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Short Communication

NUTRIENT INTAKE AND DIGESTIBILITY OF VARIOUS WINTER FODDERS FED TO BEETAL GOATS AND LOHI SHEEP

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ABSTRACT

Nutrient intake and digestibility of berseem clover (*Trifolium alexandrium*), lucerne (*Medicago Sativa*) and oats (*Avena sativa*) as winter fodders were fed to female goats (*n* = 45, age = 720 days, body weight = 32 kg) and sheep (*n* = 45, age = 690 days, body weight = 32 kg). Intakes of dry matter (DM), crude protein (CP), neutral detergent fibre (NDF), acid detergent fibre (ADF), and gross energy (GE) were determined over a 30-day period. In addition, total tract apparent digestibility of DM, CP, NDF and ADF were measured for 5 days with 3 animals per treatment. Intakes of NDF and GE were higher ($P<0.05$) with lucerne compared to berseem clover independent of animal species, and oats presented the lowest ($P<0.05$) CP intake compared to other fodders. The highest ($P<0.05$) CP digestibility was obtained with feeding of lucerne, with NDF digestibility comparable among fodders within animal species. With the exception of DM, intakes and digestibilities of nutrients were higher ($P<0.05$) in goats than in sheep.

Key words: Goats, sheep, winter fodders, nutrient intake, digestibility

INTRODUCTION

Small ruminant production has the potential to become an economically viable option for small full-time farmers and the growing number of part time farmers in Pakistan. There are many factors that support this assumption. These include increasing demand, lower cost of production compared with other livestock, and the ability of small ruminants to effectively utilize poor quality forage (Nasrullah *et al*., 2013).

A major misconception throughout the scientific literature is that low productivity of ruminants fed on forages could be attributed to low digestibility of the forages. However, it is now proved that sometimes inefficient utilisation of feeds results from dietary deficiencies of nutrients which are very important for maintenance and growth of rumen microbes which in turn play their role in proper digestion of feeds (Habib, 2009).

Goats and sheep are preferred species in the drier areas (Ben Salem and Smith, 2008) such as Pakistan. In this country, goat and sheep production systems are still traditional, with animals grazing on fodders and forages. The availability and production of fodder species mainly depend on the climate and soil, with quality varying due to seasonal changes (Bruzon, 2007). Fodders can be classified into summer (Kharif) crops, which include cowpeas (*Vigna unguiculata*), guar (*Cyamopsis tetragonoloba*), Jantar (*Coriandrum sativum*), maize (*Zea mays*), millet (*Pennisetum glaucum*), sorghum (*Sorghum bicolor*), and winter (Rabi) crops, consisting mainly of barley (*Hordeum vulgare*), berseem clover (*Trifolium alexandrinum*), lucerne (*Medicago sativa*), mustard (*Brassica spp*.), oats (*Avena sativa*), rye grass (*Lolium perenne*), shaftal (*Trifolium resupinatum*), and vetch (*Vicia* species*)* (Lodhi *et al.*, 2009).

Similar to information on improved technology to increase forage yield (Iqbal *et al.*, 2012), knowledge on the nutritional value of fodders utilised for feeding of goats and sheep in Pakistan is lacking, and therefore this study was conducted to evaluate the nutrient intake and digestibility of the winter fodders berseem clover, lucerne, and oats. A secondary aim was to compare intake and digestibility of these fodders between goats and sheep. Information obtained would indicate if any differences exist among fodders or between animal species, which could be utilised in further studies and applied in practice.

MATERIALS AND METHODS

Experimental animals, design, and feeding: Forty-five goats and 45 sheep were selected from flocks maintained at the University of Veterinary and Animal Sciences, Pattoki, Pakistan. All goats were females from the Beetal breed with an average age of 720 ± 21 days old, and body

weight of 32.2 ± 0.31 kg. Female Lohi sheep, 690 ± 18 days old and body weight of 32.3 ± 0.33 kg, were used. All animals were ear tagged for identification and treated for ecto- and endo-parasites before the start of experiment.

The experiment was conducted as a 3 (fodders) × 2 (animal species) factorial design. Animals of each species were divided in 3 groups, which were further subdivided in 3 replicates of 5 animals each. All replicates were housed in the same open-sided cement-roofed shed, with fresh water available ad libitum. Each pen provided 1.1 m^2 space per animal, and was supplied with a 3 m-long feed trough.

Replicates within each group were fed berseem clover, lucerne, and oats, respectively. Fodder was offered ad libitum at 30% of body weight. These 3 fodders were grown in the Kasur district (longitude 73.85, latitude 31.02, altitude 186 m) in Pakistan during February 2009. Fodders, at the full-bloom growth stage during the time of the experiment, were cut daily with hand clippers and fed to animals as such. Chemical composition of fodders is presented in Table 1. After an adaptation period of 7 days fodders were fed twice daily (8.00h, 16.00h) to animals in each replicate for a period of 30 days. Refusals were measured the next morning throughout the study period of 30 days to calculate feed intake. Sampling of offered fodders and composite refuseals were done at 3-day intervals. These samples were pooled at the end of the experiment for proximate analysis. Intakes were based on the group intake of 5 animals per replicate.

Table 1. Dry matter and chemical composition of winter fodders.

Nutrient	Berseem clover	Lucerne	Oats
Dry matter (%)	17	20	21
Crude protein (%)	17	18	8
Neutral detergent fibre (%)	44	48	48
Acid detergent fibre (%)	40	42	35
Gross energy (MJ/kg)	14.7	15.5	14.2

Digestibility: At the end of feeding trial 1, animal from each replicate was selected randomly and kept in separate pens for determination of apparent digestibility of the respective fodders. Area of individual pens was 1.1 m^2, and each pen contained a feed trough of 0.6 m long. Animals were fed (30% of body weight) the same fodders that they have received during the intake study. Total faecal output was manually collected from the cement floor for 5 days and faeces from each animal were stored in covered buckets. Daily output from each animal was weighed and a 25% sample was dried in a forced oven at 70°C for 24 hours.

Analytical methods: Samples of fodders, refusals and fecal samples were analyzed for dry matter (DM), crude protein (CP), neutral detergent fibre (NDF), acid detergent fibre, and gross energy (GE). Plant samples were oven-dried at 80°C for 24 hours before analyses for chemical components. Dry matter was determined by drying in an oven at 105°C until constant weight. Crude protein (nitrogen × 6.25) was analyzed by the Kjelhdal procedure (AOAC, 2000). Neutral detergent fibre and ADF were determined as described by Van Soest *et al.* (1991) and expressed inclusive of residual ash. Gross energy values were determined with an adiabatic bomb calorimeter (IKA C2000, Janke and Kunkel, Staufen, Germany).

Statistical analysis: The Fit Model Platform of JMP (release 5.0.1.2, SAS Inst. Inc., Cary, NC) was used to analyze data with fodders (berseem clover, lucerne, oats), animal species (goats, sheep), and their interactions as the treatment structure. Difference among treatment means were compared using Tukey HSD post hoc tests, with $P<0.05$ considered as significant.

RESULTS

Intake of CP presented a significant interaction between fodders and animal species (Table 2). Although CP intake from berseem clover and lucerne were similar ($P>0.05$) in goats, lucerne presented a higher ($P<0.05$) intake compared to berseem clover in sheep. In both animal species, CP intake was lowest ($P<0.05$) with oats compared to other fodders. Notwithstanding animal species, intakes of NDF and GE were higher ($P<0.05$) from lucerne compared to berseem clover, whereas ADF intake was lower ($P<0.05$) from oats compared to lucerne. Neutral detergent fibre intake from oats was similar ($P>0.05$) to that from lucerne. Intakes of DM, NDF, ADF and GE were, regardless of fodder species, higher ($P<0.05$) in goats than in sheep.

Table 2. Nutrient intakes (least square means, n = 3 replicates of 5 animals each) in goats and sheep fed different winter fodders.

Nutrient	Goats			Sheep			S.E.	P-values		
	Berseem clover	Lucerne	Oats	Berseem clover	Lucerne	Oats		Fodder	Animal	F × A
Dry matter (g/day)	1529	1566	1527	1207	1413	1454	57.7	0.089	0.002	0.130
Crude protein (g/day)	264[a]	290[a]	126[c]	205[b]	258[a]	120[c]	8.17	<0.001	<0.001	0.024
Neutral detergent fibre (g/day)	666	744	722	504	623	686	28.8	0.003	<0.001	0.124
Acid detergent fibre (g/day)	609	653	524	463	544	497	24.2	0.009	<0.001	0.076
Gross energy (MJ/day)	22.3	24.3	21.5	17.8	21.9	20.7	0.860	0.012	0.003	0.145

S.E. = standard error, F x A = fodder × animal interaction. [a,b,c]Values within a row with different superscripts were different (P<0.05). Indicated where a significant interaction was detected.

A significant interaction showed that digestibility of NDF was comparable (P>0.05) among fodders within each animal species, but higher (P<0.05) with berseem clover in goats compared to sheep (Table 3). Whereas berseem clover presented a higher (P<0.05) digestibility of ADF compared to oats in goats, the opposite (significant lower value) was found in sheep. Crude protein digestibility of fodders, notwithstanding animal species, followed a decreasing (P<0.05) sequence in the order of lucerne > berseem clover > oats. Furthermore, CP digestibility was, independent of fodder, higher (P<0.05) in goats than in sheep. No animal species effects were detected with DM digestibility, however, berseem clover presented a lower (P<0.05) value compared to lucerne and oats.

Table 3. Nutrients % Digestibility in goats and sheep fed different winter fodders.

V	Goats			Sheep			S.E.	P-values		
	Berseem clover	Lucerne	Oats	Berseem clover	Lucerne	Oats		Fodder	Animal	F × A
Dry matter (g/day)	56.3	63.0	61.3	54.6	61.0	64.0	1.66	0.002	0.806	0.331
Crude protein (g/day)	66.6	70.9	51.0	59.8	69.6	46.5	1.73	<0.001	0.011	0.311
Neutral detergent fibre (g/day)	53.5[a]	50.3[ab]	46.1[ab]	43.7[b]	46.9[ab]	48.1[ab]	2.04	0.712	0.045	0.041
Acid detergent fibre (g/day)	55.4[a]	49.2[ab]	43.4[bc]	36.8[c]	42.0[bc]	46.5[ab]	2.02	0.849	<0.001	<0.001

S.E. = standard error, F x A = fodder × animal interaction.
[a,b]Values within a row with different superscripts were different (P<0.05). Indicated where a significant interaction was detected.

DISCUSSION

This study presented evidence that lucerne presented higher intakes of NDF and GE, and DM and CP digestibilities, independent of animal species, and higher CP intake in sheep, compared to berseem clover. Berseem clover is a leguminous fodder grown in winter in Asia as a protein and mineral source (Osti *et al.*, 2006). However, berseem clover has high indigestible oligosaccharide contents, and excessive intake might cause reductions in feed intake and gastric disturbances (Vasilakogloua and Dhima, 2008). Furthermore, more moisture in berseem clover compared to lucerne could have resulted in a faster rate of passage for berseem clover, which would reduce its intake (Pasha *et al.*, 1994).

Lower intakes of CP and ADF in goats and sheep of comparable age and body weight found with oats compared to lucerne in the current study, could be attributed to its low dietary contents. Although small cereals such as oats are grown throughout Pakistan in winter both under irrigated and natural conditions to provide palatable feed to livestock (Iqbal *et al.*, 2009) and provide high yields of DM, they produce forages with CP contents that are too low to fulfil in requirements for satisfactory production levels for most livestock species (Lawes and Jones, 1971).

Except for DM digestibility, intakes and digestibilities of all nutrients were higher in goats compared to sheep. Possible mechanisms responsible for higher voluntary feed intakes found in goats compared to sheep included: (1) differences between species in rumen pool size; (2) rumen fractional outflow rate of digesta; (3) particle size distribution of rumen contents; and (4) threshold of particle size to passage from the rumen (Domingue *et al.*, 1991). Although Van Soest (1994)

mentioned that a smaller gut in proportion to body weight in goats would result in a more rapid movement of digesta along the gastrointestinal tract compared to other ruminants, several authors stated a slower fractional outflow rate of particulate DM from the rumen of goats. This would cause longer exposure of plant cell walls to ruminal microbial attack, and consequently better fibre digestion, especially on high-fibre, low-quality forages (Watson and Norton, 1982; Doyle *et al*., 1984; Domingue *et al*., 1991).

Based on especially CP intake and digestibility, it can be concluded from this study that lucerne is a superior fodder compared to berseem clover and oats in goats and sheep. Despite differences in intakes, digestibilities of fibre components were, in general, comparable among fodders. This study clearly demonstrated that intakes and digestibilities were higher in goats than in sheep.

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