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MORPHOMETRIC, PRODUCTIVE AND REPRODUCTIVE TRAITS IN INDIGENOUS CATTLE OF NORTHERN AZAD JAMMU & KASHMIR

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ABSTRACT

The objective of this research was to study the morphometric measurements, productive and reproductive performances of indigenous cows and heifers in Northern Azad Jammu & Kashmir (AJ&K). A total 237 phenotypic characteristics was recorded visually. Five main coat colors (reddish brown, light brown, black, white and grey) were found with black muzzle and eye-lashes. The head length was 37.7±0.2 cm with small horns (11±0.3 cm). The positive correlation between horn length/horn base circumference, ear length/ear width, forehead width/horn length were found statistically significant ($p \leq 0.01$). The highest positive correlations were found between age/rump width (0.77), age/parity (0.66), body weight/ heart girth (0.62) and parity/rump width (0.60). The average age at puberty (41.02±0.6 months), average age at first service (49.3±0.7 months), age at first calving (58.54±0.7 months), mean gestation period (279.6±0.2 days), mean post-partum heat period (253.2±14.8 days), mean service period (257.69±5.8 days), mean calving interval (17.87±0.4 months), mean service per conception (1.5±0.06) and average milk yield per day (1.20±0.06 litre) were also recorded. In conclusion, the indigenous cattle are short stature, reddish brown in color with poor reproductive and productive performance.

Key Words: Morphometric, Productive, Reproductive, Indigenous cattle**,** Azad Kashmir

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INTRODUCTION

Livestock is the most important and fastest growing part of the agricultural economy in Pakistan and presently it contributes 60.6 percent to the overall agriculture and 11.7 percent to the GDP during 2019-20 (Pakistan Economic Survey, 2020). Native breeds are commonly preferred in village production systems due to their adaptation to local stresses. Generally, in developing countries, the local livestock breeds are under exploited and insufficiently renowned (Shahid *et al*., 2019). Conservation of livestock in developing countries highly depends upon breed characterization, which helps in designing suitable management programs. In this context, external characterization bears a major role in the breed standards (Canelon, 2005). The biometric body traits called morphometric traits can be studied by using measurements with appropriate instruments. Morphometric measurements are helpful for cultural characterization and population's classification. This also helps to compare hereditary groups and make the relationship between an animal's function and conformation. Moreover, these qualities help in process of selection, for recognizing morphologically better animals and in removing the not needed traits (Lucena *et al*., 2015).

Productive and reproductive traits are crucial factors determining the profitability of dairy production (Lobago *et al*., 2007). The reproductive performance of the breeding female is probably the single most important factor that is a prerequisite for sustainable dairy production system, herd replacement and the production of milk (Kiwuwa *et al*., 1983). Age at first puberty is an important determinant of reproductive efficiency (Mukasa-Mugerwa, 1989).

It is feasible to find a number of body-traits about domestic animals (Dhami *et al*., 2015; Shahid *et al*., 2019), but study about the correlation between them is limited in literature, even though they are extremely significant to genetic development programs. A strong correlation is present between body measurements, the productive and reproductive characters among cattle (Silva *et al*., 2011).

Heritable possessions and the main characters for Pakistan's livestock breeds are not well explained (Khan *et al*., 2014). It is essential to assess local cattle for external characteristics, productive and reproductive performance ability especially in- their home tracks. The main objectives of this study were to characterize the indigenous cattle of Azad Jammu and Kashmir (AJ&K) both morphologically and morphometrically and investigate their reproductive and productive performance.

MATERIALS AND METHODS

Study area: The research was carried out in Northern districts (Muzaffarabad, Bagh and Hattian Bala) of AJ&K. Topographically, the entire Northern districts are mountainous, usually inclined from northeast to south-west and the area falls in smaller Himalaya's region. These districts are with mild, and generally warm temperate climate and significant rainfall. The summer is hot and humid, and the winters are chilly with snowfall at high peaks.

Animal selection: Animals were randomly selected regardless of their productive/reproductive status, age and body condition. The body condition of cows/heifers selected ranged from 3 to 4 on a scale from 1 to 5 (Wildman *et al*., 1982). A total of 237 animals were selected, which involved 216 cows of mixed parity and 21 heifers between 2 and 5 years of age. A questionnaire proforma was used to collect the data regarding their age, parity, morphological characters, productive and reproductive traits.

Morphological characteristics: Morphological variations such as colors of coat, coat patch, muzzle, eyelashes, eye lid, horn, leg, shin, vulva, hoof, tail-switch, rump patch and presence of strip along the backbone were recorded visually, and each color was expressed in percentage.

Morphometric traits and methods of recording: Morphometric traits were measured in centimeters (cm), using a measuring tape and a caliper ruler, with the animal standing on a flat surface in normal position. The measurements were obtained using the methodology applied by Wenceslau *et al*. (2000), Oliveira *et al*. (2001) and Carvalho *et al*. (2010), in which all the measurements were obtained from cows before milking.

The traits of the head measurement were: head length (HL): distance from the occipital to muzzle (except muzzle), forehead width (FW): the distance between the exterior face of orbital arcade, horn length (HoL): from base to tip of horn, horn base circumference (HBC), distance between the base of horns (HS), ear length (EL): distance between ear's attachment point and ear tip, ear width (EW): the distance between two tips in largest width of ear, and muzzle circumference (MC): measured as the circumference, a little above the nostrils and around the point of muzzle (Coffie *et al*., 2018).

The traits of the body measurements included: live body weight (LBW): recorded early in the morning after overnight fasting on a weighing mechanical scale (0-1000 Kg), heart girth (HG): circumference around the heart at the fourth rib, body length (BL): distance between the shoulder point and pin, height at withers (HW): distance between ground and highest point of withers, leg height (LH): measured from medium malleolus of tibia, in a straight line to the front edge, shin length (SL), crown rump length (CRL), chest width (CW), tail length (TL): distance between the tail root and tip of the tail except switch at tip, dewlap length (DL), dewlap width (DW), rump width (RW): the distance between the ischia, hump length (HuL), hump width (HuW), navel depth (ND), udder depth (UD): measured by comparing the distance between the deepest part of the udder and hock length of teat, length of teat (LT): all teats were measured; from the upper part of the teats where they hang perpendicularly from the quarter to the tip and average was calculated for four teats of one animals, distance between front teat (DFT), distance between rear teat (DRT), and hoof circumference (HC): circumference of the hoof's coronary band, were taken. The HG of pregnant animals was not included for analysis.

Reproductive performance: The reproductive parameters of the cattle recorded were: age at puberty: determined by the age at first estrus after birth, age at first service, gestation period (GP), age at first calving (AFC), service period (SP): time period after calving to subsequent conception, calving interval (CI): time period between the dates of two consecutive calving, post-partum heat period (PPH): time period after parturition to first time estrus appearance after calving (Kunbhar *et al*., 2016). The number of services per conception was also recorded.

Productive performance: The information about productive performance of the cattle recorded was lactation length (days): time period from calving date to drying date, average milk yield/day (liters): morning and evening milk produced was added to obtain average daily milk yield for individual cattle, dry period (days): time period from date of drying to the next calving.

Statistical analysis: All data were expressed as mean±Standard Error of Mean (SEM) and coefficient of variance (CV). The coefficient of correlation was applied to determine the relationship between various morphometric traits. The value of $p \leq 0.05$ was considered significant. All the statistical analysis was implemented using SPSS version 16.

RESULTS AND DISCUSSION

Morphological Characteristics: Majority of cattle had reddish brown (33%) coat color with predominantly white patches (53%). Black color was most common on muzzle, eyelids, eye lashes, horns, hoof and tail-switch (Table 1). Variation in coat color depends upon geographical and climatic environment (Seo *et al*., 2007; Desta *et al*., 2011). Achai cattle have grey to whitish color with black pigment on muzzle (Khan *et al*., 2015). Kayastha *et al*. (2011) reported that majority of local cattle in Assam had black color on muzzle, horns, hoof

and tail-switch. Khirari *et al*. (2014) reported black (87.22%), grey (9%), white (1.70%) and brown (2.11%) eyelid color in cattle of Ratnagiri district (India).

Morphometric Traits

Head measurements: The descriptive analysis of the head morphometric measurements of indigenous cattle is presented in Table 2. The head measurement is very important in description and standardization of different cattle breeds. The coefficient of variation (CV) varied from 5 to 26%. The mean±SEM HL and FW of local multiparous cattle of AJ&K was 38.5±0.2 cm, 14.02±0.07 cm respectively which is comparable to that of Cholistani cattle of Punjab Pakistan (Shah *et al*. 2018). There was no significant difference (P>0.05) between HL of the multiparous and the heifers of indigenous cattle in present study.

Table 1: Proportion of color characteristics in indigenous cattle of AJ&K.

Variable	Reddish Brown (%)	Light Brown (%)	Black (%)	White (%)	Grey (%)
Coat color	33	20	19	15	13
Coat patch pattern	23	12	12	53	-
Vulva	4	-	94	2	-
Muzzle color	8	6	45	36	5
Eyelid color	5	-	89	6	-
Eyelashes	4	-	89	8	-
Horn color	-	-	100	-	-
Leg color	13	1	37	49	-
Shin	11	2	35	52	-
Hoof color	-	-	100	-	-
Tail switch	3	-	76	21	-

Table 2: The descriptive analysis of the head morphometric measurements in indigenous cattle of AJ&K.

Variables	Category	Mean±SEM (cm)	Min. value (cm)	Max. value (cm)	CV%
Head Length	Heifers	36.7±0.9	33.02	39.0	5
	Multiparous	38.5±0.2	33.04	40.9	6.4
Forehead Width	Heifers	13.3±0.4	10.0	15.5	7.5
	Multiparous	14.02±0.07	11.5	15.5	5
Horn Length	Heifers	9.4±0.8	2.5	12.7	26
	Multiparous	14.0±0.2	9.2	20.4	14
Horn Base	Heifers	3.3±0.06	3.0	4.0	6
Circumference	Multiparous	4.2±0.05	3.5	5.5	11
Distance between Horns	Heifers	8.9±0.1	7.0	10.0	6
	Multiparous	10.1±0.06	9.1	11.2	5
Ear Length	Heifers	18.5±0.4	10.5	22.1	9
	Multiparous	19.0±0.1	11.4	24.8	5.4
Ear Width	Heifers	10.0±0.2	8.8	12.7	11
	Multiparous	10.7±0.1	11.4	15.9	18
Muzzle Circumference	Heifers	35.4±0.7	30.4	40.4	9
	Multiparous	38.1±0.2	33.0	46.6	6

The observed mean±SEM horn length was 9.4±0.8 cm (heifers) and 14.0±0.2 cm (multiparous cows). Khan *et al*. (2015) reported a higher average (17 cm) HoL in Achai cattle. The observed HBC in indigenous cattle was 4.2±0.05 cm which is similar to that of local cattle of Mizoram (5.05±1.27 cm) (Saidur and Girin, 2015) and in native cattle of Sylhet district of Bangladesh (3.94±4.05 cm) (Koirala *et al*., 2011). The average distance between the horns was 10.1±0.06 cm. The average horn distance in Inkuku (21.3 cm) and Inyambo (28.4 cm) breed of Rwanda are higher than present findings (Hirwa *et al*., 2017). The mean±SEM ear length and ear width in indigenous multiparous cows were 19.0±0.1 cm and 10.7±0.1 cm respectively. Comparable findings were obtained by Khan *et al*. (2015) in Achai cattle of Lower Dir, Pakistan (19 cm). The EL (25.6±1.70 cm) and EW (15.8±0.89 cm) in Sahiwal cattle of Pakistan were higher than in the present study (Khan *et al*., 2018). The appearance, structure and size of the ear have importance in explanation of racial cattle standards. Usually, the required standard of head size is from small to medium. The muzzle circumference of indigenous

cattle of AJ&K was 38.1±0.2 cm. Coffie *et al.* (2018) reported the similar MC (37.22 cm) in dual-purpose cows of Ghana.

To describe and standardize different cattle breeds the correlation of head measurements play a significant role. The correlation between head measurements varied from -0.874 to 0.66 (Table 3). The positive correlation between HoL/HBC, EL/MC, EL/EW, FW/HoL, EW/MC and FW/HBC were found statistically significant ($p \leq 0.01$). The positive correlation among EL/EW was similar ($p \leq 0.01$) to the correlation obtained by Khan *et al*. (2018) in Sahiwal cattle of Pakistan. The negative correlation between HBC/EW ($p \leq 0.05$), HBC/MC ($p \leq 0.05$), HL/HoL ($p \leq 0.01$), FW/EW ($p \leq 0.05$), HL/FW ($p \leq 0.01$), HoL/HS ($P \leq 0.01$) and HBC/HS ($p \leq 0.01$) were found statistically significant. Similar negative correlation between HL/FW (-0.04) was recorded by Tolenkhomba *et al*. (2012) in local cattle of Manipur (India). In the present study, no correlations were found between EL/HL (0.08) and EW/HL (0.07).

Body measurements: The descriptive analysis of the body morphometric measurements of indigenous cattle is presented in Table 4. The CV varied from 1.4 to 26%. In several circumstances for defining performance, body measurements can be valuable (Bene *et al*., 2007). The average body weight was 186.8±7.5 Kg and 305.5±5.34 Kg in indigenous heifers and multiparous cows respectively. In selection practices and experimental work body measurements and live weights have been extensively used taken on live animal (Gunawan and Jakaria, 2010). The average heart girth (HG) observed in indigenous heifers and cows was 133.1±2.3 cm and 158.6±1.7 cm respectively. Heart girth is excellent parameter for estimating the live body weight due to the simplicity of handling the animal when performing this task. Shah *et al*. (2018) reported the average HG (119.80 ± 11.90 cm) of Cholistani cattle in Punjab Pakistan. The results obtained by Koirala *et al*. (2011) in local cattle of Bangladesh (112.09±16.68 cm); Al-Amin *et al.* (2007) in North Bengal Grey cattle (117.8±18.5 cm) is lower than the results obtained during the present study.

Table 3: Phenotypic correlation of head morphometric characteristics of indigenous cattle of AJ&K.

	FW	HoL	HBC	HS	EL	EW	MC
HL	-0.33**	-0.20*	0.02	0.03	0.08	0.07	-0.02
FW		0.28**	0.23**	-0.17	-0.01	-0.21*	-0.006
HoL			0.66**	-0.63**	-0.05	-0.18*	-0.08
HBC				-0.87**	-0.02	-0.09	-0.18*
HS					0.003	0.06	0.09
EL						0.29**	0.32**
EW							0.24**

* P≤ 0.05; ** P≤ 0.01; head length (HL), forehead width (FW), horn length (HoL), horn base circumference (HBC) distance between horn (HS), ear length (EL), ear width (EW) and muzzle circumference (MC).

The body length of heifers and multiparous was 100.4±1.5 cm and 118.3±1.1 cm respectively. Khan *et al*. (2015) reported the similar BL (112 cm) in Achai cattle and similar results (114.38±1.56 cm) were reported by Habib *et al.* (2003) in Red Chittagong cow.

The mean height at withers of indigenous multiparous cattle of AJ&K was 110.7±0.8 cm. Similar results (107.71±0.93 cm) were obtained by Habib *et al*. (2003) in Red Chittagong cow of Bangladesh. In India Karthickeyan *et al*. (2006) reported higher average HW (116.4±1.2) in Krishna valley cattle. These results showed that indigenous cattle of AJ&K have medium stature and medium size which is suitable for mobility in the difficult hilly terrain of Northern part of AJ&K.

The mean leg height and shin length of indigenous cattle was 57.8±0.5 cm and 24.6±1.1 cm respectively. Shah *et al*. (2018) reported a higher average LH (74.160±4.31) in Cholistani cattle.

The average tail length of heifers and multiparous cows was 79.7±1.0 cm and 80.9±1.0 cm respectively in the present study. The higher TL (99.8±7.49 cm) in Sahiwal cattle of Pakistan was measured by Khan *et al*. (2018). A shorter tail length was observed in Achai (75±1.332 cm) and Cholistani (63.44±8.61 cm) cattle (Khan *et al*., 2015; Shah *et al*., 2018). The average dewlap length and width of indigenous cattle was 53.8±0.3 cm and 14.8±0.1 cm respectively. Similar dewlap width (15.4±2.51 cm) was obtained by Khan *et al*. (2018) in Sahiwal cattle of Pakistan.

The average rump width was 30.0±0.6 cm in indigenous cattle. Khan *et al*. (2018) reported the higher average (33.7±2.37 cm) RW in Sahiwal cattle of Pakistan. The lower average (25.28±3.75) RW of Cholistani cattle of Punjab (Pakistan) was recorded by Shah *et al*. (2018). The rump width of female cows in this present study reflects virtuous reproductive capability for these animals and which may be considered as of average height. According to de Melo *et al*. (2018) rump area contains female reproductive structures, specifically, the womb. The uterine development will be higher with wider rump width, while females are more disposed to

have complications in their calving along with smaller rump. However, females are less efficient and have less longevity with large rumps and generally are heavy weight animals. For the movement of the cattle, the rump is an important structure beyond the reproductive function.

The average udder depth and LT of indigenous multiparous cattle were 20.3±0.9 cm and 2.4±0.1 cm respectively. Bag *et al*. (2010) reported a higher average LT (5.10±1.02 cm) in Red Chittagong Cattle in Bangladesh. The mean distance between the front and rear teats in the present study was 3.9±0.1 and 3.2±0.1 cm respectively.

The correlation in morphometric measurements of body ranged from -0.36 and 0.77 (Table 5). The 81 correlations (between all combinations) were assessed, out of which 56 were positive and 25 were negative. The highest positive correlations were found between Age/RW (0.77), Age/Parity (0.66), BW/HG (0.62) and Parity/RW (0.60). The moderate significant correlations between various traits indicate the association between these traits and shows harmony in cattle bodies examined. There was significant correlation ($p\leq 0.05$) between body weight and body length, heart girth and withers height. The body weight was highly correlated ($p\leq 0.01$) with the heart girth as reported by Siddiqui *et al*. (2015) in Sahiwal cattle of Pakistan. The correlation in BW and HG (0.62) is comparable to correlations obtained by Kugonza *et al*. (2011). The positive correlation between the Age/BL, BL/HW and Age/HG are similar to the correlations obtained by Musa *et al*. (2011) in Sudanese Kenana cattle whose Age/BL correlation was 0.40 ($p\leq 0.01$), BL/HW correlation was 0.59 ($p\leq 0.05$) and HG/Age correlation was 0.57 ($p\leq 0.01$). The positive correlations found between the HG/HW, HG/RW and HG/BL are similar to the correlations obtained by Shah *et al*. (2018) in Cholistani cattle of Punjab Pakistan (HG/HW, 0.86; HG/RW, 0.80 and HG/BL, 0.91). The similar positive correlation between HW/BW, HG/BW, HG/BL, BL/BW, HG/HW and BW/Age were reported by Musa *et al*. (2011) in Sudanese Kenana cattle. Tolenkhomba *et al*. (2012) reported similar positive correlations between HW/BL and HG/BL in native cattle of Manipur (India) (HW/BL, 0.31 and HG/BL, 0.21). The lowest negative correlations in the present study were found between Age/SL (-0.36), HW/SL (-0.34), BW/HuL (-0.31) and HuL/DRT (-0.31). There is a balanced relationship between measurements of body and body weights. At this point of view, live body weight is estimated to close to kilogram (kg) and subsequently it might be assessed for selling. The variations in morphometric measurement are useful for making division between animal strains (Gatesy and Arctander, 2000), breeding goal evaluation (Zechner *et al*., 2001), and making a comparison of production and feeding systems. To appraise the beef cattle classes for business the height at withers play an important role (Alderson, 1999). The nutritional status of the cattle is affected by body weight and heart girth measurement and is associated with fat and muscle accumulation. To indicate the inherent size of the cattle, body measurements as body length and height at wither are most important factors (Kamalzadeh *et al*., 1998).

Reproductive performance: Data regarding reproductive traits is presented in Table 6. The mean age at puberty was 41.02±0.6 months. The results recorded in this study for the age at puberty were higher than the results reported by Kunbhar *et al*. (2015) in Red Sindhi cattle (20.5 months) of Baluchistan (Pakistan). Puberty is the manifestation of reproductive competence. The late age at puberty recorded in this study may be due to the genetic factors, climatic factors and feeding conditions. The mean age at first service was 49.4±0.9 months.

The mean age at first calving (AFC) in indigenous cattle was higher (1756.2 days) than Red Sindhi cows (1346 days; Mustafa *et al*., 2003), Sahiwal cattle (1243 to 1358.80±7.9 days; Mohiuddin *et al*., 1991), and Cholistani cows (1041.15 days; Chaudhary and Shafiq, 1994). The difference in AFC may be due to management and genetic factors particularly care and nourishing system. To reduce the rearing cost of a heifer the age at first calving (AFC) plays a significant role. The accomplishment of maturity both physically and sexually is determines by first calving age. Moreover, economically minor investment and faster capital resume will be ensured by early first calving.

The mean gestation length in indigenous cattle was 279.6±0.2 days. Similar results (285 days) were reported by Rehman, (2006) in Sahiwal cattle of Pakistan. The gestation length is characteristic of the species. Gestation length variations may be subsidized mainly by parental and fetal features within an individual in different animals (Al Amin *et al*., 2007).

The mean postpartum heat period in the present study was recorded as 253.2±14.8 days. A lower average (105 days) post-partum heat period in Red Sindhi cattle of Pakistan was reported by Mustafa *et al*. (2003). However, the results recorded in the present study were higher than some other breeds; this may reveal the poor management in the field conditions and genetic factor of the breed.

The mean SP in indigenous cattle during present study was 257.69±5.8 days. Khan *et al*. (2008) reported a lower service period in Sahiwal cattle (155 days), Red Sindhi cattle (210 days) and Cholistani cattle (140 days). This can be reduced with appropriate detection of heat, inseminate on time with good quality semen and in case of natural service, breeding bull efficiency.

Table 4: The descriptive analysis of the body morphometric measurements in indigenous cattle of AJ&K.

Variables	Category	Mean±SEM	Min. value	Max. value	CV%
Body Weight (Kg)	Heifers	186.8±7.5	136.0	243.0	18
	Multiparous	305.5±3.4	175.0	469.0	26
Heart Girth (cm)	Heifers	133.1±2.3	121.9	152.4	6
	Multiparous	158.6±1.7	124	185.4	11.6
Body Length (cm)	Heifers	100.4±1.5	86.9	110.3	1.4
	Multiparous	118.4±1.1	86.6	149.9	11.2
Height at Withers (cm)	Heifers	102.1±0.9	93.9	110.5	4.4
	Multiparous	110.7±0.8	101.0	129.5	9.0
Leg Height (cm)	Heifers	53.5±3.3	22.8	63.5	6.4
	Multiparous	57.8±0.5	22.8	73.2	14.9
Shin Length (cm)	Heifers	23.9±0.6	13.0	28.1	20
	Multiparous	24.6±1.1	19.7	34.4	14.9
Crown Rump Length (cm)	Heifers	139.8±2.4	121.9	161.3	7
	Multiparous	159.4±0.8	127.0	182.8	6
Chest Width (cm)	Heifers	33.6±0.4	24.4	36.8	6
	Multiparous	34.1.9±0.7	26.2	41.6	10.5
Tail Length (cm)	Heifers	79.7±1.0	73.6	86.3	4.9
	Multiparous	80.9±1.0	74.7	86.9	6.6
Dewlap Length (cm)	Heifers	39.8±2.1	31.7	58.4	21
	Multiparous	53.8±0.3	48.0	63.8	7
Dewlap Width (cm)	Heifers	10.0±0.2	8.0	12.0	9
	Multiparous	14.8±0.1	12.0	18.0	6
Rump Width (cm)	Heifers	31.5±0.8	22.8	36.6	9
	Multiparous	30.0±0.6	23.2	37.9	12.3
Hump Length (cm)	Heifers	20.9±0.7	12.7	27.9	14
	Multiparous	23.3±0.2	18.0	33.0	15
Hump Width (cm)	Heifers	15.1±0.5	11.5	22.8	133
	Multiparous	20.3±0.3	12.0	27.9	10
Udder Depth (cm)	Heifers	17±0.5	15.2	19.2	8.7
	Multiparous	20.3±0.9	20.0	36.0	15
Length of Teat (cm)	Heifers	2.3±0.2	1.5	3.0	26
	Multiparous	2.4±0.1	1.5	3.0	16
Distance between front teat (cm)	Heifers	3.8±0.4	2.5	4.3	17
	Multiparous	3.9±0.1	2.5	7.6	26
Distance between rear teats (cm)	Heifers	2.9±0.4	1.2	5.0	26
	Multiparous	3.2±0.1	1.2	6.3	26
Hoof Circumference (cm)	Heifers	33.9±0.6	21.5	38.10	8.4
	Multiparous	33.9±0.3	27.9	39.3	11

Table 5: Phenotypic correlation of body morphometric characteristics in indigenous cattle of AJ&K.

	Parity	BW	HG	BL	HW	LH	SL	CRL	CW	TL	DL	DW	RW	HuL	HuW	UD	LT	DFT	DRT	HC
Age	0.66**	0.49**	0.53**	0.40**	0.26**	0.09	-0.36**	-0.01	-0.23**	0.31**	-0.14	0.40**	0.77**	-0.229*	0.33**	0.246**	0.06	-0.04	-0.13	0.008
Parity		0.26**	0.19*	0.25**	0.20*	0.05	-0.23**	0.01	-0.12	0.20*	0.04	0.29**	0.60**	0.01	0.27**	0.10	0.07	-0.09	-0.18*	0.03
BW			0.62**	0.21*	0.19*	0.11	-0.11	-0.02	-0.05	0.19*	0.13	0.25**	0.48**	-0.31**	0.07	0.30**	-0.09	-0.05	0.09	0.05
HG				0.40**	0.26**	0.16	-0.12	-0.02	0.01	0.09	-0.04	0.15	0.55**	-0.21*	0.16	0.49**	-0.08	-0.13	0.16	0.04
BL					0.58**	-0.16	-0.45	0.29**	0.09	0.17	0.03	0.34**	0.29**	-0.03	0.19*	0.44**	0.19*	-0.15	-0.21*	-0.04
HW						-0.25**	-0.34**	0.33**	-0.02	0.17	0.03	0.35**	0.16	-0.09	0.35**	0.35**	0.17	-0.11	-0.01	-0.13
LH							0.37**	0.12	-0.29**	0.26**	-0.09	-0.18*	0.08	0.31**	-0.07	-0.03	-0.05	-0.25**	-0.06	0.28**
SL								-0.03	-0.10	-0.27**	0.002**	-0.39	-0.21*	0.11	-0.18	-0.08	-0.10	0.16	0.20*	0.15
CRL									0.07	0.37**	-0.04	0.16	-0.08	0.04	0.08	-0.06	-0.08	-0.10	0.003	0.10
CW										-0.23*	0.08	-0.12	-0.1	0.07	-0.15	0.03	-0.05	-0.07	-0.16	0.01
TL											-0.2	0.40**	0.15	0.01	0.17	-0.13	-0.18*	-0.18*	-0.11	0.23**
DL												0.22*	-0.02	-0.10	0.00	0.21	0.05	-0.12	0.12	-0.05
DW													0.32**	-0.25**	0.22*	0.08	-0.05	-0.05	-0.04	-0.29**
RW														-0.20*	0.07	0.27**	0.01	-0.04	-0.03	-0.13
HuL															0.09	-0.16	0.26**	-0.27**	-0.31*	0.20*
HuW																0.26	0.15**	-0.15	-0.06	0.07
UD																	-0.03	-0.19	-0.12*	0.05
LT																		-0.02	-0.06	-0.01
DFT																			0.35	-0.05*
DRT																				-0.25**

* P≤ 0.05; ** P≤ 0.01; body weight (BW), heart girth (HG), body length (BL), height at withers (HW), leg height (LH), shin length (SL), crown rump length (CRL), chest width (CW), tail length (TL), dewlap length (DL), dewlap width (DW), rump width (RW), hump length (HuL), hump width (HuW), udder depth (UD), length of teat (LT), distance between front teat (DFT), distance between rear teat (DRT) and hoof circumference (HC)

Table 6: Reproductive and productive performances of the indigenous cattle of AJ&K.

Variables	Mean±SEM	Min. value	Max. value
Age at Puberty (Month)	41.02±0.6	29.0	60
Age at First Service (Month)	49.3±0.7	30	65
Age at First Calving (Month)	58.54±0.7	37	74.12
Gestation Period (Days)	279.6±0.2	271	289
Post-Partum Heat Period (Days)	253.2±14.8	90	530
Service Period (Days)	257.69±5.8	90	930
Calving Interval (Month)	17.87±0.4	12.23	26
No. of Services per Conception	1.5±0.06	1	4
Lactation Length (Days)	136.8±4.9	60.0	330.0
Milk Yield/day (Liters)	1.20±0.06	0.50	3.0
Lactation Yield (Liters)	160.8± 6.7	45.0	450.0
Dry Period (Days)	399.3.6±4.7	230.0	510.0

In the present study the mean CI in indigenous cattle was 17.87±0.4 months. Lower calving interval was reported by Rehman and Khan (2012) in Sahiwal cattle (438 days) and Farooq *et al.* (2010) in Cholistani cattle (422 days) of Pakistan. In an earlier study the calving interval of indigenous cattle of AJ&K was reduced from (536±0.4) up to (368.8±5.32 days) by artificially inseminating the cows with frozen-thawed Jersey semen (Khan *et al*., 2014).

In indigenous cattle mean services per conception was 1.5±0.06. Saidur and Girin, (2015) reported higher (2.47±0.11) services per conception in Zobawng cattle of Mizoram (India). The outstanding performance of cattle related to services per conception lower than 1.5 (Campbell and Marshall, 1975).

Productive performance: The data related to the productive performance of animal is given in Table 6. The mean lactation length in indigenous cattle was 136.8±4.9 days. The higher lactation length was recorded in some cattle breeds of Pakistan such as Sahiwal (235 days), Red Sindhi (200 days) and Cholistani cattle (200 days) by Rehman and Khan, (2012), Aslam *et al*. (2002) and Ashfaq, (2020) respectively. These variations in overall lactation period and total milk production could be because of their natural habitat, exercise and open grazing in the mountainous pasture.

The mean daily milk yield was 1.20±0.06 litre. Lower daily milk yield has been recorded during the present study than daily milk yield of Achai cattle (2.81±0.12 litres) of Peshawar, (Pakistan) (Uddin *et al*., 2014). The daily milk yield is also lower than the indigenous cattle of Rwanda (3.6±0.19 litres) (Hirwa *et al*., 2017). The native cow of Sylhet has 1.33±0.4 litres mean milk yield per day (Koirala *et al*., 2011) which is closer to present findings. The variations observed in milk yield provides chances of selection in resources of indigenous cattle for increasing milk yield of AJ&K.

Conclusions: It is concluded that the indigenous cows of AJ&K may be considered short structured humped animals with different coat colors. They have low productive performance, late age at puberty, long service period and calving interval. The smaller udder depth and length of teat indicated that these cattle cannot be categorized as a dairy breed. However, because of its smaller size, these cattle are ideal to be used as a foundation cow for crossbreeding program.

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Novelty Statement: The standard scientific information about several traits of the indigenous cattle of Azad Jammu and Kashmir is yet deficient. Therefore, the local parental lines should be preserved, and breeding plans must be designed for upgradation. Hence, the present study is designed for appraising and characterizing indigenous cattle.

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