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Nutritional status and compensatory growth in yak calves maintained on different plane of nutrition

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The yak (*Poephagus grunniens*), the life line of high landlers is a unique bovine species which plays a major role in the economy of the tribal population living in the difficult terrains in the foot hill of Himalayas. Most of the yak rearing areas of the country is facing an acute shortage of both feeds and fodders especially during winter when entire grassland remains covered with snows. In India, the yak keepers practice two-pasture utilization strategies. The summer pasture extends for 190 days (May-October) and the winter pasture extends for about 138 to 150 days (November- April). The rest period is spent on transit from winter pasture to summer pasture. Traditionally they maintain yaks to allow heavy weight gain through feeding *ad lib.* summer forages and utilize the reserved fat for survival in winter when there is scarcity of feed (Ramesha *et al*. 2009). Supplementary feeding is limited except occasional supply of salts. Over-grazing due to competition of different livestock on summer pasture and snowfall during winter has resulted in the deterioration of pasture land. Yaks are taxed heavily in winter due to inadequate fodder resulting 25 to 30% loss of body weight and the milk yields (Baruah *et al*. 2012). Yak herdsmen usually feed these animals with salt at regular interval. The periodic feed shortage results in the weight loss of grazing ruminants and is particularly evident in young animals (Ryan 1990). The accelerated growth after a period of restricted development especially due to reduced feed intake to reach the weight of animals whose growth was never reduced is defined as compensatory growth (Hornick *et al*. 2000) and is very much experienced in cattle and sheep. However, records in these aspects in yak and its hybrids are very much scanty. Hence, the study was conducted for 120 days to observe the effect of different plane of nutrition on nutrient utilization and compensatory growth in growing yak calves.

The study was conducted at Nyukmadung farm of National Research Centre on Yak, West Kameng district of Arunachal Pradesh under Indian Council of Agricultural Research situated at 7500 ft. above msl. Eighteen male calves of about 12-13 months of age and having 154 kg body weight were randomly allocated into three groups, viz. G_1, G_2 and G_3 of six calves each. Calves of G_1 group were fed on paddy straw and concentrate mixture (C_1) based diet for 120 days which supplied 100% of DCP and TDN requirement of dairy cattle for 500 g average daily gain as per NRC (1989) for dairy cattle. Calves of G_2 group were maintained for 60 days on paddy straw and concentrate mixture (C_2) based diet which supplied 75% of digestible crude protein (DCP) and total digestible nutrient (TDN) requirement followed by a ration which supplied 100% of DCP and TDN requirement for 500 g average daily gain as per NRC (1989) for another 60 days (61–120 days experimental period). Calves of G_3 group were maintained for 60 days on paddy straw and concentrate mixture based diet which supplied 75% of DCP and TDN requirement followed by a concentrate mixture (C_3) which supplied 100% of DCP and 110% of TDN requirement for 500 g average daily gain as per NRC (1989) (61–120 days experimental period). Green grasses (*Dactylus glomerata)* were offered to the all the experimental animals at the rate of 1kg/animal/day to meet out their Vitamin A requirements. At random, one dietary treatment was allotted to each group. All the animals were fed individually and fresh drinking water was made available at any time to the experimental animals. At the end of 120 days of the experimental feeding, a digestibility trial of six days duration was carried out for all the experimental animals and the samples of feed, faeces and residue left collected were analyzed for proximate composition according to AOAC (1990). The data were subjected to statistical analysis (CRD design) as per the methods described by Snedecor and Cochran (1986).

The physical and chemical compositions of different experimental rations are presented in Table 1 and the values were as per recommended levels for dairy animals. During initial 60 days of experimental feeding, the average dry matter intake per cent (DMI/100 kg body weight) were 2.2±0.17, 2.4±0.13 and 2.5±0.11 kg in G_1, G_2 and G_3 groups, respectively. The values reported were in the same trend as

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Table 1. Composition of the experimental ration

Ingredient (%)	Experimental diet		
	C_1	C_2	C_3
Physical composition (parts per 100 kg)			
Maize grain	42	06	67
Wheat bran	27	81	-
Mustard oil cake	28	10	30
Mineral mixture	02	02	02
Common salt	01	01	01
Vitamin AD_3	@20g per quintal		
Chemical composition (on % DM basis)			
Organic matter	95.2	92.8	95.7
Crude protein	17.8	13.2	17.4
Ether extract	1.7	1.5	1.8
Crude fiber	7.9	11.6	6.8
NFE	67.8	65.4	69.7

Table 2. Performances of the experimental animals on different plane of nutrition

Particular	G_1	G_2	G_3
Body weight gain, feed intake and FCE			
Initial body weight (kg)	154.4	155.1	154.7
Final body weight (kg) at 60 days	178.6	171.4	170.6
Average daily gain (g) during 1-60 days	403.3	271.7	265.5
DMI (kg/ kg BW gain)	9.1^a	11.6^b	11.7^b
DCPI (kg/ kg BW gain)	0.84	0.82	0.84
TDNI (kg/ kg BW gain)	5.4^a	6.7^b	6.8^b
Body weight (kg) at 120 days	202.5	200.1	202.3
Average daily gain (g) during 61–120 days	398.3^a	478.3^b	528.4^c
DMI (kg /100 kg BW/day)	2.3	2.4	2.4
DMI (g /kg $W^{0.75}$/day)	83.9	89.1	87.1
DMI (kg/ kg BW gain)	9.4^c	8.2^b	7.4^a
Nutritive value of ration & plane of nutrition			
DCP	9.2^b	7.1^a	7.2^a
TDN	59.8	57.7	57.9
Plane of nutrition			
DCP intake			
g/day	358.8^a	291.1^b	288.8^c
g/100 kg body weight/day	214.3^b	176.5^a	175.5^a
g/kg $W^{0.75}$/day	7.7^b	6.3^a	6.2^a
TDN intake			
kg/day	2.3	2.4	2.3
kg/100 kg body weight/day	1.4	1.5	1.4
g/kg $W^{0.75}$/day	50.1	52.2	50.7

Means bearing different superscripts within the same rows differ significantly

reported by Liu *et al*. (1997) and Medhi *et al.* (2016). Studies undertaken by Han *et al*. (1990a) in 2 to 3 year old castrated yaks under stall-fed condition observed a dry matter intake varying from 1.38 to 2.34 kg/100 kg body weight when the animals are maintained on green forages, dry roughages, or on diets based on dry roughages and concentrates. They also recorded the 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 dry matter intake (DMI) was 3.01 and 3.38 kg/100 kg body weight, when they were maintained on mature and premature forages respectively (Liu *et al*. 1997). It has been observed that yaks graze comfortably at a temperature as low as -30°C to –40°C or even lower. In contrast, at higher temperature, their grazing activity is reduced resulting in lower feed intake.

Their digestibility of dry matter (DM), organic matter (OM) and crude protein (CP) were higher in G_1 group; however, the crude fibre (CF) digestibility was reversely higher in G_2 and G_3 groups than that of G_1. The average daily gain and feed conversion efficiency was significantly higher in the calves of G_1 than G_2 and G_3 groups and the values of their average daily gain in G_1, G_2 and G_3 groups were 403.3±9.13, 271.7±8.62 and 265.5±9.17 g, respectively. The higher level of protein and energy with their better utilization could meet their requirements with lesser quantity of feed might be the reason for better growth in G_1. On the other hand, feed restriction with lowering their nutrient quality might be the reason for lower growth in the follower groups. During the second phase of experiment (61-120 days experimental period), the average daily gain in body weight was 398.3±11.53, 478.3±13.47 and 528.4±12.63 g in G_1, G_2 and G_3 group, respectively. The gain in body weight of group G_3 was significantly higher than group G_2 and G_1. Further, gain in body weight of G_2 group significantly was higher than G_1 group. The increased growth rate during re-alimentation of goats which were feed restricted for a longer duration (75 days) were in agreement with other data in cattle and sheep (Ryan *et al*. 1993, Yambayamba *et al*. 1996a). The decrease in live weight gains of native goats of Iran with their proportionate changes of the dissectible fat, internal fat, liver and testis weight, meat dry matter and fat contents; however, the goats could compensate their growth after 75 days of feed restriction without any deleterious effect on carcass composition (Dashtizadeh *et al.* 2008). Feed conversion efficiency was highest in the calves of G_3 group followed by G_2 and G_1 group. The study revealed a compensatory growth phenomenon in growing yaks during the second phase of the experiment in group G_2 and G_3.

The feed efficiency in terms of feed intake per kg body weight gain of the yak calves during the first 60 days of feed restriction in group G_2 and G_3 were 27.47 and 28.57% less in comparison to the control group (G_1) and were increased with a value of 12.77 and 21.28%, respectively by re-alimentation of feed restriction in 60 days with supply of higher plane of nutrition. Dashtizadeh *et al.* (2008) recorded upon re-alimentation of feed restriction in growing kids a 60% improvement in their overall FCR after 75 days restricted goats compared with their control goats. The intake of the crude protein (CP) in terms of g per day, g per 100 kg body weight and per kg metabolic body weight differed significantly among the groups and the values were

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

It was concluded from the study that with an increased intake level of digestible crude protein and total digestible nutrients after a significant loss of body weights due to restriction in their nutrient intakes in growing yaks in spite of their significant reduction in dry matter intakes could compensate the reduction of the body weights and feed efficiency indicating compensatory growth in growing yak calves with better plane of nutrition.

SUMMARY

Growing male yak calves (18) of uniform age (12-13 months of age) and body weights (154.7 kg) were randomly divided in to three groups (G_1, G_2 and G_3) and fed with three different types of paddy straw and concentrate based mixed rations namely C_1 for G_1 with 100% DCP & TDN for a period of 120 days, C_2 for G_2 with 75% of DCP & TDN for a period of 60 days followed by 100% of DCP & TDN for another 60 days (C_1) and C_3 for G_3 with 75% of DCP & TDN for 60 days (C_2) followed by 100% of DCP & 110 % of TDN as per NRC (1989) for dairy cattle for another 60 days (C_3). The average daily gain in body weight of the animals significantly decreased in group G_2 and G_3 though their dry matter intakes were significantly higher in comparison to the group G_1 during the 1st phase of the experiment (1–60 days). However, with increased level of digestible crude protein and total digestible nutrients in next phase (61–120 days) of the experiment, the body weights of the animals under group G_2 and G_3 significantly increased in spite of their significantly lower intakes of dry matter; indicating compensatory growth in growing yaks with better plane of nutrition that loose due to under nutrition.

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