



Effects of partially replacing rice straw with browse plants on the haematology and serum metabolites of Djallonke sheep

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Abstract

*This study was carried out to investigate the effect of browse plants within the savanna zone of Ghana with varying levels of condensed tannin on the haematology and serum metabolites of Djallonke sheep. Eight rams with an average weight of 13.9 ± 1.5 kg were randomly assigned to three treatments with a control in a cross over design. The treatments were T0 (60% straw+40% *Albizia lebbbeck*), T1 (60% straw+40% *Ceiba pentandra*), T2 (60% straw+40% *Gmelina arborea*) and T3 (60% straw+40% *Senna siamea*). There was no significance difference ($P > 0.05$) among the treatments for the haematology except for the eosinophil counts. Rams on T1 obtained the highest level of eosinophil with T0 recording the least. The Hb content was in the range of 7.75-8.57 with rams on T3 recording the highest. The highest PCV content was recorded in T3 (25.75%) and the least in T1 (23.25%). Similarly, no significant difference ($P > 0.05$) was reported among the treatments for the serum metabolites. The total protein was in the range of 72.4-77.6 with the highest reported in rams on T3. Plasma urea was in the range of 8.26-12.45 with the highest reported in T0 and the least in T1. The study revealed that the browse plants could be used as supplement to small ruminants without any detrimental effect.*

Keywords: browse plants, condensed tannin, haematology, serum metabolites

INTRODUCTION

Sheep production conveys several benefits which include economic, social, nutritional and religious aspects of human. Many people keep sheep because they produce milk, meat, wool, skin and manure. Gatenby (1982) reported that, the major factor limiting the productivity of small ruminants in Africa is poor nutrition in semi-arid areas. Le Houèrou (1980) reported that compared with tropical grasses, browse is richer in protein and some minerals in the dry season. The crude fibre content of browse plant also tends to be lower than that of grasses and usually ranges between 20-40% and lower for

shoot and leaves (Pellew, 1980). Given the low content of crude fibre in browse plants as compared with dry grass, the energy content appears to be higher than that of dry grass (Le Houèrou, 1978). Browse plants can satisfy the needs of small ruminants provided that the animal can gain access to them and sufficient quantity is available to them directly. Ansah *et al.* (2011) observed that smallholder farmers feed various parts of different tree crops to livestock throughout the year. The presence of plant secondary metabolites such as condensed tannin (CT) and saponin may impose some health

challenges on livestock feeding on them. The study was to determine the effect of browse plants on the blood haematology and serum metabolite of Djallonke sheep.

MATERIALS AND METHODS

Study Area

The feeding trial was conducted at the Animal Metabolic Unit of the Department of Animal Science of the University for Development Studies Nyankpala campus. It is located in the Tolon District of Northern Region of Ghana and about 20km from Tamale.

Experimental animals and housing

Eight rams of about one year old with an average weight of 13.88 ± 1.56 kg were randomly assigned to four different browse plants with rice straw as the basal diet. The animals were housed in metabolism cages made of metal. The cages were 45.7cm above ground, 91.4cm in length, 40.1cm in breadth and 76.2cm of height.

Source and processing of browse plants

Albizia lebbbeck, Senna siamea, Ceiba pentandra and Gmelina arborea leaves were harvested from trees in and around the Nyankpala campus in January to February 2014 and shade-dried for about three days. The leaves were then separated from the branches and stored in sacks.

Experimental design

The 8 animals were randomly assigned to four (4) treatments with two (2) animals per treatment. The cross over design was used in two different periods. The animals were allowed to adjust to the feed and cages for in ten (10) days and three (3) days respectively. The data collection lasted for 5 days. After the first period, the animals were rested and adjusted to the new the feed in six (6) days. The treatment diets were T0 (60% straw+40% Albizia lebbbeck), T1 (60% straw+40% Ceiba pentandra), T2 (60%+40% Gmelina arborea), and T3 (60% straw+40% Senna siamea). T0 was the control diet.

Feeding and Watering

The experimental diet was prepared by chopping the rice straw into pieces to facilitate easy picking by the animals. The experimental diet comprised 60% rice straw and 40% browse plants. About 2% of the total weight of each diet was computed and used to measure the quantity of salt and vitamin to be included in the diet. The salt and vitamin were dissolved in one liter tap water and sprinkled onto the diet. The ingredients were mixed on plywood by hand thoroughly and packed into sacks and their weight where taken.

Feed was offered ad-libitum in a plastic container. Before feeding each day, a sample of the feed was collected in plastic bags and stored. Water was served at 10:00 in the morning and 16:00 in the afternoon in plastic containers.

Blood Sampling and processing

On the 5th day of each period of data collection, blood sample was taken at about 07:00 in the morning before feeding. Approximately 5mls of blood was taken from the jugular vein using a syringe and needle and transferred into (i) test tubes without anti-coagulants for blood metabolite analysis and (ii) test tubes containing anti-coagulant (E.D.T.A) for determining haematological parameters. The blood was centrifuged at a speed of 500rpm and the serum separated. The serum was then transferred into a clean test tube and stored at 4^oC for analysis.

Estimation of Total Protein, Urea and Albumin

The BT 3000 Random Access Chemistry analyzer (Elan Diagnostics, Smithfield, CA, USA) was used for protein, urea and glucose estimation.

Assay Principles

Albumin (ALB) g/L

The method used for this assay was based on that of Doumas *et al.*, (1971) where at a controlled pH, bromocresol green (BCG) forms a coloured complex with albumin. The intensity of the colour at 630 nm is directly proportional to the albumin content.

Total protein (PRO) g/L

Estimation of total protein in this study was based on the modifications of Gornall *et al.*, (1949). Protein in serum forms a blue coloured complex when reacted with cupric ions in an alkaline solution. The intensity of the violet colour is proportional to the amount of proteins present when compared to a solution with known protein concentration.

Globulins (GLO) g/L

Globulin was a calculated parameter using the formulae: Globulin=Total protein-Albumin.

Glucose (GLU) mmol/L

The extracted serum was analysed for glucose following the method of Amidu *et al.* (2013) using the BT 3000 Random Access Chemistry analyzer.

Urea (Ur) mmol/L

The blood urea nitrogen was analysed following the method of Amoako *et al.* (2014) using the BT 3000 Random Access Chemistry analyzer.

Estimation of haematological parameters

PCV- The blood samples stored in the EDTA was centrifuged at 500 rpm for 10 minute, the PCV was then read using the Haematocrit reader.

HB- Cymmethaemoglobin method was used and a spectrometer was used for the reading.

RBC's-RBC diluting fluid was used for dilution and counting was done using Haemocytometer with the aid of a microscope.

WBC Total- WBC was analysed using WBC diluting fluid (Turks Solution) with the Haemocytometer with the aid of microscope.

WBC Differentials- Thin Smears of blood stained was used on Giemsa stain and with oil immersion. Microscope was used to identify and count various white cells.

Data Analysis

Data was analysed using ANOVA in randomized block design from Genstat 12.1 (2006). The means were separated using LSD at 5%. The results were presented in table.

RESULTS

Table 1 Effect of browse plants on haematology and nutrient metabolites in the plasma.

Parameters	A. <u>lebbeck</u>	C <u>.pentandra</u>	G. <u>arborea</u>	S. <u>Siamea</u>	Sed	p.value
DMI (g/d)	468.3 ^b	456.1 ^b	509.1 ^b	255.1 ^a	24.91	0.001
Hb g/dl	8.32	7.75	8.32	8.57	0.798	0.767
PCV %	25.00	23.25	25.00	25.75	2.382	0.758
RBC *10 ⁶ µl	3.25	3.00	3.25	3.35	0.310	0.713
WBC * 10 ⁹ /l	5.68	5.60	6.38	5.80	0.726	0.711
Basophils	0.001	0.001	0.250	0.250	0.213	0.465
Eosinophils	0.00 ^a	1.75 ^c	1.25 ^{bc}	0.75 ^{ab}	0.433	0.012
Lymphocyte	49.50	47.50	53.75	51.50	2.497	0.133
Neutrophils	50.2	50.7	44.0	46.5	2.87	0.115
Total protein	72.4	72.9	75.5	77.6	2.87	0.269
Albumin	27.48	26.55	28.10	28.17	1.203	0.520
Globulin	44.97	46.34	47.40	49.46	2.002	0.185
Blood Urea N	12.45	8.26	7.11	8.85	2.097	0.100
Glucose	2.36	1.98	2.20	2.12	0.290	0.622

Means with different superscripts are significantly different (P<0.05) whereas means with no superscripts are not significant different (P>0.05)

Dry matter intake

There was a significant difference ($p < 0.05$) in total dry matter intake per day among the treatments. The lowest feed intake was observed in T3 (255.1g/d) and the highest in T2 (509.1g/d).

Effect of browse plants on haematology and serum metabolites

There was no significant difference ($P > 0.05$) among the treatments for all the haematological parameters except eosinophil. The highest Hb (8.57) was recorded in animals fed on T3 followed by both T0 and T2 recording the same value (8.32) with *Ceiba pentandra* recording the least value (7.75dl). The packed cell volume and RBC were highest in T3. The lowest WBC was obtained in animals fed on T1 with the highest obtained in T2. The WBC differential for the treatments diets did not follow any pattern. The eosinophil was significantly higher ($P = 0.012$) for T1 but least in T0.

There was no significant difference ($P > 0.05$) in all the serum metabolite parameters of animals on the various treatments but their levels varied. The highest serum glucose concentration was reported in T0 followed by T2 while the lowest was recorded in T1. Urea levels in the blood, was highest in T0 and lowest in T2. The total protein was in the range of 72.4 to 77.6 with the highest reported in T3. The albumin and globulin followed a similar pattern for the treatments. In all cases, T3 resulted in the highest Albumin and globulin.

DISCUSSION

A number of factors such as protein level and anti-nutritional factors have been reported to account for the differences in dry matter feed intake (McDonalds *et al.*, 1995; Brown, 2008; Konlan *et al.* 2012). Ansah *et al.* (2014) reported protein levels of 229.24, 126.25, 175.87 and 151.23g/kg DM for *Albizia lebbeck*, *Ceiba pentandra*, *Senna siamea* and *Gmelina arborea* respectively. Even though *Senna siamea* was higher in CP than *Ceiba pentandra* and *Gmelina arborea*, the dry matter intake was the least. The cause of the low dry matter intake might be related more to its palatability than protein

degradability in the rumen. This was confirmed by Ansah *et al.* (2014) who reported high effective protein degradability for *Senna siamea*. Various levels of CT were reported in the browse plants used in this study except for *Albizia lebbeck* which had no CT (Ansah *et al.* 2014). Even though the CT level was relatively lower in *Senna siamea* it may have caused an astringent taste in the mouth of the sheep during chewing hence the low intake. The reduction in palatability is caused by the reaction of the salivary mucoprotein with tannins or through a direct reaction with taste receptors, provoking the astringent sensation (McLeod, 1974). The lack of depression in dry matter feed intake in the *Ceiba pentandra* and *Gmelina arborea* despite the presence of CT in them suggests that CT from different plants regardless of the quantity affect feed intake differently.

The haemoglobin (Hb) values reported in the present study were lower than what was reported by Ansah *et al.* (2012) who supplemented sheep feeding on rice straw with whole cotton seed. It is also lower than what was reported by Konlan *et al.* (2012) who also fed sheanut cake as supplement to sheep receiving a basal diet of rice straw. The difference might be due to the difference in the type of supplement used suggesting that browse plants may cause moderate depression of Hb levels in sheep. A slightly lower PCV and RBC was also reported in the present study compared with what was reported by Ansah *et al.* (2012) and Konlan *et al.* (2012). The WBC was however lower than what was reported by Ansah *et al.* (2012) and Konlan *et al.* (2012). The reduction in WBC's in the present study could be due to the effect of the browse plants on pathogenic micro-organisms in the blood. Small holder farmers in a study by Ansah *et al.* (2011) indicated that parts of browse plants including the leaves were used to treat different disease conditions in small ruminants. High levels of eosinophil's have been associated with parasitic infection and allergic diseases (Hutchinson and Schexineider, 2011; Roberts 2012). Even though CT's have been found to impact negatively on gastrointestinal nematodes, in this study, that did not occur as the treatments with high CT rather had high eosinophil levels suggesting some form of infection (Iqbal *et al.* 2002). The molecular weight of CT present in

different browse plants have been cited as one of the causes of the differences in the way CT affects rumen activity and gastrointestinal infection (Foo and Porter, 1980; Foo *et al.*, 1982; Salunkhe *et al.*, 1990).

A positive correlation has been reported between dietary protein and plasma protein concentrations by Yousef and Zaki (2001) and Shahen *et al.* (2004). The dietary CP present in the browse plants was relatively higher than the minimum CP (6-8 %) required for sustenance of microbial growth (Van Soest, 1982). The total protein, albumin and globulin reported in this study were higher than what was reported by Konlan *et al.* (2012) who fed sheep with sheanut cake as feed supplement. The differences observed might be due to the difference in the digestibility of the dietary protein from different sources. The relatively high level of blood urea nitrogen in the control diet could be an indication of high protein degradation in the rumen by proteolytic bacteria. Condensed tannin has been reported to decrease dietary protein degradation in the rumen due the complex formed between protein and CT in the rumen (Barry *et al.*, 1986). Ansah *et al.* (2012) reported no CT presence in Albizia lebbbeck hence the high protein degradation and high serum urea. The glucose

level reported in the present study was lower than what was reported by Konlan *et al.* (2012). The high glucose may be attributed to the sheanut cake they added to the rice straw and groundnut haulms because concentrates tend to increase propionate level of the VFAs and propionate is the main precursor for glucose (Suhair, 2012).

CONCLUSION

Replacing 40% rice straw with browse plants did not negatively affect total protein, globulin and albumin in serum. However the serum glucose level was low and urea was lower in CT containing browse plants. Haematological parameters were not different among the treatments with WBC levels remaining low.

RECOMMENDATION

A further study is recommended to investigate different methods to improve the intake of Senna siamea.

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