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Research Article

Phenotypic, Productive, and Reproductive Traits of Domestic Yak (*Bos grunniens grunniens*) in District Chitral, Pakistan

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ABSTRACT

The aim of the present study was to determine the morphological characteristics, productive and reproductive performance, and herd composition of domestic yak (*Bos grunniens grunniens*) in Chitral, Khyber Pakhtunkhwa, Pakistan. Among morphological characteristics, 4 physical characteristics and 17 morphometric measurements were studied. For the assessment of productive performance, the data about daily milk yield, daily milk take-off, and mean lactation period were recorded. The reproductive performance observed were puberty age, postpartum anoestrus interval, calving interval, conception rate, and number of calving per lifetime. Results revealed that almost half of the yak population has a black coat color (Yak bulls, 50.38%; Yak cows, 52.33%). Similarly, the prominent muzzle color of yak bulls (52.25%) and yak cows (53.22%) was also black. Majority (93.85%) of the yak bulls were horned whereas, 65.84% of Yak cows were horned only. Yak bulls have higher values for all morphometric measurements than Yak cows. Daily milk production was 1.76 ± 0.11 kg and daily milk uptake was 0.37 kg. The mean lactation period was 143 days. Mean pubertal age of the Yak cow was 33.35 ± 1.41 months, postpartum anoestrus interval 105.16 ± 8.50 days, gestation period 257.00 ± 0.46 days, and maximum 5 calving in lifetime.

Keywords: Yak, phenotypic, productive and reproductive traits, Chitral, Pakistan.



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INTRODUCTION

Domestic Yak (*Bos grunniens grunniens*) is sub subspecies of yak (*Bos grunniens*) of the order Artiodactyla, family Bovidae and genus *Bos* (Baily et al., 2002). The domestic yaks are uncommonly present around the world, abundantly present in the Qinghai-Tibetan Plateau, Himalayan, and Altai regions in Asia, and widely distributed in China and the Central Asian region (Leslie and Schaller, 2009). Generally, these yaks are found at elevation; 3000 meters beyond the sea level (Hassan et al., 2007; Shi et al., 2016). The domestic yak has a massive body with compact sturdy short legs; large hooves; small ears; gray to black horns; no dewlap; conspicuous hump and short neck (Schaller and Liu, 1996). In Pakistan, domestic yaks are found in the cold mountainous Hindu-Kush and Himalaya regions, that border Tajikistan, China, and Ladakh (Hassan et al., 2007). Phenotypic traits are not the same for all breeds of cattle (Bobić et al., 2014). There may be variations in coat color, size, length,

height, and heart girth among the phenotypic traits. Phenotypic characterization important for conservation, breed improvement, and estimating productivity (Kugonza et al., 2011). Analysis of productive and reproductive traits in turn is used for the estimation of profitability in domestic yak (Wangdi and Wangchuk, 2018). Around the world, several studies have described the productive, reproductive, and herd composition (Garoma, 2014; Haque et al. 2011). There are few studies conducted in other regions of the world but in Pakistan, little attention is given to this animal. In the Chital region, no studies have yet been conducted to explore the morphological, productive, and reproductive traits of domestic yak. Yak farming is used to support the livelihood of the mountain communities and the rural populations in the world (Wangdi, 2015). The breed, type of management, and location alter the productive and reproductive performance of yak. Some of the breeds of yak have enhanced productivity than the others. For example, yield variation among domestic yak has been reported from studies conducted in central Asia, Bhutan, Nepal, and India. It was reported that yak of the eastern breed had higher productivity than yak of the central and western breeds. In central Asia, the mature male's yak weighs 350-600 kg while females are 30-50% lighter and they yield 200-400 L milk in the first six months (Wiener, 2013).

In Bhutan, eastern and western populations have been reported and the body weight reported for mature females is 250-300 kg and males are 400-500 kg (Gyamtscho, 2000). In Nepal, the male domestic yak weighs 300kg and the female 225 kg (Kharel et al., 2011). The studies in India have concluded that degrading the pastures in higher altitudes reduces the population of yak and the pasture may be rejuvenated by introducing suitable temperate grasses (Paul et al., 2020). The studies from China have shown a yield of 147-487 kg of milk per lactation (Dong et al., 2007). In Pakistan, there are only a few studies describing the effect of breed and locality on the yield of domestic yak. However, studies have identified management practices and resource availability as the factors affecting the productivity of the domestic yak. A study identified the management of connecting routes and grazing areas as a single system that can effectively enhance the resource availability in the enhancement of productivity in yaks (Hashmiet al., 2017). Another study from Hunza reported that the lack of human resources was the main cause of the decline of the yak population (Kreutzmann, 1986). Alternatively, in the northern Pakistan, the yaks are hybridized successfully by domestic means for the enhancement of productivity of yaks (Babar et al., 2016). As the characteristics related to the cost-effectiveness of domestic yak vary in the world so there is a need to assess the opportunities and issues related to yak rearing in Pakistan.

Objectives

The current study aimed to investigate the following objectives. (1) To explore phenotypic and morphological characteristics of yak in the study area (2) To elucidate the productive performance of domestic yak in Chitral, Pakistan (3) To evaluate the reproductive traits of domestic yak of the study area.

MATERIALS AND METHODS

This study was conducted in those areas of Chitral where habitat for domestic yak was expected. Three valleys i.e. Yarkhun, Torkow, and Laspur of district upper Chitral were selected for this study because domestic yaks are only reared in these three valleys of Chitral (Figure 1). During the field study, animals were selected from various sites in the Yarkhun, Torkow, and Laspur valleys randomly. Study was conducted through observations. A questionnaire was used to collect relevant information from yak farmers. Data related to management practices, productive performance, and reproductive performance of domestic yaks were also collected from the farmers. For this study physical parameters were studied adopted from Bobić et al., (2015) Among the physical characteristics like, coat color, muzzle color, and horned and polled characters were observed directly, because these are the parameters that are important for breed differentiation and are prominent phenotypic traits (Bobić et al., 2015). Seventeen morphometric measurements were measured for each animal at predefined anatomical points (FAO, 1986). These characteristics are, loin length, pelvic width, body length, face length, heart girth, height at the hip bone, height at wither, chine length, muzzle circumference, horn length, space between horns, length below knee joint, length below hock joint, canon circumference, hoof circumference, tail length and switch length. The unit used for all measurements was a centimeter. All measurements were done with a measuring stick and measuring tape (FAO, 1986). Information regarding productive performance i.e. about daily milk yield, daily milk takeoff, lactation period, and dry period was attained from farmers. Data related to reproductive traits like, pubertal age, postpartum anestrus interval, conception rate, and number of calving in lifetime were gathered from yak farmers through a questionnaire. The gathered data were then organized and descriptive statistics were applied using SPSS. Simple descriptives were used for the data analysis. mean and standard error of the mean.

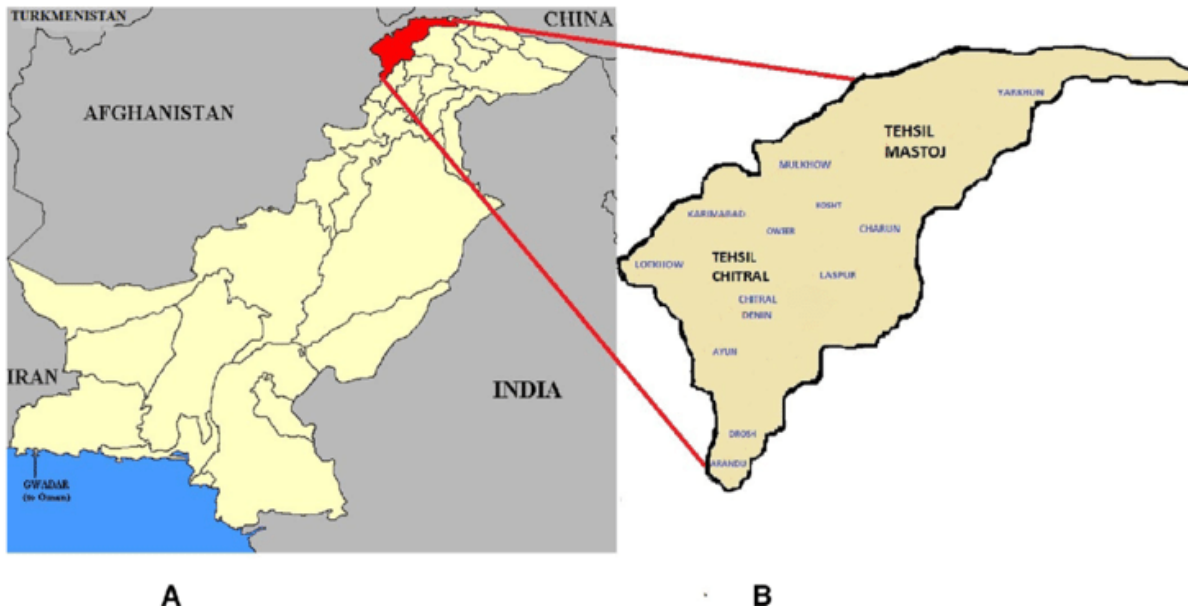


Figure 1. Map of Chitral (Yak Zone has been highlighted).



Figure 2. (A) Black coat color yak bull grazing in Alpine pasture (B) Author* taking morphometric measurements (C) Spotted yak bull grazing (D) Local community using Yak bull as a ride

RESULTS

In a study conducted in Chitral, Khyber Pakhtunkhwa, the characteristics of yak bulls and cows were analyzed across various physical, morphometric, and reproductive traits.

Table 1. Comprehensive Yak Characteristics in Chitral: Morphometric, Reproductive, and Physical Traits

Trait/Characteristic	Yak Bulls (N = 657)	Yak Cows (N = 514)
Coat Color		
Black	331 (50.38%)	269 (52.33%)
Brown	209 (31.81%)	209 (37.55%)
White	49 (7.45%)	7 (1.36%)
Grey	37 (5.63%)	11 (2.14%)
Spotted	31 (4.72%)	34 (6.62%)
Color of Muzzles		
Black	266 (51.25%)	256 (53.22%)
Brown	164 (31.59%)	208 (43.24%)
White	57 (10.98%)	9 (1.87%)
Grey	23 (4.43%)	6 (1.25%)
Spotted	9 (1.73%)	2 (0.39%)
Horned and Pooled Characteristics		
Horned	397 (93.85%)	264 (65.84%)
Pooled	26 (6.15%)	137 (34.2%)
Switch Colour		
Black	211 (48.28%)	279 (58.13%)
Brown	111 (25.40%)	104 (21.66%)
Grey	65 (14.87%)	63 (13.13%)
White	50 (11.44%)	34 (7.08%)
Morphometric Measurements		
Body Length (cm)	131.24 ± 1.73	113.15 ± 1.47
Height at Withers (cm)	126.66 ± 1.64	110.32 ± 1.23
Heart Girth (cm)	194.38 ± 2.04	176.02 ± 1.92
Height at Hip Bone (cm)	120.99 ± 1.54	107.74 ± 1.02
Lion Length (cm)	85.38 ± 1.07	75.00 ± 1.09
Chine Length (cm)	32.54 ± 0.64	27.62 ± 0.54
Pelvic Width (cm)	46.39 ± 0.57	41.98 ± 0.44
Length Below Knee Joint (cm)	24.13 ± 0.52	23.13 ± 0.49
Length Below Hock Joint (cm)	33.13 ± 0.58	29.29 ± 0.67
Face Length (cm)	44.79 ± 0.63	39.32 ± 0.43
Muzzle Circumference (cm)	42.04 ± 0.93	33.96 ± 0.65
Horn Length (cm)	48.06 ± 1.11	39.86 ± 1.40
Space Between Horns (cm)	63.18 ± 1.09	55.14 ± 1.33
Ear Length (cm)	15.70 ± 0.21	14.53 ± 0.19
Tail Length (cm)	39.98 ± 1.05	31.26 ± 0.76
Hoof Circumference (cm)	33.43 ± 0.50	31.33 ± 0.46
Canon Circumference (cm)	22.36 ± 0.29	20.79 ± 0.23
Daily Milk Production and Lactation Period		
Daily Milk Production (kg)	1.76 ± 0.11	-
Daily Milk Take Off (kg)	0.37 ± 0.04	-
Mean Lactation Period (Days)	143.00 ± 1.52	-
Mean Dry Period (Days)	176.17 ± 6.04 to 270 ± 7.00	-
Reproductive Performance		
Puberty Age (Months)	33.35 ± 1.41	-
Post Partum Anoestrus Interval (Days)	215.16 ± 8.51	-
Gestation Period (Days)	257.00 ± 0.47	-
Number of Calvings in Lifetime	5.10 ± 0.28	-

The coat color of yak bulls revealed that 50.38% were black, 31.81% brown, and 7.45% white, with smaller percentages of grey (5.63%) and spotted (4.72%) individuals. Yak cows showed a similar trend with 52.33% black and 37.55% brown coats, but white (1.36%) and grey (2.14%) were less prevalent. The muzzle color was predominantly black (51.25%) for bulls and slightly higher for cows (53.22%), while brown was more common in cows (43.24%) than bulls

(31.59%). Regarding horn status, 93.85% of yak bulls were horned compared to 65.84% of cows. The switch color, which refers to the tail color, showed that 48.28% of bulls had black tails, while cows had a higher percentage of black tails (58.13%). Morphometric measurements also showed significant differences, with yak bulls having greater body length (131.24 cm), heart girth (194.38 cm), and horn length (48.06 cm) compared to cows.

Yak bulls had a higher tail length (39.98 cm) and muzzle circumference (42.04 cm), whereas cows had shorter values in all these measurements. Daily milk production was recorded at 1.76 kg for yaks, with an average lactation period of 143 days. The reproductive performance of yaks showed that the average age of puberty was 33.35 months, and the gestation period was 257 days. Overall, yak bulls were larger and had more pronounced physical traits, while the cows showed some distinctions in coat and muzzle color and reproductive metrics.

DISCUSSION

In northern Pakistan including Chitral, many communities rely on yak rearing as a main source of income so it is important to assess the morphological char and economic aspects of the domestic yaks (Mortenson et al., 2017). Keeping in view, the current study showed that the prominent coat color, muzzle color, and switch colors and in domestic yak in Chital are black color in all cases both in yak bulls and yak cows. The study shows that in Chitral, the majority of yak bulls and yak cows are horned (Table.1). The exploration of the presence of black coat color as the most prevalent color in domestic yaks in this study was incongruent with the previous studies for China and USA (Qiu et al., 2012; Petersen et al., 2020). The morphometric measurement showed that all of the measurements taken were higher for yak bulls than the yak cows (Table. 1). The mean body length was 131 cm in domestic yak bulls and 113 cm in yak cows while the values of height at wither were 126 cm and 110 cm respectively for both. The data on productive performance showed that the mean daily milk production was 1.76 ± 0.10958 kg with a mean lactation period of 143.00 ± 1.522 days and mean dry period was 176.17 ± 6.04 to 270 ± 7.00 (Table.1).

A previous study from Bhutan has shown that mean daily milk production was 1.15-1.27 L in summer and 0.33 L in winter with a lactation period of 244 days and lactation yield of 154 L (Wangdi and Wangchuk, 2018). A previous study from Tibet has reported mean milk per lactation as 199 L (Ji et al., 2000). However, the data for the mean lactation yield in Qinghai Province China was high 487 L. The reason for the variation in the milk production in the world may be due to variations in type of breed, body, parity, and climatic conditions (Li et al., 2011). The study showed that the mean values for puberty age in months, Post-Partum anestrus interval in days, gestation period in days and number of calving in lifetime were 33, 215, 257 and 5 respectively (Table.1). A previous study showed that in Bhutan the aforementioned values in the same orders were 33-37, 148, 480, and 256 (Wangdi and Wangchuk, 2018). The value of lengthy postpartum estrus is a representation of poor nutrition and health which may be due to suckling in the late pregnancy stage and the estrus may depend on the environment (Zhao, 2000). In another previous study, the annual reproductive rate for the domestic yaks was reported as 40-60% and the puberty and other reproductive characteristics were mainly attributed to nutrition, breed, seasons, and calf survival (Zi, 2003).

CONCLUSIONS

The present study explores that the yaks in Chitral are mostly black colored, they have relatively smaller bodies, milk production is low, late onset of puberty, long postpartum anoestrus intervals. The farming community rears relatively more yaks in the herd at the high altitudes than at low altitudes in their livestock as at low altitudes they face space and fodder problems. Yet there is potential to expand the yield from domestic yaks by improving its management practices in Chitral, Pakistan.

AUTHOR CONTRIBUTIONS

Younas M and Saleem M made conceptualization, data curation and writing original draft. **Farooqi J, Hussain B Fawad and N A Arifa, Khayyam K and Khattak R M** writing-review, proof reading and editing.

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COMPETING OF INTEREST

No conflicts of interest have been disclosed by the authors.

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