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Effect of Supplementing Rice Straw with Pigeon Pea Forage on Rumen and Blood Metabolites of Yankasa Sheep

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Abstract

A study was conducted to determine the effect of supplementing rice straw with pigeon pea forage on rumen and blood metabolites of Yankasa sheep. Sisteen yearling Yankasa ewes were used for the study. A completely randomized design was used with four animals per treatment. A basal rice straw diet was provided ad libitum and pigeon pea forage supplemented at 0.5, 1.0 and 1.5% of the body weight. Rumen and blood samples were collected at 3,6,9,12 and 24 hours post-feeding. Results of the study showed low (1.16-3.81mg/100ml) NH_3-N concentration in the unsupplemented ewes. Supplementation at 1 % body weight improved the level of NH_3-N concentration to 10.38mg/ 100ml. Volatile faty acids also increased from 26.33 to 43.33mg/l in 0.0% and 1.0% of body weight pigeon pea forage supplementation. pH variations within treatments remain within acceptable range for rumen microbial activity.There was a uniformly low level of plasma urea nitrogen in the unsupplemented diet across sampling time, supplementing at 1.0% of the body weight had the highest plasma urea nitrogen level with 3 and 6 hours post-feeding being significantly ($P<0.05$) higher than other sampling time. Levels of packed cell volume and haemoglobin improved from 21.00% and 48% in the supplemented diet to 32.00% and 73% at 1.0% pigeon pea forage supplementation respectively.

Key words: Rice Straw, Pigeon pea, Metabolism, rumen, Blood, Yankasa sheep

Introduction

The presence of nitrogen in forage legumes does not always guarantee its availability to the target microbes in the rumen. International Livestock Center for Africa (1988) research shows that the content of insoluble and soluble tannins in legumes is related to nitrogen digestibility.

Roffler, (1981), stated that the synchronization of rate of degradation of nitrogen and balance of carbohydrate components in the rumen is important for the synthesis of microbial

protein. Microbial protein in the rumen is the major source of nitrogen to ruminant animals accounting for 60-85% of the total amino acid entering the small intestine (Ørskov, 1982). The pattern of degradation therefore, influences the choice of nitrogen source for efficient utilization of crop residues.

Ammonia is a key metabolite in rumen nitrogen metabolism. The concentration of ammonia which promotes maximum microbial protein production is an important factor determining the utilization of the nitrogen in the rumen. It has been suggested by Egan and Kellaway (!971) that rumen ammonia and blood urea may serve as effective indices of nitrogen utilization.

Volatile fatty acids are the main energy sources for ruminants feeding mainly on roughages. Their levels in the rumen, therefore, give an indication of the energy value of the feed. This study was therefore carried out to: Determine rumen fermentation characteristics of diets containing 0, 0.5, 1.0, and 1.5% of the body weight inclusion level of pigeon pea forage; and also to ascertain the influence of treatment on pH, volatile fatty acid, blood urea, packed cell volume and haemoglobin of sheep fed rice straw supplemented with varying levels of pigeon pea forage

Materials and Methods

Sixteen yearling Yankasa ewes of weight ranging between 14.98-15.06kg were used for this study in a completely randomized design with four ewes per treatment. The ewes were kept in individual pens through out the period of the study. The ewes were randomly assigned to four treatments consisting 0, 0.5, 1.0 and 1.5% of body weight inclusion of pigeon pea forage supplementation. A basal diet of rice straw was fed *ad libitum*. This study lasted 17 days, consisting 10 days adaptation period and 7 days of data collection of blood and rumen fluid.

Blood collection

Blood was sampled from the jugular vein with a hypodermic needle into vacutainer tubes on days 14 and 15 of the study at three, six, nine, twelve and twenty-four hours post-feeding. Blood samples were centrifuged immediately and plasma decanted into tubes and stored at -4°C. Plasma urea nitrogen was later determined (Archer and Robb,1925).

Rumen fluid collection

Rumen fluid was sampled on days 16 and 17. This was done with the aid of a stomach tube manually operated. The rumen fluid was sampled at three, six, nine, twelve and twenty-four hours after feeding. The fluid was immediately strained through a cheese cloth. pH was immediately read with a digital pH meter. Rumen fluid samples were stored in plastic containers into which 3 drops of concentrated hydrochloric acid were added. These were stored at -4°C and later analysed for ammonia-nitrogen (Roy markham, 1942). Total volatile fatty acid (AOAC 1980).

Statistical analysis

Data collected were subjected to analysis of variance procedure using GLM of SAS (SAS, 1987).

Results and Discussion

Rumen ammonia

The result of this study (fig. 1) showed a generally low level of ammonia-nitrogen in the 0.0% pigeon pea diet. The significantly low increase in ammonia-nitrogen concentration at 6 and 9 hours in this treatment indicates slow and poor degradation of rice straw. Sujatha *et al.*, (1998) obtained nitrogen balance of -74mg for sheep fed solely on rice straw

The use of pigeon pea forage at 1.0 and 1.5% of body weight increased the levels of rumen ammonia-nitrogen within 24 hours study. This indicates a more stable rumen environment which is necessary for efficient microbial fermentation. Ørskov (1982) stated that the requirement for rumen degraded protein (RDP) is considerably less with straw than for concentrates because straw is less digestible. If more RDP is given than the microbes can utilize, it will simply be wasted and excreted in urine. Also Alawa (1999) had stated that animals may maintain their weights by increasing the intake of crop residues and other low quality by-products if protein with moderate degradation within the rumen is supplied. The low ammonia nitrogen levels obtained across the treatments was not uncommon. Satter and Slyter (1974) and Satter and Roffler (1976) reported 50mg/1 as the optimum ammonia concentration for microbial growth, while Pawel *et. al,* in *in-vitro* experiments reported 3.6 to 17mg/100ml. the values obtained in this study were in agreement with these reports, the concentration of ammonia which promotes maximum microbial protein production is an important factor determining the utilization of the nitrogen in the rumen.

Volatile Fatty Acids

The volatile fatty acids results (fig.2) showed increase in the level of volatile fatty acid as the level of pigeon pea forage supplementation was

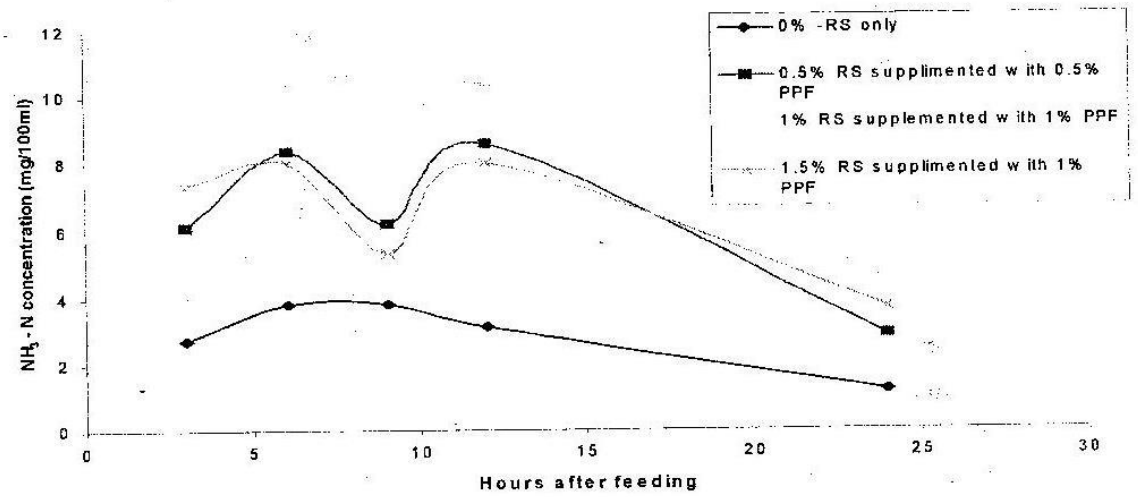

Fig. 1: Effect of level of pigeon pea forage supplementation and time of sampling on rumen NH_3 concentration (mg/100ml) sheep fed rice straw

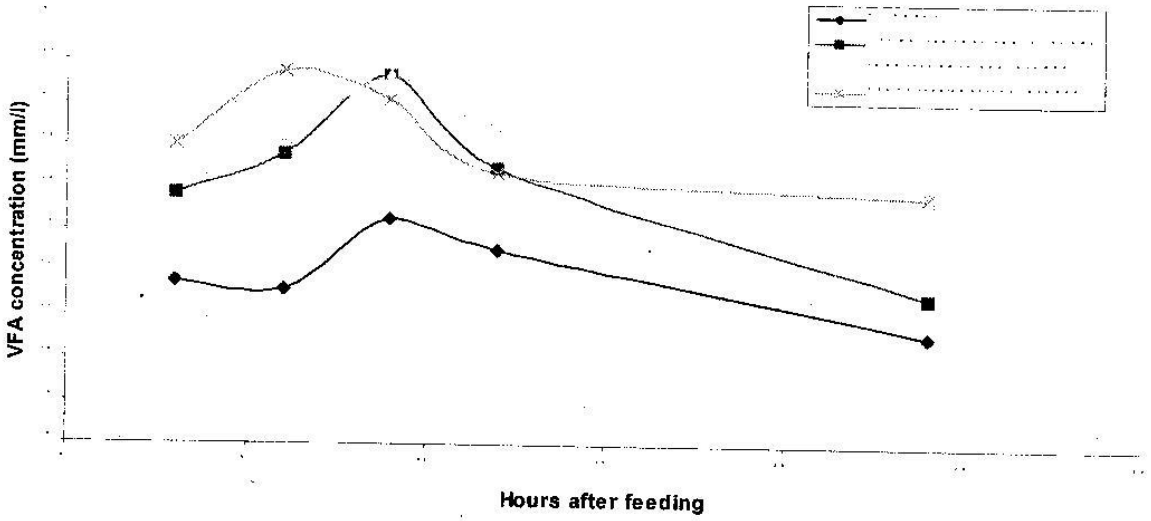

Fig. 2: Effect of level of pigeon pea forage supplementation and time of sampling on rumen VFA concentration (mm/l) sheep fed rice straw

increased up to 1.0% of body weight. The slight non significant decline at 1.5% body weight supplementation agrees with the work of Ørskov (1982) who reported that once the nitrogen limitation in the rumen is corrected, there may be no advantage in increasing nitrogen level. Volatile fatty acids are the main energy sources for ruminants feeding mainly on roughages. Their levels in these treatments gave an indication of the energy value of the feeds. The increase in volatile fatty acids from 19.87 in 0.0% treatment to 36.57mm/1 in 1.0% pigeon pea supplementation could be associated with the increase in digestibility of the feed material (Ørskov and Ryle, 1990).

Rumen PH

Though there were significant ($p<0.05$) variations in pH within treatments across sampling hours, (Fig.3) these variations were within normal pH range of the rumen environment, the pH obtained was within the range for optimum rumen fermentation. Ørskov (1982) stated that when straw or poor-to-medium quality hay is fed, the rumen pH stabilizes at about 6.8 to within the 24 hours studied, the pH remained conducive for optimum microbial digestion.

Plasma urea nitrogen

The uniformly low plasma urea nitrogen levels obtained in the control diet (Fig.4) is indicative of the low dietary protein level as well as the reduced microbial activity in the rumen. The higher plasma urea concentration at 0.5 to 1.5% of body weight pigeon pea forage supplementation showed the increase in microbial degradation as a result of increased

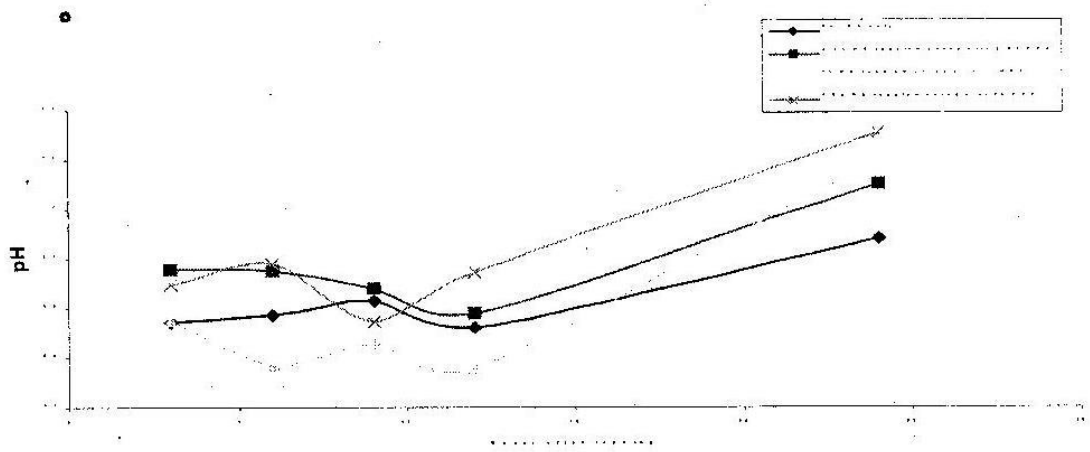

Fig. 3: Effect of level of pigeon pea forage supplementation and time of sampling on pH of rumen fluid measured from sheep fd the experimental diet

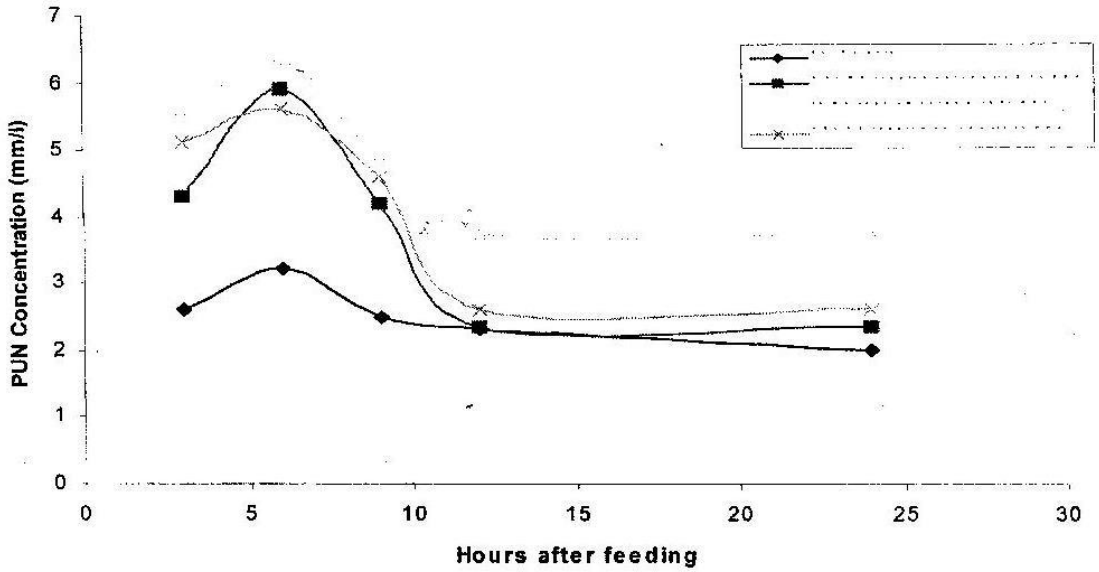

Fig. 4: Effect of level of pigeon pea forage supplement and time of smapling on plasma urea nitrogn concentration (mm/l)

protein supplied to the rumen. Plasma urea nitrogen accurately reflects the intake of effective rumen degradable protein.

Except for the unsupplemented diet, the plasma urea nitrogen levels were similar to what was reported (5.56 and 4.24mm/1) by Moloney *et at*; (1994) when they fed grass silage supplemented with barley or molasses based supplements. Rumen ammonia enters the plasma urea pool after it has been absorbed into the blood and is converted to urea by the liver. The increased concentration of plasma urea

particularly at 6 hours post feeding indicates the rate of microbial digestion of the available protein in pea forage. Plasma urea nitrogen levels obtained in this study were low to medium levels (2.0-6.37) suggesting better urea nitrogen utilization. Woodman and Evans (1974) stated that a high value of plasma urea nitrogen indicates an inability of the animal to utilize nitrogen made available by digestion. Low levels of plasma urea nitrogen could also result from high concentrations of tannins in diets.

Reed, *et al*; (1990) showed that plasma urea nitrogen was higher in animals fed diets of *Sesbania sesban* compared to those fed with *Acacia brevispica* which has higher levels of tannins. Similar result was reported by Rittner (1987) when he compared diets containing *Sesbania sesban* with diets containing *Acacia seyal* and *Acacia nilotica.* Reed, *et al;* (1990) attributed these differences to their high tannin content which affected protein digestibility. The tannin content of this pigeon pea forage (0.5mg/kg) is too low to have such an effect. Tannin levels that could have negative effect in sheep and goats was reported to be within the range of 8-10% of the diets (Bejovic *et al*; 1978). This study has shown that even though pigeon pea forage contained some amount of tannin (0.5mg/kg), it was not enough to cause a deleterious effect on microbial digestion and utilization of nitrogen contained in the forage.

Blood Variables

The positive influence of diets on blood parameters reported in this study (Table 1) is in agreement with the work of Rekwot *et al;* (1997), who observed that feeding levels affected heamoglobin and packed cell volume. The mean concentrations of packed cell volume, haemoglobin and white blood cell count obtained in this study except for the unsupplemented rice straw were within average values. They were

Table 1: **Blood parameters in sheep fed rice straw supplemented with pigeon pea forage**

Parameter	Pigeon pea forage inclusion in diets (% of body weight)				
	0.0	0.5	1.0	1.5	SEM
PCV (%)	21.00^{b}	28.33^{ab}	32.00^{a}	30.33^{a}	4.84
Haemogolobin	48.00^{b}	64.00^{ab}	73.00^{a}	68.11^{ab}	10.81
WBC (x 10^{9}/l)	5.43	5.00	4.40	4.33	NS
Plasma urea-N (mm/l)	2.52^{c}	4.03	4.94^{a}	4.19^{b}	0.10

^{a,b,c} Mean on the same row bearing different superscript are significantly ($P<0.05$) different.
NS- Not significant

within the range of 39.79-42% packed cell volume reported by Moloney *et al;* (1994), when grass silage and rolled barley or sugar cane molasses based supplements were fed to steers. Alabi (2005), stated that there is a relationship between nutrition and blood profile, she reported that protein deficiency can lead to clinical anaemia due to decreased erythrocytes and hypo-proteinemia. Hewet, (1974) also reported that the plane of nutrition affects haemoglobin level. Haemoglobin is important for oxygen transport. Saror and Coles (1975), had reported lower packed cell volume and hemoglobin values for zebu cattle under native husbandry practices.

Conclusion

Supplementation of rice straw with pigeon pea forage improved the levels of rumen ammonia, volatile fatty acids and plasma urea nitrogen with high levels, occurring between 6-12 hours post-feeding. ph levels remained within acceptable range for optimum rumen fermentation. Levels of packed cell volume, white blood cell and haemoglobin were improved.

Supplementation of rice straw based diet with pigeon pea forage at 1.0% of body weight resulted in the best levels of rumen and blood metabolites required fore maintenance of Yankasa sheep.

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