FUDMA Journal of Agriculture and Agricultural Technology
ISSN: 2504-9496
Vol. 9 No. 4, December 2023: Pp.35-40.

https://doi.org/10.33003/jaat.2023.0904.05

RUMEN FLUID CHARACTERISTICS OF YANKASA RAMS AS INFLUENCED BY COWPEA HAY AND GROUNDNUT HAULMS SUPPLEMENTATION

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ABSTRACT

This study was conducted to determine the effect of cowpea hay and groundnut haulms supplementation on rumen characteristics of Yankasa rams. The experiment involved Sixteen (16) growing Yankasa rams weighing 20.19 ± 2.2 kg randomly assigned to four treatment groups: Rice straw (I), groundnut haulms (II), cowpea hay (III) and combination of cowpea and groundnut haulms supplementations (IV). The experiment was laid in a Completely Randomized Design (CRD) with four (4) replications for a period of 84 days. The rumen liquor (15 ml) was drawn individually from the experimental animals. The rumen pH and microbial populations were determined using standard procedures. Data obtained were analyzed using Analysis of Variance with Duncan's New Multiple Range Test used to separate significant means at 5% level. The results obtained revealed significant difference ($P \leq 0.05$) among the treatments in terms of pH and microbial counts. Treatment I had the least acidic value (6.29) at four hours after feeding. Treatment II had highest microbial counts (5.87×10^6cfu/ml for bacteria and 4.26×10^5 cfu/ml for fungal counts) after 4 hours of feeding. The result inferred that supplementing basal rice straw with cowpea hay and groundnut haulms maintained the quality of rumen's fluid pH of Yankasa rams. There was sufficient number of bacterial and fungal species in the rumen fluid for fibre degradation which aid digestibility and rumen fermentation. Thus, it is recommended that, cowpea hay and groundnut haulm be fed at 300g/day to growing Yankasa rams to enhance growth performance.

Key Words: Rumen pH, Bacteria, Fungi, Cowpea hay, Groundnut haulms.

INTRODUCTION

There is an increasing concern upon the scarcity of feeds and fluctuation in quantity and quality of animal feeds the year-round which served as the major constraint to livestock production in Northern Nigeria. The available feeds during the dry season are usually very low in protein, energy and minerals leading to a marked decrease in the voluntary feed intake and digestibility (Akinwande *et al.*, 2011). With increasing demand for mutton due to rapid population growth, evaluation of potential feed resources is deemed necessary. One such factor that increases efficiency in mutton production is the proper maintenance of rumen fluid with subsequent effect on rumen microbial quality which may consequently result in improvement in yield and feed efficiency ratio (Hobson and Stewart, 1997). Ruminants depend on the microbial flora present in the rumen to digest cellulose. These microorganisms aiding digestion of cellulose in the rumen can either be several species of bacteria, protozoa, yeast and fungi which Hackmann and Spain (2010) estimated that, in each 1ml of rumen, there were 10^{-5} billion bacteria, 1 million protozoa, several yeasts and fungi.

The activities of such microbial flora aiding rumen digestion is influenced by rumen pH as Kung (2011) puts it that, the optimum pH for the rumen to efficiently and effectively ferment or degrade feeds (especially fibre) ranges from 6.2 to 6.8. At pH below 6.0, fibrolytic bacteria in the rumen become less active and fibre digestion is decreased (Carro *et al*., 2000). Further decrease in pH to between 5.8-5.9 results in mildly acidic rumen environment and cessation of fibre digestion (Carro *et al*., 2000). Excessive feeding of concentrate diets especially grains has been implicated as the cause of acidosis in ruminants when rumen pH falls below 5.0–5.2 (Carro *et al*., 2000). While rumen pH is higher prior to morning feeding as the animals tend to ruminate during the evening, it decreases after feeding because of the presence of highly fermentable carbohydrates (Ghorbani *et al*., 2002). A strategy to improve the quality of rumen fluid is needed to ensure that the well-being of the ruminant animals is maintained.

Cowpea hay and groundnut haulms supplementations were reported to promote feed intake and digestibility (Dan Abba *et al.*, 2021), thereby influencing growth performance and rumen fluids characteristics of Yankasa rams. There is paucity of information on the use of cowpea hay and groundnuts supplementation to modify the rumen fluid quality so as to enhance digestion and assimilation in rumen. The objective of this study therefore was to determine the influence of cowpea hay and groundnut haulms supplementation on rumen quality in Yankasa rams.

MATERIALS AND METHODS

Study Area

The study was conducted at the Microbiology Laboratory, Kano University of Science and Technology, Wudil, Kano State. All the experiments were carried out in the same laboratory.

Sources and Processing of Materials

Experimental forage were procured from the market, bagged separately in clean labelled poly sacks. The rice straw was chopped using a forage chopper to about 4 cm length and bagged in a clean poly sack. All the experimental diets above were stored at room temperature (27 ºC) until required for use.

Proximate Composition of the Experimental Diets

Each experimental feedstuff was analyzed for proximate composition according to the methods described by AOAC (2019). Percentage dry matter content, crude protein, crude fibre, ether extract, ash, and Nitrogen free extract were determined. However fibre fractions, acid detergent fibre (ADF), neutral detergent fibre (NDF) and acid detergent lignin (ADL) were determined according to the method described by Goering and Van Soest (2006). Hemicellulose and cellulose were obtained by difference between NDF and ADF values as described by Church and Pond (1982).

Experimental Design

The experimental animals were Sixteen (16) growing Yankasa rams weighing averagely 20.19 ±2.2kg. The animals were fed wheat bran and rice straw for two (2) weeks for acclimatization. The experimental animals were balanced by weight before being allotted to treatment groups. The animals were randomly divided into four groups (I-IV) laid out in a Completely Randomized Design (CRD) with four (4) replicates. To the first group (Treatment I), rice straw was offered *ad libitum* as control. To the second group (Treatment II) groundnut haulms were fed at 300g/day and rice straw *ad libitum*. Treatment III was given 300g/day cowpea hay and rice straw *ad libitum.* Treatment IV was given a combination of groundnut haulms and cowpea hay (150g/day Groundnut haulms + 150g/day Cowpea hay) and rice straw offered *ad libitum*. A concentrate diet containing wheat bran (WB) and sorghum chaff mixed in a ratio 2:1, 1% salt and 1% bone meal were mixed and given at 1.5% body weight to all the experimental animals once daily. The experimental forages were given twice a day in the morning at 8:00 am after concentrates feeding and afternoon at 4:00 pm while rice straw was fed *ad libitum* to all the experimental animals. The experiment lasted for 12 weeks (84) days.

Approximately, 15 ml of rumen fluid was drawn individually from the animals, using rubber stomach tube before feeding (0 hours) and at 4 hours after feeding, middle and last week of the experiment. The pH of the rumen fluid for each treatment was determined using a digital pH meter (Model: JENWAY 550) and stored in sterile glass bottles placed in ice-bags and then transported to Microbiology Laboratory, Kano University of Science and Technology Wudil, for microbial analyses.

The microbial analyses were conducted using serial dilution technique following the procedure of Adams and Moss (2007). Sterilization of all glass wares was done by washing with detergent, rinsed with distilled water and sterilized using hot air oven at 160 ºC for 1 hour. All the liquid media were sterilized in an autoclave. For bacterial counts, 1 ml from the stock sample of 10^{-6} of the rumen sample was inoculated on Nutrients Agar and incubated at 37 ºC for 24 hours. Bacterial colonies formed were observed and identified under high and low resolution objectives of a compound microscope using gross morphology and sub-cultured. Enumeration of bacterial flora was carried out using colony counter as described by Prescott *et al*. (2005). For fungal count, 1 ml from the stock solution was inoculated on Potato Dextrose Agar containing 30 mg/l of chloramphenicol to prevent bacterial growth. The samples were incubated at 37 ºC for 5 days. Developed colonies were counted in colony forming units using colony counter.

Data Analysis

The data obtained were analyzed using Analysis of Variance (ANOVA) using SAS (2008) version 9.0. Duncan's New Multiple Range Test was used to separate significant means at 5% level.

RESULTS

Proximate composition of the experimental forages (Table 1) showed significant difference ($P \leq 0.05$) in proximate composition except in the ether extracts; where no significant difference was found. Treatment III had the highest protein content of 17.5% while the control (treatment I) had the highest fibre, ash, neutral detergent fibre and acid detergent fibre values. The concentrate diet was higher in dry matter values (96.5%).

Table 1: Proximate Composition of the Experimental Materials and Concentrate Diets

Constituent (%)	Treatments				Concentrate diet
	RS	GH	CH	GH+CH	
Dry matter	93.4[b]	92.2[b]	90.1[b]	92.2[b]	96.5[a]
Crude protein	4.6[c]	14.8[b]	17.5[a]	16.8[a]	18.5[a]
Crude fibre	35.7[a]	22.4[c]	20.9[c]	27.3[b]	20.6[c]
Ether extract	1.2[a]	2.1[a]	2.0[a]	2.4[a]	2.7[a]
Ash	12.4[a]	5.4[c]	5.4[c]	9.3[b]	8.5[b]
Nitrogen free extract	46.1[b]	55.1[a]	48.3[b]	44.1[c]	49.8[b]
Neutral detergent fibre	74.3[a]	44.2[c]	46.8[c]	57.5[b]	45.1[c]
Acid detergent fibre	43.2[a]	24.4[c]	26.8[b]	29.6[b]	20.9[d]
Acid detergent lignin	5.2[b]	5.3[b]	6.5[b]	9.1[a]	6.1[b]

KEY: KEY: [ab] Means with the same superscript within the same row are not significantly (P≤0.05) different, RS= Rice Straw
GH= Groundnut Haulms CH= Cowpea Hay

The result for rumen fluid pH of experimental animals fed with experimental forages is shown in Table 2. The result showed significant difference (P≤0.05) in the pH with sampling times. Treatment II recorded a higher acidic value of 6.2 at 4 hours post-feeding than the other treatments, while the control (I) had the least acidic value.

Table 2: Rumen fluid pH of experimental animals

Sampling Time (Hours)	Treatments				SEM
	RS	GH	CH	GH+CH	
0	6.7[a]	6.7[a]	6.7[a]	6.6[a]	0.06
4	6.3[a]	6.0[b]	6.2[ab]	6.1 [ab]	0.12

KEY: [ab] Means with the same superscript within the same row are not significantly (p < 0.05) different
SEM = Standard Error of Mean RS= Rice straw GH= Groundnut Haulms CH= Cowpea Hay

The result for the microbial counts at different feeding hours is presented in Table 3. The result showed that the highest bacterial counts of $5.87x10^6$ cfu/ml at 4 hours after feeding was obtained among animals fed with groundnut haulms, while similar values were found for cowpea hay fed group. The values are significantly (P≤0.05) higher than those of the control (animals fed rice straw). Furthermore, the fungal count revealed that, the group treated with cowpea hay had the highest fungal count at 4 hours post-feeding time.

Table 3: Microbial Counts in Rumen Fluids of Yankasa Rams fed Different Forages

Parameters	Sampling Time (Hours)	TREATMENTS				SEM
		RS	GH	CH	GH+CH	
Bacterial count $x10^6$(Cfu/ml)	0	5.17[c]	5.83[a]	5.46[b]	5.57[b]	1.32
	4	5.21[c]	5.87[a]	5.59[b]	5.66[b]	0.09
Fungal count $x10^5$ (Cfu/ml)	0	3.65	3.41	3.75	3.36	1.21
	4	3.31[c]	4.26[a]	3.98[b]	3.26[c]	0.78

KEY: [abc] Means with the same superscript within the same row are not significantly (P<0.05) different, SEM = Standard Error of Mean RS= Rice straw GH= Groundnut Haulms CH= Cowpea Hay
CFU: Colony Forming Unit

DISCUSSION

The proximate composition of the experimental forages and concentrate proved the vital components present in each of the diets. The values presented by this study for dry matter contents agrees with the previous findings by Omokanye *et al*. (2001), Chakeredza *et al*. (2002) and Nyako (2015) who individually reported the values of dry matter contents in experimental diets using cowpea hay and groundnut haulms to be above 90%. Similarly, the Crude Protein contents in the experimental diets reported by the present study agrees with the finding of Yashim *et al*. (2016) who reported crude protein values in diets supplemented by cowpea hay and groundnut haulms to range between 13.70-20.13%. The crude protein contents recorded by this study are slightly higher than the range 8.9-16.0% recommended by NRC (2001) for ruminants' optimum growth performance. This therefore makes the supplements good source of protein for ruminants' growth and development as they are products of leguminous plants with more affinityto proteins as stressed by Tolera (2008). This also conforms with the work of Aduku (2005) that, any diet with crude protein values ranging between 9-14% is adequate for ruminants' growth and development.

The proximate contents of the experimental diets reported by the present study are high enough for maintenance of Yankasa rams. This conforms to the findings of Yusufu *et al*. (2017) who reported high proximate contents in *Andorographis paniculata* leaves adequate promote high quality meat in goats. The values obtained for crude fibre contents, ether extracts and neutral detergent fibre by the present study are in agreement with that reported previously by Yahaya *et al*. (2001), Siulapwa and Simukoko (2001), Addass (2011), and Yashim *et al*. (2016) in their individual studies on ruminants' nutrition. The NDF and ADF values of rice straw in this study were higher than those of cowpea hay and groundnut haulms. This can be due to the fact that, rice straw as a cereal residue contains high concentration of neutral and acids detergent fibres compared to the legumes as stressed by Belewu *et al*. (2010).

The present study revealed that, supplementation of rice straw with legume haulms increases the acidity of rumen fluids. This could probably be attributed to the high amount of amino acids present in such supplements and is the basis for high bacterial counts in the rumen liquor. This finding is in conformity with that of Lana *et al.* (1998) who reported that low rumen fluid pH regulates microbial proliferation. According to Dan Abba *et al.* (2020), changes in pH could be due to plane feeding which provided conducive environment for microbes to proliferate. As the rumen fluid pH decreases, the rate of digestion increases (Saricicek and Osman, 2010). Under normal condition, rumen pH values range between 5.5–7.0 (Russell and Rychilk, 2001).

The high bacterial counts in treatment II at 0 hour might be due to the starvation since all the animals were not given any feed. The observed increase in bacterial count at 4 hours after feeding could be ascribed to increased acidity of the rumen fluid which subsequently improves their rate of metabolism resulting in the conversion of feed to VFAs. McAllister (2000) reported that remarkable change in rumen was seen when the diets changed from roughage-based diets to concentrate based diet. While, Varal and Dehority (1989) showed that bacterial count increased due to concentrate and feed supplementation. This study illustrates that the bacterial count 4 hours after feeding was higher than the bacterial count before feeding; fungal count was also observed to be statistically different at 0 and 4 hours. This might be attributed to the fungal efficient enzymes system which can degrade structural elements of the plant cell wall. Akin *et al.* (1989) reported that differences in fungal count can arise from diet differences used in studies

CONCLUSION

It was concluded that, cowpea hay and groundnut haulms supplementation modifies the fluid pH of rumen thereby providing a conducive atmosphere for bacterial and fungal flora to proliferate and aid digestion and assimilation in the animals.

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