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EFFECTS OF *Commelina benghalensis, Vicia sativa* AND *Medicago sativa* USED AS PROTEIN SUPPLEMENTS ON PERFORMANCE OF DORPER SHEEP FED *Sorghum almum*

[EFECTO DE *Commelina benghalensis, Vicia sativa* Y *Medicago sativa* COMO SUPLEMENTOS PROTEICO SOBRE EL COMPORTAMIENTO PRODUCTIVO DE OVINOS DORPER ALIMENTADOS CON *Sorghum almum*]

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SUMMARY

This study was conducted in Naivasha, Kenya over 84 days to examine effect of vetch (*Vicia villosa*), *Commelina benghalensis* and Lucerne (*Medicago sativa*) used as protein supplements on growth rate and feed intake of Dorper sheep wethers fed *Sorghum almum*. A total of 24 wethers (5 ± 0.32 months; 17.3 ± 2.58 kg BW) in a randomized complete block design were used (4 treatments, 6 wethers each). Treatments were: In control diet (D1), 4 kg fresh *Sorghum almum* (of about 158.8 g DM/kg) was fed as sole diet (≈ 635 g DM/wether/d), whereas diets D2, D3 and D4, daily ration comprised of *S. almum* (about 508 g DM/d) + 127 g DM/d pre-wilted *C. benghalensis*, vetch hay and Lucerne hay, respectively. The mean ADG of wethers in D1 was lower than those recorded by wethers in D2, D3 and D4 ($P < 0.0001$). The mean DM intake in D1 was also lower ($P < 0.0001$). Results indicate that *C. benghalensis*, vetch and Lucerne improved the overall performance of the wethers.

Key words: Protein supplement, daily gain, sheep.

RESUMEN

Se evaluó el efecto de *Vicia villosa*, *Commelina benghalensis* y *Medicago sativa* como suplemento proteico sobre el consumo de alimento y crecimiento de ovinos Dorper alimentados con *Sorghum almum*. Se emplearon 24 animales (5 ± 0.32 meses edad, 17.3 ± 2.58 kg PV) en un diseño de bloques al azar. Los tratamientos fueron: Control (D1), 4 kg base fresca *S. almum* (*c*. 158.8 g MS/kg) (≈ 635 g MS/animal/d); dietas D2, D3 y D4, *S. almum* (*c*. 508 g MS) + 127 g MS/d *C. benghalensis* pre-secada, heno de *V. villosa* y heno de *M. sativa*, respectivamente. La ganancia diaria de peso y el consumo de MS fueron menores en D1 en comparación con D2, D3 y D4 ($P < 0.0001$). Se concluyó que *C. benghalensis*, *V. villosa* y *M. sativa* mejoran el comportamiento productivo de los ovinos.

Palabras clave: Suplementación, proteína, ganancia de peso, ovinos.

INTRODUCTION

Rapid human population growth in Kenya has led to an unprecedented increase in cultivation of food crops, which in turn has reduced availability of land for forage production. Consequently, most ruminants on smallholder farms rely heavily on low quality tropical grasses and crop residues (Preston and Leng, 1987) for major part of the year with little protein, energy and mineral supplementation (Lanyasunya et al., 2005). It is these factors that have heavily contributed to their current poor performance on smallholder farms as evidenced by reduced animal growth rate (Gitau et al., 1994), low milk yield (Omore et al., 1996) and poor reproductive performance (Lanyasunya et al., 2005). This amounts to a severe economic drain for resource-poor smallholder farm households. It has however, been realized that these losses can be minimized through use of inexpensive locally available supplementary feed resources to sustain and/or increase animal production. Indeed, many past research studies have recommended use of protein rich legume forages as the most feasible option to improve the quality and intake of low quality forage (Köster et al., 1996) to increase overall animal productivity (Bohnert et al., 2002). This study determined whether inclusion of *Commelina benghalensis* or vetch as protein supplements would enhance feed intake and

growth rate of post-weaned Dorper sheep wethers fed a basal diet of *Sorghum almum*.

MATERIALS AND METHODS

Experimental feeds

This study was conducted in Naivasha Kenya over a period of 84 days to determine effects of supplementing medium aged (8 – 12 weeks; about 158.8 g DM/kg) fresh Columbus grass (*S. almum*) offered as a basal diet with either Vetch (*Vicia villosa*), *C. benghalensis* or Lucerne (*Medicago sativa*) on feed intake and body weight (BW) changes of young wethers. A total of 24 Dorper weanling wether lambs aged about 5 ± 0.32 months with BW of 17.3 ± 2.58 kg, were selected from a large flock at a Dorper breeding ranch based on their date of birth and BW. At the ranch, the wethers had been grazed on a mixture of tropical natural pastures dominated by *Cynodon dactylon* and *Themeda triandra*. Prior to the study, all wethers were drenched with a broad-spectrum anthelminth, Valbazen (Smith-kline, Berne, Switzerland), sprayed with an accaricide to eradicate both internal and external parasites, and then ear-tagged and placed into individual pens (floor size: 2 x 1.2 m^2) with slatted wooden floors and water and feed troughs.

The wethers were allotted, in a randomized complete block design, to four treatment diets (i. e., D1, D2, D3, D4) of 6 wethers each. In control diet (D1), 4 kg fresh *S. almum* (of about 158.8 g DM/kg) was fed as sole diet (≈ 635 g DM/wether/d), whereas diets D2, D3 and D4, daily ration comprised of *S. almum* (about 508 g DM/wether/d) + 127 g DM/wether/d pre-wilted *C. benghalensis*, vetch hay and Lucerne hay, respectively. Diets were provided according to the recorded individual voluntary daily fresh matter intake, with about 60 g DM/wether/d allowance and adjusted upward daily based on previous day's intake. To ensure that about the same quality of *S. almum* was fed, clearing cuts were planned and executed sequentially starting on the plots with grass to be fed first and ending with those to be fed last. Each morning, fresh *S. almum* was cut and chopped using a hand operated chaff-cutter to a mean particle length of about 2 cm. Vetch and Lucerne were harvested at about 10 weeks of age and air-dried for 3 days and packed as hay in well perforated open gunny bags to prevent leaf loss through shattering as well as to ensure aeration. *C. benghalensis* was harvested weekly in a synchronized manner to ensure similarity in quality and wilted for about 5 days to reduce the moisture content before feeding. All diets were fed daily in two equal portions at 07:00 and 17:00 h and, at each time, were well in excess of estimated daily intake. The feeds offered and refusals were recorded for each wether daily prior to the next feeding. Representative samples of feed offered and refusals by each wether, were collected and dried at 65^o C for 24 h, bulked on a weekly basis and stored in tightly closed strong polythene bags for subsequent laboratory analyses.

Laboratory analysis

The DM was determined by oven drying at 105^{o}C for 24 h. To determine total ash, samples were incinerated at 500^{o}C in a muffle furnace for 3 h (AOAC, 1990, ID 942.05). Total N was determined by a micro-Kjeldahl procedure (AOAC, 1990, ID 954.01) and cell wall components were analyzed by the procedure described by Van Soest et al. (1991). Sodium (Na) and Potassium (K) were determined by flame photometry and N was analyzed calorimetrically on a flow analyzer (Kjeldahl method). Phosphorus (P) was determined by spectrophotometery. Calcium (Ca), Magnesium (Mg), Manganese (Mn), Copper (Cu) and Zinc (Zn) were determined by AAS (Atomic absorption spectrophotometer) (AOAC, 1990). Feed intake was determined as the difference between feed offered and refusals per wether per day. Individual weekly nutrient intakes were also determined and BW's were determined weekly using an electronic weighing bridge.

Statistical analysis

Data collected was stored in MS-Excel and analyzed using the GLM procedures of SAS (2002). Analysis of variance (ANOVA), to determine effects of treatments on the studied parameters (i. e., nutrient intake and live-weight changes) was according to a randomized complete block design. The statistical model was: $Y_{ijk} = D_i + C\,[D]_{ij} + W_k + D_i{*}\,W_k + e_{ijk}$; where, Y_{ijk} = BW (kg) or DM intake (g/d); D_i = diets (i = 1, 2, 3, 4); C = animal nested into D_i to test the treatment effect (j = 1, 2, …. 23, 24), W_k = number weeks (time) (k = 1, 2, …, 11, 12), $D_i{*}\,W_k$ = treatment – time interaction and e_{ijk} = error term.

RESULTS

The CP content in *S. almum* was lower than the other 3 forages, with vetch having a higher CP concentration (Table 1). The NDFom concentration also differed among forages, with *C. benghalensis* and vetch having lower NDFom concentration, whereas that of *S. almum* was higher. The Ca content was higher in Lucerne, whereas P was higher in vetch and *S. almum*. *S. almum* forage had a low concentration of Na and Zn. Comparatively high Mg content occurred in *C. benghalensis* (Table 1). Vetch also had the highest Ca/P ratio. The mean BW of wethers in D1 was lower than those in D2, D3 and D4 ($P < 0.0001$; Table 2). Though the mean BW of wethers in D2 was slightly lower than that recorded for those under D3, they were

not different ($P > 0.05$), but much lower than that recorded for wethers in D4.

The BW's of wethers in D3 and D4 were similar ($P > 0.05$). Wethers in D1 recorded lower ADG than those under D2, D3 and D4 respectively ($P < 0.0001$; Table 2). The ADG of wethers in D2 and D3 were not different ($P > 0.05$), whereas that of wethers in D4 was higher ($P < 0.0001$; Table 2). The mean DM intake of wethers in D1 was comparatively lower than those recorded for D2, D3 and D4, with wethers in D3 and D4 recording higher intake (Table 2).

Feed efficiency ration also differed between diets, with wethers under D1 recording lower ($P < 0.01$) feed efficiency ratio than those under D2, D3 and D4, respectively (Table 2). Though small differences in FE ratios were observed between wethers under D2, D3 and D4, they were however similar ($P > 0.05$). The general trend of BW change patterns of wethers over the study period also differed (Figure 1). The figure demonstrated that, wethers in D3 and D4 recorded both higher DM intake and higher growth patterns.

Table 1. Chemical composition of the forage materials used to formulate treatment diets

Parameter	N	Forage				SED
		M. sativa	*C.benghalensis*	*V. villosa*	*S. almum*	
Tot. DM (g/kg)	12	903.1	920.5	919.4	930.1	3.73
Composition (g/kg DM)						
Organic matter	12	878.9	720.7	815.3	845.0	3.61
Crude protein	12	188.6	133.5	249.4	93.6	2.64
NDFom	12	426.8	376.5	359.8	664.5	2.49
ADF (with ash)	12	318.1	262.4	302.7	366.4	2.09
ADL (sa)	12	105.7	42.6	54.1	40.9	2.12
Ether extract	12	21.3	14.2	27.3	16.2	2.72
Calcium	12	1.3	1.1	0.3	0.3	0.07
Phosphorus	12	0.5	0.7	0.4	0.4	0.03
Potassium	12	9.7	1.4	1.4	0.5	0.54
Sodium	12	1.4	1.4	1.4	0.5	0.08
Magnesium	12	0.3	0.6	0.2	0.2	0.01
Composition (mg/kg DM)						
Copper	12	11.8	7.7	8.0	8.1	0.69
Manganese	12	122	112.5	59.8	8.8	4.56
Zinc	12	318	151.3	73.1	29.0	4.97

SEM – Standard error of the mean; N – Number of samples.

Table 2. Performance of Dorper sheep wethers fed *S. almum* and supplemented with Lucerne, vetch or *C. benghalensis*

Parameter	N	Treatment diets				SEM	*P*
		D1	D2	D3	D4		
DM intake (g/d)	70	847.9	896.2	1056.5	1136.9	8.07	****
OM intake (g/d)	70	661.4	672.9	905.9	912.1	6.30	****
CP intake (g/d)	70	79.4	91.1	146.0	128.0	0.90	****
Initial mean BW (kg)	70	17.9	16.9	17.4	16.7	1.03	NS
Final mean BW (kg)	84	28.8	33.9	35.4	38.8	1.17	****
Mean wt gained (kg)	84	10.8	17.0	18.0	22.1	0.85	****
ADG (g/d)	84	128.9	201.9	213.8	263.1	10.13	****
Feed efficiency ratio	77	0.154	0.225	0.203	0.234	0.01	**

ADG, average daily gain; N – Number of days; DMI – dry matter intake; OMI – organic matter intake; CPI – Crude protein intake; Wt – weight; T – Treatment; SEM – Standard error of the mean; BW – Body weight; **** $P < 0.0001$; ** $P < 0.01$; NS – not significant ($P > 0.05$).

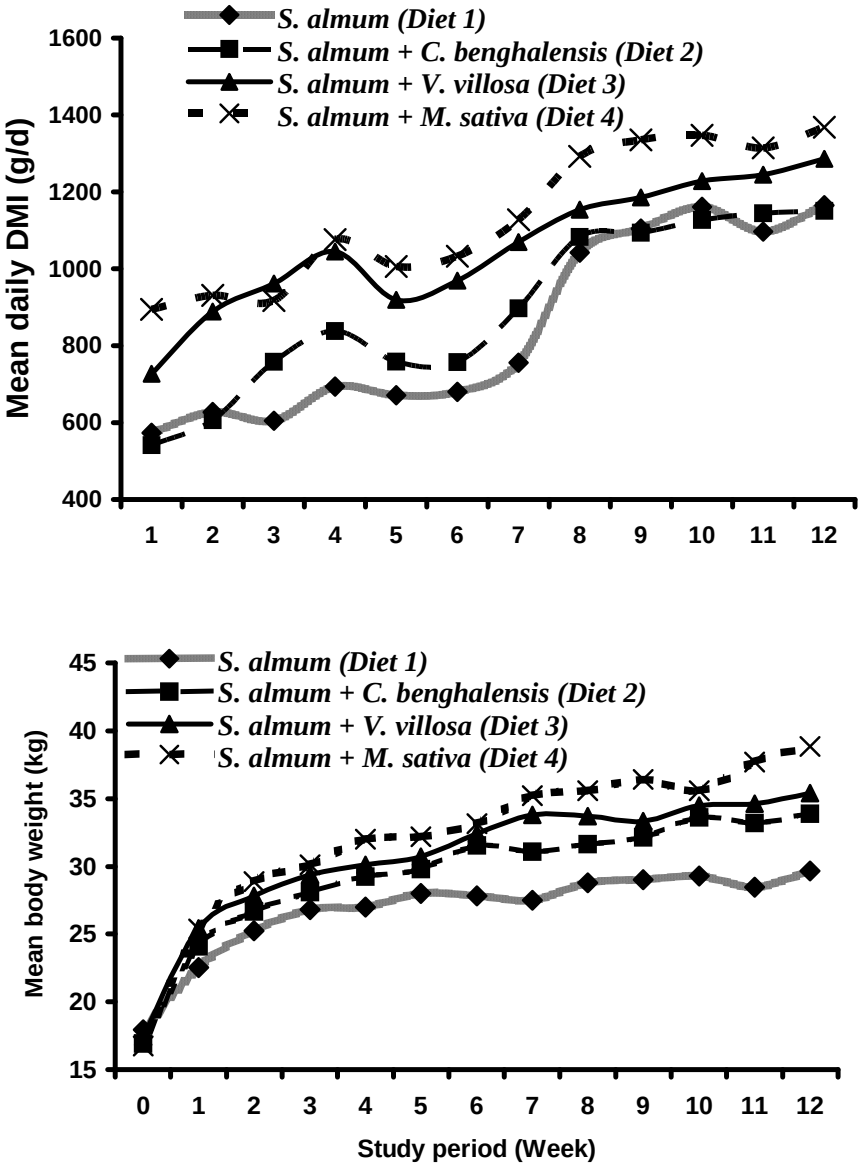

Figure 1. Body weight and DMI change patterns of wethers over the study period

DISCUSSION

The higher performance of the supplemented wethers is attributed to the increase in nutrients in the forage supplements, which in turn, might have created a more favorable rumen environment to support higher microbial function. Higher digestibility may have stimulated higher DM intake, perhaps leading to higher generation of rumen fermentation end products, thereby positively impacting performance of the wethers. This hypothesis is consistent with the findings of Lindberg et al. (1984) who reported that the low CP and high fibre content limits utilization of tropical grasses by ruminants. Jung and Allen (1995) also asserted that the potential for forage DM intake and its ability to act as a source of fermentable nutrients depends on cell wall concentration and digestibility. Van Soest (1994) pointed out that NDFom content of between 550 – 600 g/kg DM is the critical limit for ruminants above which feed intake will be adversely affected. The same author also reiterated that, in contrast, low level of fibre facilitates colonization of diet by the rumen microbes, which in turn, might induce even higher fermentation rates, hence improving digestibility. On the other hand, proteins in most legume forages are susceptible to

rapid degradation in the rumen (Klopfenstein et al., 2001; Vérité et al., 1987), thereby improving fibre digestibility, feed intake and subsequently animal performance. Their effect on animal performance, when used as protein supplements (Muia et al., 2000; Larbi et al., 1991; Lanyasunya et al., 2006a, b and c) concur with our findings which indicate that use of *C. benghalensis* and vetch, as protein supplements improved growth rate, feed intake and feed efficiency of the Dorper weanling wethers. *C. benghalensis*, which has been largely ignored by ruminant nutritionists, improved performance of the wethers, when used as a supplement, suggesting its potential as a ruminant forage supplement.

CONCLUSIONS

Results clearly demonstrated that inclusion of *C. benghalensis*, or vetch, in *S. almum* based diets improved growth and DM intake of the wethers, indicating their potential as supplements for ruminants. It is however recommended that, since *C. benghalensis* has not been evaluated previously in the context of ruminant feeding, further research is required to validate our findings and elucidate other nutritional factors not addressed in the current study.

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