Journal of Agriculture and Environment Vol. 17 No. 2, 2021: 63-70
ISSN: 1595-465X (Print) 2695-236X (Online)

GROWTH PERFORMANCE OF BALAMI RAMS FED FOUR VARIETIES OF HYDROPONIC SORGHUM FODDER (HSF) WITH SUPPLEMENTS IN SEMI-ARID ENVIRONMENT

Z.M. Chana[1], M. Abubakar[2], D.J.U. Kalla[2] and K.M. Bello[2]

[1]Department of Animal Science, Faculty of Agriculture, University of Maiduguri, P.M.B. 1069, Maiduguri, Borno State, Nigeria.
[2]Department of Animal Production, School of Agriculture and Agricultural Technology, Abubakar Tafawa Balewa University, P.M.B. 0248, Bauchi State, Nigeria

ABSTRACT

A study was conducted during the dry season of the year 2020 aimed to determine the growth performance of Balami rams fed with hydroponic sorghum fodder (HSF) from four different varieties of Red chakalari (V1), White chakalari (V2), Kaura (V3) and Jigari (V4) as basal diet with supplements. Each treatment was fed with one variety of HSF plus supplement as V1, V2, V3 and V4. The research was carried out at the Livestock Teaching and Research Farm University of Maiduguri in a completely randomized design (CRD) using four treatments with five replicates. Data collected were daily dry matter (DM) intake, live weight gain (LWG), feed conversion ratio (FCR) and dry matter intake per percent body weight. The results showed significant ($P<0.05$) differences in DM intake, LWG and FCR across the treatments. Animals fed V4 had the highest DM intake of 803.65g/animal/day with corresponding highest LWG of 142.86g/animal/day and the lowest FCR of 5.69. In conclusion, animals fed different HSF varieties with supplements showed no adverse effects on growth performance hence, rams in treatment 4 were superior and all the HSF varieties used in this study sustained the growth of Balami rams.

Keywords: Hydroponic Fodder; sorghum varieties; Balami rams; Growth Performance

INTRODUCTION

Small ruminants form an integral and important component of animal production system in most rural communities (Devendra, 2005). Sheep and goats are widely distributed in Nigeria in both rural and urban areas representing about 63.7% of total grazing domestic animals in the country (Gefu, 2002). National Agricultural Sample Survey indicated that Nigeria was endowed with an estimated 19.5 million cattle, 72.5 million goats, 41.3 million sheep, 7.1 million pigs and 28,000 camels (Premium Times, 2016) and their role is extremely important within most farming systems and they have the potential of accumulating capital (Gefu, 2002).

The interest in the value of small ruminants as domestic livestock is widespread and is stimulated by an extensive recognition of their role in food production (Devendra, 2005). Hooft *et al.* (2008) also reported that the goal for livestock rearing is to attain self-sufficiency in their production and products. However, unavailability of grazing feedstuffs is one of the major problems of livestock production particularly ruminants (Jehsan, 2012). This problem can be alleviated by introduction of modern techniques of livestock feed production called hydroponic fodder production (Jehsan,2012) and it is essentially the germination of a seed sprouted into a high quality, nutritious and contaminant-free animal feed within short period of time (Naik, 2013).

The use of hydroponic fodder production ensures availability of high-quality fodder throughout the year and will increase the sustainability of ruminant production (Mooney, 2005; Naik, 2013). Therefore, the current study was designed to investigate the nutrient intake and growth performance of Balami rams fed hydroponically grown sorghum fodder-based diets with supplements.

MATERIALS AND METHOD

Study Area

The experiment was carried out during the dry season of 2020 at the Livestock Teaching and Research Farm, University of Maiduguri. Maiduguri is situated at latitude 11^0 51^lN, longitude 13^0 09^lE and at an altitude of 354 m above sea level (Encarta, 2007), which falls within the semi-arid zone of West Africa. The area is characterized by short period of rainy season (3-4 months) from June to September with annual rainfall ranging from 500 to 600 mm. Long period of dry seasons (8-9 months) spanning October to May were also observed annually. Ambient temperatures were high (38-44^0C) in the months of March to May whereas low temperatures are recorded in December and January ranging from 15-19^0C (Weather and climate, 2016). Relative humidity is low in the month of March (30%) and high in the month of August (80%).

Hydroponic Fodder Production

A hydroponic unit was constructed at the Livestock Teaching and Research Farm University of Maiduguri and installed into growth room. The growth room was constructed with cemented floor, walls of nets and roofed with aluminium sheets surrounded by trees which provide additional cooling and ventilation to the room. The unit was made up of metal frame with a dimension of 3.5m length, 1.5m height and width of 0.75m consisting of 4 shelves. Each shelf contained seven (7) aluminium planting trays. The planting trays have a length of 70cm, a width of 45cm and 6cm depth. The trays also have holes at the bottom to allow drainage of excess water in order to prevent waterlogging. Planting materials used were aluminium trays, knapsack sprayer, watering can, buckets and four varieties of sorghum seeds for the fodder production. The sorghum varieties used were Red Chakalari, White Chakalari, Kaura and Jigari which are commonly grown in the research area owing to their adaptability and affordability. The seeds were purchased from Maiduguri Gamboru market and sorted out for viability and good quality for better production. Seed rate of 800g was used per tray which was the capacity of planting trays. The seeds were cleaned from debris and other foreign materials, weighed and washed thoroughly with clean water. It was soaked in

water for 24 hours then rinsed with clean water before planting. The washing and soaking facilitate the metabolism and utilization of reserved nutrients of the seeds for growth and development of the plant, it also softens the seed coat for easy germination. The soaked sorghum seeds were sown in an aluminium planting tray and irrigated manually using knapsack sprayer and watering can. Knapsack sprayer was used at an early stage of planting (1 to 3 days) to avoid scattering of the seed on the trays. The trays were stacked on the shelves and were irrigated twice daily (morning and evening) to keep the seedlings moist. Fodder was harvested at 8th day after planting and were fed to the rams as basal diet.

Experimental Animals and their Management

Twenty (20) growing Balami rams with an average weight of 20±1kg were used for the experiment. The animals were purchased from Maiduguri Livestock Market, individually weighed and randomly allotted to four treatments and replicated five times with each animal serving as a replicate. The animals were tagged and housed in an individual pens of concrete floors which were washed and disinfected prior to the beginning of the experiment. The rams were quarantined for three weeks to observe for any health problems and also adapt to the environment and the diets before inception of the study. During the quarantine period, they were dewormed with broad spectrum dewormer (Albendazole® tablets) for internal worms, ivermetin (1ml/10kg body weight) injection subcutaneously against ecto-parasites and oxytetracycline long acting (1ml/10kg body weight) injected for protection of harmful microbial infection. Experimental diets of known quantity were offered to the experimental group twice daily (at 700hours and 1400hours). Water and mineral salt lick were offered *ad libitum*.

Experimental Design and Diets

The animals were randomly assigned into four treatment groups consisting of five rams per treatment in a Completely Randomized Design (CRD). The hydroponically grown fodder were used as basal diet in which each variety represents a treatment group. A Supplement diet was formulated at 60:40 energy protein ratio which consist of maize bran, cotton seed cake, bone meal and table salt as shown in Table 1. Supplement diets of 1.5% body weight of the animal was offered per head per day throughout the experimental period.

Table 1: Ingredient's composition of supplemented diet

Ingredients	Quantity **(%)**
Maize bran	58.50
Cotton seed cake	39.00
Bone meal	02.00
Salt	00.50
Total	100.00

Data Collection

During the experiment, residual basal and supplement diets were weighed daily to determine the total intake of each ram. Body weight of individual animal was measured at

the onset of the experiment and subsequently on weekly basis throughout the study period and the experiment lasted for 10 weeks.

Chemical Analysis

Samples of diets were collected and analysed on Dry Matter (DM) basis for Crude Protein (CP), Ether Extract (EE), Crude Fibre (CF) and Ash according to AOAC (2000). Acid Detergent Fibre (ADF) and Neutral Detergent Fibre (NDF) were determined using the method of Van Soest *et al.* (1991). Organic Matter (OM) and Nitrogen Free Extract (NFE) were calculated.

Statistical Analysis

Data collected were subjected to analysis of variance) using General Linear Model of SAS (2000) and means were separated using Least Significant Difference (LSD).

RESULTS AND DISCUSSION

Chemical composition of basal and supplement diets

The chemical composition of basal (four varieties of HSF) and supplement diets are presented in Table 2. The DM content of the basal diets range from 12.10% to 16.35%, and DM of the supplement diet was 93.33%. Organic Matter was 11.10%, 14.45%, 15.35%, 13.00% and 82.49% for V1, V2, V3, V4 and supplement diet respectively. The CP of the fodder were within the range of 9.31% to 14.05% with V4 having the highest value. Similarly, supplement diet has a CP of 31.52%. NDF and ADF were also high in V4 with 44.36% and 30.86% respectively. Lowest values of NDF (36.08%) and ADF (19.36%) were recorded in the supplement diet.

The dry matter contents of basal fodder (four HSF varieties) compared favourably with Super-1 HSF (14.55%) harvested at 12 days and KD4 HSF (15.68%) harvested at 16 days (Christidiana, 2018), but lower than hydroponic maize (18.30%) at 8 days harvest (Naik *et al.*, 2014). Al-Karaki and Al-Momani, (2011) reported 12.2% DM for barley hydroponic fodder harvested at 10 days, similar to the value for Red Chakalari HSF but lower than the other varieties used in this study. Generally, the decrease in DM content for all types of hydroponic fodder is attributed to decrease in starch content because of water imbibition. The DM for the supplements in this study was within the range values for most of the supplement diets reported by many authors such as 92.98 to 94.61% for various nitrogen supplement fed to rams (Abubakar *et al.*,2012; Chana *et al.* (2017) reported a ranged DM values of 92.50 to 93.23% for graded levels of sorrel seed meal supplement.

The crude protein for HSF varieties observed in the current work ranged from 9.31 to 14.05% which were adequate for ruminant feeds, the CP increases with corresponding decrease in DM and OM hence, the values were in agreement with most of the hydroponic fodder CP content. Naik *et al.* (2015) reported a CP content of 8.88 to 13.57% for hydroponic maize while higher CP values were reported by Christidiana (2018) and Al-Karaki and Al-Momani (2011) for hydroponic sorghum varieties and hydroponic barley respectively. These differences may be due to seed variation, type of hydroponic unit, condition of growth room (green house), irrigation frequencies, nutrient supply, location etc. The CP for the supplement

was higher and can intercede even if the basal were poor. The NDF and ADF for both the basal and supplement feeds were low, and of better feeding quality since they were all below the reported value of 55 to 60% that can limit feed intake (Meissner *et al.,* 1991) and subsequent growth performance.

Nutrient Intake and Growth Performance of Balami Rams fed Different Varieties of HSF with Supplements

The nutrients intake and growth performance of Balami rams fed varieties of HSF with supplement diets is presented in Table 3. The results of the dry matter intake of the current study indicated a significant ($P<0.05$) difference among the treatment groups. The experimental animals had higher intake of h V4 (803.65g/day/animal) and the least intake for V1 (762.63g/day/animal). This is inconsistent with the findings of Naik *et al.* (2014) who observed no differences in DM of animals fed of concentrate mixture and hydroponic maize fodder. Daily weight gain exhibited significant ($P<0.05$) difference between treatments. The increase in weight gain by the animals could be linked to DMI, because group with higher DMI (803.65g/day) had higher weight gain (142g/day).

The CP intake was 136.36, 135.44, 137.97 and 145.41g/day for animals fed HSF made from V1, V2, V3 and V4 correspondingly. There was significant ($P<0.05$) effect of HSF variety on CP intake of the animals. Rams fed HSF of V4 had the highest CPI (145.41g/day) as compared to other groups. This may be attributed to the high CP content in the HSF of V4. The results agree with the report of Christidiana (2018) who stated that lower dry matter value give higher CP which was in conformity with the results of this experiment and the increase in CP is probably due to loss in the dry matter.

The neutral detergent fibre intake of the animals differed significantly ($P<0.05$) across the treatments in the following ranking V4V3>V2V1 with a similar trend in acid detergent fibre intake. However, the NDFI and ADFI were lower than both the DMI and CPI values. Carmi *et al.* (2006) reported that increase in NDF and ADF values occurs because of the synthesis and accumulation of lignin which usually occurs during the formation and thickening of secondary cell walls, therefore, the rate of maturation and irrigation affect the accumulation of lignin.

Daily weight gain of the rams ranged from 97.14g/animal recorded for rams in V2 to 142.86g/animal for those fed V4 with statistical ($P<0.05$) variation among the groups. The result of the current study indicates that the group that received the higher nutrient intake had higher daily weight gain (V4) hence, the positive response in the weight of rams in all the treatments led to support the importance of supplementation in animal feeding.

The DM intake per body weight were 2.44%, 2.77%, 2.63% and 2.48% in respect of animals in V1, V2, V3 and V4 which did not ($P>0.05$) differ among the groups. Generally, the fodder intake in this study were high because animals voluntarily consumed more due to its palatability and tenderness. However, less DM intake values were recorded because of high moisture content of the fodder. The feed conversion ratio (FCR) of Balami rams across the treatments was significantly ($P<0.05$) different ranging from 5.69 to 8.94. It indicated that groups with lower FCR had better feed efficiency and subsequent higher weight gain. It was revealed in this study that animal on Jigari HSF (V4) with supplement had better FCR, higher DMI and higher weight gain. The result agrees t with the report of Abubakar *et al.* (2011) and Dangut (2016) who reported lower and higher FCR respectively.

Table 2: Chemical composition (%) of HSF varieties (basal) and supplements

Parameters	DM	OM	CP	ASH	EE	NDF	ADF
V1	12.10	11.10	11.71	01.00	01.00	43.15	29.04
V2	15.95	14.45	10.62	01.50	01.00	40.75	25.85
V3	16.35	15.35	09.31	01.00	01.50	38.12	22.20
V4	14.50	13.00	14.05	01.50	01.00	44.36	30.86
SUPP	93.33	82.49	31.52	10.84	07.80	36.08	19.36

HSF = Hydroponic Sorghum Fodder, DM = Dry Matter, OM = Organic Matter, CP = Crude Protein, EE = Ether Extract, CF = Crude Fiber, ADF = Acid Detergent Fiber, NDF = Neutral Detergent Fiber, V1 = Red Chakalari Variety, V2 = White Chakalari Variety, V3 = Kaura Variety and V4 = Jigari Variety, SUPP= Supplement.

Table 3: Nutrient intake and growth performance of Balami rams fed different varieties of HSF with supplements

Parameters	Varieties				SEM
	V1	V2	V3	V4	
Dry Matter Intake (g/day)	762.23^{b}	796.53^{ab}	783.33^{ab}	803.65^{a}	18.86
Organic Matter Intake (g/day)	586.20^{c}	590.18^{bc}	599.54^{a}	595.77^{ab}	3.82
Crude Protein Intake (g/day)	136.36^{b}	135.44^{b}	137.97^{b}	145.41^{a}	2.13
Neutral Detergent Fibre Intake (g/day)	295.90^{b}	296.18^{b}	315.80^{a}	318.27^{a}	5.67
Acid Detergent Fibre Intake (g/day)	164.25^{b}	159.03^{b}	176.01^{a}	182.33^{a}	3.40
Initial Weight (kg)	22.80	22.00	22.00	22.40	01.14
Final weight (kg)	31.20^{ab}	28.80^{b}	29.80^{ab}	32.40^{a}	1.37
Daily Weight Gain (g/day)	120.00^{a}	97.14^{b}	111.43^{b}	142.86^{a}	14.43
DM Intake Per (% Body Weight)	02.44	02.77	02.63	02.48	0.82
Feed Conversion Ratio	06.50	08.94^{a}	07.21^{ab}	05.69^{b}	1.11

V1 = Red Chakalari, V2 = White Chakalari, V3 = Kaura, V4 = Jigari, SEM = Standard Error of Mean, LS = Level of Significance, * = ($P<0.05$), ^{a,b,c,d} = Means in the same row with different superscripts are significantly different, NS = Not Significant.

CONCLUSION

It is concluded that animals fed HSF varieties with supplements had no adverse effects on performance, therefore, all the varieties used in this study sustained the growth of Balami rams. The results of the current study recommended feeding of Jigari HSF (V4) harvested at 8^{th} day with supplements to growing Balami rams because it gives the highest DM intake of 803.65g/animal/day with corresponding highest daily weight gains of 142.86g/animal and best feed conversion ratio of 5.69 for the rams.

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