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Performance of growing yak calves on different planes of nutrition

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Only a little investigation has been carried out on nutrient requirement of yaks *(Poephagus grunniens),* the hairy bovine of snow-covered high altitude, due to natural and social constraints. Yak herdsmen usually do not give any supplementary feed except some salt at regular interval. Generally milch and pregnant yaks are fed small amounts of concentrates in the form of wheat flour or maize flour to support optimum milk production and normal foetal development. Information on nutrient requirements of yaks is scanty. Hence, this study was planned for a period of 360 days in growing yaks to determine their nutrient requirement for growth based on NRC, 1989 for dairy cattle and buffaloes.

Four divergent rations were formulated to supply 2 levels 75 and 100% of digestible crude protein (DCP) and 2 levels e.g. 75 and 100% of total digestible nutrients (TDN) requirement for 500 g daily body weight gain as recommended by NRC (1989) for daily cattle and buffaloes. Four rations, viz. low protein-low energy (LP-LE), low protein-high energy (LP-HE), high protein-low energy (HP-LE) and high protein-high energy (HP-HE) were prepared for conducting the animal growth experiment. Yak calves (24: 12 male and 12 female) of about 1 year of age with an average body weight of 90.3±1.19 kg, were randomly divided into 4 groups with 6 animals (3 male and 3 female) in each. All the experimental animals were fed individually under stall feeding for 360 days on the mixed ration which contained concentrate mixture and paddy straw. Green grasses (*Dactylis glomerata)* were offered to all the experimental animals at the rate of 1 kg/animal/day to meet out their vitamin A requirements. At random one dietary treatment was allotted to each group. Three digestion trials were conducted on all the experimental yaks at their different body weights e.g., 100–150, 150–200 and 250–300 kg (during 120, 240 and 360 days of experimental period). Blood samples were collected from all the experimental animals to determine the concentration of blood metabolites before and after feeding trial.

Table 1. Composition of the experimental rations

Attribute	Experimental ration				Paddy straw	*Dactylis glomerata*
	LP-LE	LP-HE	HP-LE	HP-HE		
Physical composition						
Maize grain	19	72	15	52		
Wheat bran	68	-	44	-		
Ground nut cake	9	24	37	44		
Urea	1	1	1	1		
Mineral mixture	2	2	2	2		
Common salt	1	1	1	1		
Chemical composition						
OM	93.3	94.2	95.7	95.3	85.6	90.2
CP	15.2	15.4	20.1	19.8	3.4	13.4
EE	1.3	1.5	1.8	1.9	1.4	3.3
NFE	66.3	70.6	64.6	66.1	50.3	52.4
CF	10.5	6.8	9.3	7.6	30.7	20.9

LP-LE, low protein-low energy**;** LP-HE, low protein-high energy**;** HP-LE, high protein-low energy**;** HP-HE, high protein-high energy.

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Table 2. Feed intake and nutrient digestibility of the experimental yaks on different planes of nutrition

Attribute	Experimental groups				SEm
	LP-LE	LP-HE	HP-LE	HP-HE	
Dry matter intake					
kg/day	4.4[a]	4.6 [a]	4.5 [a]	5.0[b]	0.16
kg/100 kg BW/day	2.5[a]	2.4[ab]	2.3[ab]	2.2[b]	0.04
g/kgW$^{0.75}$/day	79.90	78.38	78.64	82.50	1.31
Nutrient digestibility (%)					
Dry matter	60.2	61.8	60.8	62.7	0.39
Organic matter	62.5	63.8	62.9	65.1	0.41
Crude protein	65.9	66.7	68.6	69.2	0.56
Ether Extract	67.9	69.1	71.0	72.8	0.76
Crude fibre	61.4[b]	57.1[a]	58.7[ab]	55.6[ab]	0.87
Nitrogen free extract	63.7	65.5	64.9	66.4	0.40

*LP-LE, Low protein low energy**;** LP-HE, Low protein high energy; HP-LE, High protein low energy; HP-HE, High protein high energy. **Means bearing different superscripts within the same raw differ significantly.

The samples of feed, faeces and residue left were analyzed for proximate composition according to AOAC (1990). The data were subjected to statistical analysis (2 × 2 factorial designs) as per Snedecor and Cochran (1986).

The physical and chemical compositions of different experimental rations are presented in Table 1. Daily dry matter intake (DMI)/100 kg body weight was significantly higher in (LP-LE) group (2.5 kg) than (HE-HP) fed group (2.2 kg). With higher level of protein and energy along with better utilization animals could meet their requirements with less feed intake which might be the reason for low dry matter intake in HE-HP group. However, daily dry matter intake per unit body weight in male and female yak calves was almost similar and their values are in the same trend as reported by Liu *et al.* (1997). Several factors like age, body weight, sex, nature of feed, climatic condition and management may affect the dry matter (DM) intake in yaks. Moreover, yaks generally consume less DM than the cattle and buffaloes, probably because of their smaller rumen capacity. There is also a correlation between the DM intake (DMI) and body weights in yaks. Han *et al.* (1990a) observed that dry matter intake varied from 1.38 to 2.34 kg/100 kg body weight in 2– to 3–year-old castrated yaks under stall-fed condition, when the animals are maintained on green forages, dry roughages, or on diets based on dry roughages and concentrates. They also observed that values increased at lower temperature both under stall fed and grazing conditions. The faster rate of passage of feed at lower temperature might be the reason for higher intake. However, in grazing yaks, the DMI was 3.01 and 3.38 kg/100 kg body weight, when they were maintained on mature and premature forages, respectively, and this might be due to the restriction of feed offered (Liu *et al.* 1997) under stall feeding conditions. The DMI was 2% of the body weight in adult yaks (average body weight, 212 kg) maintained under grazing at an altitude of 4,242 m above sea level (Basu *et al.* 2005). Yaks graze comfortably at a

Table 3. Growth performances, nutritive values and plane of nutrition of the experimental yaks

Attributes	Experimental groups				SEm
	LP-LE	LP-HE	HP-LE	HP-HE	
Growth performance					
Initial body weight (kg)	90.7	90.3	90.1	90.0	2.76
Final body weight (kg)	209.5	228.1	220.5	238.1	6.32
Total body weight gain (kg)	118.8[a]	137.8[b]	130.4[a]	148.1[b]	4.73
Average daily gain (g)	330.1[a]	383.3[c]	362.5[b]	411.4[d]	13.15
Feed efficiency					
DMI (kg)/kg BW gain	9.9[b]	8.4[a]	8.6[a]	7.9[a]	0.31
CPI (g)/kg gain in BW	931.1[a]	790.3[a]	1074.6[b]	1034.0[b]	34.19
TDNI (kg)/kg gain in BW	5.9[b]	5.1[ab]	5.2[ab]	4.8[a]	0.16
Nutritive value of ration (% DM)					
DCP	6.2[a]	6.3[a]	8.6[b]	9.0[b]	0.52
TDN	57.8[a]	60.3[a]	59.0[b]	60.8[b]	0.49
Plane of nutrition					
CP intake					
g/d	398.0[a]	424.0[a]	581.5[b]	595.1[b]	32.20
g/100 kg BW/d	237.2[a]	240.3[a]	303.6[b]	295.4[b]	11.59
g/kgW$^{0.75}$/d	8.2[a]	8.7[a]	11.2[b]	10.7[b]	0.57
TDN intake					
kg/d	2.5	2.6	2.5	2.7	0.12
kg/100 kg BW/d	1.45	1.45	1.31	1.34	0.02
g/kgW$^{0.75}$/d	52.5	53.2	48.5	47.4	1.08

*LP-LE, Low protein low energy; LP-HE, Low protein high energy; HP-LE, High protein low energy; HP-HE, High protein high energy; DMI, Dry matter intake; CPI, Crude protein intake; TDN, Total digestible nutrients intake; DCP, Digestible crude protein; TDN, Total digestible nutrients.**Means bearing different superscripts within the same raw differ significantly.

temperature as low as –30 to –40^{0}C or even lower. In contrast, at higher temperature, their grazing activity is reduced resulting in lower feed intake. The DMI in yaks also depends on the type of feed resources. Feed blocks with area-specific mineral mixture could supply adequate nutrients to yaks for supporting optimum growth rate during winter (Ghosh and Chatterjee 2011a). They recorded the DMI in growing yaks ranged from 2.17 to 2.70 kg/100kg body weight.

The dry matter (DM) and organic matters (OM) digestibility were similar among experimental groups; the crude fibre (CF) digestibility was higher (P>0.01) in LP-LE group in comparison to HP-HE group.

The experimental rations contained 6.2, 6.3, 8.6 and 9.0% digestible crude protein (DCP) and 57.8, 60.3, 59.0 and 60.8% total digestible nutrients (TDN) on dry matter basis in LP-LE, LP-HE, HP-LE and HP-HE groups, respectively. Average daily gain (ADG) in body weights and feed conversion efficiency (kg dry/kg body weight of the yak in HE-HP followed by HP-LE, LP-HE and LP-LE groups and the values were 330.1 and 9.9, 383.3 and 8.4, 362.5 and 8.6 and 411.4 and 7.9 in the group LP-LE, LP-HE, HP-LE and HP-HE, respectively (Table 2).

The intake of the crude protein (CP) in terms of g/day, g/100kg body weight and per kg metabolic body weight differ significantly among the groups. The values were within the same line as reported by Xue *et al.* (1994) in China. However, the intake of total digestible nutrients (TDN) in terms of g/day, per cent and per kg metabolic body weights were almost similar among all the groups indicating no effect of the experimental diets on energy utilization in growing yaks. Similarity was also observed in both CP and TDN intakes in male and female experimental calves.

Higher blood glucose level in HP-HE group in comparison to other groups; besides non-variability the values for plasma protein, albumin and blood urea nitrogen irrespective of their sexes. The study revealed growing yaks consumed on an average 79.86 g DM, 6.10 g DCP and 47.15 g TDN/kg $W^{0.75}$/day to support an average body weight gain of 371.8 g/day during 250 to 300 kg of their body weight (Table 3).

SUMMARY

Four divergent rations with 2 levels of DCP and TDN (100 and 75%) namely low protein-low energy (LP-LE), low protein-high energy (LP-HE), high protein-low energy (HP-LE) and high protein-high energy (HE-HP) were supplied to 24 growing yaks (12 male and 12 female) randomly divided into 4 groups of 6 animals (3 male and 3 female) each in completely randomized design. The average daily gain and feed efficiency was highest in HE-HP group. The blood glucose level was highest in HP-HE group in comparison to the others; however, plasma protein, albumin and urea levels were almost similar for all the experimental groups. The study revealed that growing yak calves ranging from 250 to 300 kg body weight consumed an average 79.86 g DM, 6.10 g DCP and 47.15 g TDN/kg $W^{0.75}$/day to support an average body weight gain of 371.8 g/day.

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