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INFLUENCE OF CONCENTRATES SUPPLEMENTATION ON MICROBIAL ACTIVITY OF MALE GOATS

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ABSTRACT

Ruminants have a unique characteristic to utilize fibrous fodder material through anaerobic fermentation. The rumen of a ruminant animal is a complex, open and self-contained ecosystem where nutrients consumed by the microorganisms such as bacteria, protozoa and fungi are digested anaerobically. The rumen located at the beginning of the gastro intestinal tract plays a major role because over 50% of the digestion takes place at the rumen. The feed consumed by ruminant animals is fermented by rumen microbes to volatile fatty acids and microbial biomass that serve as source of energy and protein for the host animal. Microbial activities in the rumen differ according to the type of roughages fed to the animals. Short- chain volatile fatty acids such as acetic, propionic, butyric acids, carbon dioxide, and methane and ammonia nitrogen are the products of fermentation in the rumen.

Dry mature pastures provide unbalanced levels of nutrients and subsequently do not create the environment for efficient rumen metabolism and thus do not ensure an efficient utilization of absorbed nutrients. Feed intake and the nutrients absorbed from such diets are insufficient to meet the maintenance requirement of the animal and thus animals are bound to lose weight if they do not receive additional nitrogen and mineral supplements. Supplementation with crude protein, minerals, fermentable carbohydrates provide energy that enhances rumen microbial growth and improve voluntary feed intake despite being fed with low quality roughages. The addition of bypass protein such as sunflower seed cake results in a synergistic effect that could trigger considerable improvement on the average daily gain of ruminants and hence become more efficient in using available nutrients

Keywords: Ruminant animal's, volatile fatty acids, voluntary feed intake

INTRODUCTION

Feeding of high concentrate diet to high producing ruminants could cause a major negative consequence through the occurrence of subacute ruminal acidosis. Acidosis is defined as a decrease in rumen pH below a threshold value of 6. On a daily basis, goats adapt their feeding behaviour depending on the composition of the diet offered, especially in terms of the quality and quantity during the day. Small ruminants like goats might adapt to the diet offered depending on the percentage of concentrate in the diet.

Ruminants have a unique characteristic to utilize fibrous fodder material through anaerobic fermentation (Kibria *et al*., 1991). The rumen of a ruminant animal is a complex, open and self-contained ecosystem where nutrients consumed by the microorganisms such as bacteria, protozoa and fungi are digested anaerobically. The rumen located at the beginning of the gastro intestinal tract plays a major role because over 50% of the digestion takes place at the rumen.

MATERIALS AND METHODS

Experimental Diets and Ration

The basal diet used in this experiment was wilted napier grass. The napier grass was harvested and delivered into the study area a day before the actual day of the experiment. The napier grass was properly chopped by a chaffcutter into 2-3 inches' length and stored into gunny bags after chopping. The basal diet was offered to the experimental animals after

the concentrate diet mixture was offered in the morning. A concentrate diet mixture constituting of ground maize flour (70%) and sunflower seed cake (30%) was offered before the basal diet was consumed by the goats. Clean and fresh water was provided in plastic containers firmly fixed in the metabolic crates. A mineral block was also provided in the feed trough. The concentrate dieters were offered 200 and 400 grammes per day while the control dieters were offered only chopped napier grass.

Experimental Animals

Twenty seven male goats tagged from three breeds, Toggenburg, Alpine and Small East Africa aged 16 months with an average weight of 20 kgs and dependent on their body condition and weight were used in the experiment. The goats were randomly selected from a population of 36 goats that had been kept at the experimental site for 11months. The animals were properly managed against endo-parasites and ecto-parasites through routine spraying, deworming and vaccinated against Contagious Caprine Pre- Pneumonia (CCPP). The animals were sprayed after every 3-4 weeks against ticks during the actual period of the experiment.

Animal Housing and Management

The experimental goats were housed individually in separate well ventilated pens measuring 4 feet's in Length by 3 feet's in width and 4 feet's in height. All the goats were housed in individual metabolic crate with free access to mineral salt block and fresh water provided in plastic containers. Four goats from each breed were randomly distributed to the three experimental treatment comprising control, low plane and high plane of nutrition.

Study Design

The design of the study was a 3×3 factorial experiment. The experimental animals were blocked into group of four animals per breed each based on their initial body weight determined before the experiment commenced. Each treatment diet was randomly assigned to each animal in the group within the block.

Analysis of Samples pH Analysis

The pH of rumen liquor was analysed immediately after its collection from the rumen of twenty seven randomly selected goats (three per treatment) using a general purpose pH Meter.

Ammonia Nitrogen Determination

Fifty milliliters of rumen liquor well labeled and stored in a deep freezer was used to analyse for ammonia nitrogen concentration (Mingung *et al.,* 2019). The samples were filtered through three fold cheese cloth. From each sample the ammonia nitrogen concentration was evaluated according to the Kjeldahl method. Five milliliters of aliquots of a standard solution were poured into glass tubes that were coupled in a Kjeldahl distiller. Two milliliters of potassium hydroxide solution (KOH) was added and the material was distilled in a Bolic acid solution (40g/l). The solution obtained from the distillation approximately 100mls was titrated with hydrochloric acid (HCL, 0.02N). Methyl red and bromocresol green were added go boric acid solution and was used as indicators. The NH_3-N concentration was estimated as follows: -

$$N\text{-}NH_3 = Vx0.02xFx14x100/A$$

Where:- A=Aliquot Volume

$N\text{-}NH_3$=Ammonia nitrogen concentration (mg/dl)

V=Volume of hydrochloric acid (ml)- Titre volume

F=Correction factor of the hydrochloric acid after standardizing with 0.02 sodium carbonate

14=the atomic weight of nitrogen

Figure 1: Extraction of rumen liquor for pH and ammonia nitrogen analysis

Statistical Analysis
Data collected from each experimental animal for both ammonia nitrogen and pH was entered into the computer for later analysis. The data was subjected to a two-way analysis of variance (ANOVA) with the aid of the standard error test for the comparison of means (SPSS, 2008). Data was analysed using the GLM procedures of analysis of variance. Individual goats were the experimental unit for all measured variables.

RESULTS
Effect of Supplementation on Ruminal pH Levels
The mean of ruminal pH for the three breeds of goat is presented in Table (1). The ruminal pH for the three breeds Toggenburg, Alpine and Small East Africa was 6.76, 6.83 and 6.69 respectively. The mean of ruminal pH at different level of supplementation was 6.86 (Control), 6.65 (200gms) and 6.77 (400gms).

Table 1: Rumen fermentation parameters (Mean± SE) of goats fed diet at different levels of concentrate supplementation (Control, 200, 400 grammes per day).

Breed	**pH**	**Ammonia Nitrogen**
1	6.76^{bac}±0.04	5.83^{abc}±0.52
2	6.83^{ab}±0.04	5.69^{bac}±0.50
3	6.69^{cb}±0.04	5.29^{cab}±0.57
Levels	pH	Ammonia
0	6.86^{ab}±0.02	5.18^{cba}±0.42
200	6.65^{c}±0.04	5.76^{bca}±0.52
400	6.77^{ba}±0.05	5.89^{acb}±0.61
Hours		
	pH	Ammonia
0	6.93^{a}±0.041	5.38^{b}±0.34
3	6.75^{cd}±0.04	9.07^{a}±0.60
6	6.61^{d}±0.05	5.08^{cb}±0.46
12	6.77^{bd}±0.04	2.73^{d}±0.21

Breeds Ruminal Ammonia Nitrogen Levels
The ruminal ammonia nitrogen for three breeds was 5.83 (Toggenburg), 5.69 (Alpine) and 5.29 (SEA)(Table 1). The mean of ruminal ammonia nitrogen at different level of supplementation was 5.19 (Control), 5.76 (200gms) and 5.89 (400gms).

Effect of Sampling Hours on Ruminal pH and Ruminal Ammonia Nitrogen Levels
The pH of the ruminal liquor at four set of hours namely 0, 3, 6 and 12 hours was 6.93, 6.75, 6.61 and 6.77 respectively (Table 1). The ruminal ammonia nitrogen levels at the four set of hours, 0, 3, 6 and 12 hours was 5.38, 9.07, 5.08 and 2.73. 5.5.3 Effect of Sampling hours on ruminal pH and ruminal ammonia nitrogen levels
The highest level of ammonia nitrogen concentration in the rumen was after the concentrate diet was offered 3 hours. The ammonia nitrogen level decreased on a linear scale as the hours of sampling increased except after three hours. The lowest ammonia nitrogen level was recorded after 12 hours of rumen liqour collection. The ruminal pH and the ruminal ammonia nitrogen levels (Table 2) in this experiment for the three breeds was different and significant (Wanapat *et al*., 2007).

Table 2: Effect of breeds and plane of nutrition on level of significance

Parameter	**Level of Significance(pH)**
Breed	P<0.05
Level	P<0.05
Breedx Level	P>0.05
Parameter	Level of Significance (Ammonia nitrogen)
Breed	P<0.05
Level	P<0.05
Hours	P<0.05

DISCUSSIONS

Effect of Supplementation on Breed Ruminal pH Levels

The ruminal pH can vary depending on the diet and the time after feeding (Silveira *et al*., 2000). The high pH observed before feeding is related to the low amount of nutrients available to the rumen microbial metabolism and rumination activity of the animal. According to Orskov (1986) values above 6.2 ruminal fluid is considered as a minimum limit for adequate fermentation of the fiber. The ruminal pH levels in this study were within the normal range of 6.0-7.0 for effective microbial rumen digestion.

Breed Ruminal Ammonia Nitrogen Levels

NH_{3-N} is regarded as the most important nitrogen source for microbial protein synthesis in the rumen (Puwadon *et al*., 2018) and the level in the rumen is usually high when feeds are more digestible (Erdmen *et al.*,1986). Kinyua, (2019), found that there was a significance difference ($p \leq 0.05$) in the rumen pH of the Kenyan Alpine and Toggenburg for the three trial diets fed at 6^{th} and 9^{th} hours post feeding. It was concluded that goats poses a unique characteristic of being able to maintain larger rumen ammonia nitrogen levels without noticeable rumen distension than sheep.

Diet Effect on Sampling Hours for pH and Ammonia Nitrogen

Goats utilizes most of their time ruminating than eating, regardless of the diet offered. This behaviour of goats is in accordance with study results obtained in lactating goats (Kawas *et al*., 1991) and cows (Maekawa *et al*., 2002). There was a significant difference observed by the interactions of treatments with the days of sampling. This suggests that ammonia levels in the rumen might be associated with the shift of the microbial population by time due to the addition of the concentrate mixture

CONCLUSION

This study demonstrates that supplementation of a basal diet with a concentrates diet improves rumen fermentation. Incorporation of a concentrates diet positively improved nutrient intake, digestibility, growth performance and feed conversion efficiency of growing meat goat (Chanjula *et al*., 2015).

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