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Goat Performance under Natural Grazing in Juba Area, Central Equatorial State, South Sudan

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ABSTRACT

The objectives of this study were to quantify and assess the performance of the goat in Juba conditions and its environment under natural grazing in Juba area capital city of the Republic of South Sudan. During the grazing period of six months (May-October). Goat's kids were brought from Terekeka county were selected from different community. Plants were cut from the ground level weighted freshly and then dried at 70℃ for a day. Chemical analyses of feed (pasture) were carried out in laboratories in ARC Wad-Medani, Sudan. *In vitro* digestibility was determined in the department of animal production laboratory in the unversity of Gezira. For animal performance sixteen Mundari goats that brought from different communities in the area were used. The animals were divided into four groups each of four. The result revealed that nutrient composition differed with time. Pasture composition and were significantly ($P \leq 0.05$) differed with time were the plants that formed the pasture. And *in vitro* digestibility differed significantly ($P \leq 0.05$) with time. However weight gain of animals ranged from 0.11-0.4 kg/day. The information derived from this study will serve as baseline for goat nutrition status in South Sudan. The study recommended that, for goat live weight gain improvement, pasture should be supplemented with highly nutritive feed such as concentrate.

Keywords: Goat; Nutrition status; Performance; Natural grazing and management; Pasture; *In vitro*

INTRODUCTION

The Nilotic goat is found in the humid areas of West Coast of Africa. And in South Sudan, it is considered as meat animal having low milk yield [1]. It is resistant to trypanosomiasis. Animal feeding systems in South Sudan are mainly based on grazed native pastures, and poor quality crop residues are the main sources of feed in most parts of the region, which vary seasonally and this may affect animal performance. In the highland and mid-altitude mixed farming areas, the land available for natural grazing and browsing is rapidly decreasing due to the increasing human population and increasing demand for cropping land [2]. Forage quality is an expression of a characteristic that refers to how well animals eat a forage and how efficiently the nutrients in the forage are changed into animal products. Thus the greatest measure of forage quality is the productivity of animal, which is affected by feed and nutrient intake, digestibility and utilization efficiency [3]. There is a great seasonal variation of even during years of good rainy season, forage is not sufficient to feed livestock in the highlands for reasons associated with restricted grazing land and poor management [4].

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Diseases, parasites and tsetse flies, in the humid and sub humid zones, are also major problems, causes high mortality amongst [5]. Southern Sudan goats are characterized by variable physical features of compact body and small in size, the forehead is convex and facial profile is straight. The ears are of medium size both sexes usually carried small horns and beard. The color is variable and nearly all colors are found but the most common is mixture of black and whitish hairs. Most of Juba population depends on livestock, practiced farming around the villages for their livelihood [6].

MATERIALS AND METHODS

Animals and Management

Sixteen local weaned goats with initial average body weight of 8 kg-12 kg and 4-7 months of age were used. They included 7 females and 9 males. These animals were purchased from Terekeka state. They were housed in one shelter divided into four sub-groups. The portions made from woven wires, pens made from wood and bamboo.

Live Weight Changes

Animals were weighed at the beginning of the experiment (initial weight) and every two weeks during the experimental period with a spring balance. Weight gain was determined by subtracting the weight of the animals in two weeks and that of the two weeks period before. Then the Average Daily weight Gain (ADG) was determined by dividing the weight gained by each animal by the 14 days and total weight gain was determined as shown in the formula below:

$$\text{ADG (kg)} = \frac{\text{Final weight (kg) - Initial weight (kg)}}{\text{Number of days (days)}}$$

Feed Conversion Ratio (Feed/Gain)

Feed to gain ratio was estimated as the daily feed intake divided by the daily weight gain in kg of each animal. Feed/ gain ratio=Daily feed intake kg/day/Daily weight gain kg/day.

Feeding of Experimental Animals

The animals were grazed on natural pasture in specific paddock area of 4200 meter square and the pasture been analyzed chemically and the nutrients content was determined the animals were monitored using the natural pasture as stated above. The animals were allocated randomly to sub-group group one (G1), (G2), (G3) and group four (G4) where each sub-group consisted of four experimental animals selected randomly (**Figure 1**).

Figure 1: Grazing land in Mafao Farm.

Experimental Animals and Design of Experiment

Sixteen animals were used they were divided into 4 groups and then divided 4 sub-groups each with 4 animals. The animals weighed every two week using spring weighing scale.

Proximate Analysis

The samples of grasses that exist in the grazing land which been utilized by the experimental animals and feces were collected to be analyzed according to AOAC at the agricultural research cooperation-Wad Medani, Sudan for CP, CF, ASH, EE, DM and NFE of feeds as well as fecal material of three animals goat, in the three period of the rain season (beginning of the season, medium and end of the season) [7].

Selection of Samples for Proximate Analysis and *In vitro* Digestibility

Three sub samples were collected from sample of each stratum for chemical analysis according to AOCA (DM, CP, CF, EE, Ash and NFE) in triplicate basis, in the interval period of time during rainy season first in the beginning of the season, second in the mid of season and end of the season.

Determination of *In vitro* Digestibility

The technique for determination of conventional *in vitro* digestibility complied with the Galyean, et al. modification of the Tilley, et al. two-stage procedure [8,9]. Twenty four 50 mL nalgene tubes were placed in a rack. Subsequently, 0.5 g of experimental samples were added to each of 20 tubes, 0.5 g samples from laboratory standards (grass hay) were added to 2 tubes and 2 tubes were used as blanks for the experiments. In each tube, 35 mL of a buffer inoculums mixture as described by Marten and Barnes was added under purging with CO_2 and caped tightly with a rubber stopper/gas release port (**Tables 1 and 2**). Samples were incubated for 48 hrs in a water bath at 39℃, followed by further digestion in an acid-pepsin solution containing 6.6 g/L pepsin (catalog # P53-500, Fisher scientific, Pittsburgh, PA, USA) and 0.1 N hydrochloric acid (35 mL of acid-pepsin solution was added to each tube) and incubation for 48 hrs in water bath at 39℃. All tubes were mixed by swirling (vortex genie-2 mixer, VWR scientific, West Chester, PA, USA) them at 2, 4, 20, and 28 hrs after adding the buffer inoculums and at 2, 4, and 6 h after adding acid-pepsin [10-15].

Table 1: Solutions A.

Content	Grams/liter
KH_2PO_4	10
$MgSO_4.7H_2O$	0.5
NaCl	0.5
$CaCl_2.2H_2O$	0.1
Urea (optional)	0.5

Table 2: Solution B.

Content	Grams/100 ml
$NaCO_3$	15
$Na_2S_9H_2O$	1

After completion of the digestion, contents were filtered into pre-weighed standard coarse fritted disk gooch crucibles under mild vacuum, dried at 10℃ for 12 hrs, weighed for determination of DM, placed in a muffle furnace at 525℃ for at least 12 hrs, and reweighed to complete calculation. Mix 20 ml of solution B with 1000 ml of Solution A and adjust pH to 6.8 by adding solution B.

Statistical Analysis

Statistical Package for Social Sciences (SPSS) software was used for data analysis. Data gathered in the field and the results of proximate analysis were entered into the software in a coded format and stored. The program was subsequently used to generate descriptive statistics of the variables presented.

RESULTS AND DISCUSSION

Intakes from Pasture

As shown in the **Table 3** that, the highest daily feed intake of 0.9 kg DM/animal was observed in month (July). While the lowest daily intake of 0.34 kg DM/animal was observed in October this indicates that the feed intake and quality decrease with time, as the rainfall declines. The mean daily weight gains of 0.069 kg/day in average observed in this study for goats grazing freely on pasture were higher than that of 45 g/day observed by Leng, et al., in study carried out in Australia on goats grazing freely on pasture and supplemented with *L. leucocephala* while it was lower than that of 82 g/day reported by Rashid, et al., for Boar goat.

Table 3: Means of daily intake (Kg DM/animal) and daily body weight gain Kg.

Month	Mean		FCE
	Daily intake	Daily weight gain	
May	0.45	0.05	0.11
June	0.8	0.08	0.1
July	0.9	0.085	0.09
August	0.8	0.115	0.14
September	0.68	0.045	0.06
October	0.34	0.04	0.12
Mean	0.66	0.069	

Mean body weight gain and feed intake in this study were lower than that of 0.088 kg/daily and 0.79 kg DM intake from soy waste reported by Mohammad, et al. This may be due to the supplement of soy waste used by the author and breed of goat. The daily live weight gain **Table 4** ranged between 0.04-0.115 kg/animal/day during the period of trial [16]. In the present study it was revealed that growth performance of goat is lower than previously reported, by Phillips, this might be due to differences in breeds and agreed with Hart, et al., who found breed effects with Alpine, Nubian and Angora in ADG, on Bermuda grass where their gains were 46.5 g/d, 61.g/d and 44.1 g/d, respectively; or fluctuation

of feed availability around the year. In general, live weight gain of the experimental animals in the current study was comparable to better known tropical breeds at similar age and given traditional forage. However, Swingle, et al., concluded that, inclusion of halophyte forages supported the same weight gain of lambs as cynodon (Bermuda grass) hay. All the experimental animals had adequate total Dry Matter Intake (DMI) which ranged from 0.34 kg to 0.9 kg/animal/day (in average 0.66 kg/animal/day). Those values were higher than the range of (288.48 to 354.49 g/animal/day) for West Africa Dwarf (WAD) goat, reported by Asaolu, et al. Also these values met the minimum daily DMI of 3% of body weight recommended for small ruminants by (NRC, 1985).

Several reports by Ajayi, et al., indicated that feed intake is an important factor in the utilization of feed by livestock and is a critical determinant of energy and protein as well as performance in small ruminants. This study goes in line with Humphery who reported that the availability of pasture, the structure of the sward and nutritive values of its components reflect the characteristics of the species percentages and environment which determine its senescence. Generally an increased level of feeding will lead to better possibilities for selection and a higher feed intake [17].

Table 4: Chemical composition of pasture.

Time	Chemical composition					
	DM%	CP%	CF%	ASH%	EE%	NFE%
Beginning of season	45	14.35	29.5	8.75	1.1	46.3
Mid of season	60.5	12.5	31.5	8.9	1.1	46
End of season	75.5	12.22	32.5	9	0.65	45.63
General mean	60.3	13.02	31.17	8.88	0.95	45.97

The CP content was higher in the beginning of rainy season (May and June) compared to the end of rainy season (September and October). The same trend of variation was observed for dry matter and CP content which, decreased as grazing season advanced. This is in line with results of Carcia, et al., noted that DM intake and digestible dry matter increased with CP content of the herbage. Avondo, et al., suggested that a pasture constrains potential ingestion when the CP content is below 16% of DM.

The proximate analysis of mixed pasture of the three interval period during rainy season is presented in the **Table 5**. DM was (60.2%) in average and it increased with time. In the beginning of the season it was (45.0%), in the mid was (60.5%) and at the end of season was (75.5%), this agreed with Hetta, et al., who reported that an increase in DM with an increase in maturity date in timothy grass (*Phleum pratense*). Also this is consistent with the report of Balagopalam, et al., who pointed out that the iber content and quality of diet is a contributory content and quality of diet is a contributory reduced digestibility and utilization of nutrients.

Table 5: Chemical composition of the feces.

Time	Chemical composition					
	DM%	CP	CF	ASH	EE	NFE
Beginning of season	70	0.89	30	7.4	0.75	60.96
Mid of season	78	1.14	34.5	7	0.85	56.51
End of season	72	1.6	35	7.2	0.75	55.45

The dry matter is less than of that reported by Topps and Oliver who reported that a DM of 70%-80%, except at the end of season (75.5%). The CP analyzed showed variation among months during rainy season. The highest CP was observed on the beginning of the season (14.4%) and the lowest on the end of experiment (12.2%) with average value of 13%. The crude protein content of about 13% in average obtained in the proximate analysis is comparable to the range of 12%-18% recommended for growing ruminants in the tropics. As reported by NRC, et al. the average of 13% CP (Crude Protein) in the present study was far above 7% which recommended for tropical live stock by Minson, et al., below which there will be decline in performance. Also CP for mixed pasture was lower than 16.68% that obtained by Ocheja, et al., and higher than 10.55% that obtained by Okolo, et al., and 9.70% obtained by Osakwe, et al.

The range of 12.2%-14.3% CP in this study was lower than that of 20% to 30% CP found by Asaolu, et al., and of 14% to 18% found by Binh, et al., in foliage found in the resent study CP range 12.22-14.35 of this study was higher than that reported by Heuze, et al., who stated that, Crude Protein (CP)

values of pangola grass are commonly in the range of 5% to 12% of dry matter. The nutritive value of the pasture is greatly affected by luctuation of rainfall, during rainy season specially when advance toward dry season. Therefore, grazing alone on the natural pasture may not be sufficient for optimizing live weight gain (low weight gain in June was 0.4 kg/d/animal). Where there is scarcity of pasture during this time. As found in this study that as the dry season approaches the crude protein decline and crude ibre increase and this adversely affect weight gain of the animals as presented in and digestibility as shown in table. This goes in line with the indings of Yami, et al., who reported that the inclusion of varying levels *Leucaena leucocephala* leaves in the diets had signi icantly ($P \leq 0.05$) affected body weight gain. The nitrogen free extract of 45.97% average obtained in this study was higher than 38.32 nitrogen free extract reported by Ocheja, et al., and lower than 52.28% nitrogen free extract reported by Ocheja, et al. The average value of 0.85 Ether Extract (EE) obtained in mixed pasture was lower than that 3.50 Ether Extract (EE) content reported by Ocheja, et al., and lower than of 3.72% reported by Amakiri, et al. The average value of 8.88% obtained for ash was lower than 9.70% reported by Osakwe, et al. The average dry matter content of (60.2%)(mixed pasture) in this study was lower than that of 65.00%reported by Ocheja, et al. and higher than that of for 35.50%obtained by Okolo, et al. This disparity could be due to the stage of maturity of the grass. There are also presences of discrepancy among individuals' animals. And this may need an improving by selection of efficient animals, as suggested by El Khidir, et al.

In vitro Digestibility of Protein and Fibre of Pasture

In the study the CP digestibility was almost similar during the whole grazing period, it was slightly decreased at the end of season. While the CF digestibility was higher in the beginning of season then declined progressively with time.

As presented in **Table 6** the digestibility declined with increasing fibre content. Some studies Man, et al., have shown that the feed intake of some roughage resources is low, probably due to the high fibre content and high content of anti-nutritional factors such as tannins. In general the quality and quantity of feed produced from the natural pasture was low as reported by EARO, et al. Grasses are abundant and form the major feed for livestock. They are of low quality for most of the year especially after the lowering stage. They also contain high fibre and are poorly digested by animals as reported by Leng, et al. The average crude fibre found in this study was 31.16% which is almost similar to that reported by McDonald, et al., who found that the crude fibre is higher in panicum maximum (35.50%). While the value of ash 8.88% obtained in this study was less than of 10.40% that reported by McDonald, et al. Therefore, natural pasture alone cannot support growth of goats especially when approaching dry season. The seasonal variation contribute largely to the availability of grasses for grazing, this agreed with Odeyinka, et al., who reported that forage plants and grasses are unable to withstand drought, deplete in nutrients and become unacceptable to small ruminants which are very selective in their choice of grazing resources.

Table 6: Digestibility (%) of whole pasture, protein (CP) and fiber (CF) during the period of trial.

Period	Digestibility		
	Whole pasture	Protein	Fibre
Beginning of season	77	97	77
Mid of season	70	97	67
End of season	61	95	58

This observation in this study agrees with that reported by Galal, et al. The CP content of mixed pasture grass in this experiment was (13.02%) in average which is higher than the result of (120.0 g/) obtained by Manaye, et al.

In vitro Digestibility of Pasture

Table 7 shows the *in vitro* digestibility of the mixed pasture in three different periods during the trial (6 months). It was found that there was a highly signi icant ($P \leq 0.05$) difference between the three period intervals. The present study goes with that of Hanna, et al. who mentioned that, various factors like species and growing conditions can affect the nutrient composition of forages.

Table 7: *In vitro* digestibility (%) of mixed pasture collected from the field in different intervals.

Time	Mean	SE	Prob.
Beginning of season	76.7		

Mid season	70		
End of season	60.7	2.4	0

Throughout the entire season generally, in this study the digestibility decreased with time. In the beginning of the season it was (76.66%) while in the mid was (70.66%) and at the end of season was (60.66%). However, the range of *in vitro* digestibility in the present study was (60.6%-76.6%) which is higher than that of 56.1% found by Minson, who suggested that rumen distention could be a primary factor in regulating voluntary intake.

The communal rangelands in Juba areas of South Sudan are the source of all feeds for domestic ruminants. However, the quality and quantity of feed fluctuates in response to rainfall patterns. Little is known about the capacity of these rangelands to support ruminant productivity [18-20].

CONCLUSIONS

- The basic reason for the poor performance of goat in Juba town (Mafao) is the seasonal inadequacy of feed, both in quantity and quality of the grass cover on the grazing land.
- There is variation for dry matter and CP content in chemical composition in respect to season.
- Grazing of goat on natural pasture alone could result in poor performance.
- Goats grazing on natural pasture have a lower body weight gain.
- Chemical compositions were within the ranges reported by many authors.

RECOMMENDATIONS

- Natural grazing animals should be supplemented with some feed with highly nutritive value
- There is a need of adequate planning and pasture management during these periods in anticipation of the looming dry season.
- It is highly recommended to work on native pasture from the quality point view, since there was no study at least that concerning central equatorial state area matter found in the reviewed literature.
- Further investigation on evaluating other parts and species and animal feeding trials are required to establish the nutritive values of these species.

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