INDIGENOUS TRADITIONAL KNOWLEDGE OF YAK REARERS

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PREFACE

Yak rearing is an eco-friendly and economically important traditional technology in high altitude hilly Himalayan ecosystem. It continues to represent the lifeline of highlanders. It fulfills a much wide range of functions and provides a large number of products. Yak thrives under harsh environment and its maintenance is ecologically important.

Indigenous Traditional knowledge (ITK) associated with biological resources is an intangible component of the resource itself. ITK has the potential of being translated into commercial benefits by providing leads for development of useful products and processes. Yak keepers in high altitude have developed knowledge, innovations and practices associated with yaks over the years. Traditional Knowledge is developed over a period of time and retained in oral traditions over generations. Documentation of traditional knowledge is one means of giving recognition to knowledge holders and helps to prevent biopiracy. Documentation of ITK would facilitate tracing of indigenous communities with whom benefits of commercialization of such materials/knowledge has to be shared.

It was a long felt need to document indigenous traditional knowledge of Indian yak keepers. Due to encouragement and support extended by Dr S. Ayyappan, Deputy Director General (AS), ICAR, Dr S. Mauria, Assistant Director General (IPR), ICAR and Dr C.S. Prasad, Assistant Director General (AN &P), ICAR, New Delhi, we are now able to bring out this technical bulletin entitled “Indigenous traditional knowledge of yak rearers”. Our effort would be successful if this bulletin becomes beneficial to all concerned.

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Introduction

Yak (*Poephagus grunniens*, Fig. 1) farming is an eco-friendly economically important traditional technology practiced based on traditional knowledge by tribal's living in high altitude hilly ecosystem. It is part and parcel of social and cultural fabric of tribal yak herdsmen living in difficult hilly terrains of Himalayas in India. The yak belongs to the order Artiodactyla, family Bovidae, sub family Bovinae, genus Bos and subgenus Poephagus. P.R.China is the original home-tract of yak having long history of yak rearing. Bos grunniens means the grunting ox. The yaks are reared under free-range system and are found in alpine and sub-alpine regions usually between 3000 – 4500m above mean sea level (msl) with a cold, semi-humid climate and even at 6000m above msl. The home tract of yaks is characterized by a harsh climate of cool moist summer, severely cold winter having availability of grazing resources restricted by very short growing seasons.

Fig. 1.Yak (*Poephagus grunniens*)

Yak plays a multifarious useful role and indispensable to the highlanders under the prevailing cultural and socio-economic conditions. The range of products and services provided by the yak includes; milk, meat, wool and leather for clothing, blankets, bags, implements, rugs, and tents; bones for carving; as means of transport for trade and agricultural production and nutrient recycling. They also

serve as important asset for socio-economic (financial security) and cultural functions (status, dowry and religious festivals) besides serving as tourist attraction for trekking. They maintain commercial linkage between the nomads in high altitude and sedentary people at lower altitude. Yak plays an important role in the maintenance of agro-biodiversity in most fragile ecosystem through seed dispersion and manuring. Different byproducts from yak milk and meat are used for human own consumption as well as for religious offerings, and for procuring other essential items from the lower altitude habitat through barter system. There is huge demand for white tail as white tail is preferred for making holy chawar (Fig. 2) which is used in temples, gurudwaras (place of worship for Sikhs), and by business community for religious purpose.

Fig. 2. *Chawar*

With traditional knowledge and wisdom acquired from generation to generation; yak keepers developed traditional package and practices for yak husbandry and yak products' technologies, which are organic, and nature friendly. The high altitude yak tracts in India are the hub of various medicinal herbs. These herbs has got therapeutic efficacy and are parent source of medicines not only for humans but also for their yaks. Over the years these tribes developed traditional breeding, feeding, managemental and healthcare technologies for yak rearing which is integral part of the present day traditional yak rearing. In this bulletin an attempt is made to document the indigenous

traditional knowledge of yak keepers. The document is the outcome of survey conducted in the Indian yak breeding tracts in Arunachal Pradesh, Sikkim, Himachal Pradesh and Jammu and Kashmir states with an aim to record the indigenous traditional knowledge of yak keepers. Over the years they have developed their own yak production system including usage of various medicinal herbs for different ailments and sufferings,and process technologies for making various products. The people living in these hilly difficult terrains are devoid of modern communication and medical facilities. Therefore, these nomadic tribes have to rely on the indigenous medicinal resources to overcome common health ailments of them and their livestock.

There is an urgent need for value addition to traditional knowledge for converting it into economically profitable investments or enterprises. There is a need to provide appropriate legal and institutional means for recognizing the rights of tribal communities on their traditional knowledge based on biological resources at the international level (Ramesha *et al*., 2007, 2008a). There is also a need to institute mechanisms for sharing of benefits arising out of the commercial exploitation of biological resources using such traditional knowledge. This can be done by harmonising the different approaches of the Convention on Biological Diversity on the one hand and the Trade Related Intellectual Property Rights (TRIPS) Agreement on the other, as the former recognizes sovereign rights of States over their biological resources and the latter treats intellectual property as a private right.

As regard to protection of knowledge, innovations and practices associated with biological resources, these do not seem to fall within the conventional legal systems of IPR protection (e.g. patents, copyrights, trademark, etc.). These conventional forms of IPRs are inadequate to protect indigenous knowledge essentially because they are based on protection of individual property rights whereas traditional knowledge is by and large collective. Further, the informal knowledge presents other difficulties in being recognized for

the purpose of IP protection. The Traditional Knowledge associated with yak rearing is developed over a period of time and retained in oral traditions over generations. The traditional knowledge is held in parallel. The conditions of novelty and innovative step necessary for grant of patent are therefore not satisfied.

The development of an appropriate form of protection for traditional knowledge of local communities is of great interest to biodiversity rich countries. Traditional knowledge (TK) associated with yaks is an intangible component of the yak genetic resource itself. TK has the potential of being translated into commercial benefits by providing leads for development of useful products and processes. The valuable leads provided by traditional knowledge save time, money and investment of modern biotech industry into any research and product development.

Population

The world population of domestic yak is about 14.2 million of which more than 90 percent (13.3 million) are in P.R.China. As per 17th All India Livestock census 2003, the population of yaks in India was 65000 distributed in Ladakh region of Jammu & Kashmir (47,000), West Kameng and Tawang districts of Arunachal Pradesh (9,000), North, West and East districts of Sikkim (7,000) and Lahul, Spiti and Kinaur districts of Himachal Pradesh (2000). In Jammu & Kashmir during the period 1997 to 2003 the yak and their hybrid population increased from 33000 to 47000, mainly due to increase in hybrids. In Himachal Pradesh yak population reduced from 7000 to 2000 during the period 1997 to 2003.

Socio-economic aspects

In Arunachal Pradesh, Monpa, a mongoloid Buddhist tribe is the only tribe rearing yaks. Buddhist tribes as well as Muslim nomads raise yaks in Ladakh region. It was observed that in Sikkim Aho, Bho and Bhutia tribes (mostly Buddhists) raise yaks while in Himachal Pradesh they are raised by Buddhist tribes in Spiti and Hindu tribes in Kinnur and Chamba districts. The yak rearing among Himalayan

highlanders is a lineage from Mongolia and P.R.China. Rearing of yaks is an integral part of the socio-religious lifestyles of highlanders (Pal et al., 1990). These tribes are culturally and socially so closely connected with yaks that their culture and identity cannot be defined without yaks. The social and cultural importance of yaks to these tribes could be assessed from the fact that yak dance is performed by tribal youths on their community festivals. Two persons enter a case made up of yak skin or black cloth, wear a yak mask and perform dance with vigorous movement (Fig. 3). They use mostly yak products in festivals and rituals. Even lighting of candle for Pooja is done using yak butter only.

Fig.3. Yak dance – a traditional tribal dance

There is an intrinsic link between culture and the way they perceive and manage their land and livestock. Over the years these tribes developed traditional breeding, feeding, managemental and healthcare technologies for yak rearing which is integral part of the present day traditional yak rearing. They consider that number of yaks maintained is the indicator of wealth, and aim to increase the number, which sometimes take precedence over improvement in quality and even overall productivity. Herding of small number of yaks is not economically viable and the owners usually offer yaks to tenant herders called as *'Brokpa'* (Fig.4). Nomadic lifestyle of yak raisers (*Brokpas*) in mountainous terrain is associated with interrelated difficulties. The economics of traditional yak farming has been attractive for long because of the hard work and dedication of *Brokpas.* Economically yak keepers are poor but self sustaining due to their limited needs.

Fig. 4. *Brokpa* with his yak

Traditional management practices

Yaks are reared under free-range system in the high hills where the air, water, and pasture are free from any pollution, and their produce (milk, meat, hair) are organic and just natural. They are well adapted to harsh environment of highland with thick coat of hair possessing outer coarse and inner dense fine hair, better lung capacity and ability to climb over rough terrains (Ramesha *et al*., 2006). The traditional yak management practices are based on traditional knowledge and many of which have scientific basis. They are efficient feed converters and are efficient as well as economic user of feed during nutritional deficiency, which it experiences during winter. In India, yaks are reared under semi migratory (transhumance) free-range system. Yak keepers move their animals in a predetermined known route which is determined by the locals based on traditional knowledge. This is a special zero input production system characterized with extensive management, lower efficiency and longer production cycle. Due to interrelated constraints of high altitude yak rearing is a low efficiency low input - output system. However, for highlanders in remote terrain, yak is the only source of sustainable livelihood due to non-availability of arable land for major agriculture. Anatomical features of yaks viz., spacious thorax with large heart and lungs, and ability to survive on lesser oxygen has enabled this large beast to subsist and even produce at high altitude mountains, where other bovines cannot sustain. They utilize small blades of grasses on

high altitude pastures and also travel long distances in snow bound areas.

Seasonal migration and grazing pattern

The seasonal migration and grazing pattern is based on yak keepers' traditional knowledge which takes into account thermo neutral zone for yaks and gives time for growth of grass. Traditional yak husbandry system involves migration in search of better pasture. In India and other neighbouring countries like Nepal and Bhutan, the farmers practice two-pasture utilization strategy. During summer, yaks are taken to high altitude alpine pasture (4,500 m and above). In winter, they return to pockets nearer to their villages located at mid altitude (3000m above msl). Grazing in summer pasture is from May to September while in December to February, winter pastures are utilized; the rest of the period is spent on transit from winter pasture to summer pasture.

Year round activities of herders

Based on the climatic condition and availability of fodders, the year round activities of yak herders differ from region to region on the basis of climate, topography, farmer's expertise etc. During spring (March – April) yak herds are moved from winter pasture to summer pasture. During this period yaks start calving, milking of animals initiated. Their body condition improves due to availability of grass on the transit route.

During summer (May – September) yaks stay in alpine pasture, maximum calving in the first half of the season, milk yield reaches the peak. Yak keepers prepare milk products like *churpi* (Fig. 5) and butter (Fig. 6) in a traditional way. They also comb down fibers and prepare hair products. Yaks gain body weight and breeding occurs in the later half of the season.

During autumn (October – November) yaks are moved from summer pasture to winter grazing ground. Productivity of animals increases due to availability of grasses, which remained ungrazed during summer. There are chances of picking up infections due to

mixing with other animals. During winter (December – February), yaks graze near the farmers land, however maximum areas covered with snow; grazing area infested with weeds. During winter yak keepers stop milking and calves are allowed to suckle the dam. Young calves and few pregnant animals are given locally available maize floor as feed supplement. Shelters in the form of small enclosures is provided to animals (especially calves and pregnant, Fig. 7).

Fig. 5. *Churpi* preparation in indigenous cylindrical churner made of wood and bamboo strips-a traditional knowledge

Fig.6. Yak butter preparation

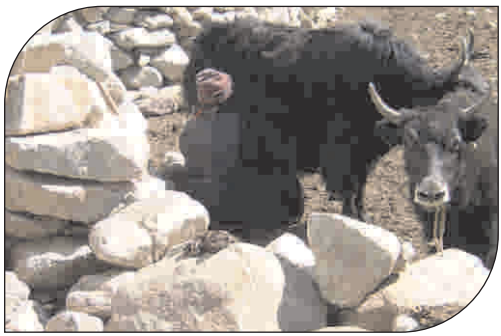

Fig. 7.Shelters in the form of enclosures

General management

Care of calves & milking practices

Generally yak females are not milked for first one month after calving. During this time, calf takes all the available milk. Weaning of calves is not practiced in the field condition. Usually, during daytime, calves graze along with the dam and continue to suckle, in night, they are separated from dam and dams are milked (Fig. 8) in the early morning. At about 12 months of age, dam and calves are separated into different herds. The yaks are brought to the area earmarked for milking in summer camps. Milking stalls are constructed with locally available materials. Milking is done by stripping as the teats are small (2 – 4 cm) and funnel shaped. A little amount of butter is used to lubricate the teats before milking.

Fig.8. Milking of yak by striping

Shearing

Yaks produce two types of fibre: coarse outer hair (Fig. 9) and a fine down fibre, which grows prior to the onset of winter as additional protection for the yak against cold. The down fibre of yak is like pashmina or mohair of goats. Shearing is done mostly once in a year in May or June. By combing out the down first with a wire comb and shearing few days later gives better yield and quality. The fibres are utilized by herders themselves for making tents, ropes, caps etc in a traditional way.

Fig. 9. Coarse outer hair

Castration

Castration of unselected bulls is a traditional practice to avoid breeding by inferior bulls. Yaks are usually reared in small and isolated packets. Castration is a common practice in some yak pockets in India as an effective way to cull the yak bulls not selected for breeding. Castration is usually done on a clear morning in early summer or late autumn, when the risk of infection to an open wound is less. An incision is made on lower part of the scrotum; testicles are pushed out of the scrotum and totally removed.

Traditional feeding management

In India, the yak keepers practice two-pasture utilization strategy. The summer pasture extends for about 190 days (May - October) and the winter pasture extends for about 138 to 150 days (November - April). The rest of the period is spent on transit from winter pasture to summer pasture. The traditional way of maintaining the animals is to allow them to put on weight as much as possible in summer and utilize the fat as an energy reserve for survival in winter months, when there is scarcity of feed. The availability of the fodder, its growth stage and nutritive value largely influences the production performance of yaks, as the supply of supplementary feeding is limited.

Locally available alternative feed resources like tree fodder, agricultural by products, coarse roughages are utilized for feeding of yaks during peak winter. In India, alpine pastures are true grasslands, and cover 3.6 million hectares. High altitude pastures have a variety of low growing grasses, sedges, forbs and bushes that are utilized by yaks and other domestic animals. In Northern Himalayas, yaks have the opportunity to graze fresh and tender shoots of plants like Kobresia sp. and Cyperus Sp. In Sikkim, and Arunachal Pradesh, these start growing above 4000 m whereas, in Ladakh, Kinnaur, Spiti and Chamba, they are at higher altitude. In Sikkim, between 3000 and 4800 m in the alpine and subalpine vegetation, the generas found are Deyeuxia, Deschampsia, Poa, Hierochoe, Stipa, Agrostis, Calamagroostis, Helictotrichon, Glyceria and Festuca (Chatterji *et al*., 2003). No leguminous plants except Astragalus sikkimensis were recorded. Different forages available in alpine region of North-Eastern hills were tufty grasses, lichen, mosses, a few bulbous plants and sedge like plants. Cladonia and Cetraria are the edible lichens which go into the mixture of forages eaten by domestic yak in Sikkim. Arboreal lichens like Usnea pectinata grow abundantly during August to September in forest areas above 3500 msl, and yaks consume them in winter.

The important locally available tree fodder species commonly fed to yaks are phrengpa (Quercus wallichiana, Fig. 10), syluli (Acer campbellii, Fig. 11), salyx (Salix humboldtiana), blemkar (Buddleja asiatica, Fig. 12), domkar (Symplocos racemosa, Fig. 13), maar (Castanopsis sp, Fig. 14), bagar (Berberis sp., Fig. 15), zimbu (Ligustrum myrsinitis, Fig. 16) and karsingh (Acer hookeri, Fig. 17, Chaterjee *et al*., 2003, 2006). Most of these tree fodders are deciduous in nature. The Spring-Autumn pastures are similar to that of summer pasture. Due to relatively lower altitude, temperature begins to rise in April. During the return of yak herds from summer pasture the vegetation in these grasslands en-route is at their best. Yaks stay in these pastures till October-November, depending upon the altitude and snow cover.

Fig. 10. Prengpa


Fig. 11. Syulili

Fig. 12. Blemkar

Fig. 13. Domkar


Fig. 14. Maar


Fig. 15. Bagar


Fig. 16. Zimbu


Fig. 17. Karsingh

Yak can graze long grasses, using their tongue as do cattle, but they can also graze in the manner of sheep, using incisor teeth and lips to graze short grasses, creeping stems and roots of grasses. It can take tender branches of shrubs in alpine bush meadow. Yak will also readily graze the rough stems and leaves of sedges in low-lying marshy areas. When the ground is covered with snow, yak will paw through quite thick snow layers, and they will use both head and face to help them in this task to gain access to the wilted vegetation underneath. Yaks are versatile grazers and take variety of different herbage and are equipped to do so by their variable feeding habits.

This ability of yaks contributes for better utilization of the total grazing.

Traditional breeding practices

Yaks are living in the harsh environment and unfriendly ecosystem, the natural selection has played a pivotal role in yak breeding. Traditionally, the yak herders are breeding their animals within their herds in isolated geographical boundaries. The pure breeding is the predominant practice. Under field conditions, yaks are seasonal breeders. The duration of breeding season and conception rate is mostly dependent on pasture availability and climatic conditions. The age at puberty among Indian yaks ranged 36-42 months under field conditions. The age at first service was 3 to 4 years in all the states and gestation period is about 258 days in yaks. The pure breeding is predominantly practiced. It was observed that in many herds the male sires the females consecutively for two to three generations. The aggressive behavior of yak bulls during breeding season helps dominant bull to have maximum number of progenies while old and weak bulls will not be able to retain dominant position in the hierarchy of the herd. The traditional system of rearing also helps to weed out weak bulls from breeding. Thus replacing old bulls by stronger and younger bulls, before their daughters in the herd attain puberty helps to reduce inbreeding. The traditional breeding helped to have more number of animals with genotypes to best fit the total environment of its production system including climate, management, social, cultural and economic factors. Economic efficiency of yaks has to be measured on the basis of overall lifetime profitability.

Traditional technology of hybridization

Yak keepers developed traditional technology of hybridization between yak and cattle to improve productivity. These hybrids find a special niche with herdsmen in providing extra milk and as draught animals usually at somewhat lower altitudes than the yak tract (Pal, 1992, Ramesha and Bhattacharya, 2008). The hybrids are always mated back to either yak or cattle males as male hybrids are always sterile. F_1 hybrids are most often more productive than either of their

parents. However, the subsequent generations (F_2 onwards) are less productive and uneconomical.

Species hybridization between cattle and yak is common in India and F_1 hybrids are superior and exhibit hybrid vigour and preferred by yak keepers. Species hybridization between cattle bulls and female yak is common in Arunachal Pradesh but only on a limited scale in Sikkim. In Arunachal Pradesh, yak females (Fig. 18) are bred by Tibetan hill cattle male (Galang, Fig. 19) to produce hybrids. In Ladakh region of Jammu and Kashmir and Himachal Pradesh, farmers generally breed male yak with local cow or crossbred cow (HF and Jersey crosses with local cattle) to produce hybrids. The F_1 females are known as Dzomo (Fig. 20) while males are known as Dzo (Fig. 21) in most part of breeding tract. In Himachal Pradesh, hybrid female is known as Churi and male as Churu. They are used for agricultural operations. Yak herders in India practice inter species breeding to raise a number of generations (F_1 onwards to F_5/F_6). F_1 hybrids are more productive than either of their parents and are preferred by farmers. However, the subsequent generations (F_2 onwards) are less productive and uneconomical. The F_1 hybrids have better milk yield, higher beef production and better draftability. Yak hybrids adapt better to the intermediate zone between cattle and yak

Fig. 18. Yak female

Fig. 19. *Galang* (Tibetan hill cattle male)

habitat, and are therefore, able to utilize grazing areas too low in elevation for yak, but too high for cattle. The performance of hybrids is superior to yaks, and is preferred by farmers. First crosses between yak and cattle adapt well to the conditions in which they are used,

displaying good characteristics of both parental types, including resistance to a harsh environment and improved productivity.

Fig.20. *Dzomo* (F_1 female hybrid)

Fig. 21. *Dzo* (F_1 male hybrid)

Generally under field conditions, yaks give 2 calves in 3 years. The inter-calving period ranged between 18-24 months in yaks while it was 15-18 months in Dzomo in all the states. Generally yaks and Dzomos are not milked for first 2 weeks after calving. During this time, calf takes all the available milk. Usually, during daytime, calves graze along with the dam and continue to suckle. During night, calves were separated from dam, and dams were milked in the early morning at the area earmarked for milking. It was observed that hybrid female calves generally get extra care. At about 12 months of age, dam and calves are separated into different herds. Normally, the farmers do not practice proper health care management like periodical deworming, vaccination etc. Milking is done mostly once a day in the morning however it was observed that in few high yielding hybrids two times milking is practiced particularly in yak tracts of Himachal Pradesh and Jammu and Kashmir. The overall milk production of yak and Dzomo (F_1 hybrids) under field condition was 259.4 ± 5.78kgs and 708.0 ± 31.24 kgs per lactation respectively (Table 1, Ramesha *et al*., 2008b). Among hybrids (Dzomo) the milk yield was more in Himachal Pradesh and Jammu and Kashmir states as compared to Arunachal Pradesh and Sikkim (Table 1), which is mainly due to usage of crossbred cows as dam for producing hybrids in Himachal Pradesh and Jammu and

Kashmir besides better care and management. In all the states, yak raisers generally do not sell or consume milk as such and they make churpi and butter. The lactation length was also more among hybrids as compared to yaks in all the states (Table 1). Hybrids produced very less undercover of fine hair. Even coarse wool production also reduced to around 1-2 kg per annum and fetched very less price. Weiner *et al*., 2003 reported heterosis effect among hybrids from P.R China to the extent of milk yield is increased by 25 per cent, meat yield by 22 per cent and conception rate by 80 -85 per cent as compared to yaks.

Table 1 Production performance of Indian yaks under field conditions

State	Production Performance					
	Yaks				Hybrids	
	Lactation milk yield (Kg)	Lactation length (Days)	Coarse wool (Kg)	Fine wool (Kg)	Milk yield (Kg)	Lactation length (Days)
Arunachal Pradesh	129-282	120-360	3-6	0.4-0.5	400-800	200-300
Sikkim	150-300	130-365	3-6	0.4-0.6	400-800	200-360
Himachal Pradesh	130-335	135-357	3-6	0.5-0.7	490-1200	280-365
Jammu & Kashmir	150-450	150-360	3-6	0.5-0.8	500-1000	280-365

The milk yield and lactation length are enhanced in hybrids but fat percentage is reduced by 10-15 percent. The main problem faced by the keepers is that they are not able to produce hybrids by inter se mating as male hybrids are always sterile. Hence, farmers always have to maintain both cattle and yak to produce hybrids. The male hybrids including backcross males are sterile while female hybrids are fertile and produce higher milk as compared to both the parents.

Traditional yak health management

The people living in the high altitude hilly regions have been utilizing these medicinal herbs for their various ailments and sufferings. It is their traditional knowledge, and the same is passed on from generations to generations through mouth. The herbs play a major role in the treatment of highlanders and their livestock. The important indigenous medicinal herbal wealth (Fig 22-32) of the highlanders of yak tracts is listed in Table 2 (Bora *et al*., 2009).

Table1 Indigenous medicinal herbal wealth of the highlanders of yak tracts

Sl. No	Local Name and Figure no.	Botanical name	Part used	Utility
1.	Nyan-thub (Fig. 22)	*Thalictrum foliosum*	Root	Used for treatment of inflammation and fever
2.	Ba –spru (Fig. 23)	*Mirabilis himalaica*	Root	It is used against dropsy, debility and reduces excess accumulation of fluid in the joints
3.	Ser-shing (Fig. 24)	*Barbaris* sp.	Stem and flower	Traditionally used for treating conjunctivitis, sore mouth, infection of throat and larynx
4.	Ruta (Fig. 25)	*Saussurea costus*	Root	Traditionally used as anodyne, antibacterial, antispasmodic, carminative,
5.	Shug-pa (Fig. 26)	*Juniperus squamata*	Leaves	Used for the treatment of kidney diseases
6.	Fak-daru-gong (Fig. 27)	-	Roots and Fruits	It is traditionally used in the treatment of cough and asthma
7.	Karta (Fig. 28)	*Pterocephalus hookeri*	Entire plant	It is traditionally used for the treatment of cough, asthma, colic pain, gout and arthritis
8.	Main-sela (Fig. 29)	*Aralia sp.*	Root	It is effective against diphtheria, leprosy, constipation, body-ache and joint pain.
9.	Kanchang (Fig. 30)	*Berbaris* sp.	Stems and leaves	Traditionally it is used for the treatment of diarrhoea

10.	Sukulung (Fig. 31)	-	Leaves	It is used against allergic reactions of the body
11.	Kanda-kari (Fig. 32)	*Rubus ellipticus*	Branches and twigs	Traditionally used for the treatment of common cold and infectious fever
12	Ngur- mo	*Drynaria* sp.	Root	Traditionally used for the treatment of herb poisoning.
13.	Dum-bu	*Dryopteris* sp.	Root	Traditionally used for the treatment of herb poisoning.
14.	Rasatika	*Rubus idaeus*	Stem	Traditionally used for treating fever, common cold, cough and lung diseases
15.	Sunithera	*Hedychium spicatum*	Root	Used as a fibrinolytic agent
16	Ru-se-da	*phytolacca acinosa*	Root	Used for treating fever and pain
17.	Khonlong	*Picrorhiza kurroa*	Leaves	Used for the treatment of diarrhoea
18.	Wang-fu-lappa	*Dactylorhiza hetegeria*	Root	Used for the treatment of infertility and impotence of reproductive tract.
19.	Shin-tu dug-med	*Aconitum heterophyllum*	Root	Used as antiseptic, antidote against snake and scorpion bite and treatment for infectious fever.
20.	Fluma	-	Root	Used in the treatment of diarrhea
21.	Brimappa	-	Root	Root extract is used traditionally for the symptomatic relief of asthma.
22.	Koinung	-	Leaves	The leaf is traditionally used as an anti-emetic.

23.	Tongchar-goa	-	Leaves	Traditionally used for blood purification and to improve liver functions.
24.	Mangdolang	-	Root	It is traditionally used as a nerve tonic and as stimulant of cardiac functions
25.	Goga-Karpu	-	Root	It is traditionally used in stomach-ache
26.	Solubang	-	Leaves	It is traditionally used as an antifungal agent and is effective in healing wounds
27.	Khanglanzeli	-	Fruits	It is used as antifungal agent. It cures itching and specially helps in blood purification.
28.	Shamzer	-	Leaves	It is used as a n antifungal agent and is effective in healing wounds
29.	Chirata	-	Stem and branches	It is used as an anthelmintic, blood purifier and liver tonic.
30.	Pang-pos	*Nardostachys jatamansi*	Leaves	It is used in treating chronic fever, spleen disorders and subsides swelling.

Fig. 22. ***Nyan-thub*** **(*Thalictrum foliosum*)**

Fig.23. ***Ba-spru*** **(*Mirabilis himalaica)***

Fig. 24. ***Ser-Shing*** **(*Barbaris* spp.)**

Fig. 25. ***Ruta*** **(*Saussurea costus*)**

Fig.26. ***Shug- pa*** **(*Juniperus squamata*)**

Fig.27. ***Fak- daru-gong***

Fig. 28. ***Karta*** **(*Pterocephalus hookeri)***

Fig. 29. ***Main Sela*** **(*Aralia* Sp.)**

Fig.30. *Kanchang* (*Berbaris isp.*)

Fig.31. *Sukulung*

Fig.32. *Kanda Kari* (*Rubus ellipticus*)

There is an urgent need to document these medicinal herbs and to evaluate their real utility. There is a need to make scientific evaluation of these herbs and to study their pharmacodynamics. It is very important to save and conserve these valuable floras from mishandling and destruction.

Traditional yak products

The yak products like milk and meat are the main source of protein requirement of the isolated highlanders who have little access to modern life. The milk yield in yaks ranged from 129-282 Kg in a lactation length ranging from 120 days to 300 days, meat yield ranged between 70-190 Kg, coarse hair yield ranged from 3.0 to 6 Kg per year, fine hair ranged between 0.3-0.6 Kg (Ramesha *et al*., 2008b). The performance of hybrids of yak and cattle are superior, which are preferred by farmers.

Yak milk products

The major source of income for the yak farmers comes from milk. The total dry-matter is 1.2-1.4 times more than that of cattle's milk;

and thus yak milk is concentrated than cattle milk. The yak milk has a rich composition of protein, fat, lactose, mineral elements and essential amino acids (Table.3). The yak farmers do not consume milk as such, rather they convert, summer milk abundance into butter and churpi (a wet cheese, Fig. 33) by traditional methods in an indigenous cylindrical churner made of wood and bamboo strips. Churpi making is one of the low cost technologies of the yak keepers. Churpi plays an important role in day-to-day life of the inhabitants of high altitude tribes. Churpi is ripened and stored for years together in Churra Dorchi (Fig. 34, Churpi container- made up of yak skin). After long storage its colour

Table 3 Average composition of yak milk

Sl. No.	Milk constituent	Value
1	Fat	7.50 per cent
2	Total protein	5.94 per cent
3	Total solids	17.93 per cent
4	Lactose	4.68 per cent
5	SNF	11.50 per cent
6	Ash	0.87 per cent
7	Total nitrogen	0.60 per cent
8	Casein nitrogen	0.46 per cent
9	Non protein nitrogen	0.04 per cent
10	Calcium	0.30 per cent
11	Iron	0.74mg/100ml
12	Potassium	122.50mg/100ml
13	Sodium	70.50mg/100ml
14	Phosphorus	0.29 mg/100ml
15	pH	6.64
16	Titratable acidity	0.17
17	Specific gravity	1.04

Fig.33. *Chura* (*Churpi*)

Fig. 34. *Churra Dorchi* (*Churpi* container)

changes to yellowish and it has particular type of fungal growth. The long stored churpi is liked by local people. The variations during storage in sensory attributes, compositional and microbiological quality have been high.

A by- product of *Churpi* making process is whey. Boiling whey until it becomes a dark and thick concentrate makes *Doja* (Ramesha and Sharma, 2006). Some of this is applied immediately (with a small tuft of wool) on face while the rest is stored in a can or wood box. A single batch of *Doja* can last for weeks or even months. For reusing, a few drops of water are added to the thick concentrate, which is then reheated at the edge of the fire. *Doja* is carefully applied by women on their forehead, nose and cheeks with a small tuft of wool. Besides butter tea, traditional dairy products such as *shosim* and naturally fermented milk *sho* (yoghurt) are prepared from buttermilk after churning out butter and *thera* (yoghurt, butter milk). The buttermilk is heated to coagulate and the curd (*serkam*) is made into *churpi* (a type of cheese), *chursife* and *shomaar* containing curry by addition of milk fermentation (Sharma, 2004). *Chursife* is the basis for a number of products, e.g. *shopka* and *chursife-maar* (a sweet meat containing butter, milk and sugar). Traditional butter products include milk membrane (*orom*) and yellow and white butter.

Out of the many yak milk products, "*Churkam*" (Fig. 35) is a local product which is rich in protein and energy content, and is suitably used as toffee in high altitude. The process of *Churkam* preparation is a traditional technology of highlanders. This product may be very well utilized as energy supplement in defence sector especially for the personnel posted in forward high altitude areas. The product may also be utilized by the people engaged in mountain expeditions

Fig. 35. *Churkam*

Yak meat and meat products

The yak meat is usually a by-product from the dead animals, killed by predators and occasionally from slaughter of surplus castrated steers and aged females. It is regarded, as very palatable but muscular and marbling is poor. It is rich in myoglobin and has a flavour akin to wild animals. Among local people, yak meat has been highly prized above that of ordinary cattle since ancient time. Yak meat has excellent cooking qualities. The herdsmen preserve yak meat using various types of traditional methods. Surplus meat is either smoked immediately on kitchen earth driers or kept deep frozen under snow.

During *Lossar* (New year day of Buddhist tribe) period usually in February or March, the herdsmen cut yak meat into long narrow strips (approx. 4-5 cm wide and 30 cm long) and dry them by suspending from woven-hair ropes. These strips of meat (Fig. 36) could be kept upto 1 year either hung or in hide bags. In this method meat can be stored longer than naturally frozen meat. Preparation of sausages from yak meat (Fig. 37) and blood is very popular among yak herdsmen. Traditionally sausages from yak blood are prepared by mixing yak blood with grinded maize, salt and fruits of *Zanthoxylum nepalense* fruit (Fig. 38) and encased in intestine and boiled. Fresh meat is minced in to small pieces and mixture of 50 per cent yak meat, 25 per cent visceral fat and 25 per cent blood is used as filling material. This mixture is added with salts and condiments before filling in the casing.

Fig. 36. *Shaa Sangbu* (Dry Meat)

Fig. 37. *Juma*-Sausage

Fig .38. *Zanthoxylum nepalense* plant with fruit

Yak wool products

Like other ungulates native to cold region, the yak also possesses two coats. The outer coat consists of hair of coarse and intermediate thickness whereas inner coat consists of fine hair. The down fiber of yak is like pashmina or mohair of goats. Yak herdsmen utilize the yak hair for their livelihood. They utilize traditional hand spinners for converting fine yak wool into yarn (single or double ply thread). It is very difficult to make value added handicraft from coarse yak wool. Traditionally, the hair is used for making caps (Fig. 39a, 39b), coat (Fig. 40), ropes, blankets, bags, carpets (Fig. 41) and tents for daily use by the herdsmen in a traditional way in all the yak rearing states. Yak hide is used for making tents, shoes, bags etc.

Fig. 39a. *Jamu*- cap

Fig. 39b. Cap used by *Brokpas*

National Research Centre on yak

Considering the unique species specific characteristics of Yak, its role in the economy of the highlanders, Indian council of Agriculture Research established National Research Centre on Yak at Dirang,

Arunachal Pradesh in the year 1989. Since then, the centre is making consistent endeavour and effort to improve traditional yak husbandry and related indigenous technologies with a cherished objective of socio-economic development of the yak rearers living in difficult terrains.

Epilogue

With traditional knowledge and wisdom acquired from generation to generation; yak keepers developed traditional package and practices for yak husbandry and yak products' technologies, which is organic, and nature friendly. Integrated management of yak genetic resources as part and parcel of highland hilly ecosystem is absolutely necessary for sustainable yak husbandry.

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