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Seasonal Variation in Eating Behaviour and Nutritive Value of Mixed Jungle Grass for Goats

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ABSTRACT

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Seasonal variation in biomass yield, herbal and chemical composition, samples of mixed jungle grass were assessed by conducting three digestibility trials during the month of August (monsoon), December (winter) and May (summer). During each period, 4 Sikkim local adult, non-producing does (body weight 19.1±1.8 kg) were stall fed with mixed jungle grass *ad libitum*. After a preliminary feeding period of 22 days a digestibility trial of 5-day collection period was conducted during each of the season mentioned. Biomass yield of the pasture of mid altitude location of Sikkim was maximum during monsoon, followed by winter and summer. DM and CF contents were significantly ($P<0.01$) less and CP content was significantly ($P<0.01$) more in samples collected during monsoon in comparison to those collected during winter and summer. The time spent on rumination during summer month was higher ($P<0.01$) than monsoon Time spent on eating (min) per 100g DM was 42.40, 37.08 and 42.23 in summer, monsoon and winter, respectively. Time spent (min) on ruminating per 100g DM was higher ($P<0.01$) in summer months (124.75) as compared with monsoon (86.63) and winter (108.15). Dry matter intake and digestibility was significantly ($P<0.01$) higher in monsoon than summer and winter. Nutritive value of mixed jungle grass in terms of DCP and TDN content was found to be significantly ($P<0.01$) higher in monsoon season as compared to winter and summer. It was concluded that quality of pasture was superior during monsoon in comparison to winter and summer.

Key words: Mixed jungle grass, Goat, Eating behaviour, Nutritive value.

INTRODUCTION

Sikkim has 123,841 goats (Anonymous, 2007). Most of these goats are raised by poor and landless farmers. They cut and carry vegetations from backyard, farm boundaries, community land and nearby forest land. Such vegetations which comprises of many different kinds of plant species and leaf blades are grossly termed as “mixed jungle grass”. As forest grazing is not desirable to conserve the fragile ecosystem of the state,

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mixed jungle grass play a pivotal role in raising goats under stall-fed condition. Earlier, Balaraman and Gupta (1990) suggested that mixed jungle grass of monsoon season can support maintenance of goats. However, availability and nutritive value of mixed jungle grass is dependent on climatic variables. Seasonal variation in pasture quality has been reported from semi-arid, (Sharma *et al.,* 1998) and arid (Shinde *et al.,* 1998) zone of the country. However, no such information regarding the seasonal variation in nutritive value of mixed jungle grass of Sikkim is available. Hence, the objective of the present experiment was to study the seasonal variation in biomass yield, eating behaviour and nutritive value of mixed jungle grass for Sikkim local goats.

MATERIALS AND METHODS

Experimental site

The experiment was conducted at the Indian Council of Agricultural Research (ICAR) Research Complex for the North Eastern Hill Region, Sikkim Centre, Tadong, situated in the East District of Sikkim State in the Northeast region of India, at an elevation of 1325 m above mean sea level. The general topography of the site is hilly. The climate of the area is sub-tropical humid with distinct seasonal variation. During the monsoon (July to September) the site recorded 1314 mm of rainfall. The average temperature ranged from 18 to 27°C. Similarly during winter (November to February the site recorded 212.4 mm of rainfall, the average temperature ranged from 7.2 to 22.9°C.

Biomass yield, herbal and chemical composition

For estimation of biomass yield 5 plots of 4 m^2 each was randomly selected during each of the periods i.e. summer, monsoon and winter. All the vegetation was removed at ground level and was weighed. Samples of native pastures were collected from ICAR farm Tadong on 5 consecutive days during August, December or May. Three composite samples of 1 kg (fresh basis) each were collected on each occasion and were separated into different constituents.

Experimental protocol

Four Sikkim local adult non-producing goat (avg. BW 19.4 ± 1.08) were used for this experiment. All animals were housed in well ventilated shed with facilities of individual feeding under strict hygienic and uniform management condition. Prior to experiment all goat were dewormed for ecto and endoparasites. Fresh and clean drinking water was made available *ad libitum* two times a day. Three digestibility trial were conducted either during month of August, December or May during each period, four Sikkim local adult non producing goat were stall fed with mixed jungle grass *ad libitum* after a feeding period of 22 days a digestibility trial of 5 days collection was conducted during each of period mentioned.

After the metabolism trial, eating behaviour of goats was measured by recording behavior for 1 minute at 5 minutes interval for 2 consecutive days. Eating pattern of the

animals was measured by weighing the amount of feed left in front of the animals every 4 hours after first offering the feed. Feed refusal and fecal samples were analyzed for DM, CP, ash (AOAC, 1990), and, neutral detergent fibre (NDF), acid detergent fibre (ADF) and acid detergent lignin (ADL) (Van Soest *et al.,* 1991). Data obtained were analyzed statistically following procedure for completely randomized design, and treatment means were separated using students "t" test (Snedecor and Cochran, 1967).

RESULTS AND DISCUSSION

Data pertaining to seasonal variation in biomass yield is presented in Table 1. Biomass yield of mixed jungle grass was significantly ($P<0.01$) higher during monsoon, followed by winter and summer. It seems that biomass yield depends largely on climatic variables like rain fall.

Herbal composition

Mixed jungle grass of Sikkim comprised of various species of grasses, shrubs and weeds. The components of the mixed jungle grass were identified by local names and then correlated to literature for botanical name. It is now known that predominant species during Monsoon are *Persicaria nepalensis* (Ratnavlu, 19.5-22.5%), *Galinsogo perviflora* (Udase, 19-20%), *Atrimisia vulgaris* (Tittepatti, 20-22%), *Ageritum conzoides* (Eelamay 5-7%), *Crystella parasitica* (Unew, 6-7%), *Heydyatis scandens* (Kane, 6-9%), *Setaria palmifolia* (Dhutesaro, 3-5%), *Thysanolaena agrostis* (Amliso, 2-3%) and *Cynodon dactylon* (Doobu, 3-4%). During winter, however the predominant pasture species were, *Eupotarium* sp. (Banmara, 25-30%), *Ageritum conzoides* (Eelamay, 26-30%), *Setaria palmifolia* (Dhutesaro, 4-8%), *Crystella parasitica* (Unew, 5-9%). The composition of summer pasture was similar to that of monsoon, but contained more Ratnavalu and Udase and Less Titepatti. These findings will be helpful in conducting future ecological study. These findings will also help to formulate feeding strategies based on mixed jungle grass, which in turn will help in formulation of development projects for upliftment of poorer section of the society involved in goat rearing.

Seasonal variation in chemical composition

CP content of mixed jungle grass (Table 2) declined from monsoon to winter and summer with concomitant increase in NDF content. Similar change in nutrient composition was also reported in arid pasture (Shinde *et al.,* 1998). The change in nutrient composition could be correlated with stage of maturity. During monsoon most of the pasture components

Table 1. Seasonal variation in yield (t/ha) of mixed jungle grass

Year	Summer	Monsoon	Winter	SEM
2000	5.30^{b}	13.30^{ab}	11.50^{ab}	2.96
2001	7.23^{a}	10.60^{a}	7.85^{b}	1.43
Mean	6.26^{a}	11.26^{b}	9.68^{c}	1.53

^{abc}Values bearing different superscripts in a row differ significantly ($P<0.01$).

were in pre-flowering/full bloom, stage, during which the nutrient concentration is maximum. Seasonal variation in proximate composition of mixed jungle grass (during trial period) was given in Table 3.

Seasonal variation in nutritive value

Data pertaining to seasonal variation in eating behaviour are given in Table 4. Cumulative intake pattern and diurnal variation in eating behaviour of the goats is presented in Fig. 1 and 2, respectively. The maximum consumption of jungle grass was observed within first 4h of offering irrespective of season. Goats consumed 63, 58 and 60% of their total feed consumption during this period. The rate of intake during this period was 1.29, 1.46 and 1.35 g/min, during summer, monsoon and winter, respectively. During the feeding cycle of next 4 h (1-5 PM) goats consumed 18, 20 and 24% of their total DM consumption in summer, monsoon and winter season, respectively. During the rest of the day goats consumed very little of feed irrespective of season. A similar pattern of feeding was observed by Sharma *et al*. (1998) under extensive system of feeding. Even though, it is reported that diurnal feeding behaviour of goat is influenced by environmental variables (Lu, 1988), no such seasonal variation was observed in this

Table 2. Seasonal variations in chemical compositions of mixed jungle grass collected from mid attitude location of Sikkim (N=6, 3 each in a year)

Parameter (%)	Season of collection		
	Summer	Monsoon	Winter
DM	31.27±1.44	12.30±0.36	22.25±0.98
CP	3.97±0.38	9.97±0.25	6.71±0.66
NDF	69.17±1.14	60.54±0.42	66.80±2.07
ADF	47.88±0.85	40.99±0.53	44.49±1.83
Hemicellulose	21.64±0.76	12.81±0.36	22.92±1.33
Cellulose	37.25±0.64	3.95±0.42	33.28±1.11
Lignin	14.55±0.53	10.59±0.025	12.73±0.33

Table 3. Seasonal variation in proximate composition of mixed jungle grass (during trial period)

Parameter (%)	Summer	Monsoon	Winter
DM	27.83	17.63	21.94
% DM Basis			
CP	4.90	9.67	7.64
OM	87.29	89.11	86.68
CF	32.89	26.15	28.57
EE	3.45	2.45	1.81
NFE	48.05	50.84	48.66

Table 4. Seasonal variation in eating behavior of goats fed mixed jungle grass based diets

Parameter	Summer	Monsoon	Winter	SEM
Time spent (min/d)				
Eating	205	222.5	222.5	6.46
Ruminating*	607.5[a]	517.5[b]	570.5[a]	13.11
Total chewing	827.5	740.0	792.5	11.24
Idling	627.5[a]	700.0[b]	647.0[ab]	13.55
Time spent eating (min)				
Per 100 g DM	42.40	37.08	42.23	2.73
Per 100 g NDF	60.76	61.99	63.49	3.84
Time spent ruminating (min)				
Per 100 g DM	124.75[c]	86.33[a]	108.15[b]	6.03
Per 100 g NDF	180.12[a]	144.33[b]	162.63[ab]	3.07

[abc]Values bearing different superscript in a row differ significantly *$P < 0.01$.

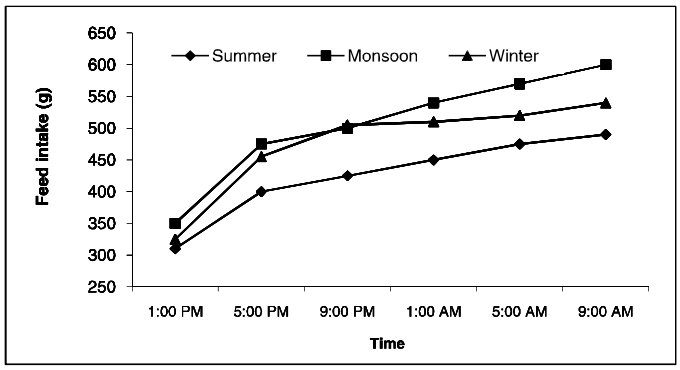

Fig. 1. Seasonal variation in cumulative intake pattern of goats fed mixed jungle grass.

study. This could be due to mild sub-tropical climatic condition of the experimental site, whereas, such seasonal variation in diurnal eating pattern has been observed in places where the climatic variables are extreme (Sharma *et al.,* 1998). Goats spent 42, 36 and 40% of their time ruminating during summer, monsoon and winter, respectively. They spent significantly ($P < 0.05$) more time ruminating during summer, followed by winter and monsoon. This could be due to more NDF content of mixed jungle grass during summer in comparison to winter and monsoon. The efficiency of rumination was increased during monsoon as is evident from the decrease in time required to ruminate 100 g NDF. Increased efficiency of rumination is explicable from the decreased hemicellulose content which facilitated particle size reduction (Chai *et al.,* 1984). Further, it is likely that

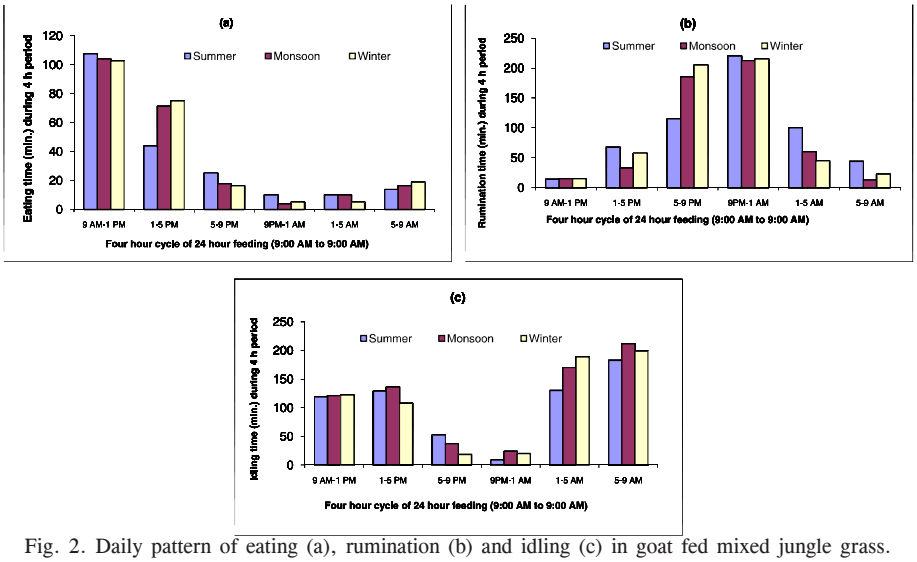

Fig. 2. Daily pattern of eating (a), rumination (b) and idling (c) in goat fed mixed jungle grass.

mixed jungle grass during monsoon provided more digestible fibre which facilitates colonization of fungi, known to assist in particle size reduction (Bouchop, 1979). Average rumination time was 8.6 to 10.1 h. This about the maximum time goats can ruminate (Bell and Lawn, 1957). However, Lu (1988) and Sharma *et al.* (1998) reported that average time a goat can ruminate is upto 7h in extensive condition. In free range conditions goats exhibit opportunistic feeding behavior and only select those feed ingredients which are less in fibre content. Further, in previous studies, rumination time was under estimated because of difficulties in night time observation under range condition. Irrespective of seasons goats exhibited a distinct diurnal pattern of rumination and spent a greater proportion of their time in these activities during night hours. Similar diurnal variation in goats was also observed by Sharma *et al.* (1998).

Inspite of large seasonal variation in nutrient composition and rumination efficiency, DMI of goats was similar during all the seasons (Table 5). Similarly, Sharma *et al.* (1998) found no seasonal difference in feed consumption by goats grazing in semi-arid pasture. Seasonal variation in feed consumption has been reported from places where there is extremely hot climate resulting in reduction of feed consumption during summer (Dulphy *et al.,* 1980). In this experiment goats were stall fed. Further, summer at the experimental site was rather mild. Total DMI was 61, 64 and 59 g/kg $W^{0.75}$ in summer, monsoon and winter, respectively. Intake level of 40-90 g/kg $W^{0.75}$ has been reported to be normal for goats (Cordova *et al.,* 1978).

Digestibility of DM ($P<0.05$), OM ($P<0.01$) and CF ($P<0.01$) was significantly higher during monsoon, followed by winter and summer (Table 6). Similarly, Bhatia *et al.* (1973) reported that nutrient digestibility linearly declined in sheep grazing on *Cenchrus*

Table 5. Seasonal variation in feed consumption and nutrients intake in goats fed solely on mixed jungle grass

Parameter	Summer	Monsoon	Winter	SEM
DM intake				
g/d	495	569	524	27.67
% BW	3.07	3.07	2.88	0.12
g/kg $W^{0.75}$	61.45	64.74	59.27	2.60
DCP intake				
g/d**	11.85[a]	38.73[c]	23.71[b]	1.40
g/kg $W^{0.75}$**	1.48	4.41	2.69	0.17
TDN intake				
g/d**	216.76[a]	332.14[b]	247.08[a]	17.74
g/kg $W^{0.75}$*	26.98[a]	37.84[b]	28.02[a]	2.15
Nutritive value %				
DCP**	2.42[a]	6.81[c]	4.50[b]	0.18
TDN**	43.95[a]	58.41[b]	47.12[a]	2.50
Avg. BW (kg)	16.13	18.13	18.40	0.63

[abc]Values bearing different superscript in a row differ significantly *$P<0.05$, **$P<0.01$.

Table 6. Nutrient utilization and digestibility of nutrients (%)

Parameter	Summer	Monsoon	Winter	SEM
Dry matter*	47.71[a]	59.56[b]	51.82[ab]	0.82
Organic matter**	49.32[a]	64.58[b]	52.77[ab]	1.99
Crude protein**	49.48[a]	70.37[c]	58.93[b]	2.72
Crude fibre*	43.47[a]	53.61[b]	48.02[ab]	1.97
Ether extract	50.27[a]	54.55[b]	61.75[b]	2.02
NFE	53.28	66.89	54.25	4.06

[abc]Values bearing different superscript in a row differ significantly * $P<0.05$; ** $P<0.01$.

cilliaris pasture as the season progressed from monsoon to summer and could be related to maturity and age of the pasture. Higher digestibility of OM and CP was reflected in higher DCP and TDN intake during monsoon in comparison to other seasons. A substantial decline in DCP intake could be contributed to lower CP intake during summer. Feeding solely on mixed jungle grass could not meet the maintenance requirement of DCP and TDN during summer; however, it was able to meet the requirements during winter (Ranjhan, 1998). During monsoon, mixed jungle grass supplied 34% DCP and 11% TDN in surplus of maintenance requirements, which could be utilized for production purposes.

CONCLUSION

It is concluded that biomass yield, chemical composition and nutritive value of mixed jungle grass was superior during monsoon, followed by winter and summer. Feeding solely on mixed jungle grass during summer was inadequate to fulfill DCP and TDN requirements of goats. However, feeding mixed jungle grass during winter and monsoon supplied adequate or surplus DCP and TDN to meet requirements.

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