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PERFORMANCE OF DORPER SHEEP FED ON RANGE GRASSES AND LEGUMES UNDER FEEDLOT IN KAJIADO

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ABSTRACT

A feeding trial of range grass and legume rations was conducted at Kipeto in Kajiado County to determine; nutritive value, feed intake and performance of twenty-four Dorper female sheep aged between 12-15 months old. The diets comprised of African foxtail (*Cenchrus Ciliaris)*, Bush rye (Enteropogon macrostachyus) grasses, Lucerne (Medicago sativa), and Desmodium spp legumes. Each six treatment diet had four animals as follows; Diet 1:*C. Ciliaris*+ Lucerne, Diet 2; *C. Ciliaris* + Desmodium, Diet 3: *Enteropogon macrostachyus* + Lucerne, Diet 4:*Enteropogon macrostachyus* + Desmodium , Diet 5: *C. Ciliaris* and Diet 6:*Enteropogon macrostachyus*. .Each ration was analyzed for dry matter (DM), crude protein (CP), Acid-detergent fiber (ADF) and Neutral-detergent fiber (NDF). In addition, crude fibre (CF), Nitrogen free extract (NFE),Acid detergent lignin (ADL), Ether extract (EE) and ASH were determined using wet chemistry. Completely randomized block design was employed to assess feed intake, weight gain of sheep. The data collected was analyzed using Genst at 14th edition, and the means separated with turkey HSD at 5% significant level. The results showed a significant differences (P< 0.05) amongst different rations given to sheep. The *C. Ciliaris* + Desmodium and *E macrostachyus* + Desmodium had the highest DMI of 851.9g/day and 844.0g/day respectively. They also recorded highest ADWG of 251.9±5.5g and263.0±7.6g/day respectively. Therefore, inclusion of legumes in grass diets boosted DMI and ADWG.

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INTRODUCTION

The Arid and Semi-Arid Lands (ASALs) occupy 89% of the Kenyan landmass. The ASALs are home to about 14 million people of whom 4 million are pastoralists. Approximately 95% of ASAL households derive their income from the livestock subsector where 70% of livestock is produced. Livestock contributes more than 47% of the agriculture GDP and, 12% of the national GDP in Kenya. The livestock sector employs about 50% of the agricultural workforce and about 90% of the ASALs workforce (Mwende & Bosma, 2019). The ASALs have the lowest development indicators and the highest incidence of poverty. Over 60% of the ASAL inhabitants live below the poverty line (national average - 48%), subsisting on one dollar per day. Kenya has an estimated population of 14 – 14.3 million beef cattle, 17 million sheep, 24 – 26.7 million meat goats and 3 million camels (KNBS. 2010; Kilimo News, 2020) about 70% of which are in the Arid and Semi-Arid lands. Under Vision 2030 GOK, (2027) agricultural sector is expected to grow at between 6-7% per annum for the country to realize the targeted 10% annual economic growth. The estimated demand for beef in Kenya is about 900,000 against estimated supply of 600,000 suggesting a supply deficit of about 300,000 MT (Mwangi, 2020). It is important and imperative to close this supply gap. An important cause of this beef supply deficit is feed shortage in terms of quantity and quality, which limits livestock production and productivity in the ASALs. The shortfall in livestock feed supply is attributable to limited adoption of pasture production and rangeland rehabilitation technologies, frequent droughts, overstocking, land subdivisions especially in the semi-arid areas, changes in land use systems and lack of appropriate grazing plans (Ndiritu,, 2021). This study determined the performance of Dorper sheep fed on either grass alone or grass and legume mixtures in a feedlot system with aim of improving livestock production for sustainable production in the rangeland ecosystem.

MATERIALS AND METHODOLOGY

The study was carried out at Kipeto farm, Kajiado County. The Kipeto area is located about 70 km south-west of Nairobi in Kajiado County. It lies at latitude 1º35′53″ South and longitude 36º4′15″East with an elevation of 1,891m. Kajiado is part of ASALS (Arid and Semi-Arid Lands) which is 89 percent of Kenya's total land mass. It

receives an average rainfall ranging from 300-800 mm per year occurring sporadically in both time and space (Onyango, 2016).

Experimental animals, design and feeding: Twenty-four (24) female Dorper sheep aged 12 to 15 months with an average live weight of 20.62 ±2.101 kg (mean ±s.m.e) were put in this experiment. The sheep were housed in an individual (4m by 3m) stall and offered six different diets; Diet 1; *C. Ciliaris*+ Lucerne, Diet 2; *C. Ciliaris* + Desmodium, Diet 3; *Enteropogon macrostachyus* + Lucerne, Diet 4; *Enteropogon macrostachyus* + Desmodium, Diet 5, *C. Ciliaris* and Diet 6; *Enteropogon macrostachyus.* The experiment ran for a period of 91 days. Feeds were weighed using digital Kitchen weigh balance. Feed ration was divided into two halves, offered in the morning; at 0800 hrs and another half in the afternoon; 1400 hrs. Water and minerals were offered *ad libitum*. Feed processing was done by chopping the grasses and legumes to 2cm size using motorized chopper. The rations were prepared in the ratio of 3:1 for grass to legume respectively. The weighed rations were fed to individual animal in their own pen twice a day. The refusals were weighed the next morning before general cleaning of troughs, environment and giving the day's ration. All animals' initial and weekly weights were recorded during the adaptation and experimental period.

RESULTS

The nutritive values of the six diets are recorded as shown in (Table 1) The *C. ciliaris* had CP content 43.8 g/kg DM less than the critical level of 70 g/kg DM. The legumes recorded the highest CP content being 150.6 and 148.3 g/Kg DM of Lucerne and Desmodium respectively. The lowest CP content was observed in *C. ciliaris* (43.8 g/Kg) and *E.macrostachyus* 54.9 g/Kg DM. The NDF of both legumes diets was above the range of 400-500 g/ Kg DM. The results in (Table 2) below shows that, sheep fed on the *C. ciliaris* + Desmodium diet had notably high dry matter intake of 851.9 g/day, followed by *E. macrostachyus* + Desmodium with 844.00 g/day. Ranking third were sheep fed on the *E. macrostachyus* +Lucerne diet with 774.70g/day. Higher ADWG was recorded when legume was added to diet. *E.macrostachyus*+ Desmodium recorded the highest ADWG of 263.0±7.60g/day followed by *C.ciliaris* +Lucerne recording 251.9±5.50g/day. The DMI as a percent of live weight of the experimental sheep ranged between 2.4 to 3.9. The regression analysis presented in (Table 3) shows that, the initial weight and feed ration had a significant effect on ADWG, where the former and the latter had a negative and positive effect respectively.

Table 1. Nutritive Composition of diets used in feeding experimental Dorper sheep at Kipeto, Kajiado site

SAMPLE NAME	DM g/kg	ME** (MJ/Kg)	CP g/KgDM	CF g/KgDM	NFE g/KgDM	NDF g/KgDM	ADF g/KgDM	ADL g/KgDM
C. ciliaris	92.0	8.2^{a}	43.8^{ab}	358.9^{ab}	494.0^{ab}	773.1^{ab}	553.7^{ab}	122.5^{ab}
C. ciliaris+Lucerne	96.7	8.5^{b}	120.7^{b}	409.0^{b}	374.2^{b}	690.6^{b}	435.3^{b}	97.0^{b}
C. ciliaris+Desmodium	92.0	8.2^{a}	70.9^{a}	468.0^{a}	331.5^{a}	714.0^{a}	497.0^{a}	73.7^{a}
E. macrostachyus	93.8	7.7^{c}	54.9^{ac}	424.5^{ac}	420.9^{ac}	751.7^{ac}	493.8^{ac}	82.2^{ac}
E.macrostachyus+Lucerne	91.7	7.8^{c}	81.2^{bc}	449.9^{bc}	360.9^{bc}	672.5^{bc}	456.7^{bc}	115.0^{bc}
E.macrostachyus+Desmodium	93.9	9.1^{ab}	117.9^{c}	414.2^{c}	338.7^{c}	706.1^{c}	399.9^{c}	68.4^{c}

DM; Dry matter, CP; Crude protein, ME; metabolisable energy, CF; crude fibre, NDF; neutral detergent fibre, ADF; Acid detergent fibre; ADL; Acid detergent lignin.**The asterisk indicates values obtained through computation.$^{a-c}$ means within a column without a common letter superscript differ at $p< 0.05$

Table 2. Performance of sheep in feedlot fed on range grasses and legumes at Kipeto in Kajiado County

Diet	Initial weight	ADWG	Final weight kg	Net Weight Gain (Kg	DMI g/day	%DMI
C.ciliaris +Desmodium	17.2±1.1^{a}	224.1±5.5^{d}	37.4±1.1^{f}	20.2	851.9^{b}	2.95^{c}
C.ciliaris +Lucerne	21.3±0.7^{a}	251.9±5.5^{d}	44.0±0.3^{f}	22.7	678.0^{b}	3.474^{c}
C.ciliaris	20.5±0.7^{a}	140.7±2.1^{e}	33.2±0.7^{f}	12.7	698.6^{b}	3.178^{c}
E.macrostachyus+Desmodium	22.7±0.5^{a}	263.0±7.6^{d}	46.4±1.2^{f}	23.7	844.0^{b}	3.386^{c}
E.macrostachyus+Lucerne	19.2±0.3^{a}	224.1±1.6^{d}	39.4±0.4^{f}	20.2	774.7^{b}	3.424^{c}
E.macrostachyus	22.2±0.3^{a}	196.3±3.4^{d,e}	39.2±0.2^{f}	17.7	691.3^{b}	3.417^{c}

DMI; Dry matter intake, ADWG; average daily gain $^{a-f}$means within a column without a common letter superscript differ at $p< 0.05$

Table 3. Regression coefficients analysis

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Model	904337.124^{a}	22	41106.233	5.717	.000
Initial weight	195831.441	21	9325.307	1.297	.278
Ration	112787.936	1	112787.936	15.686	.001
Error	151001.916	21	7190.567		
Total	1055339.040	43			

Dependent Variable: ADWG; Average daily weight gain, R Squared = .857 (Adjusted R Squared = .707)

The initial animals body weights were taken using spring balance (HANSON™ Model No. 21, H. Enterprises Bombay, India Max. 100 kg, calibrated at 5 kg with precision ±0.5 g). The subsequent weekly weighing up to the end of trial, the digital weighbridge balance for small stock was used. Average daily weight gain (ADWG, g/day); was obtained by dividing the difference between, the final body weight (kg) and the initial body weight (kg), by the number of days in feedlot and then, multiplied by thousand to obtain ADG in grams.

Statistical Analysis: The data on feed intake and weekly body weights recorded in excel spreadsheet were analyzed using Genst at 14th edition and the means separated with turkey HSD at 5% significant level. The percentage daily dry matter intake by each animal was calculated using the average of initial and final weights in kilograms.

An increase in the initial weight, reduced the animal performance while an increase in feed quality increased the animal performance and vice versa.

DISCUSSION

Animal performance is determined by feed availability, feed nutrient content, intake, extent of digestion, and metabolism of the feed digested. The amount of digestible energy, protein, vitamins, and minerals needed for maintenance is low relative to other animal processes. In general, forages that contain less than 70% NDF or 45% ADF and more than 8% crude protein contain enough digestible protein and energy, vitamins, and minerals to maintain older animals (Ball, 2016). Thus, even many low quality forages and crop residues can meet the maintenance needs of some classes of animals, if protein and minerals are adequate.

The animals' body size, activity, growth rate, and/or the animal's level of milk production and fat content in milk produced determines nutrient requirement (Samoes *et al*. 2021). The NDF values of grasses in all the sites were beyond the critical values recommended for efficient animal performance i.e. 600 - 650 g/Kg DM (Van Soest *et al.,* 1991). This is indeed confirmed by the fact that the ADWG values recorded in the trials were lower than what had been reported earlier by Lengarite *et al*., (2021).

Low values are associated with low quality of the grasses which were actually by-products of the grass seed production system at KALRO Kiboko station and low intake and digestibility in line with Doreau *et al*., (2026) finding. Increasing the NDF content in diets increases the rumination time and according to Sousa *et al*., (2018), this has been observed in goats. The NDF value for all legumes was within the range of critical value of 400-500 g/Kg DM recommended for quality feed. The sheep used in the trials were almost mature as it was not possible to secure true weaners considering the trials started at peak of a drought period, which also explains the low performance of trial animals. The four diets containing grass and legumes resulted in similar ADG by the experimental sheep and the ADGs were significantly higher ($p<0.05$) than for the control diets comprising grass only. It is equally important to note that the ADGs for all the diets were lower than previously documented results, which can be explained by the generally low quality of the diets particularly attributed to the grasses. The sheep on the diet *E. macrostachyus* + Desmodium had the highest ADWG of 263.0±7.60g/day explained by high ME of 9.1 Mj/Kg and CP of 117.9 g/Kg DM. The sheep fed on pure *C. ciliaris* and *E. macrostachyus* registered the lowest ADWG associated with low CP of about 44g/Kg DM and high ADF of 494 to 554 g/Kg DM.

The DMI as a percent of live weight of the experimental sheep was higher than 1.5-2% which is the recommended for small ruminants (Tripathi *et al*., 2011). This high DMI may be explained by the fact that the quality of the diets was generally low and the animals were striving to meet their body nutrients demands. The greatest expense in a feedlot production system is associated with the costs related to feeding (Sitorski *et al*., 2019). In conclusion, addition of a legume in a diet, positively affects feed intake and ADWG. The performance of sheep depends on the quality of feeds provided. Feeds without enough protein, energy and minerals reduces the growth, production and reproduction of sheep**.** Inclusion of the legume in the diets enhanced nutritive quality, feed intake and the average daily weight gain in all the trials. It is therefore beneficial for sheep farmers in the project counties to adopt growing of grasses and legumes for use in home-based feed ration formulation to finish the sheep. The alternative is to ensure supplementation of the free grazing sheep with cheaply produced protein for the livestock finishing activities to make economic sense. This would be a break from the common traditional practice where the livestock are finished under free grazing conditions taking 2 to 3 years to attain the market weight.

The results also confirm the importance of timely harvesting (no more than 20% flowering level) and proper storage of feed material in a moisture free well covered shed for optimal livestock performance. The use of low quality grass harvested from a pasture-seed production system at KALRO Kiboko slowed down the performance of goats although the responses were still higher than under the traditional grazing practices. The farmers should take good care of the livestock if they were to realize good performance. Finishing of the sheep should start when they are between 4 to 6 months to take advantage of the naturally fast growth at this stage and in a feedlot system. The trial showed that the daily weight gain was high when the diet was mixed with legumes (Desmodium or Lucerne). This growth rate was attributed to the high CP of the diets that indicates that farmers should be advised to include protein rich feeds in the livestock feeds. Additionally, the breed and genetics of the animal influences feed efficiency, carcass merit and economic benefits significance. Thus it is fundamental to select the right breeds whether buying the animal or raising it from home.

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