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EFFECT OF HYDROPONIC RICE FODDER SUPPLEMENTED DIETS ON GROWTH PERFORMANCE, NUTRIENT DIGESTIBILITY AND RUMEN ECOLOGY OF RED SOKOTO BUCKS

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Abstract

This study assessed the effect of hydroponic rice fodder supplemented diets on growth performance, nutrient digestibility and rumen ecology of Red Sokoto bucks. A total number of sixteen (16) Red Sokoto bucks of average of 10kg were randomly allocated into four treatments comprising four (4) replicates in a Completely Randomized Design (CRD). The Animals were given basal diets with hydroponic fodder supplement at 0g, 250,500g, and 750g per kg diets for T1, T2, T3 and T4 respectively. The feeding trial lasted for 84days after which two bucks were randomly selected from each treatment and allocated to metabolic cage for faecal and urine sample collection. Animal was allowed to acclimatize with the cage for seven days followed by feeding trial where faecal sample was collected daily and weigh. The urine sample was collected in a jarcan containing 10% concentrated sulphuric acid to prevent bacterial microbial activities and urine ammonia and nitrogen escape. Rumen fluid were collected using stomach tube for volatile fatty acids and rumen microbes' determination. Data obtained were subjected to analysis of variance (ANOVA) and the treatment means were separated using Duncan multiple range test. The growth performance result revealed comparable weight gain across the treatments. The result further revealed significant ($P<0.05$) differences in nutrient digestibility. There were significant ($p<0.05$) differences in all rumen ecological parameters. It could be concluded that Supplementation of hydroponic rice fodder in the diets of goats is of immense benefits. It is therefore recommended hydroponic rice fodder can be to goats from 250g to 750g improved performance.

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INTRODUCTION

Feeds and animal nutrition presents a major sector in providing food security. However, there is a large gap between feed supply and demand (Akkenapally and Lekkala, 2021). This gap can be attributed basically to climatic changes, urbanization and increase in meat demand. Nowadays, especially after the covid-19 pandemic, there is a crucial problem in supplying fresh green feed to remote and urban regions. The main problem of feed scarcity emanates from land scarcity; actually, rapid urbanization is the major cause behind the decrease in land meant for grazing and fodder cultivation. With Water, labor shortage and elevated cost of fertilizers the farmer leans to cultivate commercial food crops over green fodder (Shit, *2019*). Fodder production cannot easily be increased due mainly to ever increasing human pressure on land for production of cereal grains, oil seeds and pulses.

To meet the increasing demand for green fodder, one of the alternatives is hydroponic fodder production to supplement the meager pasture resources (Bakshi *et al*., 2017). Hydroponic fodder is a type of feed produced by germinating seeds without using soil. Hydroponic fodder is an exciting and unique way of growing young, tender grass grown from cereal grain. The major limitations of the conventional method of fodder cultivations are overcome by the hydroponics technology. Less land is required as the vertical growing process allows the production of large volume of hydroponics fodder on a fraction of the area required by conventional cultivation and thus there is high yield in small area with increase in stocking capacity (Garba *et al.,* 2023). Under hydroponics technology, about 600 kg

hydroponic fodder can be produced daily in seven days only in 50 sq. m. area. It is estimated that to produce the same amount of fodder, about 1 ha land is required. The water requirement in hydroponics technology is very less as water can be applied and reapplied continuously. To produce one kg of fresh hydroponics fodder (7-day) about 1.5 litre (if water is reused) to 3 (if water is not reused) liters of water is required (Naik *et al.,* 2013) against about 30 liters of water per kg of fresh green fodder grown in laterite soil under conventional practices. Only one person is sufficient to work in the hydroponics system to produce 600 kg hydroponic fodder daily. The study investigated the effect of feeding hydroponic rice fodder on performance, nutrient digestibility and rumen ecology of Red Sokoto bucks.

MATERIALS AND METHOD

Experimental site:

The experiment was conducted at Professor Abdu Lawal Saulawa Livestock Teaching and Research Farm, Department of Animal Science, Federal University Dutsin-Ma, Katsina State. The Farm is situated within the latitude 12°27'18' North and 7°29'29' East and 605 meters above sea level with an annual average rainfall of 700mm and situated in the Northern Sudan Savannah zone (Gaddafi, 2019).

Preparation of hydroponics fodder

The rice seeds were procured from reputable source in Dutsin-Ma. 500g of the seeds were soaked for 24 hours in 2 liters of water after which they were sieved and spread in a hydroponic aluminum tray and covered with foiling paper to incubate for 48 hours. After that, the foiling paper was removed, and the tray was taken to the hydroponic chamber. The fodder was harvested after seven (7) days.

Sourcing of Experimental Animal

A total number of sixteen (16) Red Sokoto bucks were sourced from Dutsin-Ma. They were quarantined for two (2) weeks during which they were given prophylactic treatment with Oxytetracycline (intramuscularly at 1 ml per 10 kg body weight. They were treated with levamisole and Ivermectin against internal and external parasites. They fed with groundnut haulm, cotton seed cake, rice milling, salt and bone meal throughout the quarantine period. Water was offered them *ad libitum*.

Experimental animals and design

The experimental animals of average weight of 20kg and within the same age of six months were randomly allocated into four treatments comprising four (4) replicates in a Completely Randomized Design (CRD). The animals were given basal diets with hydroponic fodder supplement at 0g, 250,500g, and 750g per kg diets for T1, T2, T3 and T4 respectively.

Data Collection

Growth Performance:

Growth performance of Red Sokoto bucks fed with hydroponic fodder supplemented diets were evaluated. The initial weight of the bucks was taken on the date of commencement of the experiment while the final weight was measured at 84th days of the feeding trial. The parameters are determined as follows:

Weight gain (kg) = Final Weight-Initial Weight

Feed Intake= Feed given to the animal-left over (Ort)

$$\text{Feed conversion ratio} = \frac{\text{Feed intake}}{\text{Weight gain}}$$

Nutrient Digestibility

Two bucks were randomly selected from each treatment and allocated into metabolic cages for faecal and urine sample collection. They were allowed to acclimatize with the cage for fourteen (14) days followed by seven (7) days period of faecal sample collection. The faecal samples were bulked, weighed and representative sample taken for proximate composition and crude fibre analysis by AOAC (2005) and Van Soest (1987).

Rumen ecology

The rumen liquor was collected using stomach tube and vacuum pump. The tube was inserted into rumen and pump to obtained rumen fluid. The fluid was put in a sample bottle and taken to laboratory for rumen VFA determination. The sample was filtered with four-layer cheese cloth and subsamples was divided into two portions. The 1st portion for total volatile fatty acid (VFA3000) and the proportions of acetate, propionate and butyrate. The samples were centrifuged at x g for 10 min; they were allowed to settle and decanted. The decant were titrated with 0.1M of sodium hydroxide (4/1000gml H2O) solution each with 2-3 drops

of phenophtaline (1/100gml ethanol) as the indicator. Determination of the various fractions using the following formula:

i. Acetate = (Titre value x 0.1 x 0.06 x 100)/5
ii. Propionate = (Titre value x 0.1 x 0.04 x 100)/5
iii. Butyrate = (Titre value x 0.1 x 0.006 x 1000)/5
iv. Total volatile fatty acids (Titre value x 0.1 x 0.09 x 100)/5

The second portion of the rumen filtrate were used for microbial count and identification. 2ml of rumen liquor was subjected to microbial count were proteolytic bacteria, amylolytic bacteria, fungi Oozoorespores protozoa and total colliform bacteria counts would be analyzed. Protozoa count were obtained by direct observation using a microscope at 10 x magnification. Colony-forming units/ml (CFU/ml) of both bacterial and fungi was observed with the pour plate technique using nutrient algae (NA) and Potato dextrose agar (PDA) respectively. The plates were then incubated for 24 hours at 37ºC. All colonies appearing at the end of the incubation period was be counted using a digital illuminated colony counter. Colonies grown on nutrient agar plates was suspected to be either gram-positive or gram-negative; thus, all colonies found on each plate was used for gram staining. Colonies grown on the PDA was further incubated for three days after the first 24 hours to check for morphology and isolation of fungi. Physical characteristics of rumen liquor such as temperature, pH, colour and odour.

Data analysis

All data obtained in this study was subjected to analysis of variance (ANOVA) using the General Linear Model of SAS (2001). The means were separated using Duncan multiple range test (DMRT).

RESULT AND DISCUSSION

Effect of Hydroponic Rice Fodder on Growth Performance of Red Sokoto Bucks

Table 1 shows the effect of feeding graded levels diets supplemented with hydroponic fodder on the performance of Red Sokoto goats. There was no significant difference ($P>0.05$) in the initial and final body weight of the experimental animals. Weight gain were not significantly ($P>0.05$) influenced by the inclusion of hydroponic fodder in the diets of the animals. The total feed intake by the animals differed significantly ($P<0.05$) across the treatments with ranges of 25.21kg to 38.42kg. The feed conversion ratio showed significant difference ($P<0.05$) between T4 and other treatments. T1, T2 and T3 were not significantly different from each other. This shows that hydroponic rice fodder supplementations had a profound effect in improving live weight of Red Sokoto bucks. The findings of this study shows that feeding hydroponic to the experimental animals enhanced feed intake and weight gain. This is in accordance with the reports from several research that body weight gain in various livestock species, including goats are enhanced by hydroponics (Naik and Singh 2013; Rachel Jemimah *et al.* 2015; Shit (2019); Arif *et al.* 2023)

Table 1: Effect of hydroponic rice fodd`1qer on growth performance of red Sokoto bucks

PARAMETERS	T1	T2	T3	T4	SEM	LOS
IW(kg)	10.03^{a}	10.30^{a}	10.28^{a}	10.75^{a}	0.487	NS
FW	$11..07^{a}$	11.20^{a}	11.53^{a}	11.93^{a}	0.444	NS
WG(kg)	1.050^{a}	0.900^{a}	1.250^{a}	1.175^{a}	0.299	NS
ADWG(kg)	0.041^{a}	0.021^{ab}	0.020^{ab}	0.009^{b}	0.009	*
TFI(kg)	25.21^{b}	31.94^{ab}	31.59^{ab}	38.42^{a}	3.56	*
ADFI(g)	600.2^{b}	757.9^{ab}	773.1^{ab}	914.8^{a}	84.6	*
FCR	2.265^{b}	2.857^{b}	2.737^{ab}	3.235^{a}	0.325	*

IW = initial weight, FW = final weight, WG = weight gain, ADWG = average daily weight gain, TFI = total feed intake, ADFI = average daily feed intake, FCR = feed conversion ration

Effect of Hydroponic Rice Fodder Supplemented Diets on Nutrient Digestibility of Red Sokoto Bucks

The results of the effect of hydroponic rice fodder supplemented diets on nutrient digestibility of Red Sokoto bucks is presented in Table 2. The results clearly indicated that dry matter, ash, crude fiber, crude protein, ether extract and nitrogen free extract were all significantly (P<0.05) across the treatments. Increase in dry matter digestibility tend to increase growth rate and muscling. Hadded and Husein (2004) reported that improved DMD correlates with higher average daily gain in ram. From this study, T3 had the highest (P<0.05) dry matter and ash content. T1 had the highest value of crude fiber (4.55%) and ether extract (0.95%). Significantly higher (P<0.05) digestible crude protein ((9.91%) was recorded in T4. NFE (80.50%) was also significantly higher (P<0.05) in T4. The result of the research portrays that feeding hydroponic fodder to animals possess the potential of improving nutrient digestibility. Hydroponic maize fodder supplementation has been shown to improve nutrient digestibility, productive performance, and profitability in Tellicherry buck kids (Ebenezer *et al.* 2021; Jemimah *et al*. 2023).

Table 2: Effect of Hydroponic Rice Fodder Supplemented Diets on Nutrient Digestibility of Red Sokoto Bucks

Treatment	T1	T2	T3	T4	SEM	LOS
DM	89.55^{d}	90.47^{b}	91.12^{a}	90.37^{c}	0.009	*
Ash	5.275^{b}	5.285^{b}	6.175^{a}	4.875^{c}	0.007	*
Crude fiber	4.545^{a}	4.390^{c}	4.500^{c}	3.875^{d}	0.005	*
Crude protein	9.745^{b}	8.915^{c}	8.775^{d}	9.905^{a}	0.007	*
Ether extract	0.935^{a}	0.880^{b}	0.775^{d}	0.830^{c}	0.008	*
NFE	79.57^{c}	80.49 ^{a}	79.75^{b}	80.50^{a}	0.006	*

DM = Dry Matter, CP = Crude Protein, N = Nitrogen free extract

Effect of Hydroponic Rice Fodder on Rumen Ecology of Red Sokoto Bucks

The result of the effect of hydroponic rice fodder supplemented diets on rumen ecology of Red Sokoto bucks is presented in Table 3. The result showed that there were significant (P<0.05) differences in rumen fluid pH with T1 having significantly (P<0.0) highest values of 7.50 while T3 had significantly lowest (6.85). Rumen pH of 6 to 7 favours prediposes rumen microbes to actively performing microbial digestion and volatile gases production. The result further showed that aceatic acids were significantly (P<0.05) higher in T1 followed by T2 while lower in T3. Acetate (C_2) is the dominant in high-fibre diets (60-70% of VFAs); precursor for fat synthesis and ketogenesis. In some ruminant species like rams high acetate is critical for fat deposition and sperm production (Brito *et al.,* 2007). Both butyric acid and propanoic acids were significantly (P<0.05) different in this study. The result revealed that total volatile fatty acids were significantly (P<0.05) higher in T2 (16.44 nmol/L) while lower in T4 with 14.86 nmol/L.

Rumen microorganisms play a crucial role in modulating the rumen ecosystem through microbial fermentation, digestion, producing volatile gases, synthesis of some vitamin, microbial protein formulation and others. The result revealed that there were significant (P<0.05) difference in which T2 had the highest bacterial count ($25.30x10^5$/cfu). Rumen bacteria such as *fibrobacter succinogenes* and *ruminococcus albus* play important role of fiber digestion by producing cellulase and hemicellulases enzymes to degrade plant cell walls (Bera-Maillet, 2005). Significantly (P<0.05) higher fungi population were observed in Red Sokoto bucks fed diet T3 with $14.41x10^3$/cfu while significantly (P<0.05) higher protozoa were recorded in T1 ($9.250x10^3$/cfu). The rumen fungi obtained in this study clearly indicates that it plays important role fiber digestion. Rumen fungi are crucial microorganisms in the rumen ecosystem that contributed to fibre degradation by hyphal penetration via plant tissue invading

with the aid of rhizoids. Also, it synergized with bacteria to ferment sugars to volatile fatty acids (acetate, propionate) and enzymatic hydrolysis to releases cellulases and hemicellulases (Wang *et al.,* 2019). Ammonia were found significantly (P<0.05) higher in T1 followed by T4, T3 and T2. The values for ammonia in all the treatments was within the normal range of 16.5mg/l to 37.9mg/dl.

Table 3: Effect of Hydroponic Rice Fodder on Rumen Ecology of Red Sokoto Bucks

Treatment	T1	T2	T3	T4	SEM	LOS
Ph	7.500^{a}	7.345^{b}	6.845^{d}	7.295^{c}	0.006	*
AA (nmol/l)	28.39^{a}	27.21^{b}	24.80^{d}	25.55^{c}	0.007	*
BA (nmol/l)	6.295^{b}	7.415^{a}	4.945^{d}	5.590^{c}	0.006	*
PA (nmol/l)	11.59^{b}	13.72^{a}	10.84^{c}	9.95^{d}	0.006	*
Bacteria ($x10^{5}$/cfu)	22.70^{c}	25.30^{a}	24.24^{b}	21.91^{d}	0.006	*
Fungi($x10^{3}$/cfu)	12.27^{c}	13.52^{b}	14.41^{a}	11.86^{d}	0.007	*
Protozoa ($x10^{3}$/cfu)	9.250^{a}	8.435^{b}	7.875^{c}	7.585^{d}	0.006	*
NH3 (mg/l)	32.22^{a}	30.05^{d}	30.15^{c}	31.10^{b}	0.003	*
VFA (nmol/l)	15.64^{c}	16.44^{a}	16.12^{b}	14.86^{d}	0.005	*

CONCLUSION

It could be concluded that supplementation of hydroponic rice fodder greatly influenced growth performance and nutrient digestibility. For best rumen ecosystem T3 and T2 had the best pH, rumen microbial population and total volatile fatty acids. It is therefore recommended hydroponic rice fodder should be given to animals from 250g to 750g for improvement of growth performance, nutrient digestibility and overall health performance.

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