Research Article

Morphological Characterization of Indigenous Goats Breeds of Khyber Pakhtunkhwa, Pakistan

Mohammad Nazeer* and Safdar Hussain Shah

Institute of Biotechnology and Genetic Engineering, The University of Agriculture Peshawar, Pakistan.

Abstract | Livestock play a significant role in the developing economy of Pakistan. Goat is population wise one of the major livestock specie of Pakistan. This study was conducted to analyze morphological traits of four indigenous goat breeds of Khyber Pakhtunkhwa (KP) province of Pakistan. The breeds selected for this study were namely Damani, Surguli, Kaghani and Gaddi. Data was collected from two districts to the south (Dera Ismail Khan and Kohat) and two districts to the north (Kaghan and Naran) of KP province. Total number of 120 goat specimen (30 per breed) was selected for this study from random locations. A pretested questionnaire was used to record the morphological parameters of each individual. The results showed differences in morphological traits of different goat breeds. The facial appearance of Surguli and Damani was predominantly convex, whereas straight shape facial outline was observed in most of Gaddi and Kaghani goat individuals. The ears of Damani and Surguli goat were mostly straight, whereas Kaghani and Gaddi had rounded edge ears in most cases. Horn color was predominantly black, with a little percentage of brown and red in Damani and Gaddi goat. Body hairs were mostly straight with medium length in Damani and Surguli, and long in Kaghani and Gaddi breed. Body size manifested by weight, length and other body measurements, was highest in Gaddi, followed by Kaghani and then Surguli. The body size of Damani was the smallest compared to the other breeds; however, statistically it was similar to Surguli. Kaghani is the highest ranking along with similarities to Gaddi breed and also recommended for management to achieve the utmost benefits within goat breeds.

Received | July 19, 2017; **Accepted** | March 05, 2018; **Published** | April 09, 2018
***Correspondence** | Mohammad Nazeer, Institute of Biotechnology and Genetic Engineering, The University of Agriculture Peshawar, Pakistan, Pakistan; **Email:** nazeerswabian@gmail.com
Citation | Nazeer. M. and S.H. Shah.2018. Morphological characterization of indigenous goats breeds of Khyber Pakhtunkhwa, Pakistan. *Sarhad Journal of Agriculture,* 34(2): 258-267.
DOI | http://dx.doi.org/10.17582/journal.sja/2018/34.2.258.267
Keywords | Damani, Kaghani, Gaddi, Morphological characterization, Surguli

Introduction

The domestication process of goat is thought to begin as early as 10000 years before in Southeast Asia, as revealed by the study of mitochondrial genes (Nomura et al., 2013). Goat is a multipurpose animals producing meat, milk, hide, fiber, manure as well as used for carrying light loads. Goats are referred to as "poor man's cow" (MacHugh and Bradley, 2001), they support millions of poor, landless people and those living in the rural areas of Pakistan. Goats are valuable asset for these farmers due to its natural ability to adapt to prevailing environment (Aziz, 2010). According to Skapetas and Bampidis (2016), about 95% of the total goat population in the world is found in the developing countries of Asia and Africa. Asia holds the first place with a total goat population of 597 million, which is 59% of the world population. Asian countries contribute considerable amount goat products to the world's economy. Percent contribu-

tion of goat products produced Asia to the world's production is: milk (58.3%), meat (70.7%) and skin (76.5%) (Skapetas and Bampidis, 2016). Pakistan is one of the largest producers of goat and its products in Asian countries.

According to the economic survey of Pakistan, total goat population in the country is estimated to be 72.2 million, which is 37.7% of the total livestock population in the country (GOP, 2016). Pakistan is the third largest country in the world after China and India, in terms of goat population (FAO, 2007). The annual contribution of goat products to the economy of Pakistan include milk (0.9 million tons; 1.6% of the total milk production), skin (27.8 million; 50% of the total skins produced) and 27 thousand tons of hair (GOP, 2016). In addition meat produced collectively from sheep and goat is estimated to be 0.7 million tons, which is 17.3% of total meat production of the country (GOP, 2016). Pakistan is the fourth largest country of the world in terms of goat meat production (FAO, 1986).

A total number of 36 goat breeds have been reported from various geographical regions of Pakistan (Khan et al., 2008). However, this list is not exhausting because of within breed variation which is not very well presented, as well as because of a number of undocumented breeds especially in the Khyber Pakhtunkhwa (KP) province of Pakistan. According to the livestock census of 2006, 17.8% of the total goat population in Pakistan is found in KP (GOP, 2006). Few of the documented goat breeds of KP include Damani, Gaddi, Kaghani, Kohai Ghizer and Piamiri with an estimated population size of 1320, 416, 532, 238 and 79 thousand heads, respectively (Khan et al., 2008).

Most goat breeds of Pakistan are medium to large in size. Some of the known phenotypic characteristics show variation among different breeds found in the country. Their hair colour varies from white, black, red, brown, grey or tan to a mixture of these colours. Hairs are usually long in breeds from northern areas, compared to breeds from southern areas. Horns shape varies from twisted, spiral or curved to screw shape though some are polled. Beard is found in some breeds but wattles are less common (Ali and Afzal, 2006).

Majority of the goat breeds in Pakistan are primarily raised for meat except for a few milch breeds such as Nachi (Iqbal et al., 2008). Evolutionary process has enabled these goat breeds to adapt to feeding behaviour, disease and environmental stress of a particular geographical region. Morphological characterization of goats is essential to evaluate the extent of diversity between these breeds. The information obtained is helpful to define breeding strategies for the enhancement of the goat reproduction. For breeding, farmers generally consider only the production traits; however, other morphological traits are also equally important. Goats are easily adapted to various agro-climatic conditions and are reared under three different farming systems that are sedentary also known household system, nomadic and transhumant system (Iqbal et al., 2008). Effective management sustainability in livestock sector contributes substantially to the economy of a country. Such sustainability involves breed characterization including population size and structure, geographical distribution, production environment, and genetic diversity within the breed (Ali and Afzal, 2006).

Characterization of livestock breeds is the first approach to a sustainable use of its animal genetic resources (Lanari et al., 2003). The first step of the characterization of local genetic resources is based on the knowledge of variation in the morphological traits (Delgado, 2001). It is very important that the present genetic resources be documented for phenotypic variation, social importance and unique genetic characteristics for effective management and conservation of livestock resources (Ruane, 1999; Duchev and Groeneveld, 2006). KP province of Pakistan is rich in livestock genetic resources. The major native goat breeds of KP include Damani, Kaghani, Gaddi (already documented previously) and Surguli (undocumented).

Morphogenetic evaluation of some of local goat breeds of Pakistan has been carried out previously. These goat breeds include Teddy, Beetal and Dera Din Panah, which have been characterized for their performance, body weight and linear measurements (Yaqoob et al., 2009). These morphological data could be implemented in various genetic improvement programs (Riva et al., 2004). Identification of variation in morphological traits is the essential step toward characterization of livestock breeds (Riva et al., 2004). The linear body and physical measurements are highly informative regarding the performance traits like kidding efficiency, lactation length, and milk and meat

production.

Most of the morphological research work in small ruminants especially in goats has been carried out in the other region of the world under diverse environmental conditions. On the other hand, despite the fact the goat rearing is playing vital role in the subsistence of the poor and landless people of the society, no comprehensive evaluation have been conducted on the indigenous goat breeds of KP Province of Pakistan. Therefore here we attempted to elucidate the morphological aspects of four goat breeds namely Gaddi, Damani, Kaghani and Surguli from KP.

Material and Methods

Geographical regions selected for sample collection

The current study was executed in two different agro-ecological zones of KP in order to describe the morphological characteristics of the four indigenous goat breed found in those areas of the province. Zone-1 comprises of Kohat, Dera Ismail Khan and Paharpur region, which are located to the south of KP at latitude of 33˚0N, 31˚86N, 32˚1N and longitude of 71˚5E, 70˚91E and 70˚97E. Zone-2 comprised of Kaghan, Naran, Mansehra and Abbottabad area, located to the north at 34˚87N, 34˚77N, 34˚33N, 34˚10N and longitude of 73˚69E, 73˚52E, 73˚20E and 73˚15E.

Selection of purebred animals

Surguli and Damani sample data were collected from zone-1 whereas Kaghani and Gaddi sample data were collected from zone-2 as described above. Data were collected on the visual assessment of the indigenous goat breed and their morphological depiction. Before collecting the data, a field survey was conducted for identification of pure breed flocks; their population size, structure and distribution; the production system in which they are raised, various farming systems, management practices and feeding practices through interview on a prescribed proforma based on guideline from FAO (2008).

Number of samples per breed

For morpho-biometeric traits 30 samples of each breed were selected randomly from their breeding tracts. The samples included 6, 7, 10 and 4 males; and 24, 23, 20 and 26 females of Surguli, Damani, Gaddi and Kaghani breed, respectively. The differences in the ratio of male and female animals were because of no buck or only one male in some flocks.

Data collection

Data regarding morphological characteristics of each population was recorded on descriptor guide based on FAO (2008). Qualitative (discrete) traits like physical features and appearance (shape, colour, hair coat colour, horn shape, ear length), and quantitative traits such as size and dimension of the body parts like body weight, body length, chest girth, height of animal at withers and rump were recorded according to FAO (2008) criteria. All the measurements were done with the help of an inching tape. The animals were brought to stand on a plan surface during its body measurements. Body weight was measured by using the following formula, adopted from Ensminger (2002).

$$\text{Body weight (lb)} = \frac{G^2 \times L}{300}$$

Where G stands for chest girth and L for body length (from shoulder to tail).

Statistical analysis

The qualitative data was analyzed by percent distribution of different morphological appearance traits in different breed type using SPSS V20.0. The quantitative data was analyzed for means and standard error using SPSS V20.0. One way analysis of variance (ANOVA) was performed in SPSS to test the significance differences in the morphometric traits between different goat breeds. Multiple comparisons between groups of the breeds was done using Post Hoc Tukey's test.

Results

Facial and head appearance

The four breeds had different body conformation and qualitative distinctions. The various morphological trends of different body parts of these breeds are given in Table 1. Gaddi with Kaghani and Surguli with Damani had highest percent of similarity. The facial profiles were convex in Damani and Surguli compared to Gaddi and Kaghani with straight profile. Ear shape in Damani breed was straight edged (100%) followed by Surguli (60%) and Gaddi (43.3%). Kaghani, Gaddi and Surguli had round shape ears. All the breeds had ear buds in which the highest was in Damani followed by Surguli, Gaddi and the least in Kaghani. Drooping orientation was noticed in Surguli, Kaghani and Gaddi only.

Table 1: *Incidence (%) of facial and head morphology of different goat breeds.*

Body part	Trait	D	♂	♀	S	♂	♀	K	♂	♀	G	♂	♀
Facial profile	Convex	100	100	100	90	83.3	91.7	16.7	25	15.4	20	20	20
	Concave	-	-	-	-	-	-	-	-	-	10	20	5
	Straight	-	-	-	10	16.7	8.3	83.3	75	84.6	70	60	75
Ear Morphology	Straight edged	100	100	100	60	66.7	58.3	23.3	25	23.1	43.3	40	65
	Rounded	-	-	-	40	33.3	41.7	76.7	75	76.9	56.7	60	35
Ear Orientation	Buds	100	100	100	60	66.7	58.3	23.3	25	23.1	29.2	40	65
	Drooping	-	-	-	40	33.3	41.7	76.7	75	76.9	70.8	60	35
Horn Color	Black	86.7	71.4	91.3	100	100	100	100	100	100	80	60	90
	Brown	13.3	28.6	8.7	-	-	-	-	-	-	16.7	30	10
	Red	-	-	-	-	-	-	-	-	-	3.3	10	-
Horn Shape	Screw shape	56.7	71.4	52.2	-	-	-	-	-	-	-	-	-
	Spiral	43.3	28.6	47.8	53.3	33.3	58.3	83.3	100	80.8	6.7	-	10
	Straight	-	-	-	3.3	-	4.2	-	-	-	16.7	40	5
	Lyred	-	-	-	-	-	-	-	-	-	10	10	10
	Curved	-	-	-	43.3	66.7	37.5	16.7	-	19.2	66.7	50	75
Horn orientation	Upward	43.3	71.4	34.8	63.3	83.3	58.3	50	75	46.2	30	30	30
	Forward	43.3	14.3	52.2	23.3	-	29.2	43.3	25	46.2	50	50	50
	Backward	3.3	-	4.3	-	-	-	-	-	-	-	-	-
	Downward	3.3	-	4.3	-	-	-	-	-	-	-	-	-
	Tips point laterally	6.7	14.3	4.3	13.3	16.7	12.5	6.7	-	7.7	20	20	20

Key: D, Damani; S, Surguli; K, Kaghani, G, Gaddi

Table 2: *Incidence (%) of color and appearance of hair in different body parts of goat breeds.*

Hair trait	Appearance	D	♂	♀	S	♂	♀	K	♂	♀	G	♂	♀
Hair color pattern	Plain	40	57.1	34.8	33.3	33.3	33.3	40	50	38.5	46.7	50	45
	Patchy	53.3	28.6	60.9	33.3	50	29.2	60	50	61.5	50	50	50
	Spotted	6.7	14.3	4.3	33.3	16.7	37.5	-	-	-	3.3	-	5
Hair Length	Medium	100	100	100	100	100	100	-	-	-	-	-	-
	Long	-	-	-	-	-	-	100	100	100	100	100	100
Hair Type	Straight	100	100	100	100	100	100	100	100	100	96.7	100	95
	Curly	-	-	-	-	-	-	-	-	-	3.3	-	5
Hair appearance	Dull	60	57.1	60.9	30	33.3	29.2	-	-	-	3.3	-	5
	Glossy	40	42.9	39.1	70	66.7	70.8	100	100	100	96.7	100	95
Beard Present		-	-	-	6.7	33.3	0	56.7	100	50	43.3	40	45
Wattles Present		20	-	26.1	40	50	37.5	-	-	-	-	-	-

Key: D, Damani; S, Surguli; K, Kaghani, G, Gaddi

Our results demonstrated that horns were present in all the breeds examined and polledness was not observed in any breed. Mostly the horn colours were black in the experimental breed; whereas the least incidence of red color was also noted in Gaddi goat breed (3.3%). Likewise, the current result indicated spiral shaped horns in the four goat breeds, with maximum occurrence in Kaghani and minimum in Gaddi. On the other hand, curved shaped horns occurrence was highest for Gaddi followed by Surguli and Khagani. The orientation of horns upward, forward and tips point laterally were observed in all breed. The incidence of backward and downward horn orientation was observed in Damani.

Hair color and appearance

Data of comparative hair morpho-biometric traits of the four indigenous goat breeds is shown in Table 2.

Table 3: *Variations between measurements of body parts of different goat breeds.*

Morphometric trait (Inches)	Mean ± SE				Sig.
	Damani	Gaddi	Kaghani	Surguli	
Body Length	25.8 ± 0.2[a]	29.8 ± 0.2[c]	28.6 ± 0.3[b]	26.4 ± 0.1[a]	***
Body Weight (Kg)	29.9 ± 0.5[a]	43.9 ± 0.6[c]	38.1 ± 0.9[b]	30.4 ± 0.4[a]	***
Chest Girth	27.5 ± 0.1[a]	31.1 ± 0.2[c]	29.5 ± 0.2[b]	27.5 ± 0.1[a]	***
Ear Blade width	2.0 ± 0.1[a]	3.8 ± 0.1[b]	3.7 ± 0.2[b]	3.3 ± 0.3[b]	***
Ear Length	3.2 ± 0.2[a]	7.8 ± 0.4[c]	8.1 ± 0.5[c]	6.2 ± 0.4[b]	***
Head Length	9.1 ± 0.2[b]	11.0 ± 0.1[c]	8.5 ± 0.2[b]	7.5 ± 0.3[a]	***
Height at Rump	29.7 ± 0.3[a]	35.6 ± 0.2[c]	31.3 ± 0.4[b]	31.5 ± 0.4[b]	***
Height at Wither	28.9 ± 0.3[a]	34.9 ± 0.2[c]	29.7 ± 0.4[a,b]	30.8 ± 0.4[b]	***
Neck Circumference	12.0 ± 0.4[c]	11.1 ± 0.1[b,c]	10.7 ± 0.2[a,b]	10.0 ± 0.3[a]	***
Horn Length	5.5 ± 0.3[a]	10.4 ± 0.3[c]	7.7 ± 0.4[b]	7.2 ± 0.4[b]	***

*Key: ***, p<0.001; superscripts "a, b and c" on the values shows differences with the same row (multiple comparison test from Post hoc Tukey's test)*

Table 4: *Age and sex wise relations to body length, chest girth and body weight in Kaghani breed*

Breed	Trait		Age class (Year)				
				2	3	4	5
Kaghani	Body Length	Overall	28.63±0.30[2]	32.18±0.00	38.07±0.93	38.89±0.44	41.74±0.61
		♂	29.62±0.25	37.86±0.00	----------	39.56±0.00	44.15±1.70
		♀	28.48±0.34	31.24±2.37	38.07±0.93	38.82±0.48	41.06±0.40
	Chest Girth	Overall	29.49±0.21[2]	28.00±0.54	29.50±0.28	29.74±0.12	30.36±0.18
		♂	30.30±0.56	29.00±0.00	----------	30.00±0.00	31.10±0.60
		♀	29.36±0.22	27.83±0.61	29.50±0.28	29.71±0.13	30.15±0.08
	Body Weight	Overall	38.07±0.85[2]	32.18±2.21	38.07±0.93	38.89±0.44	41.74±0.61
		♂	41.43±1.75	37.86±0.00	----------	39.56±0.00	44.15±1.70
		♀	37.56±0.91	31.24±2.37	38.07±0.93	38.82±0.48	41.06±0.40

Age and sex wise increase in body length, chest girth and body weight in Kaghani breed denotes a gradual increase in body parts as age of animal increase. The comparative higher values of body measures of males are also manifested in table.

Results showed that plain and patchy hair colour pattern included in all breeds, with maximum incidence in Kaghani (60% patchy) and minimum in Surguli (33.3% plain). Spotted pattern was not observed in Kaghani breed, with least incidence in Gaddi (3.3%) and Damani (6.7%), however it was (33.3%) in Surguli. The hair length was medium in Damani and Surguli, and long in Kaghani and Gaddi breed. The hairs were straight throughout the breeds with a low incidence of curly hair in Gaddi (3.3%). Kaghani breed had total glossy hair type sheen, followed by Gaddi, Surguli and Damani while dull hair type was reported in Damani. Beard was noticed in all breeds except Damani. There was slight incidence of wattle in Damani and Surguli whereas Kaghani and Gaddi were totally wattle free.

Measurements of different body parts

Table 3 presents the results of morpho-biometric traits of goats in different breeds. Significant using multi comparison Tukey Test. Variation was observed in the recorded data. Gaddi was the heaviest in size manifested by large in body length, chest girth, ear blade width, head length, heights and horn length. It was followed by Kaghani. On the other hand Surguli and Damani were lighter in weight.

Our result further demonstrated that ear length in Gaddi and Kaghani goat breed were 7.80 ± 0.45 and 8.14 ± 0.52 inches followed by Surguli goat breed 6.20±0.44 inches, Low value of ear length was noted in Damani goat breed as 3.21±0.20 inches. Moreover Gaddi and Kaghani were found having large ear blade width as compared to Surguli and Damani.

Likewise, Long head length was reported in Gaddi breed (11.02±0.14 inches).

During current investigation significant variation was observed in the height at rump and at withers among the four goat breeds. Gaddi had height at rump and height at wither of 35.60±0.25 inches and 34.94±0.25 inches respectively followed by Kaghani goat breed having height at rump and at wither 31.28±0.45 inches and 29.70±0.40 inches respectively. Damani had height at rump and height at wither of 29.7 ±0.3 inches and 28.9 ±0.3 inches respectively while Surguli had height at rump of 31.50±0.40 inches and height at wither of 30.8 ±0.4 inches. The neck circumference observed during current study, was maximum in Damani 12.02±0.41 inches followed by Gaddi 11.13±0.12 inches whereas Horn length is an important feature and it was found that Gaddi had the longest horn (10.40±0.33 inches) among the four goat populations.

This was investigated during study that linear body measures varied according to age and sex. A substantial increase in different body parts of the sampled animals was noted at different ages and sex as shown in Table 4.

The body parts of males were recorded with higher values than those in females.

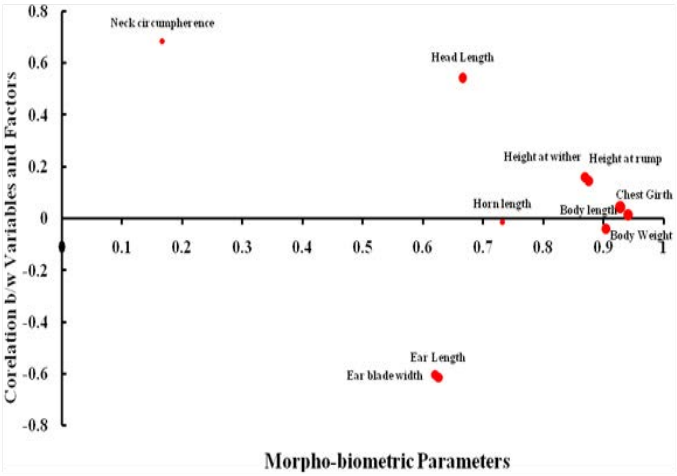

Figure 1: *Correlation between variables and factore of morpho-biometric parameters. Red dots represent morpho-biometric parameters and their occurance in the same region shows positive correlation.*

Correlations between variables and factors

Principle component analysis was performed and correlation between variables and factors was studied. Four clusters appeared comprising of different morph-biometric parameters. Ear length and ear blade width were found in same cluster showing positive correlation. Similarly Chest girth, body length and body weight were found to have positive correlation as were shown to be residing in same cluster. Height at wither and height at rump were also seen to be positively correlated.

Discussion

Variation in the morphological features among the goat breeds may be a result of heredity potential, geographical distribution, environmental conditions and production system (Gizaw et al., 2007). Documentation of morphological characteristics of indigenous livestock breeds is important to implement reliable selection strategies for breeding (FAO, 2007). Therefore, here we attempted to describe the morphological features of four indigenous goat breed of Khyber Pakhtunkhwa. Our data showed significant morphological variation between these breeds, which can further be utilized for breed improvement program.

In our results, the facial profile was convex in Damani and Surguli and straight in Kaghani (83.3%). Similarly ear morphology like shape and orientation was alike in Damani and Surguli having buds and straight edged ears while majority of Kaghani and Gaddi had round and drooping or pendulous ears (Table 1). These findings were in agreement with those reported by Tsegaye et al. (2013) who studied that 93.1% Hararghe goats in Ethopia had long and drooping ears with 98.2% straight facial profile.

An imperative economic characteristic in small ruminants is differences in their hair type, which are of great importance in textile industry. In the present study, majority of the studied breeds had smooth, straight hair, long and glossy hair in Kaghani and Gaddi and short and medium hair in Damani and Surguli with 3.3% curly hair in Gaddi. Similar hair style has been reported by Hagan et al. (2012) who studied indigenous goats in the Coastal Savannah and Eco forest zones of Ghana. We observed that majority of the indigenous goats sampled had smooth hair. Kaghani and Gaddi breed had long and glossy smooth hair, whereas Damani and Surguli breed had short and medium smooth hair. In one of the previous studies, it has been demonstrated that Sirohi goat of arid and semi arid region of Rajasthan (India) having

long haired have better productive and reproductive performance in comparison with the short haired goats (Acharya et al., 1995).

Figure 2: *Goat breed selected for the current study.* **a)** *Surguli Buck,* **b)** *Damani Buck,* **c)** *Khagani Buck and* **d)** *Gaddi Doe.*

Goat breed selected for the current study i.e. Surguli Buck, Damani Buck, Khagani Buck and Gaddi Doe with their morphological traits are illustrated in Figure 2. Furthermore, the previous studies indicated that soft hair type is beneficial in small ruminants in comparison with coarse hair. The former has been associated with usual heat loss from the animal body surface. On the other hand, coarse hairs that may include curly and rough hair are usually associated with anchor dirt and disease producing organisms causing a breeding place for disease (Yakubu et al., 2010). Since smooth hair has been associated with heat dissipation from the animal exterior, therefore the smooth hair of the goat breeds studied here would be beneficial for its survivability in hot harsh environments. This is supported by the affirmation that hair structures have a potential role in compliance of ruminant animals to diverse ecological zones (Banerji, 1984). Additionally, the smooth hair type has strong provision in small ruminants for rapid removal of the external parasites due to the high prevalence of disease causing parasites in the scorching and humid milieu (Kusiluka and Kambarage, 1996). Thus it could be deduced from these reports that smooth hair type of Kaghani and Gaddi goat breed in our study might have played a vital role in their adaptability to the severe cold environment of Northern areas of KP.

Our study regarding hair colour pattern showed that more than 50% Kaghani, Gaddi and Damani had patchy pattern and 40% plain hair colour pattern in the breeds studied here were in agreement with the results of Hagan et al. (2012) showing 41.5% patchy and 42% plain hair pattern in coastal areas of Ghana. All the individuals of the goat breeds that were examined in the current study were horned. Existence of horns in indigenous goats is a significant self-defensive contrivance and an important gauge of their knack to shield themselves and endure the ruthless environments in which they are reared (Katangole et al., 1996). Additionally the occurrence of horn is an adaptive attribute to fight predation particularly in the tropical region where animals had to fight consistently for food and during natural service or breeding (Katangole et al., 1996) The finding of the current study corroborated the conclusion of other researches in different region of the world that uses different goat breeds in diverse environment. Since all four breeds were horned, our current results avowed Odubote (1994) and Adedeji et al. (2006), who have reported that there is a diminutive happening of polledness in native goat breed from southern Nigeria. In the current study also, all the four goat breeds were found having horns irrespective of sex, and no polled animal was observed throughout data collection in the respective region. Beard was dominant in Kaghani and Gaddi, overall (26.7%) while wattles were reported only in Damani and Surguli making overall 15% in all four breeds. These findings are in line to some extent with the results of Hagan et al. (2012) who found 18% beard samples and 27% had wattles. The present study is also in agreement with earlier reports 95.5% goats had no wattles by Tsegave et al. (2013) who worked on Indigenous Hararghe Highland Goat Breed in Their Native Environment, West Hararghe, Ethiopia. According to Traore et al. (2008) absence of 75.33% beard and 70.92% wattles was observed in goat breeds from Burkina Faso.

Gaddi and Kaghani had larger chest girths, heights at rump and withers as compared to Damani and Surguli. These features contributed to the heavy body weights of Gaddi and Kaghani breeds. The body measurement values were higher for males as compared to females. This sexual dimorphism in the form of phenotype has been associated with skeletal and body mass differences (Wronski et al., 2010). This difference may be due to hormonal action which leads to differential growth rates. Our study showed that body weight and other

body parts of the goats increased with the increase in their age. It was more interesting to see that sex and age had a significant ($p<0.01$) positive effect on body weight and many of the linear body measurements as presented in Table 4. These findings are in agreements with the reports of (Hassan and Ciroma, 1992; Tsegaye et al., 2013; Solomon, 2014). The results of the current research showed a strong correlation of body weight to body length and chest girth (Figure 1) as presented in findings of Salako and Ngere 2002, Semakula et al. (2010), Solomon (2014), Vargas et al. (2007). It is seen that hearth girth and body length are enough to estimate body weight accurately. This is in accordance with the reports by Afolayan et al. (2006) in sheep. The consistently higher magnitude of body weight measurements in males compared to females is in conformity with the earlier works of (Lorato et al., 2015; Yakubu et al., 2009; Sowande et al., 2010; Akpa et al., 1998), where almost all body measurements in males were higher than those in females.

Conclusions

The current study demonstrated phenotypic variation in all four goat breed. Gaddi goat was found the heaviest goat breed in Khyber Pakhtunkhwa. Kaghani and Gaddi were more morphologically similar to each other. On the other hand, Damani and Surguli were similar due to their same home tract. The direct relation of linear body parts to body weight is treated as the best selection criteria. These morphological characterizations of Kaghani, Gaddi, Surguli and Damani have to be managed for efficient conservation and utilization in breeding programs. Among the morphological parameters, positive correlation was found between body weight, length and chest girth, ear blade and length and height at wither and height at rump.

Acknowledgements

The present study was a part of first author's original research work during his Ph.D Thesis , Institute of Biotechnology and Genetic Engineering The University of Agriculture Peshawar . The concept was developed by the author with the support of major supervisor. Dr Safdar Hussain Shah. Data was analysed by Muhammad Ibrahim lecturer at IBGE The financial support of Higher Education Commission of Pakistan for this postgraduate research is gratefully acknowledged. The farmers who served as enumerators are also appreciated, including those who showed cooperation by allowing their flocks to be evaluated.

Author's Contribution

Mohammad Nazeer: Conducted the research and wrote the article.
Safdar Hussain Shah: Supervised and guided the whole research project.

References

Abdul Aziz, M. 2010. Present status of the world goat population and their productivity. Lohman Information. 45: 42-52.

Acharya, R.M., U.D. Gupta, J.P. Sehgal and M. Singh. 1995. Coat characteristics of goats in relation to heat tolerance in the hot tropics. Small Rumin. Res. 18: 245-248. https://doi.org/10.1016/0921-4488(95)00703-6

Adedeji, T.A., L.O. Ojedapo, S.O. Adedeji, T.A. Aderogba and A.R. Abdullah. 2006. Characterization of traditionally reared West African Dwarf goats (WAD) in the derived Savannah zone of Nigeria. Anim. Vet. Adv. 5: 686-688.

Afolayan, R.A., I.A. Adeyink and C.A.M. Lakpini. 2006. The estimation of live weight from body measurements in Yankasa sheep. Czech J. Anim. Sci. 51: 343-348.

Akpa, G.N., S. Duru. and T.T. Amos. 1998. Influence of strain and sex on estimation of within-agegroup body weight of Nigerian Maradi goats from linear body measurements. Trop. Agric. (Trinidad), 75: 462–467.

Ali, A and M. Afzal. 2006. Genetic evaluation of Beetal goats for performance traits in Pakistan. Ph.D. Thesis, Deptt. of Animal Breeding Genetics Univ. Agric. Faisalabad, Pakistan.

Banergi, R., 1984. Effect of solar radiation on biochemical constitutents of bloodingoats of different coat colours. Livestock Advisor. 9: 34-38.

Delgado, J.V., C. Barba, M.E. Camacho, F.T.P.S. Sereno, A. Martinez and J.L. Vega Pla. 2001. Livestock characterization in Spain. Anim. Genet. Resour. Instit. 29: 7-18. https://doi.org/10.1017/S1014233900005162

Duchev, Z. and E. Groeneveld., 2006. Improving the monitoring of animal genetic resources on national and international level. Arch. Tierz. Dummerstorf, 49: 532-544. https://doi.org/10.5194/aab-49-532-2006

Ensminger, M.E., 2002: Sheep and goat science: 6th

edn. Interstate Publishers, Danville, IL.

FAO 2008. Global project for maintenance of domestic animal genetic diversity (MoDAD on http://www.fao.org/dad-is/), Food and Agriculture Organization of the United Nations, Rome, Italy.

FAO, 1986: FAO animal production and health paper 58. Small ruminant produciton in the developing countries, by V. M. Timon and J. P. Hanrahan. Food and Agriculture organization of the United Nations, Rome, Italy.

FAO, 2007: Status of animal genetic resources. In: B. Rischkowsky, D. Pilling and B. Scherf (eds), The state of the world's animal genetic resources for food and agriculture, 1st edn. pp. 23-48. Commission on genetic resources for food and agriculture, Food and Agriculture Organization of the United Nations, Rome, Italy.

FAO, 2011: Dairy development in Pakistan, by Umm-e-Zia, T. Mahmood and M. R. Ali. Food and Agriculture Organizaito of the United Nations, Rome, Italy.

FAO. 2011. Dairy development in Pakistan. Food and Agriculture organization of the United Nations Rome.

Fernandez, J., B., Villanueva, R.P. Wong and M.Á. Toro. 2005. Efficiency of the Use of Pedigree and Molecular Marker Information in Conservation Programs. Genetics. 170: 131–132. https://doi.org/10.1534/genetics.104.037325

Gizaw, S., J.A.M.V.A.H. Komen, J.J. Windig and O. Hanotte. 2007. Population structure, genetic variation and morphological diversity in indigenous sheep of Ethiopia. Anim. Genet. 38: 621–628. https://doi.org/10.1111/j.1365-2052.2007.01659.x

GOP, 2006. Pakistan livestock census 2006, Partners available at: http://www.pbs.gov.pk/content/pakistan-livestock-census-2006 (Retrieved Nov 16, 2017).

GOP, 2016. Pakistan economic survey 2016-17, Partners available at: http://www.finance.gov.pk/survey_1617.html (Retrieved Nov 16, 2017).

Hagan, J.K., S.O. Apori, M. Bosompem, G. Ankobea and A. Mawuli. 2012. Morphological Characteristics of Indigenous Goats in the Coastal Savannah and Forest Eco-Zones of Ghana J. Anim. Sci. Adv. 2(10): 813-821.

Hassan A. and C. Ciroma. 1992. Body weight measurements relationship in Nigerian Red Sokoto. P. 428-432 in Proc. 1th Biennial Conf. African Small Rumin. Research. Networks, ILRAD, Nairobi, Kenya.

Iqbal, A., B.B. Khan, M. Tariq and M.A. Mirza. 2008. Goat-A Potential Dairy animal: Present and future Prospects. Pak. J. Agri. Sci. 45: 227-230

Khan, M.S., M.A. Khan and S. Mahmood, 2008. Genetic resources and diversity in Pakistani goats. Int. J. Agric. Biol. 10: 227-231.

Katangole, J.B.D., B. Sebolai and M.J. Madimabe 1996. Morphological Characterization of Tswana goat. In: S.H.B.Lebbie and E.Kagwini(ed). Small Ruminant Research and Development in Africa. Proc. 3rd Biennial Conference of the African Small Ruminant Research Network, UICC, Kampala Uganda 5-9 Dec.1994 pp 43-46.

Kusiluka, L. and Kambarage, D. Diseases of small ruminants in Sub-Saharan Africa A handbook. Center for Tropical Veterinary Medicine, VETAID, Scotland.

Lanari, M.R., H. Toddeo, E. Domingo, M.P. Centeno and L. Gallo. 2003. Phenotypic differentiation of exterior traits in local Criollo goat population in Patagonia (Argentina). Arch. Tierz. Dummerstorf, 46: 347-356. https://doi.org/10.5194/aab-46-347-2003

Lorato, Y., K.M. Ahmed and B. Belay. 2015. Morphological Characterization of Indigenous Woyto- Guji goat type in Loma district, Southern Ethiopia. 10: 2141-2151.

MacHugh, D.E. and D.G. Bradley, 2001. Livestock genetic origins: goats buck the trend. Proc. Natl. Acad. Sci. U S A, 98: 5382-5384. https://doi.org/10.1073/pnas.111163198

Nomura, K., T. Yonezawa, S. Mano, S. Kawakami, A.M. Shedlock, M. Hasegawa and T. Amano, 2013. Domestication process of the goat revealed by an analysis of the nearly complete mitochondrial protein-encoding genes. PLoS One. 8: e67775. https://doi.org/10.1371/journal.pone.0067775

Odubote, I.K., 1994. Characterization of the West African Dwarf goat for certain qualitative traits. Nigerian J. Anim. Prod. 21: 37-41.

Riva, J., R. Rizzi, S. Marelli and L.G. Cavalchini. 2004. Body measurements in Bergamasca sheep. Small Rumin. Res. 55: 221–227. https://doi.org/10.1016/j.smallrumres.2003.12.010

Ruane, J., 1999. A critical review of genetic distance studies in breed conservation. J. Anim. Breed.

Genet. 116: 317-323. https://doi.org/10.1046/j.1439-0388.1999.00205.x

Salako, A.E., and L.O.Ngere.2002. Application of multifactorial structural discriminant analysis in the morphometric structural differentiation of West African Dwarf and Yankasa sheep in South West Nigeria. Niger. J. Anim. Prod. 29(2): 163-167

Sarwar, M., M.A. Shahzad and M. Nisa. 2010. Small Ruminant Production in Pakistan. 3 rd International Scientific Conference on Small Ruminant Development, Hurghada, Egypt. Egypt. J. Sheep Goats Sci. 5: 17-26.

Semakula, J., D. Mutetikka, D.R. Kugonza and D. Mpairwe. 2010. Variability in body morph metric measurements and their application in predicting live body weight of Mubende and Small East African goat breeds in Uganda. Middle East J. Sci. Res. 5: 2.

Skapetas, B. and V. Bampidis, 2016. Goat production in the world: present situation and trends. Livest. Res. Rural Develop. 28: 200.

Solomon, A., 2014. Design of community based breeding programs for two indigenous goat breeds of Ethiopia. Doctoral Thesis. Vienna, Austria.

Sowande, O.S., B.F. Oyewale and O.S. Iyasere. 2010. Age and sex-dependent regression models for predicting the live weight of West African Dwarf goat from body measurements. Trop. Anim. Hlth. Prod. 42: 969–975. https://doi.org/10.1007/s11250-009-9515-4

SPSS Version 20.0. Software Package for Social Sciences for Window.

Traoré, A., H.H. Tamboura, A. Kabere, L.J. Royo, I. Farnandez, I. Alvarez, M. Sangare, D. Bouchel, J.P. Poivey, D. Francois, L. Sawadogo and F. Goyache 2008. Multivariate analyses on morphological traits of goats in Burkina Faso. Arche. Tierz. Dummerstorf. 51: 588-600. https://doi.org/10.5194/aab-51-588-2008

Tsegaye, D., B. Belay and A. Haile 2013. Morphological Characterization of Indigenous Hararghe Highland Goat Breed in Their Native Environment, West Hararghe, Ethiopia American-Eurasian J. Scient. Res. 8: 72-79.

Vargas, S., A. Larbi and M. Sanchez. 2007. Analysis of size and conformation of native Creole goat breeds and crossbreds used in smallholder agrosilvo pastoral systems in Puebla, Mexico. Trop. Anim. Hlth. Prod. 39: 279–286. https://doi.org/10.1007/s11250-007-9012-6

Wronski, T., A. Mohamed. Sandouka, M. Plath and P. Cunningham.2010. Differences in sexual dimorphism among four gazelle taxa (*Gazella* spp.) in the Middle East. Anim. Biol. 60:395–412. https://doi.org/10.1163/157075610X523279

Yakubu, A.A., O. Raji and J.N. Omeje.2010. Genetic and Phenotypic differentiation of qualitative traits in Nigerian indigenous goats and sheep populations. ARPN J. Agric. Biol. Sci. 5.

Yaqoob, M., F. Shahzad, M. Aslam, M. Younas and G. Bilal. 2009. Production performance of Dera Din Panah goat under desert range conditions in Pakistan Trop. Anim. Hlth. Prod. 41: 1413-9. https://doi.org/10.1007/s11250-009-9329-4.