



# Effects of Chopping and Supplementation of Sorghum Straw on Feed Intake, Hematological Parameters and Performance of Desert Goats in El Nuhud, North Kordofan, Sudan

## KEYWORDS

Goats nutrition, crop residues, physical treatment, supplementation

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**ABSTRACT** This study was conducted at El Nuhud locality, West Kordofan State, Sudan, with the objective of evaluating the effects of chopping and supplementing sorghum straw with concentrates on feed intake, digestibility, body weight changes and some hematological indices of Desert goats. Feed-sex interaction was also studied. Eighteen Desert male and female goats (6-8 months old, average weight of 12.5 kg) were divided into three groups of six animals (three females and three males) and fed three rations; un-chopped sorghum straw (UCSS), chopped sorghum straw (CSS) and chopped straw supplemented with concentrate ration (CSS+Supp). The experiment was in a randomized complete block design with six replicates and the data was analyzed via analysis of variance. The results showed that dry matter intake was significantly ( $P < 0.01$ ) affected by ration and sex ( $P < 0.01$ ). Males consumed more feed compared with females. Total dry matter intake was 3.19, 3.91 and 4.71% body weight for goats on un-chopped, chopped and chopped straw with supplementation respectively. Dry matter and organic digestibility coefficients as well as crude fiber, ether extract and nitrogen free extracts were highest ( $P < 0.01$ ) for chopped and supplemented straw whereas crude protein digestibility was highest ( $P < 0.01$ ) for chopped straw that was supplemented with concentrates. Total digestible nutrients, digestible organic matter and digestible crude protein were significantly higher ( $P < 0.01$ ) for CSS +Supp. The Hb and PCV% was significantly ( $P < 0.01$ ) affected by type of feed. There was significantly ( $P < 0.01$ ) positive correlation between total weight gain and both total dry matter intake and hematological indices.

The study concluded that feed intake and digestibility of sorghum straw could be improved by chopping only or with chopping and supplementation leading to improved goats' performance.

## 1. Introduction

Goats are important livestock species in all ecological zones and agricultural systems in tropical Africa including Sudan. They play important role in the livelihood of a large proportion of small marginal farmers and landless laborers. Their importance is well recognized in rural Sudan and North Kordofan in particular where under the harsh semi arid conditions, raising goats proved being the most suitable livestock production pattern by the small subsistent farmers. The economic importance of goats depends on the value of their products that include meat, milk, hair and skins. The functional role of goats as meat producing animal in Sudan has only recently drawn the attention of researchers. The proportion of income coming from meat to total income from goat (milk, meat, skin, etc) is very high and estimated at 70 - 80%. The milk is often used for domestic purposes and the cash flow comes only from meat (Taneja, (1977).

The Sudan Desert goats represent about 27.1% of the total goats' population of the country, ranking second to the Nubian goats and they dominate the western zone of the Sudan, (Hassan, 1977). They are reared in the arid areas of the Sudan and well adapted to local environmental conditions. The large population of the Desert goats suggests that they probably have good potential for meat production (Gaili, 1976).

The majority of livestock species including goats are raised under extensive systems on rangelands and fibrous crop residues in North Kordofan. The rangelands are diverse and the crop residues, though abundant, are of low quality. The residues can most economically be used for livestock feeding if properly treated including physical, biological and chemical treatments as well as supplementation with suitable and

low cost locally available feed supplements because most of these crop residues that animals depend on as feed source are generally low in minerals, protein and vitamins, especially vitamin A and E (Owen, 1978).

This study was undertaken with an overall objective for assistance in developing sustainable livestock production systems under agro-pastoral arid zone of Sudan.

Specific objectives were to study the effects of chopping and supplementing sorghum straw on dry matter intake, digestibility and also on live body weight changes in addition to some hematological factors of the Desert goats.

## 2. Materials and Methods

### 2-1. the Study Area

El Nuhud locality is located in North Kordofan State, Sudan, latitudes 11.5° and 13.75° N and longitudes 27° and 29.5° E. The long term mean annual rainfall ranged from some 200 mm in north east to about 500 mm in south east. The maximum temperature (40° C) was recorded in summer and minimum (10° C) was recorded in winter with a monthly average of 35° C. The soil varies from sandy to sandy loam with clay deposits in seasonal streams. Loamy sand soils cover scattered parts in southern area of the locality. The main crops grown here are divided into three groups, cereal crops like millet and sorghum, cash crops like groundnut, watermelon, Roselle and multipurpose crops like cowpea, sweet sorghum ...etc. Crop residues left after harvesting of sorghum and millet are considered low quality roughages, while groundnut, sesame cake and watermelon seeds are considered high quality concentrates. Livestock in the area play an important economical role together with agricultural production

with animal population of about 1.6 million cattle, 2.8 million sheep, 1.00 million goats and 0.55 million camels. Most of these animals are kept by nomads depending on natural grazing and crop residues (Hamad, 1999).

## 2.2. Experimental Animals

Eighteen male and female Desert goats were used in this study. The animals were 6–8 months old with average weight of 12.5 kg. The animals were ear-tagged, divided into three groups of six animals each with three males and three females. The animals were also dosed with (Ivermectin<sup>®</sup>) against internal and external parasites at 1cc per animal. Each animal was kept in a separate pen, offered feed and water in separate troughs and allowed two weeks as an adaptation period (McDonald *et al.*, 1998). The last ten days were used to digestibility trial where feed consumption and fecal output were recorded.

## 2.3. the Experimental Feed

The experimental diets used are presented in table (1). Ration I was un-chopped sorghum straw (USS), II chopped sorghum straw (CSS) and III was chopped sorghum straw with supplement (CSS + supp). The sorghum straw was fed *ad libitum* while the daily amount of the supplement offered was 200 grams/ animal. The concentrate ration was formulated using 71% groundnut hulls, 18% groundnut seed cake, 10% sorghum grain and 1% salt. All feed ingredients were purchased from the local market. The chopped sorghum straw was prepared to a length of 2.5- 3 cm using a manual chopper.

## 2.4. Dry matter intake measurements

All animals were given the feeds daily in the morning at 7:30 am and the dry matter intake (kg/d/animal) was estimated by subtracting the amount of feed left at 7:00 am the next day from the quantity provided the day before.

## 2-5. Body weight changes

The animals were weighed at weekly interval for nine weeks using weighing scale. They were fasted overnight before being weighed.

## 2-6. The digestibility trials

The last ten days were considered as digestibility estimation period. Feces voided by each male animal were collected daily using canvas bags attached to the males by harness whereas females were kept in feeding crates. The feces were dried under shade and weighed and stored for chemical analysis for the purpose of estimating nutrients digestibility.

## 2-7. Chemical analysis

Feed and fecal samples were analyzed for determination of dry matter (DM), organic matter (OM), crude protein (CP), crude fiber (CF), ether extract (EE), nitrogen free extract (NFE) and ash. This was done according to the procedure described by the Association of the Official Agricultural Chemists (A.O.A.C, 1990). Moisture was determined by oven drying at (100–105 C ) for about 18 hours and fat by soxhlet extraction method using petroleum ether solution. Determination of ash was by means of burning the sample at 550- 600c in a muffle furnace for three hours and the kjeldahl procedure using a conversion factor 6.25 was used to convert nitrogen content percent to percentage protein (A.O.A.C,1990). The digestible energy (DE) was calculated as follows (McDonald *et al.*, 1998):

$$1 \text{ kg DOM} = 1.05\text{TDN}$$

$$\text{ME (Mj/ Kg DM)} = \text{DOM} \times 4.4 \times 0.82 \times 4.184$$

## 2-8. Hematological Parameters

Three to five ml of blood sample were collected from each animal and examined prior experimentation and at the end of the trial for packed cell volume (PCV), hemoglobin concentration (Hb) and total white blood cell counts (TWBCs).

In the laboratory, the haematocrit centrifuge was used to determine the packed cell volume (PCV) hemoglobin concentration (Hb) was determined by the cyanmt hemoglobin using a calorimeter and the TWBCs were done by the chamber slide to count the number of cells and hence calculating the cell count (X 100) Schalm, *et al.*, (1975).

## 2.9. Statistical Analyses

The data for feed intake, goat weights, digestibility coefficients and blood parameters were statistically analyzed for each group in complete randomized block design.

Abi- factorial design was used to test the effect of ration and sex as well as their interactions. A comparison t- test was also used to test significant between nutrient composition according to Snecedor and Cochran (1976), by the following relationship: the correlation coefficient was calculated as relation:

$$r = 3\sum (x.y) - \sum (x) \sum (y) / ( 3 \sum (x)^2 - (GX)^2 ) ( 3 \sum (y)^2 - (GX)^2 )$$

## 3. Results and Discussions

### 3.1 Diets Composition

The nutrients composition has shown significant ( $p < 0.01$ ) differences in rations given to each goats' groups where sorghum straw contained 93.1% when fed alone and 94.4% dry matter when fed supplemented. Similarly there were significant differences among the rations in their organic matter contents where sorghum straw alone had 87.5 % compared with 88.2 % DM for the supplemented straw. Crude protein content of the supplemented ration was 19.3 % and was significantly ( $p < 0.01$ ) higher than that of sorghum straw (2.6 %). Crude fiber content of sorghum straw (38.6%) was higher than that of supplemented straw ration (23.4%). Ether extract content of sorghum straw (0.6 %) was significantly ( $p < 0.01$ ) lower than that of the supplemented ration (2.4 %). Nitrogen free extract and ash contents of untreated sorghum straw and the straw supplemented with concentrate ration showed similar differences. Supplementation increased CP, NFE and EE contents of the rations consumed by different groups.

**Table (1) Ingredients and chemical composition (%) of experimental rations on dry matter basis**

Ingredients (%)	Rations	
	Straw	Straw plus supplement
Ground nut hulls	-	71
Ground nut seed cake	-	18
Sorghum grains	-	10
Salt	-	1
Chemical composition of the rations		
Dry Matter DM%	93.1	94.4
Organic Matter OM	87.5	88.2
Crude protein CP	2.6	19.3
Crude Fiber CF	38.6	23.4
Ether Extract EE	0.6	2.4
Nitrogen Free Extract	45.7	43.1
Ash	5.6	6.2
Overall mean SE $\pm$	$\pm$ **0.637	$\pm$ **0.637

\*\* Significant at ( $p < 0.01$ )

**Table (6). Digestibility coefficient by male Desert goat fed experimental diet**

Parameters	Over all mean	SS	CSS	CSS+ SUPPL	± SE
NO of animal	9	3	3	3	
OMD %	61.9	53.3 <sup>ab</sup>	62.2 <sup>a</sup>	66.6 <sup>b</sup>	± **1.75
CP %	62.9	75.2 <sup>a</sup>	46.1 <sup>b</sup>	68.5 <sup>b</sup>	± **1.67
CF %	66.1	66.9 <sup>c</sup>	69.9 <sup>b</sup>	61.8 <sup>a</sup>	± **1.50
EE %	80.1	81.3 <sup>a</sup>	62.1 <sup>a</sup>	69.4 <sup>a</sup>	± **2.31
NFE %	63.6	54.4 <sup>a</sup>	74.3 <sup>a</sup>	85.32 <sup>a</sup>	± **1.59
			64.7 <sup>b</sup>	71.8 <sup>c</sup>	

Means with different superscript on the same row, a,b,c, are Significant at LSD (P<0.01) control (UCSS), (CSS) chopped sorghum straw ,(CSS + supplement) chopped sorghum straw + supplement . \*\*Significant at (p < 0.01)

**Table (7) Digestible nutrient and energy content g/Kg DM in the experimental feed**

Nutrients	SS	CSS	CSS+supp	SE
DCP	148.7	181	279	± ***2.25
DCF	256	243	219	± 12.21 NS
DEE	49	47	129	± ***0.15
DNFE	245	294	307	± **24
DOM	467	546	581	± **11.1
TDN	49.03	57.33	60.9	± **1.12
ME MJ/Kg DM	7.04	8.21	8.77	± **0.25

control UCSS, CSS chopped sorghum straw (CSS + supplement) chopped sorghum straw + supplement . \*\*Significant at LSD (p < 0.01) \*\*\*Significant at LSD ( p < 0.001) ME metabolizable energy

### 3.2 Feed intake and weight of goats as affected by rations and sex

The total, weekly and daily feed intake (kg) increased significantly (p < 0.01) by chopping sorghum straw and by supplementation. Sex also significantly (p < 0.01) affected DMI. Interaction of both treatment and sex was not significant. The DMI for UCSS, CSS and CSS+Supp was 3.19, 3.91 and 4.71% , of the initial body weight of the three groups respectively. The differences were significant (p < 0.01) among the rations and animals feed intake was significantly (p < 0.01) affected by sex. The DMI (g/kg final W<sup>0.75</sup>) showed highly significant (P < 0.001) differences among the rations. Sex also affected feed intake expressed DMI of final W<sup>0.75</sup> significantly (p < 0.01). The increased DMI observed in this study could be attributed to increased digestibility of nutrients upon chopping and / or supplementation of the straw with concentrates. Osafo(1993) reported that chopping could increase DMI of sheep from 18.9g to 21.4g/kg body weight though it decreased intake in cattle from 23g when offered whole straw to 19.2g/kg live body weight. In this bucks had significantly (P<0.01) higher DMI than females. This in line with observations reported by McDonald et al.,(1995) who reported that sex could affect feed intake with males consuming greater

amount of feed than females.

### 3.3 Digestibility coefficients of the diets

There were significant (p < 0.01) differences in the digestibility coefficients of all nutrients resulted from supplementation. The dry matter digestibility increased from 62 and 62.2 when the straw fed alone to 66% upon supplementation. The organic matter digestibility also showed significant (p < 0.01) differences where CSS and UCSS had lower (53.3%) than the CSS with supplementation (68.5%). Similarly the digestibility of the crude protein CP significantly (p < 0.01) increased from 57.2% when the UCSS, CSS fed to goats to 69.9% upon feed CSS+Supp. diet to goats. The ether extract digestibility followed the same trend where significant differences (P < 0.01) were observed between their values for the straw fed alone when compared with the supplemented and CSS. The digestibility of crude fiber (CF) and nitrogen free extract (NFE) also significantly (p < 0.01) increased upon supplementing the straw. Chopping the straw could not improve nutrients' digestibility coefficients and that was attributed to increased rate of passage of digesta through the digestive tract. These findings are in agreement with McDonald et al.,(1995) who observed that physical treatments that reduces length of fibrous material taken by ruminants could increase rate of passage of digesta through the tract hence allowing very short time for the micro organisms to degrade the cellulytic material of the roughage. On the other hand the authors noticed that the improved nutrients digestibility coefficients found in this study is attributed to improvement of rumen ecosystem as a result of provision of nutrients needed by cellulytic bacteria and other fiber digesting micro-organism to increase in population and digest the straw more efficiently.

### 3.4 Total digestible nutrients, energy content and live body weight change of goats

Total digestible nutrient (TDN) value was significantly (p < 0.01) lower in control group compared with values of CSS and CSS with supplementation. The DOM, NFE and ME (Mj/Kg DM) were significantly (P < 0.01) lower in control ration when compared with the other two. Comparison between CSS and CSS with supplementation with control groups revealed no significant difference in DCF. The DCP was significantly (p < 0.001) higher in CSS with supplementation than CSS and control group. DEE showed highly significant (p < 0.001) difference in CSS with supplementation when compared with other two rations. The improved TDN and energy intake of goats on sorghum straw that was supplemented with concentrates could be attributed to the improved nutrients digestibility upon supplementation. The results reported here are in agreement with Preston and Leng (1984) who showed that improvement of low quality could attained though proper supplementation strategy.

**Table (2). Hematological indices of Desert goats as affected by rations and sex**

Factors	NO of animals	TWBCs	PCV	Hb%
Over all mean	18	4192.2	0.26	49.43
Over all SE ±		± 74.5	± 0.002	± 0.848
Rations				
Control	6	4060	0.024	44.52
Chopped SS	6	4055.6	0.25	45.49
CSS+SUPP	6	4493.3	0.27	59.06
SE ± rations		± 129.09NS	± **0.003	± **1.469
Sex				
Male	3	4224.44	0.26	50.21
Female	3	4160	0.25	48.66
SE ± sex		± 14.9NS	± 0.0003NS	± 0.17NS

Interaction				
Control – male	3	4063.3	0.24	45.4
Control-female	3	4055.3	0.25	42.77
CSS – male	3	4040	0.26	46.67
CSS – female	3	4086.7	0.24	43.13
CSS+supp- male	3	4570	0.28	58.55
CSS+supp- female	3	4340	0.27	60.07
SE interaction		± 4655.3NS	± 0.613NS	± 5.29NS

Hb% hemoglobin, PCV packed cell volume, TWBCs total white blood cells.

\*\*Significant at ( $p < 0.01$ ) NS not significant.

All goats that received supplements showed positive total body gain with an average value of 1.98 kg but goats received CSS and that fed UCSS had shown slight body weight loss (-2.34 kg and -2.31 kg, respectively). The differences were significant ( $p < 0.01$ ) among the rations and also affected by sex. This positive live weight gain of goats upon supplementation could be attributed to increased feed intake, higher digestibility coefficients of nutrients and higher energy vale intakes.

### 3-5. Hematological indices of Desert goats as affected by rations and sex

The hematological indices of the experimental animals are shown in Table 3 The hemoglobin Hb% and Packed Cell Volume PCV were highly significantly ( $p < 0.001$ ) affected by the rations but there were no significantly ( $p < 0.05$ ) differences that could be attributed to sex or to the interaction between sex and rations. The value of Hb% was comparatively higher for animals that received the supplement diet (59.06). On the other hand the value of total white blood cells TWBCs were not significantly ( $P < 0.05$ ) affected by the type of ration, sex and interaction between sex and rations. The better hematological indices of Desert goats observed in this study could be attributed to the improved nutritional status of the animals upon supplementation.

It was concluded that feed intake of sorghum straw could be improved by chopping and nutrients digestibility coefficients together with intake could be increased by suitable supplementation leading to improved goats' performance. Nair (2002) found that chemical treatment and supplementation of sorghum straw increased serum albumin and globulin though it decreased glucose in buffalo calves. Suleiman (1999) found that in sheep on low quality roughage blood Hb and PCV was lower when the animals were supplemented with watermelon seeds.

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