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Effects of Chopping on Utilization of Sorghum Stover by Nubian Goats

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Abstract: Effects of chopping sorghum stover (Tabat variety) on Dry Matter Intake (DMI), apparent digestibility and body weight changes in Nubian goats were studied in the Gezira, Sudan. The chemical composition of the stover (%) was 96.78±0.83, 1.43±0.02, 4.65±0.39, 42.98±0.01, 9.99±0.89 and 40.96±1.24 for DM, EE, CP, CF, ash and NFE, respectively. Dry matter intake on different basis was higher for the chopped stover and the effect was significant ($p<0.05$) as g/d (606 for the long and 687 for the short). Chopping decreased losses in BW, but not significantly. It was (kg/week) 0.616 for the long and 0.366 for the short. Chopping increased nutrients apparent digestibilities and the effect was significant ($p<0.05$), except for CF and EE. They were 55.20, 59.11, 18.60 and 41.78 and 67.89 for DM, OM, CP, EE and CF, respectively for the long and 65.87, 68.15, 45.28, 53.90 and 72.47, respectively for the short.

Key words: Sorghum stover, chopping, digestibility, Nubian goats

INTRODUCTION

Animal production is important in the Sudan due to large livestock with 48.910, 42.179 and 39.760, 3.519 millions of sheep, goat, cattle and camels, respectively (MAW, 2005). They are mainly reared in traditional systems by nomads based predominantly on natural pastures (Elhag, 1992). Nutrition is among the main constraints limiting animal production due to seasonal variations in feeds quality and quantity associated with seasonal rainfall.

Crop residues (19 million tons DM or about 22% of animal feeds) (MAW, 2002) are important in filling the nutritional gap. However, their nutritive value is low with limited intakes due to their composition and structure (Sundstol and Owen, 1984).

Different methods are used to improve the nutritive value and Dry Matter Intake (DMI) of straws including physical, chemical and biological methods and their combinations (Sundstol and Owen, 1984). However, they are not adopted in Sudan since they are costy, laborious and hazardous. Chopping is among the effective physical methods used for upgrading straws (Castillo, 1983; Adu and Lakpini, 1983). It increased intake in sheep, but not in cattle (Osafo *et al*., 1997). Several studies indicated that chopping increased apparent digestibility (Allen and Mertens, 1988; Mertens, 1997). In Sudan straws and stover are usually fed to animals in long form. Chopping is not practiced in Sudan due to lack of equipments and farmers are not aware of its advantages. Consequently, this trial was launched to study effects of chopping on sorghum stover DMI, digestibility and body weight changes in Nubian goats.

MATERIALS AND METHODS

Basal diets: Sorghum stover (Tabat variety) from Gezira scheme, Sudan with 16-30 cm particles in length was either not chopped (long) or chopped to 1-2 cm length (short) using a machine (chopper). The proximate analysis for samples was carried-out according to AOAC (1995) and is shown in Table 1.

Animals: Ten female Nubian goats (average body weight of 23.05±3.14 kg) from Gezira villages were brought to the Goat Research Centre premises, treated against ecto (Amitraz) and endo (Albendazole) parasites, ear tagged and housed in individual wire pens (1 m x 1.5 m). Each animal had a roughage trough. They were randomly allotted to two diets, with 5 animals for each treatment.

Feeding: Feeds were offered twice daily at 09.00 and 16.00 h for 28 days with 7 days an adaptation period. Clean water was offered freely to all animals.

Parameters studied

Feed intake: Daily intake was measured for each goat and the offered straws and refusals for each animal were separately weighed. Dry Matter Intake (DMI) was calculated on different bases (g/day, g/kg live weight (LW), g/kg metabolic weight ($W^{0.75}$), % BW (body weight) and % $W^{0.75}$).

Body weight changes: Body weight of each goat was measured weekly before the morning meal throughout the experiment.

Table 1: Chemical analysis of sorghum stover (Tabat variety)

Composition	Percentage
Dry matter	96.78±0.83
Ether extract	1.43±0.02
Crude protein	4.65±0.39
Crude fibre	42.98±0.01
Ash	9.99±0.89
Nitrogen free extract	40.96±1.24

Table 2: Effects of chopping sorghum stover (Tabat variety) on DMI and body weight changes in Nubian goats in the Gezira, Sudan

Treatment	Long	Short	S.E.	C.V. (%)
DMI				
(g/d)	606[a]	687[b]	16.18	4.54
g/kg LW	26.32	30.80	1.47	4.24
g/kg $w^{0.75}$	57.56	66.89	2.68	7.32
% LW	2.63	3.08	-	-
% $W^{0.75}$	5.76	6.69	-	-
BW loss (kg/wk)	0.616	0.366	0.096	19.5

Means with different letters in the same row are significantly ($p<0.05$) different. S.E. = Standard Error of Mean.
C.V. = Coefficient of Variation

Digestibility: Digestibility was conducted using the same animals housed individually. They were divided into two groups of comparable live body weight (23 and 23.8 kg) and allocated randomly to the two treatments. They were fed the long or the short sorghum stover *ad-libitum* in two equal meals. Clean water was freely offered in iron buckets fixed in the corner of the pens. They were allowed two weeks adaptation period followed by 7 days collection.

The offered feeds and the refusals were weighed daily for each animal to determine daily intake. Samples of feeds and refusals were collected for proximate analysis.

The animals were fitted with nylon bags for faecal collection. Daily collected faeces for each animal were weighed and 10% representative samples were taken for DM determination. Samples of the diets, refusals and faeces were used for proximate analysis as described by AOAC (1995).

Data was analyzed by ANOVA for completely Randomized design using the general linear model procedure (SAS, 1997). Mean comparison was carried out by the least significant difference, with an alpha level of 0.05.

RESULTS

DM intake and BW changes: Dry matter intake on all bases was higher for the short stover and was only significantly ($p<0.05$) as g/d (Table 2). Body weight loss was less for the short stover compared to the long, but not significantly ($p>0.05$).

Digestibility: Table 3 shows the effect of chopping on the digestibility of sorghum stover (Tabat variety) by Nubian goats in the Gezira, Sudan.

Chopping sorghum stover increased apparent digestibilities of DM, OM and CP significantly ($p<0.05$) and that of EE and CF non significantly ($p>0.05$) in Nubian goats.

DISCUSSION

Dry Matter Intake (DMI): The increased DMI of sorghum stover by chopping was similar to that found by many workers (Coombe *et al*., 1979; Allen, 2000; Teimouri *et al*., 2004; Kenney *et al*., 1984; Adu and Lakpini, 1983; Osafo *et al*., 1997 and Hadjigeorgiou *et al*., 2003). However, it had no effect on DMI in goats (Hadjigeorgiou *et al*., 2003), sheep (Devendra, 1993) and cattle (Osafo *et al*., 1997). The increased DMI by chopping could be mainly due to faster outflow rates of feed particles through the alimentary tract as found by Van Soest (1982); Elimam (1983) and Lu *et al*. (2005). Furthermore, decreasing the particle size and increasing the outflow rate reduced gutfil and increased feed intake (Allen, 2000).

Body weight changes: The decreased body weight loss by chopping was similar to that reported in lambs fed groundnut haulm by Adu and Lakpini (1983) and in cows (Teimouri *et al*., 2004) where growth was improved. The decreased body weight loss by chopping was due to improved DMI and chemical composition. The results showed that chopping reduced body loss and should be supplemented with concentrates or subjected to other treatments for better response.

Apparent digestibility: The increased apparent digestibility by chopping was similar to that reported by many workers (Adu and Lakpini, 1983; Allen and Mertens; 1988; Mertens, 1997). Tafaj *et al*. (2007) in his review reported that there was a positive linear relationship occurred between forage particle size of total mixed rations and chewing time, ruminating time and the NDF digestibility. However, was different from the findings of (Teimouri *et al*., 2004; Hadjigeorgiou, *et al*., 2003) where chopping reduced digestibilities. Furthermore chopping had no effects on straw digestibility (Devendra, 1993). The increased apparent digestibility in our study was associated with increased DMI and could be due to improved rumen fermentation and digestion due to increased surface area available for microbes and improved chemical composition. Chopping increased surface area and utilization (Van Soest, 1982). The variations in straw digestibility by chopping were great among workers and could attributed to straw species and varieties, chemical composition, particle size, animal species, body weight, feed selection and concentrates used.

The beneficial effects of sorghum stover chopping on chemical composition, digestibility and DMI and body weight loss suggested that chopping is an effective and

Table 3: Effects of chopping on the digestibility (%) of sorghum stover (Tabat variety) by Nubian goats in the Gezira, Sudan

Treatments	DM	OM	CP	EE	CF
Long	55.20[b]	59.11[b]	18.60[b]	41.78	67.89
Short	65.87[a]	68.15[a]	45.28[a]	53.90	72.47
S.E.	2.675	2.236	5.353	5.721	1.296
C.V. (%)	11	8	31	37	5

Means in the same column with different superscripts are significantly ($p<0.05$) different. S.E. = Standard error of means.
C.V. = Coefficient of variation

cheap tool for upgrading straws and should be promoted among small holders.

Conclusion: Chopping increase dry matter intake on different bases and decreased BW losses. It increased apparent digestibilities. The results suggested that chopping is effective, simple and cheap and should be promoted among small holders for upgrading straws.

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