

Original Research Article

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Efficacy of Normal Maize versus Quality Protein Maize on the Performances of Growing Yaks

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ABSTRACT

Ten growing yaks of uniform age (6 to 7 months) and body weights (49.7±0.94kg) were randomly divided into two groups of five animals in each and were fed on mixed rations for a period of 112 days. The normal maize part of the concentrates in Ration-1 (R₁) was completely (w/w) replaced with QPM in Ration-R₂ and offered to group T₁ and T₂, respectively. Standard managerial practices were adopted for all the experimental animals. At the end, a metabolism trial of 6 days duration was carried out in all yaks. The average DMI/100 kg body weight and average daily gain were higher with better feed efficiency in the group T₂ fed diets based on quality protein maize. The nutritive values in terms of Digestible Crude Protein (DCP) and Total Digestible Nutrients (TDN) showed no significant variations between the groups and the values were 5.00±0.47 and 56.54±1.08 and 5.25±0.24 and 57.63±1.14 percent in group T₁ and T₂, respectively. The digestibility as well as the nutrient balances increases with 5% reduction of feed cost of growing yaks in T₂ fed quality protein maize based diets replacing normal maize in T₁. It was concluded that normal maize can easily be replaced with quality protein maize for growing yaks for higher economic returns.

Keywords

Growth performance, Yak, maize, Quality protein maize, digestibility, nitrogen balances

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Introduction

Maize is the second most important crop after rice in the North Eastern Himalayan region (NEHR) of India. In this region maize production plays an important role in the

livelihood of farmers ensuring their food security and grown under foothills and hilly terrains of the state. People used maize both for direct consumption as well as for the second cycle production in livestock. It plays a potential role as a source of human food,

animal and poultry feed and as industrial products. It is a primary source of energy supplement and can contribute up to 30 percent protein, 60 percent energy and 90 percent starch in an animal diet (Dado, 1999). It have been recorded, the local varieties of maize are deficient in its protein content to some extent and its compositions in terms of essential amino acids namely lysine and tryptophan contents (Keretsu *et al.*, 2019). To overcome this problem, the maize breeder had developed quality protein maize (QPM) which contains higher level of lysine and tryptophan with lower content of leucine for maintaining a balance ratio of leucine to isoleucine that's need for enhancement of the biological value of the protein. It is reported that supplementation of QPM improves the growth, feed efficiency and economics of feeding in different types of animals. Yak (*Poephagus grunniens*) inhabits in difficult terrains of the foot hills of Himalayas, plays a major role in the economy of the tribal population of Arunachal Pradesh. Yaks are taxed heavily in winter due to inadequate fodder resulting 25 to 30 per cent loss of body weight and the milk yields (Baruah *et al.*, 2012) and needs supplementation of concentrates with balanced amino acid compositions especially during winter. Hence, the study was planned to assess the nutritional evaluation of quality protein maize in comparison to normal maize in yak calves.

Materials and Methods

The study was conducted at Nyukmadung yak farm under ICAR-NRC on Yak, Dirang, India situated at an altitude of 7500 ft. above msl. Ten numbers of growing male yak calves of uniform age (6 to 7 months) and body weights (49.7 ± 0.94 kg body weights) were randomly divided into two groups of five animals in each. The animals were fed individually with paddy straw as dry roughage with 0.5 kg of green *Dactylus glomerata* as roughage and

concentrate mixture in the ratio of 2:1 for a period of 112 days. The ingredients of composition of the concentrate mixture was normal maize, wheat bran, ground nut cake, mustard oil cake, mineral mixture and common salt in the proportion of 50, 20, 15, 12, 2 and 1 percent, respectively in Ration-R₁ and the proportionate amount of the normal maize was quantitatively (w/w) replaced with QPM in Ration-R₂ and the same was offered to the experimental animal group T₁ and T₂, respectively. All the experimental animals were fed individually under stall feeding for 112 days on mixed rations containing both concentrate mixtures and paddy straw. Green grasses (*Dactylus glomerata*) were offered to all the experimental animals at the rate of 0.5 kg/animal/day to meet out their Vitamin A requirements. At random one dietary treatment was allotted to each group. Standard managemental practices were applied for each animal. Fresh drinking water was made available at any time to the experimental animals during the whole experimental period. The fortnightly body weights and daily feed intake of the animals were recorded for calculation of average daily gain and dry matter intake of the experimental animals.

A metabolism trial was conducted on all experimental yaks at the end of 112 days of the experimental feeding for a period of six days and the samples of feed, faeces and residue left collected were analyzed for proximate composition according to AOAC (2007). Digestible energy (DE) was calculated as 1.0kg Total Digestible Nutrient (TDN) being equal to 4.4 Mcal DE and metabolizable energy (ME) was equal to 0.821 times of DE as per Agnew and Yan (2000). Calcium and phosphorus were estimated by modified methods of Talapatra *et al.*, 1940. The data were subjected to statistical analysis by paired "*t test*" for every measurements using statistical package Minitab, 2003, version 13.20.

Results and Discussion

The chemical compositions of paddy straw, *Dactylus glomerata* and experimental concentrate mixtures with normal maize (R₁) and QPM (R₂) in terms of their dry matter, organic matter, crude protein, crude fibre, ether extract, total ash, nitrogen free extract contents along with their fibre components were presented in Table 1 and it was observed all the findings of the present study were within the range of the reported values of Ghosh and Bandopadhyay, 2008, Baruah *et al.*, 2012 and Medhi *et al.*, 2018.

It also indicated, the compositions of concentrates changes with replacement of the normal maize by QPM although their values were with the reported range of earlier workers for yak feeds (Baruah *et al.*, 2012 and Medhi *et al.*, 2015).

The average daily gain in body weights of the experimental yak calves were slightly higher in group- T₂ (0.270kg±0.01) against the group-T₁ (0.277kg±0.05), though the values showed no significant variations between the groups (Table 2). The higher level of protein with better amino acid compositions probably higher content of lysine and tryptophan in QPM might be the reason for better growth in T₂. Similar observations of better growth in yak calves with increased protein level in yak rations were also observed by Medhi *et al.*, 2018. The findings of the present study were in congruence with the findings of Keretsu *et al.*, 2019, who recorded significant increased in growth rate of growing mithun calves with replacement of normal maize with QPM.

Ladely *et al.*, 1995 also recorded similar findings and reported that ruminants attributed nutritional benefits in terms of weight gain with high lysine corn. During 112 days of experimental feeding, the daily dry matter intake (1.70kg±0.12 and 1.69kg±0.26) and the

per cent average dry matter intake (DMI/100 kg body weight) were 1.95±0.09 and 1.90±0.12kg in T₁ and T₂, respectively and the values showed no significant variations with replacement of normal maize by quality protein maize (Table 2). Likewise, there were no significant variations in feed efficiencies in yak calves between the groups though their feed intake per unit gain decreases with substitution of normal maize (6.03±0.62 in T₁) with quality protein maize (6.31±0.44 in T₂). The findings were well matched with the reports of Beek and Dado, 1998 and Keretsu *et al.*, 2019 who also recorded no significant variations in feed intake and its efficiencies with QPM based concentrate feed with higher lysine contents in ruminants.

The digestibility co-efficient of dry matter as well as different organic nutrients represented in Table 3 and the values for crude protein and nitrogen free extracts digestibility were significantly (P<0.05) higher in T₂ group than T₁ and the results were well matched with the findings of Andrew *et al.*, 1979 and Keretsu *et al.*, 2019. The reason might be due to higher lysine and tryptophan content of quality protein maize in comparison to normal maize Tiwari *et al.*, 2013 also revealed higher digestibility of different organic nutrients with QPM based diets in growing pigs. The better digestibility of the nutrients with higher lysine content in the diets influences the gut of the animals that's affects amino acid contents of excreta was also revealed by Short *et al.*, 1999.

The nutritive values in terms of Digestible Crude Protein (DCP) and Total Digestible Nutrients (TDN) of the experimental rations with normal maize (T₁) and its replacement with incorporation of quality protein maize (T₂) on dry matter basis were presented in Table 3 and the values recorded as 5.00±0.47 and 56.54±1.08 and 5.25±0.24 and 57.63±1.14 percent in group T₁ and T₂, respectively.

Table.1 Proximate composition of different feed components and the experimental rations

Parameters	Normal maize	QPM (Shaktiman)	Paddy straw	Green Fodder (<i>Dactylus glomerata</i>)	Concentrate mixture with NM (R ₁)	Concentrate mixture with QPM (R ₂)
Dry matter	87.66±0.95	89.65±0.89	87.12±2.14	27.8±1.24	87.86±1.47	88.02±1.22
Organic Matter	95.79±1.14	97.42±1.27	84.80±2.12	90.2±3.14	90.30±2.34	90.88±2.05
Crude Protein	8.31±0.04	9.86±0.08	3.20±0.23	13.4±1.04	17.61±0.65	18.18±0.43
Crude Fibre	2.36±0.02	2.52±0.01	32.00±0.34	21.1±1.22	7.10±0.42	6.20±0.33
Ether Extract	3.06±0.03	3.26±0.03	1.00±0.08	3.3±1.03	4.38±0.23	4.35±0.09
Total ash	2.21±0.01	2.08±0.01	15.20±0.12	9.8±0.75	9.70±0.41	9.30±0.24
Nitrogen Free Extract	84.06±1.24	82.28±1.24	48.60±1.24	52.4±2.11	61.22±1.56	59.87±1.07

Means within the same row bearing the same superscript do not differ significantly

Table.2 Effect of replacing normal maize with QPM on growth performances, feed efficiency and economics of feedings on growing yak calves (Mean ± SE)

Particulars	T ₁	T ₂
Performances of the yak calves		
Initial body weight (Kg)	56.8±3.61	56.6±3.93
Final body weight (Kg)	87.0±3.72	87.6±8.42
Experimental period	112 days	
Total weight gain/loss at 112 days (Kg)	30.200±0.96	31.012±5.99
Average daily gain (kg)	0.270±0.01	0.277±0.05
Feed Intake		
Voluntary Intake (kg/day)	1.93±0.14	1.92±0.30
DMI per day (kg)	1.70±0.12	1.69±0.26
DM intake, kg/100kg body weight	1.95±0.09	1.90±0.12
FCR (DMI, kg/kg gain in body weight)	6.31±0.44	6.03±0.62
Economics of feeding		
Cost of feeding per kg gain (Rs.)	173.44	165.87
Relative cost of feeding (%)	105	100

Means within the same row bearing the same superscript do not differ significantly

Table.3 Effect of replacing normal maize with QPM on digestibility and plane of nutrition on growing yak calves (Mean ± SE)

Particulars	T ₁	T ₂
Digestibility co-efficient (%)		
Dry matter	61.23 ^a ±0.72	63.02 ^b ±1.07
Crude protein	62.45 ^a ±1.14	64.11 ^b ±0.72
Ether Extract	64.22±0.24	65.24±0.22
Crude fibre	61.12±0.86	61.98±0.14
Nitrogen free extract	64.35 ^a ±0.42	66.41 ^b ±1.02
N balances (g/day)		
N intake	94.24 ^a ±1.65	98.75 ^b ±1.13
Faecal N voided	19.46±0.57	18.98±0.34
Urinary N voided	17.54±0.43	16.63±0.62
N balances	57.24 ^a ±0.74	64.10 ^b ±1.12
Nutritive values of ration (% DM)		
DCP (%)	5.00±0.47	5.25±0.24
TDN (%)	56.54±1.08	57.63±1.14
Plane of Nutrition		
DCP intake		
g/d	85.00±1.21	87.15±1.47
g/100 kg BW/d	97.50±1.24	99.75±2.01
TDN intake		
g/d	961.18±7.84	956.66±8.07
g/100 kg BW/d	1102.53±11.24	1094.97±12.4
DE intake (Mcal/d)	4.23±0.41	4.21±0.24
DE intake (Mcal/100kg BW/d)	4.85±0.24	4.82±0.17
ME intake (Mcal/d)	3.47±0.61	3.46±0.09
ME intake (Mcal/100kg BW/d)	3.98±0.18	3.96±0.12

Means within the same row bearing the same superscript do not differ significantly

Fig.1 Performances of growing yak calves on normal maize versus QPM based diets

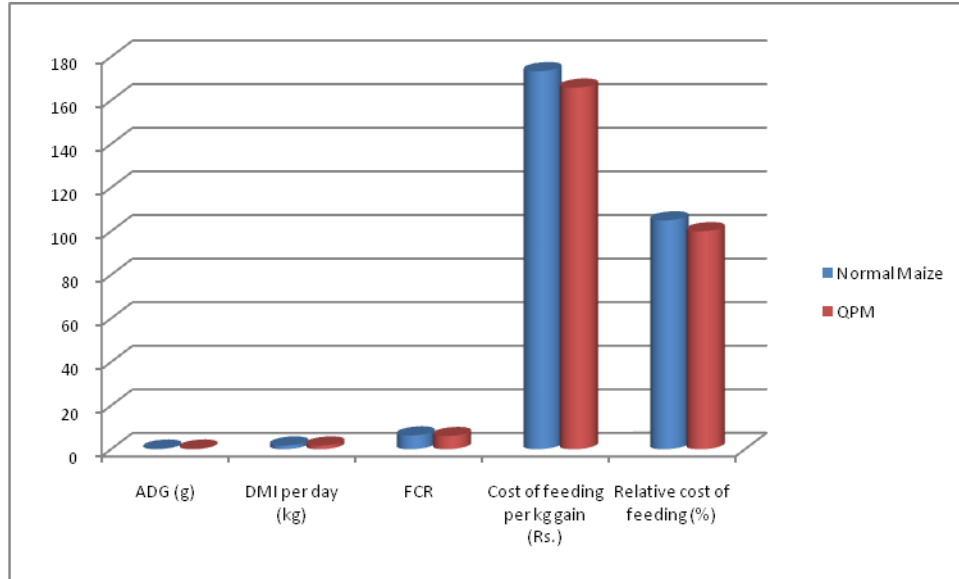
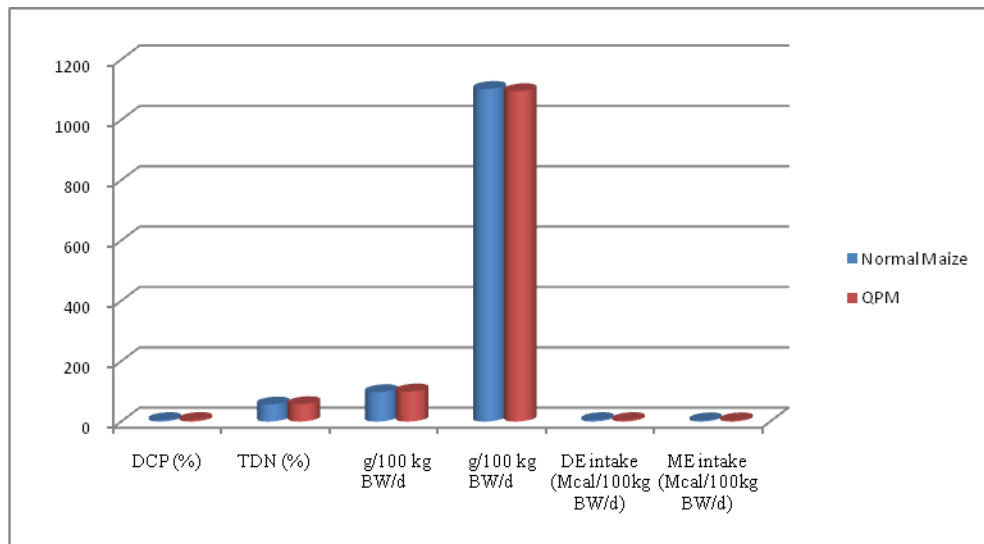


Fig.2 Plane of nutrition of the experimental yak calves on normal maize versus QPM based diets



However, there were no significant variations between the groups for both DCP and TDN values.

The nitrogen balances as well as the energy values in term of Digestible Energy (DE) and Metabolizable Energy (ME) were significantly ($P < 0.05$) higher in T_2 than that of T_1 group (Table 3). Higher digestibility of nutrients through substitution of normal maize with

QPM might be the reason for improved nitrogen and energy balances in T_2 group of yak calves in the study and the findings were in congruence with the findings of Dado (1999), Short *et al.*, 1999 and Keretsu *et al.*, 2019.

The cost of feeding calculated on the basis of feed cost per unit gain in body weights of the experimental calves fed diets containing

quality protein maize replacing normal maize was Rs. 173.44 against Rs. 165.87 and it indicates 5% reduction of feed cost of growing yaks through incorporation of quality protein maize replacing normal maize in the diets of growing yak calves.

The present study revealed complete substitution of quality protein maize in the concentrate mixture have beneficial effects in term of growth rate, digestibility and nutrient balance, feed efficiency, plane of nutrition with superior economic returns in growing yaks without any adverse effect on their health status. It was concluded that normal maize can easily be replace with quality protein maize for growing yaks for higher economic returns.

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Conflict of Interest

All the authors declare no conflicts of interest for publishing the article in “*International Journal of Current Microbiology and Applied Sciences*”

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