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EFFECT OF WHOLE-COTTON SEED SUPPLEMENTATION ON GROWTH PERFORMANCE AND HAEMATOLOGICAL PROPERTIES OF DJALLONKE SHEEP IN THE DRY SEASON

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ORIGINAL ARTICLE

ABSTRACT: *An 8-week feeding trial was carried out to investigate the effect of whole-cotton seed (WCS) supplementation on the growth performance and some blood constituents of Djallonke sheep fed rice straw. A total of 12 sheep with an initial weight of 13.7 ± 0.20 kg were randomly assigned to one of three treatments (four animals per treatment). The treatments consisted of no supplementation (T0) and supplementation with 200 g /head/d (T1) or 400 g/head/d (T2) on as fed basis. Feed intake, growth performance and some haematogical parameters (haemoglobin [Hb], packed cell volume [PCV], white blood cells [WBC], red blood cells [RBC]) were measured. Differential leukocyte (lymphocytes, neutriphils, eosinophils, monocytes and basophils) counts were also determined. Intake of basal diet was higher (P<0.05) for sheep supplemented with 400 g/head/d than for those receiving 200 g/head/d and WCS intake was higher (P<0.05) for sheep fed T2 than for those fed the T1 diet. Feeding the basal diet only resulted in weight loss and high mortalities. Haemoglobin concentration, PCV, and WBC and RBC counts increased with supplementation but the difference between T1 and T2 for these measurements was not significant (P>0.05). Eosinophilia increased (P>0.05) with increasing level of supplementation. This study suggests that WCS is a good source of rumen degradable protein and can help reduce the decline in growth of sheep especially in the dry season.*

Keywords: *Whole cotton seed, rumen degradable protein, Eosinophiles.*

INTRODUCTION

Livestock production makes numerous contributions to the lives of both rural and urban dwellers (FAO, 1991). Among the small ruminants, sheep is of more concern than goat (FAO, 1991). In Ghana, long legged and the dwarf (Djallonke) sheep are the main breeds available (Charray et al., 1992) and are efficient meat producers in the tropics due to their high prolificacy.

Natural forage is the main feed resource for sheep and goats in the tropics. Nutritional quality of natural forages however fluctuates widely between the rainy season when their nutritional value is high and dry season when they become lignified and are lower in nutritional value (Sarnklong et al., 2010). The dry season also favors rampant bush fires that destroy natural grazing lands. Consequently, feed supplementation with crop residues such as rice straw in the dry season has become necessary especially for small ruminants such as sheep. To ensure efficient utilization of such low quality crop residues in the dry season, protein supplementation is necessary to provide rumen degradable protein needed to support rumen microbial growth and improve digestibility.

Rice straw is an abundant crop residue generated from rice cultivation in the Northern region of Ghana. It has the potential to serve as a major source of feed for ruminants in the dry season but its utilization is limited by very low CP content (6%) and therefore cannot support ruminant production as a sole diet. The utilization of rice straw by small ruminants in the dry season may however be improved through protein supplementation to synchronize ruminal energy degradation of forage fiber. Whole Cottonseed (WCS) is a cheap feed resource in many countries of tropical Africa where the crop is grown. It contains 24% CP and can support the nitrogen requirement of rumen microbes fed low quality forage (Luginbuhl et al., 2000). In Ghana, 22,200 to 24,220 metric tons of cotton is

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produced annually (Karbo and Bruce, 2000). Strategic supplementation of rice straw that has lower CP content with WCS that is high in CP could help sustain sheep during dry season. Whole-cotton seed however contains gossypol that is reported to affect some haematological properties of ruminants (Calhoun et al., 1990). Haematological properties are also influenced by the nutrition of the animal (Ekenyem and Madubuike, 2007). Changes in the haematological characteristics could be used as a measure of the nutritional or physiological status of the animal but no studies have examined the effects WCS supplementation on such constituents in this region.

This study was therefore conducted to determine the effects of WSC supplementation on the feed intake, growth performance and haematological indices of Djallonke sheep fed rice straw in the dry season.

MATERIALS AND METHODS

Twelve Djallonke sheep (13.7 ± 0.20 kg) were randomly assigned to one of three treatments (T0, T1 and T2) in a completely randomized design. Animals on T0 were fed only rice straw with no supplement, T1 and T2 received 200 g/head/d and 400 g/head/d of WCS respectively. Whole-cotton seed was obtained from a commercial cotton ginnery (Ghana Cotton Company Ltd., Tamale, Ghana). Rice straw was collected from rice fields after combine harvesting, near the Department of Animal Science Farm of the University for Development Studies (UDS), Nyankpala campus. All animals were offered basal diet of 500 g rice straw separately from the supplement; the rice straw was fed in wooden feed troughs and the WCS were offered in a plastic bowls. Feed and water were offered on *ad libitum* basis. The experiment lasted for 8 weeks. The study was conducted during the dry season (December –January 2009) at the Department of Animal Science Farm of the UDS, Nyankpala campus. There were four animals per treatment and animals were housed intensively and restrained in individual pens (2.5 x 1m) on a concrete floor and fed once daily starting 09:00 in the morning. Weight of feed offered and left over were recorded daily and animals were weighed weekly for determination of feed intake of basal and supplementary diets, and growth performance of sheep respectively. Two animals in the T0 died in the 4th week of the study and the study was terminated after the third mortality occurred in the same group at the 8th week. Post mortem results on the carcass revealed that the animals died of heart water. Table 1 shows the estimated chemical composition of the basal and supplementary diets.

Table 1 - Estimated[1] Chemical composition of untreated rice Straw and whole - crop cotton seed (DM basis)

Item	Untreated rice straw (%)	Whole-cotton seed (%)
Dry Matter	89	92
Crude Protein	3.3	24.0
Crude fiber	29	20.8
Ash	12	5
Lignin	3.72	nd
Silica	15.8	nd
Calcium	0.12	0.15
Phosphorus	0.10	0.64

[1] Avornyo et al. (2007); Luginbuhl et al. (2000); nd = not determined

Blood collection and analysis

The blood samples were collected from the jugular vein of each sheep into heparin-impregnated vacutainer® using a 5 ml disposable syringe. A single blood sample was taken for each animal before the animals were introduced to the treatment diets and after the 8th week of feeding. Samples were stored in vacuum flask and sent immediately to the UDS microbiology laboratory for analysis. Samples were analyzed for haemoglobin (Hb) concentration by the cyanmethaemoglobin colorimetric method as previously described by Cheesbrough (2001). Red blood cells (RBC), white blood cells (WBC) counts, and parked cell volume (PCV) were measured by microhaematocrit and haemocytometry techniques as described by Mukherjee (2005).

Statistical Analysis

The data was analyzed by ANOVA for the effects of supplementation using GenStat® (Discovery Edition 3.0). Significant difference was declared at $P<0.05$ and difference among means were separated using the Standard Error of Differences (SED) of means.

RESULTS

Effect of WCS on intake and weight gain of Djallonke sheep

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Table 2 shows the effect of supplementation on feed intake and growth performance of sheep. Intake of the rice straw was not significantly different (P>0.05) between sheep fed T0 and T1 diets however, sheep on T2 diets had significantly higher (P<0.05) intakes than those on T0 and T1 (Table 2). Thus supplementation with WCS at 200 g/head/d did not increase intake of rice straw relative to sheep that did not receive the supplement. Similarly, sheep supplemented with 400 g/head had greater (P<0.05) intake of the supplementary diet than those receiving 200 g/head/d. The total weight gained and final weight after 8 weeks of feeding were both higher (P<0.05) for supplemented sheep than for non-supplemented ones. The loss of weight in non-supplemented sheep was associated with high mortalities in that group (Table 2).

Table 2 - Effect of WCS on intake (*as fed basis*) and growth performance of Djallonke sheep after 8 weeks of being supplemented with 0 (T0), 200 (T1) or 400 (T2) g/head/d of whole-cotton seed

	Treatments			
Item	T0	T1	T2	SED[1]
Intake of rice straw (g/d)	215[a]	201[a]	304[b]	32.3
Intake of WCS (g/d)	0.0	152.7[a]	305.3[b]	15.36
Initial weight (kg)	13.63	13.95	13.58	0
Final weight (kg)	10.25[a]	15.20[b]	15.25[b]	0.75
Total weight gain (kg)	-3.75[a]	1.25[b]	1.67[b]	0.71
Average daily weight gain (g/day)	-67.0[a]	22.3[b]	22.4[b]	13.48
Mortality	3	0	0	0

[1]Standard error of differences of means; Means in the same row with different superscripts are significantly different (P<0.05)

Effect of WCS on the haematology of Djallonke sheep

The effects of WCS supplementation on some haematological indices of sheep are presented in Table 3. White blood cells and RBC, and differential leukocyte counts of WBC for supplemented animals were within the range for Djallonke sheep kept under semi-intensive management system under similar conditions (Addah and Yakubu, 2008). Animals on the sole rice straw had significantly lower (P<0.05) Hb, PCV, WBC and RBC values. The difference between T1 and T2 was not however significant (P>0.05).

Table 3 - Effect of WCS on the haematology of Djallonke sheep supplemented with 0 (T0), 200 (T1) or 400 (T2) g/head/d of WSC

Items	Treatments			
	T0	T1	T2	SED[1]
Haemoglobin (g/dL)	8.30[a]	9.80[b]	10.65[b]	0.58
Parked cell volume (%)	25.01[a]	29.50[b]	32.00[b]	1.76
White blood cells ($\times 10^9$/L)	2.90[a]	5.95[b]	5.95[b]	0.40
Red blood cells ($\times 10^6$/µl)	3.30[a]	3.80[b]	4.15[b]	0.23
Differential leukocyte count (%)				
Lymphocyte	52.00	56.99	58.00	2.15
Neutrophils	34.50	36.50	37.00	2.69
Eosinophils	5.00[a]	7.50[b]	10.00[c]	0.79
Monocytes	0.00[a]	0.50[ab]	1.00[b]	0.35
Basophils	0.00	0.50	0.50	0.50

[1]Standard error of differences of means; Means in the same row with different superscripts are significantly different (P<0.05)

DISCUSSION

The improved growth performance of sheep fed the supplemented diets could be attributed to the provision of rumen degradable CP. Ruminal fiber utilization in ruminants fed low quality forages such as straws is limited by insufficient rumen degradable N. This decreases microbial protein synthesis and results in poor growth performance as observed in the non-supplemented sheep. The minimum CP required for sustenance of microbial growth is 6-8 % (Van Soest, 1982). A CP of 3.3 % (Table 1) for rice straw is extremely low to support microbial growth hence the loss of weight and mortalities observed for sheep on the basal diet alone. The synchronization of protein and energy in the rumen might account for the superior performance of sheep offered 400 g/head/d compared to those supplemented with 200 g/head/d. Even though cellulolytic bacteria have low maintenance requirements due to their slow growth rate, they have a higher preference for NH_3 than other sources of N. Ruminal production of NH_3 requires sufficient degradable energy. Higher levels of silica in rice straw similarly limit intake and digestibility (Agbagla-Dohnani et al., 2003; Van Soest, 2006).

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The loss of weight and eventual deaths in sheep fed the basal diet only is explained by extensive mobilization of nutrients from body tissues through gluconeogenesis. This study suggests that without protein supplementation in the dry season, farmers could suffer greater losses if animals are raised solely on rice straw. The results are consistent with those of Avornyo et al. (2007) who reported an increase in average daily weight gain when sheep were fed rice straw and supplemented with WCS but are contrary to the findings of Luginbuhl et al. (2000) and Sandra et al. (2007) who both reported a decrease in average daily weight gain of goats when WCS was fed at 30% inclusion level. The relatively poor growth performance reported by Sandra et al. (2007) for animals supplemented with WCS could be due to the high inclusion of soybean meal (17%) in the non-supplemented diet.

The WBC and RBC values for supplemented sheep were indicative of the nutritional status of the animals as those that did not receive protein supplementation consistently had lower values than those that did. The haematological indices observed for supplemented sheep were similar to those of Djallonke sheep raised semi-intensively and supplemented with WSC (Addah and Yakubu, 2008). Increase in eosinophiles levels is associated with stress (Addah et al*.,* 2007) or disease condition (Addah and Yakubu, 2008). Gossypol might have stimulated eosinophilia in supplemented sheep but this did not affect growth performance adversely. The WBC and RBC counts however fell below the values reported by Sandra et al. (2007) who fed goats with 15% and 30% WCS. Sandra et al. (2007) observed a decline in the WBC and RBC when WCS was increased from 15% to 30%. Gossypol content of WCS varies among varieties and high levels have been found to cause fragility of the RBC (Calhoun et al., 1990).

CONCLUSION

This study suggests that WCS is a good source of rumen degradable protein and can help reduce to decline in growth of sheep especially in the dry season. It is recommended that sheep grazing on crop residues such as rice straw be given WCS as a protein supplement to maintain or increase their productivity.

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