

NUTRITIONAL REQUIREMENTS AND STRATEGIC FEEDING MANAGEMENT OF YAK (*Bos grunniens*) AS A VULNERABLE RUMINANT IN INDIA - A REVIEW

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The Yak (*Bos grunniens*) is a long-haired and sturdy bovine, belongs to genus *Bos*, related to cattle and found throughout the Himalayan region, the Tibetan Plateau as well as in Mongolia and Russia. It was probably first domesticated in Tibet and was found at elevations of 4,000–6,000 meters (14,000–20,000 feet), mainly in China but also in Central Asia, Mongolia, and Nepal (Encyclopedia Britannica, 2009). There are approximately 12 million Yaks in China which is about 85% of the world total making China the leader in Yak population. Yaks are herd animals. Wild male Yaks stand about 2 to 2.2 metres (6.6 to 7.2 ft) tall at the shoulder and average 1,000 kg (2,200 lb) and the females weigh about one third of this (Nowak, 1999). Domesticated Yaks are much smaller, males average weighing 350 to 580 kg and females 225 to 255 kg (Bbuchholtz, 1990). Both types have long shaggy hair to protect them from the cold. Colour of Wild Yaks can be brown or black. Yaks have been declared as a vulnerable species, as their population is showing a decreasing trend (Saha and Mazumdar, 2008). In India, Yak are predominantly found in Arunachal Pradesh, Sikkim, Himachal Pradesh, Jammu-Kashmir and northern parts of Uttar Pradesh. There are a number of different phenotypic types among Indian Yak. The "common" Yak resemble medium size hill cattle in conformation, "Bisonian" Yak are bigger animals; "Bare-back" Yak have a long body and little hair on their backs (Pal *et al.*, 1994). In India, there are no distinct Yak breeds, however they have been classified according to their place of origins. Further, when Yak mated with cattle, the male born are always sterile. Therefore, sometimes

Yak also called as "*Poephagus grunniens*". In India, Yak at molecular level have been characterized for leptin gene by Dongre *et al.*, 2009.

Natural feeding behavior of Yaks

Grazing lands for Yak are located on the high altitudes generally within the alpine type of forest which is stony and difficult place for grazing, with only small areas of green forage and the availability of water. The wild Yak fed on sources such as on grasses, herbs, mosses, and lichens, and ice or snow chips as a source of water (Burnie and Wilson, 2001).

The periodic feeding pattern is common to most Yak herders in India includes the traditional migratory feeding system. The alpine pastures (4500 m and above) are grazed for the four months of June to September. The middle hills (3500 - 4500 m) are grazed from the month of March to May as the animals migrate up to the high pastures and again on their return during October and November. The winter (December to the end of February) is then spent on grazing below 3000 m. The herders and families stay in the village during the three winter months, and their Yak graze pastures along with other animals such as cattle, sheep etc. Evaluation of alpine pastures at four sites (4000 - 4300 m) in the summer identified about 25 plant species of which only four were grasses (*Carex* sp, *Cyperus vesiculosa* and *Festuca rubra*) and the rest were herbaceous (Pal *et al.*, 1993).

Feed intake

Feed intake of Yak is less than other cattle, probably because of their smaller rumen capacity. Factors affecting the feed intake include types of feeds, Pattern of feeding, environment, age, weight and sex of the

animal. Dry matter intake (DMI, kg per day) of the growing Yak under indoor feeding can be estimated as $DMI = 0.0165 W + 0.0486$ (W is body weight in kilograms), and

that of the lactating Yak as $DMI = 0.008W^{0.52} + 1.369Y$ ($W^{0.52}$ is metabolic body weight; Y is milk yield, kg per day).

Table 1. Yak population in India

States	District	Number	Total	M: F*
Arunachal Pradesh	West Kamang	1 379	8 480*	1:1.54
	Tawang	6 853		
	West Subansiri	248		
Sikkim	North	4 865	5 346	1:245
	West	441		
	East	40		
Uttar Pradesh	Pithoragarh	102	318	N/A
	Uttarkashi	175		
	Others	41		
Himachal Pradesh	Chamba	2 365	5 690	1:0.82
	Kinaur	1 321		
	Lahul Spiti	1 997		
	Others	7		
Jammu & Kashmir	Kashmir Div	191	31 379	1:1.04
	Laddak Div	25 662		
	Jammu Div	5 526		
Total Yak Population			51 213	

(Pal, 1993a & b).

Types of feeds:

Castrated Yak when fed with different diets, Han *et al.* (1990) found that the dry-matter intake of roughage decreased with the increasing content of concentrates in the diets. Dong *et al.* (2000a) studied the digestion and metabolism of protein and energy in lactating Yak given and found that inclusion of concentrates in the diets decreased the dry matter intake of Yak. Higher intakes of roughages than of concentrates by Yak may be due to more preference for concentrates and a relatively faster passage of high-quality roughage (such as oat hay) leads to reduced mean retention time of digesta (Han *et al.*, 1996) and thus results in higher intake. In these feeding studies Yak were having less feed intake than those of other cattle, possibly because of the smaller rumen capacity of Yak.

Pattern of feeding: DMI of two year old Yak (as a percentage of body weight) varied from 3.7 percent in the late growing period of forages to 3.4 percent in the mature period under grazing conditions, while that of three years old ranged from 3.7 percent to 3.1 percent.

Environment: Temperature affects the feed intake and digestibility in the Yak. Feed intake was higher in growing Yak when fed at lower temperatures indoors or grazing on natural pasture (Han *et al.*, 1990).

Age and body weight: The DMI varies with the age and body weight of the Yak.

Nutritional requirements of Yak

1. Metabolizable energy for maintenance, growth and lactation

The metabolizable energy requirement for maintenance (ME_m) in growing Yak was estimated as 460.2 kJ per kg $W^{0.75}$ per day

(Han and Xie, 1991). The daily metabolizable energy requirement of growing Yak was estimated as: $ME \text{ (MJ/d)} = 0.45W^{0.75} + (8.73 + 0.091 W) DG$, where W is the body weight and DG is daily gain (kg), and the efficiency of utilization of metabolizable energy for growth (kg) in Yak is 0.49 (Dong *et al.*, 2000a). Data on energy requirements for lactation are still scarce, as only preliminary studies on dietary energy digestion and metabolism in lactating Yak have been conducted by a few researchers (Long *et al.*, 1998; Dong *et al.*, 2000b).

2. Protein requirements for maintenance, growth and lactation

Xue (1994) measure the rumen degradable crude protein requirement for maintenance ($RDCP_m$) and obtained a value of $6.09W^{0.52}$ g per day for growing Yak. For growing Yak, the protein requirements include that for maintenance ($RDCP_m$) and for body weight gain ($RDCP_g$). According to Xue *et al.* (1994), the latter can be calculated as follows, $RDCP_g = (1.1548/DG + 0.509/W^{0.52})^{-1}$. Combining the value of $6.09W^{0.52}$ (for $RDCP_m$), the protein requirement of growing Yak can be calculated as $RDCP \text{ (g per day)} = 6.09W^{0.52} + (1.16/DG + 0.05/W^{0.52})^{-1}$, where DG is daily gain (g per day). Only preliminary studies on protein digestion and metabolism in lactating Yak have been conducted by some researchers (Long *et al.*, 1998; Dong *et al.*, 2000b).

Mineral nutrition

Compared with energy and protein nutrition, mineral nutrition in the Yak is not studied thoroughly. Dong *et al.* (2000a) analysed the calcium (Ca) and phosphorus (P) balance and suggested that either or both Ca and P showed negative balance. Yan Ping (2002) suggested that Yak living in the Qinghai Lake area in China were suffering sodium (Na) and copper (Cu) deficiency but not of other minerals.

Strategic feeding management of Yak

During the months of March to September, along with the grazing on natural alpine pasture, common salt can be fed with some amount of mineral mixture for satisfying the mineral needs of animals.

Winter months of November to February leads to downward movement of animals and competition with other livestock leads to scarcity of feeds. In this period, supplementary feeding of Yak can be done by locally available feeds like maize, barley other grains and their byproducts and straws. Hay can be made from grass and other herbage growing around cropping fields and from forest grasses. Suitable pasture development at lower altitudes with selective nutritious feed and fodders is a need of hour.

Advanced Nutritional feed techniques like complete feed blocks can be prepared from locally available feeds and supplied for Yak during scarcity periods. Area specific mineral mixture can also be prepared and required a detailed mineral profiling of soil, plant and animals in the Yak dominated areas (Baruah *et al.*, 2011).

CONCLUSION

Yak are usually found in wild and vulnerable species which has been domesticated for its economic value in different areas of India and other countries. Yak has typical migratory feeding behavior suitable for higher altitude and they graze on grasses, herbs, mosses, and lichens, and crunches ice or snow as a source of water. Although the nutritional requirements of the Yak have not been studied extensively which showed similarity with other ruminants in their dietary needs. Feeding of Yak with locally available feed stuffs and providing mineral mixture are important facets of balance feeding. Suitable pasture development at lower altitudes with selective nutritious feed and fodders is being also needed for better feeding management.

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