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Performance of lambs grazing on the sub-alpine pastures of Kashmir Himalayas

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ABSTRACT

The study aimed to evaluate the feed intake and growth performance of the local Kashmir merino lambs grazing on the sub-alpine pastures of the Kashmir valley in 2 seasons (summer and autumn). Kashmir merino male weaner lambs (50), 25 in each season were selected for the experiment. A 10-day digestion trial in each season was conducted by the indirect indicator method with chromium oxide as external indicator. Apparent digestibility of nutrients was higher in summer than in autumn. Feed and nutrient intakes (DMI, DMI/kg, MEI and CPI) were higher in summer than in autumn. Average daily gain was slightly more in summer (41 g/day) than in autumn (30 g/day) and animals suffered serious liveweight loss in the last two fortnights of autumn. Results indicated that sub-alpine pastures of Kashmir valley did not provide sufficient nutrients to sustain healthy sheep production thus necessitating supplementation.

Key words: Feed efficiency, Growth performance, Kashmir valley, Lambs, Nutrient digestibility, Sub-alpine pastures

Pastures across the world play a vital role in the sustenance of livestock production. Half of the world's grazing land is classified as pastures (Haan *et al.* 2002). Kashmir valley is also bestowed with natural temperate pastures (114 thousand ha) at alpine and subalpine altitudes (Forest Report 2017). Sub-alpine pastures are located close to the suburb areas of the valley and are indispensible for the livelihood of the people (Ahmad *et al.* 2018) especially for nomadic people (Gujjar, Bakerwals, Chopans, Changpas and Gaddies) which constitute 25% of the population (Pratap and Wani 2015). According to 19th Livestock Census, livestock population of Kashmir is 73.905 lakh with 42.11% sheep population. Most of the livestock (sheep and goat) in Kashmir are kept under extensive management system and are fed exclusively on range land grasses. The profitability of sheep enterprise depends on the performance of the sheep. The performance of sheep measured in terms of average daily gain from the natural pastures varies from 250 g/day to –42 g/day (Nicole *et al.* 2010, Xu *et al.* 2017). Livestock tend to acclimatize with the locally available plants and try to get maximum nutrition possible (Mir *et al.* 2018). However, many a times, animals may not get the adequate nutrients from the pastures, thus supplementation become inevitable or the production losses become visible (Xu *et al.* 2017). The people of the valley have been using these pastures from hundreds of years for the grazing of the livestock (especially small ruminants); however, hardly any work has been done to measure the performance of the grazing animals in these pastures except one done by Ahmed *et al.* (2015) on alpine pastures. The present study was designed to quantify the performance of growing lambs on the sub-alpine pastures of Kashmir valley so that adequate steps can be taken at the earliest to mitigate any losses in the production.

MATERIALS AND METHODS

The study was conducted on the sub-alpine pastures of the Zaberwan hills (34° 09' N, 74° 55' E) which are associated with the Govt. Sheep Breeding Farm and Dachigam National Park. These pastures are grazed upon by small domestic and wild ruminants like sheep and red deer (Hangul). The pasture is situated at the base of mountain range with an average height of 1760 m above mean sea level. The study was conducted in 2 seasons (summer and autumn). The climate of the area is humid continental with severe and moist winter and short summers. The average temperature during the study period was 25°C and 13°C in summer and autumn respectively.

Kashmiri Merino male weaner lambs (50), 25 in each season, were selected for the experiment. Animals were weighed fortnightly for 60 days in each season. The experimental animals were allowed to graze on their respective pastures for 8 h/day without any feed

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supplementation. Animals were housed in well-ventilated pens at night and subjected to managemental practices approved by the Institutional Animal Ethics Committee. Clean drinking water was provided twice daily. At the middle of the each season, 5 animals were randomly selected for the 10 day digestion experiment.

Digestibility of the pasture grasses grazed by animals was determined by double indicator method with chromic oxide (Cr_2O_3) as an external indicator. The digestibility experiment was conducted for 10 days, during which the animals were dosed with 1 g of chromic oxide (Cr_2O_3) green twice daily in the morning and evening (Sankhyan *et al.* 1999). After collection, the pooled fecal samples were dried at 65±5°C till constant weight was obtained for estimation of chromic oxide content. Small amounts of fecal samples were also preserved in 25% (w/v) H_2SO_4 for estimation of crude protein. Representative grass samples were collected by simulating the grazing patterns of sheep after closely examining for their propensities (Sun and Zhou 2007). The grass samples were pooled to make a composite grass sample.

Representative samples (composite grasses and faecal samples) were dried at 65±5°C for 48 h and ground to pass through a 1-mm screen using Wiley mill for subsequent chemical analyses (AOAC 2005) like ether extract (EE), total ash, Kjeldahl N, neutral detergent fibre (NDF), acid detergent fibre (ADF) and acid detergent lignin. Calcium and phosphorus content of samples were estimated as per Talapatra *et al.* (1940). Chromic oxide was estimated as per the method given by Hill and Anderson (1958).

Dry matter digestibility (%), dry matter intake (g/day/animal), and faeces voided (g/day/animal) by the experimental animals was measured using the following equations (Crampton and Harris 1969).

$$\text{DM digestibility (\%)} = 100 - \left(100 \times \frac{\text{\% indicator in feed}}{\text{\% indicator in faeces}}\right)$$

Pasture consumption (g/day)

$$= \frac{\text{Faeces voided (g)}}{\text{Indigestibility of pasture grasses (\%)}} \times 100$$

Faeces voided (g/day)

$$= \frac{\text{Chromic oxide fed daily (g)}}{\text{Chromic oxide content per g of faeces (\%)}}$$

TDN of composite grasses was calculated from the intake of nutrients and their corresponding digestibility coefficients, which was converted to metabolisable energy (ME) (ICAR 2013). RFQ, a forage quality index, was estimated using the following equation (Moore *et al.* 2007)

$$\text{RFQ} = \frac{\text{DMD (\%)} \times \text{DMI (\% of BW)}}{1.29}$$

An individual animal was used as the experimental unit for all data. Statistical differences of variables between two seasons were evaluated by the comparison of means using independent sample t-test procedure by Statistical Package for the Social Sciences (SAS Studio, SAS University Edition, version 3.6, Basic Edition) and significant differences were assessed based on the P values ($P<0.05$) and the values are presented as value±SE.

RESULTS AND DISCUSSION

Pastures were dominated mostly by browse species. The shrub plants found were *Berberis lyceum, Cotoneaster nummularia, Indigofera heterentha, Parrotiopsis jacquemontiana, Rosa macrophylla, Rosa webbiana* and *Crataegus songarica* and the grass species include *Cynadon dactylon, Lolium perene, Poa* spp*, Poa pretense, Medicago sativa, Lolium perene, Trifolium pretense, Iris* sp*, Orchid Grass,Trifolium repense* and *Trifolium alexandrinum.*

The chemical composition of grasses grazed by sheep in the 2 seasons showed that protein content decreased, while cellulose and lignin content increased with the advancement of season (Table 1).

Dry matter content of the pasture grasses grazed by animals increased from summer to autumn. This might be due to the increase in cell wall and lignin content of plants with maturity (Mayouf and Arbouche 2015). The decline in the CP values was possibly due to the relative increase in fibre values. Dogra *et al.* (1994) and Bayble *et al.* (2007) also reported the decline in crude protein content as the plant matures. Moreover, decrease in the concentration of Rubisco, the most abundant protein in plants, due to reduced expression of its mRNAs with senescence may also be responsible the decrease in the crude protein values with maturity (Suzuki *et al.* 2010). Also, as the plant matures, it loses its ability of photosynthesis, becoming metabolically docile thus reducing the number of proteins required. This phenomenon is more prominent in leaves which start wilting as they mature, losing colour and ability to photosynthesize. Ether extract content in pasture plants increased from summer to autumn. Similar findings were also reported by Garmo (1986) in the study on chemical composition and *in vitro* digestibility of indigenous pasture plants in different plant groups. Lignin

Table 1. Chemical composition of pasture grasses grazed by sheep in different seasons

Chemical composition (% DM)	Summer	Autumn	P-value
Dry matter	24.89±0.23	33.93±0.63	<0.001
Organic matter	92.67±0.77	90.43±0.50	0.07
Crude protein	14.41±0.63	10.23±0.34	0.004
Ether extract	1.86±0.06	0.92±0.02	<0.001
Total ash	7.33±0.77	9.57±0.50	0.07
NDF	68.70±0.60	68.90±1.06	0.88
ADF	42.00±1.05	43.80±0.42	0.18
ADL	8.90±0.45	11.60±0.31	<0.001
Hemicellulose	26.70±1.65	25.10±1.45	0.51
Cellulose	26.90±0.83	33.90±0.53	0.002
D value	645.1±5.35	460.02±2.55	<0.001
RF	224.91±34.69	113.27±4.87	0.013

content of plants increased with the advancement of season in pasture grasses. As plants grow there is a greater need for fibrous tissues to maintain their structure and therefore the main structural carbohydrates and lignin increases. Similar findings were also reported by Mayouf and Arbouche (2015) and Mir and Ahmed (2017). Total ash content of pasture grasses grazed by animals increased from summer to autumn. The quality of pasture grasses determined by D-value and RF of grasses decreased with the advancement of season. Apparent digestibility coefficient of all nutrients decreased from summer to autumn while that of DM, OM, NDF and cellulose decreased significantly with season (Table 2). This might be due to the increase in cell wall and lignin contents on maturity. These results were consistent with the findings of Bovolenta *et al.* (2008) and Mir *et al.* (2018). Dry matter intake decreases during autumn so does the energy and protein intake. The decrease in DMI (%BW) with the advancement of season might be due to increase in maturity, fibre and lignin content and decrease in crude protein content of the feed that directly affects the intake by decreasing the palatability. The decrease in energy and protein intake with the advancement of season could be attributed to lower content of these nutrients in the autumn. Nutritive value of composite grasses decreased from summer to autumn which might be due to the decrease in digestibility of most of the nutrients in autumn. DCP content of plants decreased because of the decrease in the digestibility and crude protein content of plants with the season, as there exists a direct relation between the three. There is decline in nutritive value of feed grazed by animals because of higher fibre and lower CP content in autumn. Hughes *et al.* (2012) while studying the effect of season on chemical composition, metabolizable energy and *in vitro* organic matter digestibility of rotationally grazed tropical pastures also found that season significantly ($P<0.05$) affected the chemical composition of plants selected by animals.

Table 2. Nutrient intake, apparent digestibility (%) and body weight changes of lambs in different seasons

Nutrient intake	Summer	Autumn	
Dry matter intake (DMI)			
DMI (% BW)	4.14±0.40	3.23±0.07	0.038
Total DMI (g/day)	992.48±105.10	674.45±11.99	0.017
DMI (g/kgW$^{0.75}$)	97.70±10.35	69.13±1.32	0.000
Energy (ME) intake			
TDN intake (g/day)	663.12±90.83	328.33±11.22	0.006
ME intake (Mcal/day)	2.37±0.08	1.75±0.03	0.000
Protein intake			
CP intake (g/day)	148.87±15.77	94.42±1.68	0.009
DCP intake (g/day)	77.21±11.84	51.67±3.44	0.055
Apparent digestibility (%)			
Dry matter	63.04±3.43	45.09±1.18	0.001
Organic matter	69.61±2.70	50.87±0.99	0.001
Crude protein	58.17±3.89	54.64±3.18	0.509
Ether extract	61.37±3.58	64.19±0.77	0.465
NDF	59.55±4.40	46.74±1.31	0.024
ADF	46.67±6.04	33.64±1.09	0.067
Hemicellulose	64.14±4.46	57.10±0.92	0.161
Cellulose	68.36±2.93	59.81±0.23	0.024
Body weight (BW) changes during the experiment			
Initial BW (kg)	16.18±0.27	19.99±0.31	–
Final BW (kg)	18.64±0.30	21.8±0.36	–
Total gain (kg)	2.45±0.11	1.81±0.22	–
ADG (g/15 day)	613.64±54.34	451.70±77.31	0.001
ADG (g/day)	40.91±3.63	30.11±5.41	0.001
Feed efficiency	0.044±0.005	0.044±0.002	0.999

Average daily gain was 41 and 30 g/day in summer and autumn respectively, which was quite lower than expected of a successful enterprise. Conversely, Ahmed *et al.* (2015) reported that alpine pastures of Kashmir valley can support ADG of 100–150 g/day. Similarly, Mohammed and Yagoub (2016) found that male Sudanian desert lamb grows at the rate of 120.7 g/day while grazing on the natural pastures for 8 h. However, Piaggio *et al.* (2015) reported that lambs grow only at the rate of 45 ADG while grazing on the natural pastures. These variations among other things reflect the quality of pastures on which animals graze. Total weight gain, fortnight weight gain and per day weight gain were significantly lower in autumn due to decreased energy content of the pastures. However, feed efficiency remained same across the seasons. Fortnight weight changes during last two fortnights in autumn were in negative (Fig. 1). The negative weight gain per day (-42 g/day) was also reported by Xu *et al.* (2017) in Tibetan sheep in cold season.

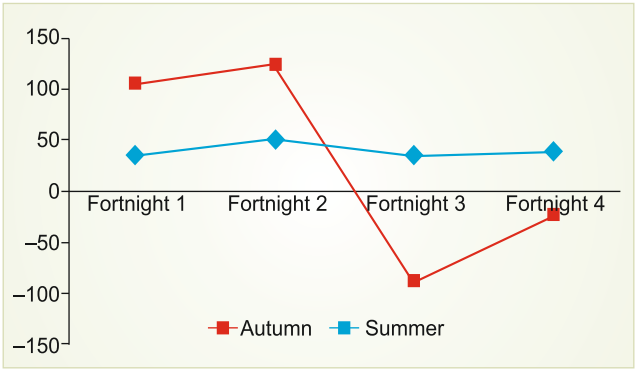

Fig. 1. Fortnight gain/ loss (g/day) in body weight of lambs in different seasons.

It can be concluded that the sub-alpine pasture cannot sustain the maintenance and growth requirements of the lambs hence warrants supplementation especially in the autumn months to prevent losses in the production performance of sheep.

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