of *Pennisetum purpureaum* in the diet of the ram. However, Superoxide dismutase (SOD) were significantly ($P > 0.05$) affected by inclusion of *pennisetum purpureaum* leaves. The SOD ranged between (24.64 - 48.37mol/l) was in agreement with recent finding by [31]. SOD test offer at best a narrow and somewhat empirical on the complex process of lipid peroxidation. The value of SOD (24.64 – 48.37mol/l) was within the range reported by [32] for clinically healthy male and female Iranian goats. Increased Thiol in all treatment suggested that the increase in protein supplementation acts in protecting both lipids and protein against oxidation by free radicals. Functional consequences of Thiol-SH group losses include protein unfolding catalytic inactivation and decreased anti oxidative capacity [33]. Oxidative stress arises as a consequence of pathogenic event as reported by [34]. A defense system promotes the regulation and expression of anti-oxidant enzymes but in protein and energy malnutrition, the defense is weak to promote the regulation of antioxidant enzymes. SOD variance which has the ability to protect cell from damage due to the secondary generation of highly reactive hydroxyl group from superoxide ion to hydrogen peroxide H_2O_2 [28]. The maintenance of body temperature within physiological limits is necessary for animals to remain healthy, survive and maintain its productivity [35]. It has been demonstrated that the ability of ruminants to regulate body temperature is species and breed dependent [30].

Conclusion

It can be concluded that the basal diet (*Pennisetum purpureum*) could be supplemented with concentrate mix at 2600kcal/kg for better growth performance without oxidative stress to the West African Dwarf rams especially during dry season when forages are scarce and low quality.

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