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White clover feeding of sheep for replacement of concentrates

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Livestock rearing is playing an important role in strengthening the economy of people in the rural areas of Himachal Pradesh especially those having small landholdings. About 37% of agricultural families are engaged in sheep rearing and the total population of the sheep in Himachal Pradesh is about 11.0 lakh (The Tribune, 10 December 2008). Sheep productivity to a great extent depends upon feeding adequate quantity of feed and fodder and digestible nutrients in right proportion. Leguminous forages are good source of protein and other nutrients and can replace some part of the concentrate feed (Kumar and Bhatt 1999). A low level of legume forage supplementation (10–20%) of poor quality roughages increased the sheep performance (Reid *et al*. 1990, Bonsi *et al*. 1996). Feeding of legume in different proportions with poor quality roughage such as crop residue and mature tropical grasses improved intake and total digestibility of total diet (Minson and Milford 1967, Bates *et al*. 1988). White clover (*Trifolium repens*) is an important pasture legume found in the grasslands of sub temperate and temperate regions of India including Himahcal Pradesh. It is rich in crude protein (17.01 to 25.22%) has a good nutritional value and is available in lean period (March–June and September–October). Direct replacement of concentrate feed with legumes may result in reduced productivity (Khalili and Varvikko 1992) because leguminous forages do not adequately replace energy in concentrate feeds. Present study was undertaken to evaluate the replacement of the costlier concentrate feed with white clover in wheat straw based diet in sheep.

Growing female sheep (16) weighing from 19.57 to 20.24 kg were divided in to 4 dietary treatments (T_1, T_2, T_3 and T_4) with 4 animals each. The sheep were dewormed with albendazole prior to the start of the experiment and housed in previously disinfected individual cages. The sheep of T_1 was offered wheat straw *ad lib.* and concentrate feed as per requirements (NRC 1985). The animals of T_2, T_3 and T_4 treatments were offered wheat straw *ad lib.* and concentrate feed @ 75, 50, and 0% of that offered to T_1 animals. The rest of the requirements of concentrate feed of the animals were met by white clover feeding. White clover was wilted 24 h before feeding and was offered in 2 equal proportions in the morning and evening hours. The experimental feeding lasts for 90 days including an adaptation period of 15 days.

Clean water was provided to the animals twice daily. The experimental sheep were weighed at fortnightly intervals for 3 consecutive days before feed and water was offered. After 60 days of feeding a digestibility trial was conducted to estimate the dry matter intake and nutrients digestibility. Forage offered and residual feed were recorded to estimate the dry matter intake. The total faeces voided in 24 h by each sheep were collected and were weighed separately. The representative samples of fodder offered, refusal and faeces were dried, ground and analysed for proximate principles (AOAC 1980) and cell wall constituents (Goering and Van Soest 1970). Daily gains in body weight were calculated according to Brody (1945). The data were subjected to statistical analysis as per Snedecor and Cochran (1967).

The crude protein content in wheat straw, white clover and concentrate feed was 2.88, 19.13 and 21.09%, respectively (Table 1). The total ash in the wheat straw, white clover and concentrate feed was 6.23, 6.95 and 6.05%,

Table 1. Chemical composition of experimental diets (% DM basis)

Parameter	White clover	Concentrate feed	Wheat straw
Dry matter	20.14	88.35	89.87
Crude protein	21.09	19.13	2.88
Crude fibre	22.61	10.75	37.74
Ether extract	2.34	5.08	1.16
Total ash	6.05	6.95	6.23
NFE	47.91	58.09	51.99
NDF	44.84	25.35	77.23
ADF	32.74	12.80	54.11
Hemicellulose	12.10	12.55	23.12

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respectively, showing that feed and fodder offered to the animals were sufficient to meet out the mineral requirements. The nutrient content in white clover and wheat straw was almost similar to those values reported by Singh and Narang (1991), while the chemical composition of white clover reported by Chakarborty *et al*. (1991) was different than the values of present study and the variations could be attributed to the site, variety differences and time of cutting (Ivory 1989), nitrogen status and availability of nitrogen fixing bacteria in the soil (Daniel 1992).

The mean DMI was high in treatment animals (Table 2) in comparison to the recommended level (NRC 1985). This indicated that the diets were palatable. The straw intake was lower in T_2 and T_3 animals; it seems that inclusion of white clover decreases the intake of wheat straw due to early attainment of maximum rumen fill (Bonsi *et al*. 1994). The DMI (% body weight and g/kg $W^{0.75}$) was significantly ($P<0.05$) high in T_2 and T_3 than T_1 and T_4 treatment animals and the values were in agreement with Reed (1991). DMI increased significantly ($P<0.05$) only up to 50% level of white clover supplementation. Giovanni (1990) observed that at least 25% more intake in sheep fed herbage containing 25–40% white clover than fed with pure grass. The water intake was significantly ($P< 0.05$) less in T_4 and T_3 treatment animals, which was due to more proportion of green white clover in the diets.

The dry matter digestibility was 52.61±3.26, 56.52±2.21, 55.48±1.68 and 51.78±1.19% in T_1, T_2, T_3 and T_4, respectively. Significantly ($P<0.05$) higher DM digestibility was observed in T_2 and T_3. Similar results were reported by Giovanni (1989). The CP digestibility was significantly ($P<0.05$) higher in T_2 and T_3. Roger *et al*. (1982) also reported higher N *in vivo* digestibility (66%) in sheep fed with 60% of white clover and 40% rye grass. Chambliss and Wofford (2006) reported 70% dry matter digestibility in cattle fed with white clover. Mc Meniman *et al*. (1988) also reported that nutrients digestibility was significantly higher when rice straw was supplemented with legumes at a level of 30%. Crude fibre digestibility decreased significantly ($P<0.05$) when sheep were fed with higher proportion of white clover. Bhatia *et al*. (1979) also reported decrease in crude fibre digestibility due to increase in the legume proportion in the diets of lambs.

Daily gain (g/day) in sheep was higher in T_2 and T_3 as

Table 2. Dry matter and water intake of animals under different treatments

Parameter	T_1	T_2	T_3	T_4
DMI/head/day				
Wheat straw	180.00±0.90	140.00±0.20	135.00±0.10	192.20±0.14
Concentrate feed	447.80±1.00	335.80±0.09	223.90±1.13	–
White clover	–	279.12±0.72	336.00±0.78	365.600±0.36
Total	627.80^{b}±0.19	754.97^{c}±0.33	704.90^{c}±1.12	557.80^{a}±1.28
DMI (kg)/100 kg Body wt.	3.102^{b}±1.18	3.853^{c}±0.92	3.544^{c}±0.71	2.760^{a}±0.36
DMI (g)/kg $W^{0.75}$	65.81^{a}±2.16	80.23^{b}±3.10	75.71^{b}±4.14	58.72^{a}±2.62
Water intake (litre/d)	2.429^{b}±1.36	2.153^{b}±1.78	1.763^{a}±1.78	1.609^{a}±1.10

Means in the same row having unlike superscripts differ significantly.

Table 3. Digestibility co-efficient (%) of nutrients in different treatments

Parameter	T_1	T_2	T_3	T_4
Dry matter	52.61^{b}±3.26	56.52^{c}±2.21	55.48^{c}±1.68	51.78^{a}±1.19
Crude protein	55.11^{a}±2.16	64.32^{c}±1.88	61.18^{b}±2.07	51.82^{a}±2.10
Crude fibre	48.78^{a}±1.60	56.24^{b}±0.40	52.61^{b}±1.03	49.37^{a}±1.14
Ether extract	56.20^{a}±2.05	60.49^{b}±2.11	58.23^{b}±1.09	54.56^{a}±1.78
NFE	51.98^{a}±1.75	57.45^{b}±1.98	55.38^{b}±0.63	49.41^{a}±2.10
NDF	46.93^{a}±1.69	52.41^{b}±1.69	50.71^{b}±2.10	45.40^{a}±0.69
ADF	50.30^{a}±2.10	58.41^{b}±1.39	56.20^{b}±1.08	48.48^{a}±1.19
Hemicellulose	54.36^{b}±2.10	56.22^{c}±1.17	55.14^{c}±2.37	50.41^{a}±1.75
Average daily body weight gain (g/d)				
1st fortnight	52.57±3.01	58.68±5.04	55.46±1.99	46.96±2.13
2nd fortnight	59.14±2.66	76.90±4.33	67.85±3.03	50.13±2.29
3rd fortnight	56.88±4.98	74.10±7.76	74.02±2.81	48.04±1.38
4th fortnight	60.25±2.14	68.78±5.30	60.97±3.49	48.34±1.77
Mean	57.21^{a}±3.50	69.62±6.70	64.58±2.87	48.36±1.94

Means on the same row having unlike superscripts differ significantly ($P<0.05$).

compared to T_1 and T_4 during second and third fortnight (Table 3). The higher gain in T_2 and T_3 might be due to higher CP digestibility. Reed (1979) reported increased carcass weight in sheep fed with 53% of white clover and 47% grass silage as compared to sole feeding of rye grass. Chambliss and Wofford (2006) also reported increase in daily gain in calves fed with white clover.

Our results showed that feeding of white clover legume with wheat straw and concentrate feed improved the nutrient utilization in sheep. It was observed that 25–50% level of white clover feeding was optimum for increased intake, digestibility and growth in sheep.

SUMMARY

An investigation was carried out to access the effect of feeding of white clover (*Trifolium repens*) as a replacement for concentrate feed in sheep. In a feeding experiment 16 growing female sheep were divided equally in to T_1, T_2, T_3 and T_4 groups. The animals of treatment were offered wheat straw *ad lib.* and concentrate feed as per requirements in T_1, while animals of T_2, T_3 and T_4 were offered wheat straw *ad lib.* and concentrate @ 75, 50, and 0% of T_1. Rest of the requirements was met by white clover wilted for 24 h before feeding. The managerial practices were similar in all the groups. Dry matter intake increased significantly only up to 50% level of supplementation. The digestibility of nutrients was higher up to 50% level of white clover feeding and beyond which no further improvement was observed. About 25–50% level of white clover feeding was observed optimum for rumen microbial activity which resulted in increased intake, digestibility and growth in sheep. White clover may replace up to 50% of concentrate feeding without any adverse effect on intake, nutrient digestibility and growth rate.

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