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COMPARATIVE STUDY OF YIELD, INTAKE, CHEMICAL COMPOSITION AND NUTRITIVE VALUES OF GAMA (*Tripsacum dactyloides*) OAT (*Avena sativa*) AND SORGHUM (*Sorghum bicolor*) FORAGES

M. N. Islam[1], M. R. Alam[2], A. K. M. A. Kabir[2], N. G. Das[3] and M. M. Khanduker[3]

Abstract

An experiment was conducted to compare the yield, composition and nutrient digestibility of gama (*Tripsacum dactyloides*), oat (*Avena sativa*) and sorghum (*Sorghum bicolor*) forages. Three fodders were cultivated and a metabolism trial was conducted with 3 indigenous sheep in a 3 × 3 Latin Square Design (LSD) for determination of nutrient digestibility. The fresh yield of gama was higher ($P<0.05$) than that of oat and sorghum. The yield of DM in gama and sorghum was similar and significantly higher ($P<0.01$) than oat. No significant differences ($P>0.05$) were observed in DM, OM, CP, NDF and ADF contents among the gama, oat and sorghum forages. The average DM and OM intake in sheep fed sorghum was higher ($P<0.05$) than that of oat or gama. Sheep fed sorghum or oat showed significantly ($P<0.01$) higher CP intake than gama. Average NDF and ADF intake was higher ($P<0.05$) in sheep fed sorghum followed by oat or gama, respectively. The DM digestibility of different forages was found non-significant ($P>0.05$). The OM digestibility of sorghum was found to be higher ($P<0.05$) compared to oat or gama. Digestibility of CP was significant ($P<0.01$) higher sorghum than oat (37 %) or gama (36 %). Higher NDF and ADF digestibility ($P<0.05$) were found in sorghum and oat, respectively than gama. It was concluded that sorghum (*Sorghum bicolor*) is better than gama (*Tripsacum dactyloides*) and oat (*Avena sativa*) forages.

Key words: Gama, Oat, Sorghum, Digestibility

Introduction

Development of livestock sector is essential for fostering rural economy of the country. The availability of roughage and concentrate are 13.4 and 1.27 million metric tons DM, respectively as against the requirements of 27 and 12.6 million metric tons and the deficit is about 50 and 90 % respectively, (BBS, 1997). In a typical small holder farm, approximately 90 % feed is of poor quality roughages, mostly rice straw and small amount of green grass with little (about 10% of roughage) concentrate are fed to livestock (Tareque and Saadullah, 1988). Cultivation of quality fodder is therefore, may overcome feed deficit. Gama

[1] Upazilla Election Officer, Bangladesh Election Commission, Sher-e-Banglanagar, Dhaka-1207, Bangladesh
[2] Department of Animal Science, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh
[3] Scientific Officer, Bangladesh Livestock research Institute, Savar, Dhaka-1341, Bangladesh

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(*Tripsacum dactyloides*), oat (*Avena sativa*) and sorghum (*Sorghum bicolor*) forages have potential to grow well in tropical country like Bangladesh. Gama is sub-tropical bunch type perennial grass with potential for high biomass production (Waller and Lewis, 1979). Oat is a seasonal fodder potential to grow if cultivated with adequate irrigation and abstraction when necessary. Sorghum is drought and salinity tolerant (House, 1985) and hence it can also be a potential fodder in Bangladesh. Therefore, the present study was undertaken to investigate the yield, intake, nutritional composition and digestibility of gama, oat and sorghum forages.

Materials and Methods

The experiment was carried out in the Goat and Sheep Farm, Department of Animal science, Bangladesh Agricultural University, Mymensingh-2202 during the period from February to July, 2007. A total of 270 sq meter land was prepared and divided in to 9 plots. Three fodder species viz, gama (*Tripsacum dactyloides*), oat (*Avena sativa*) and sorghum (*Sorghum bicolor*) were assigned in to 9 plots in Completely Randomized Design (CRD). Cow dung (2,000 kg/ha) was applied during land preparation. The seeds of fodder species were collected from Central Cattle Breeding and Dairy Farm (CCBDF), Savar, Dhaka and sown by broadcasting method at the rate of 30 kg/ha for each forage. Nitrogen fertilizer in the form of urea was applied 5 weeks after sowing at the rate of 75 kg/ ha. Harvesting of forages was done after 67 days of sowing and harvested grass and weighted individually just after harvesting in order to get fresh yield. Representative samples of forages were collected and frozen until freeze dried for determination of composition.

Three adult indigenous sheep (aged approximately 22 months with an average live weight of 17.00 kg (± 0.65) were selected and kept in individual metabolic crates having facilities for individual feeding, watering and ventilation throughout the experiment. A 3 × 3 Latin Square Design (LSD) was used and 3 sheep and three forages viz, fresh gama (F_1), oat (F_2) and sorghum (F_3) constituted the experimental treatments, respectively. The feeds were offered *ad libitum* for 14 followed by 7 days collection periods.

Forages were harvested daily from the field in the morning, chopped in to 5-6 cm and offered to one of the assigned sheep at 8:30 and 15:30 hours. Feed refused daily by individual sheep was collected and weighted in the morning before next meal. The treatment was repeated three times to different sheep. Fresh water was available all the time. Daily feed intake was estimated after subtracting the feeds refused from the supplied on the previous day. Samples of refused feed were collected, mixed thoroughly, weighted, sub-sampled and immediately frozen until freeze dried. Total feces voided by each sheep in every 24 hours was weighted and recorded at 7:30 AM and 10 % of well mixed feces were collected and packed in to polythene bags and kept until freeze dried.

Representative samples of fresh feed, faeces and refusals were freeze dried for 3 days in a freeze dry system (Free zone® 4.5 liter Benechtop; LAB CONCO, Model 77500) and were

ground at 1.0 mm sieve. These samples were chemically analyzed for the determination of dry matter (DM), organic matter (OM), crude protein (CP) according to the methods of AOAC (2003) and neutral detergent fiber and acid detergent fiber (ADF) following the methods of Faichney and White (1983).

The data were statistically analyzed using MSTAT-C statistical program. The treatment means for each parameter were tested for statistical significance by using Duncan New Multiple Range Test (DNMRT) described by Steel and Torrie (1980).

Results and Discussion

Yield of green forages

Yield of fresh forage, DM and CP of gama, oat and sorghum is shown in Table 1. The fresh yield and CP yield of different forages differed significantly (P<0.05). The yield of DM in oat differed significantly with that of gama and sorghum (P<0.01), but these two forages did not differ significantly (P>0.05). The highest yield of CP was found in sorghum and lowest in oat. Fresh and DM yields provide an assessment of forage production to meet animal carrying capacity per unit of land. The fresh and DM yield of Gama and sorghum found in this experiment was similar to the findings reported by Anderson (1985) and Banerjee (1978). The fresh and DM yield of oat in this study was 51 and 50 % lower than the values reported by Kumar *et al.* (2001). Contrarily, Ranjhan (1977) reported similar results in oat fodder when cultivated during winter season. Variation in soil composition and season may contribute to the above difference in yield. Crude protein (CP) yield of gama and sorghum is in agreement with the observation of Singh *et al.* (2002). The CP yield of oat in this study was found to be 35 % lower than the values reported by Kumar *et al.* (2001).

Table 1. Yield and chemical composition of forages

Parameters		Forages		SEM	Level of Sig.
	Gama	Oat	Sorghum		
Yield (MT/ha)					
Fresh forage	45.06[a]	17.10[c]	38.87[b]	4.22	*
DM	7.45[a]	3.24[b]	7.10[a]	0.68	**
CP	0.70[b]	0.40[c]	0.84[a]	0.65	*
Chemical composition (% on DM)					
DM (% fresh)	0.52	0.55	0.57	0.01	NS
OM	92.16	91.45	93.50	0.60	NS
CP	9.45	12.28	12.10	0.71	NS
NDF	67.68	68.00	65.31	0.68	NS
ADF	37.47	38.86	41.37	0.77	NS

[a,b,c] Means with different superscripts within rows are significantly different either at * = P<0.05 or ** = P<0.01
SEM = Standard error of mean

Chemical composition of forages

The average chemical composition of gama, oat and sorghum is shown in Table 1. The contents of DM and OM were found similar (P>0.05). Similar trend for CP, NDF and ADF (P>0.05) was also observed among the forages. Oat contained 29.94 and 1.48 % higher CP than gama and sorghum, respectively. The NDF content of gama and oat was almost similar an on average 3.87 % higher than sorghum. The ADF content of sorghum was found 9.24 and 6.06 % higher than gama and oat, respectively.

The content of DM and OM in the present experiment was found similar to the findings of Ranjhan (1980) for oat and sorghum but different to the reports of Devendra and Mcleory (1982). The DM and OM contents in gama appeared to be different to the reports of Ensminger and Olentine (1980). The CP content of oat and sorghum was found similar to the values reported by Ranjhan (1980) and CP content of gama similar to the findings of Ritchie *et al.* (2006). Values observed from NDF were similar to the findings of Singh *et al.* (2002) for sorghum and Anderson (1985) for gama. The NDF content of oat was found 29 % higher than the values reported by Ranjhan (1980). Higher NDF content in oat might be due to cultivation in late winter which may have contributed to more structural carbohydrate synthesis and increased cell wall constituents in the whole plants. Though high level of dietary NDF may suppress the forage intake (Van Soest, 1994) the physical treatment (chopping) of the forages may increase intake and digestibility. Values obtained for NDF were similar to those reported by Kumar *et al.* (2001); Ranjhan (1980) for sorghum and Ritchie *et al.* (2006) for gama. The ADF measures the less digestible portion of the fiber and an increase in feed ADF content reflects a decrease in energy value of the forage.

Intake of forages

Intake of forages in sheep (g/kgw$^{0.75}$/d) in stall feeding condition is shown in Table 2 and intake calculated as g/kg live weight (LW) is given in Figure 1. Intake of DM and OM of different forages were statistically significant (P<0.05). Sheep offered oat and sorghum consumed more DM and OM than the sheep offered gama. Similarly, there was a significant difference (P<0.05) in CP intake of different feeding groups and higher CP intake was found in sheep fed oat and sorghum than sheep fed gama. Intake of NDF by sheep differed significantly (P<0.05) among different feeding groups but there was no significant difference between sheep fed gama and oat, and similarly, sheep fed oat and sorghum. Intake of ADF was highly significant (P<0.01) among different feeding groups of which sheep offered sorghum consumed higher ADF than offered gama or oat.

The DM intake of forages in the study was differed with the findings of Anderson (1985) for gama; Vidyarthi and Sharma (2000) for sorghum and Murugan *et al.* (2002) for oat. The values of DM intake in terms of percent live weight of all feeding groups was ranged from 2.20 to 2.67 % (Figure 1) and may be considered close to the theoretical intake of 3 % of live weight needed to meet feed requirements. It is evident from the present study that higher CP intake by sheep fed these 3 forages to meet their requirements of 3.8 g/kgW$^{0.75}$/d for CP recommended by ARC (1980). Intake of NDF was 49.00, 21.89 and 9.64 % higher in

sorghum, oat and gama, respectively than the values reported by Minson (1972). Intake of ADF reported by Minson (1972) for sheep was 21.60 g/kg$W^{0.75}$/d. Intake of ADF in this study was found higher in sheep fed sorghum than that of oat or gama. Higher ADF intake is considered responsible for quick fill of rumen and increase the retention time, thereby decrease the digestibility of forage.

Table 2. Intake of forages by sheep (g/kgW0.75/d)

Parameters		Forages		SEM	Level of Sig.
	Gama	Oat	Sorghum		
DM	41.37	45.37	52.03	1.85	NS
OM	35.67	41.48	48.66	2.10	NS
CP	3.90	5.57	6.28	0.37	NS
NDF	27.75	30.84	37.70	1.24	NS
ADF	15.43	17.62	21.73	1.01	NS

[a,b,c] Means with Different superscripts within rows are significantly different either at P>0.05
SEM = Standard error of mean

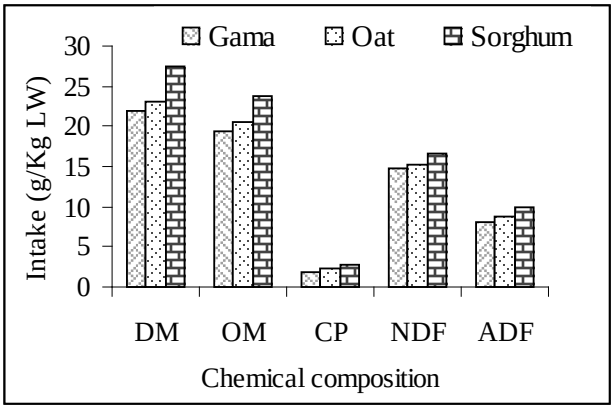

Fig. 1. Daily intake of forages by sheep

Digestibility of nutrients

Apparent digestibility of forage nutrients is presented in Table 3. There was no significant difference (P>0.05) in digestibility of DM among the forages. The OM and CP digestibility of sorghum was found different significantly (P<0.05) compared to gama and oat, but gama and oat did not differ significantly (P>0.05). The NDF digestibility of oat and sorghum did not differ significantly (P>0.05), but both of the forages differ significantly (P<0.05) with gama. Contrarily, the ADF digestibility of gama and sorghum did not differ significantly (P>0.05), but both of the forages differ significantly (P<0.05) with oat.

Digestibility of a feed is the second stage of evaluation of its nutritive value. It determines the digestible part of a feed and assessing the digestible nutrients available for absorption

post ruminally, and for utilization by ruminants. Gupta *et al.* (2000) reported that the DM digestibility for sorghum was 56.28 % and OM digestibility reported by Teka *et al.* (2001) was 60.24 %. Digestibility of DM and OM reported by Horner *et al.* (1985) for sorghum was 52.30 and 53.00 %, respectively. In the present study DM and OM digestibility for sorghum and gama were 57 and 52, and 59 and 52 %, respectively. Vidyarthi and Sharma (2000) reported that DM digestibility of oat was 64.76 % which was 17.74 % higher than the present findings of 55 %. Digestibility of OM reported by previous authors was also higher than this study. This difference might be due to higher fiber content of oat forage. Sue-Chyong *et al.* (1996) also found reduction in utilization of DM with increasing fiber in the diet.

Table 3. Digestibility of nutrients

Digestibility (%)		Forages		SEM	Level of Sig.
	Gama	Oat	Sorghum		
DM	52	55	57	0.01	NS
OM	52^{b}	53^{b}	59^{a}	0.01	*
CP	36^{b}	37^{b}	51^{a}	0.03	*
NDF	52^{b}	57^{a}	60^{a}	0.01	*
ADF	59^{b}	63^{a}	58^{b}	0.01	*

NS = P<0.05, * = P<0.05
^{a,b,c} Means with different superscripts within rows are significantly different either at * P<0.05
SEM = Standard error of mean

Digestibility of CP found in the experiment for sorghum was 51%, which was similar to the values of 50.88% reported by Teka *et al.* (2001). Horner *et al.* (1985) reported that CP digestibility of gama was 50.20% which was 28% higher than the present finding. The CP digestibility of oat was also very low (37%) in the present study compared to 71% reported by Vidyarthi and Sharma (2000). Lower CP digestibility in gama and oat might be due to these forages provided inadequate nitrogen supply to maintain rumen NH_3-N level of 50 mg/L required for optimum microbial activity (Leng and Nolan, 1984). Higher CP digestibility in sorghum than oat despite of their similarity in composition highlighted the fact that the chemical composition does not always reflect the quality of fodder and fiber components in plants and may have contributed to this difference.

Teka *et al.* (2001); Horner *et al.* (1985) and Singh *et al.* (2001) observed that the digestibility of NDF for sorghum, gama and oat was 55.85, 59.10 and 63.69%, respectively compared to 60, 52 and 57%, respectively in the present study. Digestibility of NDF is an important parameter of forage quality as higher the NDF digestibility better the forage intake. Size of the rumen, level of feed intake, chewing efficiency, microbial population and their activity, all are responsible for the digestion of cell wall (Allen and Oba, 2000). The ADF digestibility of gama and oat reported by Horner *et al*. (1985) and Singh *et al.* (2001) was 60.00 and 60.58%, respectively. Teka *et al*. (2001) reported that the ADF digestibility of sorghum was 47.19% compared to 58% of the present study. Higher ADF digestibility of forages reveals

the fact that they have less indigestible fraction which is an indication of the quality of forages. Low indigestible cell wall fraction in forage might have helped in quick rumen turnover and increased digestibility. Among the forages sorghum exhibited slightly lower ADF digestibility which might be due to the fact that it contained more ADF than oat or gama.

Conclusion

On the basis of yield and digestion of nutrients in sheep it may be concluded that sorghum (*Sorghum bicolor*) is better than gama (*Tripsacum dactyloides*) and oat (*Avena sativa*) grass.

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