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PERFORMANCE OF YANKASA RAMS FED CORN COB BASAL DIET SUPPLEMENTED WITH MIXTURE OF SUN-DRIED BROILER LITTER AND DIFFERENT ENERGY SUPPLEMENTS

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ABSTRACT
A total of sixteen (16) Yankasa rams of about 10-12 months of age and having an average weight of 24 kg were used in an 84-day trial to investigate the nutrient utilization and digestibility of Yankasa rams fed grounded corn cob as basal diet supplemented with sun-dried broiler litter (SDPL) and different energy concentrate mixture. The rams were randomly assigned into four (4) treatments with four (4) replicates per treatment in a completely randomized design (CRD). Four experimental diets were formulated and designated as: T1 (Corn cob + 150g SDPL + 150g MB), T2 (Corn cob + 150g SDPL + 150g RB), T3 (Corn cob + 150g SDPL + 150g MO), and T4 (Corn cob + 150g SDPL + 150g WO) and used to feed the Yankasa rams. The result of the performance of the rams showed that basal feed intake (35360.00-37735.00g; P<0.05), supplement feed intake (25077.50-25200.00g; P<0.05), total feed intake 60437.50-62935.00g; P<0.05), daily feed intake (719.49-749.23g; P<0.05), feed conversion ratio (7.74-9.11; P<0.05) and water intake 199.93-206.93L; P<0.05) were significantly affected across dietary treatments. On the daily weight of the rams, final weight (30500.00-32250.00g; P<0.05), weight gain (6750.00-8000.00g; P<0.05) and daily weight gain (80.36-95.24g; P<0.05) was significantly (P<0.05) while initial weight did not differ significantly. Poultry litter inclusion in ruminant diets could enhance the active utilization of fibrous feed materials and crop residues used in formulation. It could also possibly have role in supplying active microbial network that could enhance digestibility and degradability of rumen dietary fractions.

Keywords: Corn Cob, Rams, Diets, Sun-Dried Poultry Litter and Supplements

INTRODUCTION

Production of more food demanded by the increasing human population resulting rising contribution of crop residues as animal feed (Sarkar *et al.,* 2020). The excessive demand for animal feeds and a change in animal husbandry are prompting the feed industry to produce quality feeds to maintain animal production (Banglapedia, 2021a; Sarker, 2019; Kazi, 2017). As a result, crop residues are becoming an important source of livestock feed sources (Alemayehu *et al.,* 2017). Corn cobs are the by-product of corn crops. The meal of corn cobs is a great source of feed for livestock and cheaper compared to other meals (Islam and Khan, 2021). It contains all the nutritional values and 1 kg of corncob meal can provide animals with 4,000 calories (Kanengoni *et al.,* 2015). Sometimes a single item can be included alone or a combination of two or more items from agro-industrial by products (AIBPs) can be prepared with dried grounded corn cob to be used as feed for farm animals (All about feed, 2015) to improve the low-quality tropical roughage feed intake and increase digestibility, daily weight gains and feed conversion efficiency FCE (Kibrom Gebremedhin, 2017). Corn cobs are the carriers of antibiotics and vitamins in livestock feed (Heuzé *et al.,* 2016a). In addition, ground corn cobs can be utilized as a source of roughage in a total mixed ration with 60% concentrate feed, which significantly improves nutrient uptake and milk production in lactating ruminants (Wachirapakorn *et al.,* 2016). However, corn cob has low feeding value and it is also unpalatable and easily contaminated by toxic fungi such as Aspergillus flavus (Binuomote *et al.,* 2018). Supplementation of a protein source feeds was one of the methods to improve the efficiency of utilization of available roughage feed resources as suggested by different authors (Rodrigues *et al.,* 2017; Obeidat *et al.,* 2020; Shewaye Hailecherkos *et al.,* 2020). Utilization of agricultural by-product as silage during the critical period of feed shortage will go a long way in reducing feed shortage. This study therefore focused on the evaluation of nutritive quality and performance of Yankasa rams fed untreated corn cob-sun-dried poultry litter mixture ration containing different energy supplements.

MATERIALS AND METHODS

Experimental Site

The study was conducted at the Animal Farm of Aminu Saleh College of Education Azare Bauchi State from January – April, 2022. Katagum Local Government Area is situated on the northern part of Bauchi State, Nigeria. Azare is the second largest town in Bauchi State. It is located at 11^{o} 40 N 10^{o} 11E, at an elevation of 436 meters above sea level. It is 250km north of the State capital, Bauchi. It has an estimated land area of 11200 square kilometers (Katagum at a glance, 2003) located within the Sudan savanna Agro-Ecological Zone of Nigeria. The area is characterized by two distinct seasons, that is, five (5) months of rainy season (April - September) and seven (7) months of dry season (October – March) (Bura, 2000). The annual rainfall is unimodel which averages about 700mm with a maximum temperature of 35^{0}C. The mean monthly temperatures ranges from 20.10-22.50^{0}C in December and January to 30.0-32.5^{0}C in April and May. The temperature of the rainy season remains steady between 25^{0}C-27^{0}C for the month of June to October. The soils in the area are formed normally from Aeolian and/or alluvial deposits, and belongs to the entisols or inceptisol orders and the soil temperature regime is isohypothermic. The geology of the area is made up of sedimentary rocks comprising the kerri-kerri (sandstone) and Chad formation (Mustapha and Fagam, 2006).

Collection of Test Ingredient

Corn Cob

The test material (corn cob) was obtained from feed mill in Buchi metropolis where the corn cob had already been grounded and bagged. The average composition was determined according to standard methodology (Maurya *et al.,* 2013). To allow for more microbial digestion and passage out of the rumen, rumination and particle size reduction was considered essential functions to increase surface area of these feed particles (Dineen *et al.,* 2018; Abouheif *et al.,* 2012). The feed was stored in appropriate, designated areas in an economical manner (Mid-West Plan Service MWPS, 2017). Feed in sacks used were stored off the floor and away from the walls on pallets or racks, and each sack was labeled, as recommended by the Association of American Feed Control Officials, with the contents and manufacture date (AAFCO, 2019).

Sun-Dried Poultry Litter (SDPL)

Broiler litter (deep litter) was collected from poultry farms within Bauchi metropolis. The poultry litter was collected from a finished broiler pens farm after the birds had attained eight (8) weeks; where it had been stored in an enclosed container before subsequent drying and pelleting (Pandey *et al.*, 2019). The litter was a mixture of chicken feces, residual feeds, feathers and material used as bedding such as wood shavings, sawdust and rice bran (Seyed *et al.,* 2017). The litter was spread (sun-dried) on cellophane sheets for air-drying for three days, referred to as sun-dried poultry litter SDPL (Ngele, 2008). Management practices for poultry litter to reduce nutrient losses from production facilities were carried out as in Kleinman *et al.* (2012) and were then packed into synthetic bags and transported to the animal farm and stored there for use.

Experimental Diets

Four experimental diets were compounded using the corn cob and mixture of MB 150g + SDPL 150g, RB 150g + SDPL 150g, MO 150g + SDPL 150g and WO 150g + SDPL 150g supplements and corn cob was offered as basal diet, and these diets were tagged treatment T1, T2, T3 and T4 respectively.

Experimental Animals, Housing and Management

A total of sixteen (16) rams of average weight of 21 kg were bought from open market in a local market Bauchi and used for the study. Body condition of the animals was evaluated based on a 5-point scale during the purchase to take effective management decisions on the nutritional and health needs of animals in order to obtain optimum production performance and as an important tool in animal management systems whether one manages free-ranging populations, domesticated farm animals or captive zoo animal species or changing environments (Carpio *et al.,* 2015; Schiffmann *et al.,* 2017). Two weeks to the arrival of the animals, the experimental house was washed thoroughly using detergent and disinfectant (Izal) and allowed to dry. The feeding troughs and drinkers were also washed, sun-dried and kept in each compartment. After the arrival of the animals to the experimental site, all animals were thoroughly examined and closely monitored on the general health state (body temperature, food intake, behaviour, internal and external parasites and signs of their presence), and then especially on the respiratory system as described (Ibhaze, 2015). The animals were quarantined for three weeks during which they were identified using numbered plastic ear tags for easy identification. On arrival to the farm, the animals were treated against endo and ectoparasites using ivermectin and vaccinated against *Peste des petits ruminants* (PPR) disease using the PPR vaccine. The animals were weighed and randomly allotted into four (4) treatments groups and each treatment group had four (4) replicates. About 14 days were allowed for adjustment to the feed as well as the environment before data collection commenced. The animals were housed in individual pen equipped with concrete floor, feeders and drinkers under a common roof, constructed to minimize possibility of injury from aggressive behaviour or escape, to provide adequate ventilation, to enable animal to gain weight and other performance traits that may be depressed as a result of over-crowding, to allow for protection from wastes and to make appropriate postural adjustments (Callahan *et al.,* 2017; Winckler *et al.,* 2015). Daily, 150g of the concentrate supplements was offered to the animals at about 8:00 hour, then at 10:00 hour, the corn cob basal diet was served to the animals and this was *ad libitum*. Feeding of the corn cob basal diet was done twice, the first feeding was at about 10:00 hour while the second feeding was at 14:00 hour. Feeding the corn cob basal diet twice daily was to help reduce wastage of the forage and encourage intake. All groups got minerals block or salt lick in pens which have advantages both in improving texture of food and in health (Okoye *et al.,* 2016). Animals were provided with fresh feed and water daily in a consistent manner, on a regular schedule, to give the animals the right to hygienic water and freedom from thirst (Babayemi and Bamikole, 2010) in accordance with the requirements established for each species by the NRC (2016) and as recommended for the geographic area. Feed intake was measured by subtracting the weight of the left-over feed from the total weight of feed supplied. The animals were weighed weekly in order to find out their body weight changes.

Sanitation, Health Management and Animal Welfare

All animals in this trial were managed according to guidelines recommended in the Guide for the Care and Use of Agriculture Animals in Agriculture Research and Teaching to ensure the animal incurs no undue pain or stress (AVMA, 2020). Much attention as possible was shown to the needs and natures of animals (AVMA, 2019). The aim was to provide a platform geared towards educating the scientific world on global best practices as it concerns humane handling and use of laboratory/experimental animals for research purposes (James *et al.,* 2019). Faeces and urine were removed every day from the feeding pens to ensure adequate ventilation, less ammonia accumulation, adequate cleanliness of the experimental pens and ensure minimum discomfort of the experimental animals.

Chemical Analysis

Feed samples were analyzed for Dry Matter (DM), Crude Protein (CP), Crude Fiber (CF) and Ash, using the methods of (Pérez-Marín *et al.,* 2004).

Statistical analysis

The experimental design was Completely Randomized Design (CRD). The data obtained from the study were subjected to analysis of variance (ANOVA) procedure (Steel and Torrie, 1980). Significant means was separated using Duncan's Multiple Range Tests (Duncan, 1955) using the SPSS (2006) package (Statistical Package for Social Sciences) procedure.

RESULTS AND DISCUSSION

The results of chemical composition i.e. moisture content, Dry Matter (DM), Crude Protein

(CP), Crude Fibre (CF), Neutral Detergent Fibre (NDF), Acid Detergent Fibre (ADF), Cellulose, Hemicellulose, Lignin, Ether Extract (EE) and ash contents of all the feed ingredients used in the feeding trial was presented in Table 1. The DM content of the experimental diets which is important as it indicates the adequacy of wilting or dryness was 94.64-96.30, respectively. The DM obtained were higher than the values reported by some authors (90.14%) Yusuf and Garba (2020) and 87.65 (Babale *et al.,* 2018) respectively in a similar study. The difference could be attributed to proper stage of harvesting, differences in the type, quantity, chemical composition and DM content which maximizes the nutritive value of silage (Gadzama *et al.,* 2017; Brar *et al,* 2017). Higher DM obtained could mean that the corn cob is a good source of energy and roughage that could enhance rumination and prevent digestive upset in the rumen as suggested elsewhere (Inuwa *et al.,* 2020). The CP was 4.98-13.86 for untreated corn cob and the total mixed rations, respectively. The CP values were higher than the values 4.21% (Abdu *et al.,* 2017); 4.88 (Babale *et al.,* 2018) and 6.59 (Yusuf and Garba, 2020) but slightly lower to 13.99 reported in a similar work (Hamad *et al.,* 2010). Variations in the values for CP might be due to processing methods, soil nutrient composition and effect of location (Oderinwale, 2018). The disparity could also be as a result of the fact that the feed was formulated to meet the requirement of different classes of animal (Sani *et al.,* 2017). The CP content falls within the range of 11.49 – 15.60% recommended as adequate to meet the protein requirement for maintenance and production of ruminant animals and effective rumen function (Ibhaze *et al.,* 2016). It is also in agreement with the value (13.73%) recommended for sheep and goat production by Okafor *et al.* (2012). Therefore, would have supported adequate ruminal fermentation by the microbes. Neutral detergent fibre (NDF) values which reflect the amount of forage the animal can consume was 41.22 for untreated corn cob and 26.96-36.48 for the total mixed ration while acid detergent fibre (ADF) which relate to the ability of an animal to digest the diet was 28.20 for untreated corn cob and 27.54-31.52 for the total mixed ration, respectively, were similar to those reported by Fajemisin *et al.* (2012a) for West African Dwarf sheep fed with ensiled corncobs treated with or without water and urea. This marked difference between the values in CF might have been as a result of genetic origin, soil fertility and time of harvest as reported by Okoruwa *et al.* (2015). The fibre fractions contents of the CC basal diet suggested that they could be adequate to meet the fibre requirements of the animals for proper rumen function (Ibhaze *et al.,* 2016). Muya *et al.* (2020) reported that diets containing a high level of ADF content constitute an indigestible fibre fraction depressing the degradability rate. The result of NFE value ranged from 45.51- 48.76 were higher than 39.8 reported by Babale *et al.* (2018) but lower than 54.96% reported by Yusuf and Garba (2020). The result of ash content of the experimental diet 1.80, 17.4, 1.45, 1.89 and 2.15, respectively. The values are lower than 3.18% reported by Yusuf and Garba (2020) and 7.9 reported by Babale *et al.* (2018). The ash content obtained is similar with 1.76 reported in a similar report (Hamad *et al.,* 2010). High inorganic (ash) content could be an indication of high minerals and some other impurities in the corn cobs.

The body weight parameters of the experimental rams are presented in Table 2. The initial weight values of the experimental rams which ranges between 23750.00 – 24500.00g was not significant ($p>0.05$) across dietary treatments. This may be due to the availability of particular age and size of the rams at a particular time and season in the market during procurement of the animals. Although, there were significant ($p<0.05$) difference in the final weight of the animals across the treatments, nevertheless, all the rams gained weight which indicated that proteins and energy are well presented to the rams above maintenance level. This difference may be attributed due to differences in initial weight of the rams used in the current study. The weight gain (WG) values of the rams fed experimental basal diets with supplementation were significantly ($p<0.05$) affected across dietary treatments. The variations in weight gain in all treatments were associated with variations in BW and TFI. Similar results were found by Elimam *et al.* (2018). Mean daily weight gains values ranged from 80.36 - 95.24g/day, indicating that all the diets supported weight gains. This may be related to the supplement feeding of concentrate, and by degrading more polysaccharides, extra energy is generated for the host (Laursen *et al.,* 2017). SDPL attributed to the quality of the diets, nutrients intake and digestibility that lead to increase in daily live weight gain. Wu (2018) asserted that the growth rate of lambs is strongly influenced by breed and the environment under which the animals are maintained, the availability of feed and its quality. As with the weights at specific ages, the average daily gain is influenced by genetic, physiological, and environmental factors (Alemneh and Getabalew, 2019) including climatic conditions, breed, age of dam, sex of the animal, type of birth and rearing and the nutritional status of the dam (Bhattarai *et al.,* 2016).

The mean daily nutrient intakes of Yankasa rams in the study are given in Table 3. The supplement intake values ranged from 25077.50g – 25200.00g and was significant ($p<0.05$) across dietary treatments but there were no significant differences ($p>0.05$) between rams fed diets T1, T3 and T4 respectively, implying that the treatments containing the test ingredients were equally palatable and acceptable to the animals so that, the diets were adequately consumed. The mixing action also delivered adequate amount of energy and protein for the microbes in the rumen to utilize the non-protein nitrogenous substance in the poultry litter (Estefanos and Tesfaye, 2020). Lawrence *et al.* (2015) reported deep stacked broiler litter as potential protein supplement in growing/finishing ruminants. This is in agreement with the report of Bello and Tsado, (2013) that, rams fed diets supplemented with dried poultry dropping had significantly better feed intake; body weight gain and feed conversion ratio. The result of feed conversion ratio (FCR) shows a significant difference ($P<0.05$) across treatments. Feed conversion ratio (FCR) which explains the transformation capacity of dietary treatments in body tissue, was calculated as kilograms of feed intake per kilogram of gain. Feed conversion ratio (FCR) is an important index of performance which is a direct indication of how best feed offered to rams was utilized for production. The FCR observed in this study was relatively better in rams fed diet T1 (Untreated corn cob + 150gSDPL + 150gMB) than others. The result revealed the ability of animals on T1 to convert the feed consumed to weight gain. Rams fed diet T1 recorded the best feed conversion ratio which indicated efficiency in feed utilization. The low FCR (7.74) obtained in this study is an indication of high digestibility and utilization of the experimental diets compared to rams on the other treatments. Pazla and Adrizal, (2021) asserted that a good ration conversion rate is when low ration consumption can increase high body weight gain. The lower the FCR value, the better the feed utilization, thus rams with higher FCR value had suppressed growth. FCR is influenced by breed, genetics, animal condition, age, ADG, the ability of livestock to digest feed, feed palatability, type of feed ingredients, availability of

nutrients in the ration, season conditions, and management (Pazla *et al.,* 2018b; Suyitman *et al.,* 2020; Jusman *et al.,* 2020). Similarly, Jamarun and Zain (2013) demonstrated that the ability of livestock in converting feed into meat is very dependent on the quality of the feed especially the content of protein, energy, and crude fibre. It has been evident that better feed quality diets with a possible increase in the digestibility provide better weight gain for animals (Santos *et al.,* 2017). Water intake ranged from 199.93 – 212.85 L/head/day with T3 having the highest (212.85 L/head/day) followed by T4 and T1 had similar values (205.83 and 206.93 L/head/day), respectively, while T2 had the least (199.93 L/head/day). This is quite lower compared to the average daily water intake per Yankasa rams (3.00 – 3.30 L/day) reported by Yahya and Saadu (2020) when three varieties of protein lick blocks supplement were fed to Yankasa rams. This variation could be attributed to environmental temperatures, health of animals, diet and season. Thus, an amount of water that was adequate at one time for a particular diet could be insufficient for another (Abdullahi *et al.,* 2020). Thus, rams fed CC basal diet + 150gSDPL + 150gMO had increased daily water intake than other treatments. This could also be attributed to the fact that feeding concentrate stimulates water intake due to its nature (smoothness) and the level of oil in it resulting from some ingredients; hence the higher the quantity of concentrate in the diet, the more the water consumption. All the rams performed better in terms of water intake, showing that the supplements increased DMI and ultimately more water was consumed.

CONCLUSION

The result obtained in the study indicated that SDPL with grounded corncob mixed ration improved the crude protein content and also enhanced the breakdown of fibre, reduced dietary energy loss and provided a better atmosphere for the rumen microbes to operate effectively. Thus, maize cobs mixture with other energy supplements can be used as a low-cost diet for rams without adverse effects on growth performance.

Table 1: Chemical composition of experimental diets

Parameters	Diets				
	Corn cob (CC)	TRT 1 CC + MB + SDPL	TRT 2 CC + RB + SDPL	TRT 3 CC + MO + SDPL	TRT 4 CC + WO + SDPL
Moisture	4.57	4.19	3.71	4.57	5.36
Ash	1.80	1.74	1.45	1.89	2.15
CP	4.98	11.38	10.76	11.09	13.86
CF	35.08	31.09	26.42	24.56	21.18
DM	95.43	95.81	96.30	95.43	94.64
EE	4.80	5.87	10.70	10.81	9.96
NFE	48.76	45.72	46.98	47.09	45.51
NDF	41.22	36.48	31.06	28.89	26.96
Cellulose	10.10	9.13	7.77	7.10	6.75
Hemicellulose	9.91	10.40	14.58	14.40	13.34
Lignin	8.77	8.57	9.81	9.43	8.81
ADF	28.20	27.54	31.52	30.31	28.32

CP = Crude proterin; CF = Crude fibre; DM = Dry matter; EE = Ether extract; NFE = Nitrogen free extract; NDF = Neutrl detergent fibre; ADF = Acid detergent fibre; TRT = Treatment; CC = Corn cob

Table 2: Body weight parameters and feed conversion efficiency of Yankasa rams fed grounded cob and supplemented with sun-dried broiler litter and energy concentrate mixture

Parameters	TRT 1 MB + SDPL	TRT 2 RB + SDPL	TRT3 MO + SDPL	TRT 4 WO + SDPL	SEM
Initial Weight (g)	24250.00	23750.00	24500.00	24500.00	334.63^{NS}
Final Weight (g)	32250.00a	30500.00c	32125.00a	31250.00b	186.63*
Weight Gain (g)	8000.00a	6750.00b	7625.00a	6750.00b	206.50*
Daily Weight Gain (g/d)	95.24a	80.36b	90.77a	80.36b	2.46*

[abc]Means with different superscript within rows differed significantly (P<0.05), SEM = Standard Error of Mean. NS = Not significant, TRT = Treatment, MB = Maize bran, RB = Rice bran, MO = Millet offal, WO = Wheat offal, SDPL = Sun-dried poultry litter, bf = Before feeding, af = After feeding,

Table 3: Daily nutrient intake of Yankasa rams fed grounded corn cob supplemented with sun-dried broiler litter and different energy concentrate mixture

Parameters	TRT 1 MB + SDPL	TRT 2 RB + SDPL	TRT3 MO + SDPL	TRT 4 WO + SDPL	SEM
Basal Feed Intake (g)	36222.00b	35360.00d	37735.00a	35890.00c	94.03*
Supplement Feed Intake (g)	25200.00a	25077.50b	25200.00a	25200.00a	9.04*
Total Feed Intake (g)	61420.00b	60437.50d	62935.00a	61090.00c	89.25*
Daily Feed Intake (g/d)	731.19b	719.49d	749.23a	727.26c	1.06*
Feed Conversion Ratio	7.74c	9.02a	8.38b	9.11a	0.24*
Water Intake (L)	206.93b	199.93c	212.85a	205.83b	2.18*

[abc]Means with different superscript within rows differed significantly (P<0.05), SEM = Standard Error of Mean. NS = Not significant, TRT = Treatment, MB = Maize bran, RB = Rice bran, MO = Millet offal, WO = Wheat offal, SDPL = Sun-dried poultry litter, bf = Before feeding, af = After feeding,

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