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Original Research

Morphometric Characteristics and Management of the Desert Donkeys (*Equus asinus*) of Rajasthan

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Abstract

In India, donkeys constitute about 22% of total equine population but most of them are non-descript local donkeys. The present study was conducted to characterize phenotypically the donkeys of Rajasthan available in different districts and to identify their housing, feed and fodder, health management system. Body length, height at withers, heart girth in adult donkeys irrespective of sex were 97.62±0.27, 95.78±0.25, 104.49±0.32, respectively. Significant differences were observed in biometric indices viz., ear length, tail length, fore leg length, canon length, hoof length, canon circumference, pastern circumference and hoof circumference between adult male and female donkeys. Donkeys are of many coat colours but gray are more prevailing, accompanied by shoulder crosses, white muzzles, eye rings, white bellies and inner legs. The forehead of donkeys was observed slightly convex. The donkeys rarely suffer from any diseases except colic as reported by the donkey keepers of the study area. Vaccination was not in practice in donkeys of Rajasthan. Majority of the respondents were not aware about the symptoms of estrus jenney and their jennies were getting pregnant themselves through the natural covering during grazing.

Keywords: Biometric, Donkeys, Management, Phenotypic Characterization, Rajasthan

Introduction

Donkeys of Indian Thar desert are unclassified and recognized as non-descript donkeys. These animals have very good draught-power, immunity and stress bearing capabilities (Rattan *et al.*, 1998, Gupta *et al.*, 2000). In India, majority of the donkey population owned by socially and economically deprived landless people and these animals serve as the source of livelihood for their masters and play an important role in their socio-economic status (Gupta *et al*., 2017). These animals are the only source of livelihood for a particular section of the society, which includes poorest of poor countrymen (shepherds, nomadic tribes etc). These people use donkeys to carry their luggage during grazing of their livestock. In most of the Rajasthan, donkeys are used mainly as pack animals while in Sardarsahar, Churu, Rajgarh, Sikar, Ratangarh and Jhunjhunu, these are mainly used in carting (Pal *et al.*, 2013,). These are capable of thriving in hot arid climates (Pal *et al*., 1997; Pal *et al*., 2000) and can survive even in adverse conditions such as scarcity of feed (Gupta *et al.*, 1999; Pal and Gupta, 2004; Pal and Gupta, 2004a). The contribution of donkeys has been enormous in agriculture, herding and carrying materials with migratory herds of cattle, sheep and goats, transportation of agricultural produce, household material and provision as well as material for building construction. Although donkeys support the rural livelihood and low-income poor farmer's families by providing economy at minimal maintenance cost, they are not yet considered as farm animals.

The population of donkeys in India is dwindling at a rapid pace and according to the recent livestock census there was 61.23% decline in the donkey population all over India and it was recorded as 71.31% in Rajasthan state (Table 1 & Fig. 1). In this connection, it is utmost important to record, characterize the various donkey breeds present in the country and initiate necessary conservation strategies to minimize the drastic decline in their population. In this regard, a systematic and scientific generation of base line data on physical and phenotypic characteristics, feeding, housing and health management and reproductive efficiency was planned to initiate the registration of desert donkeys.

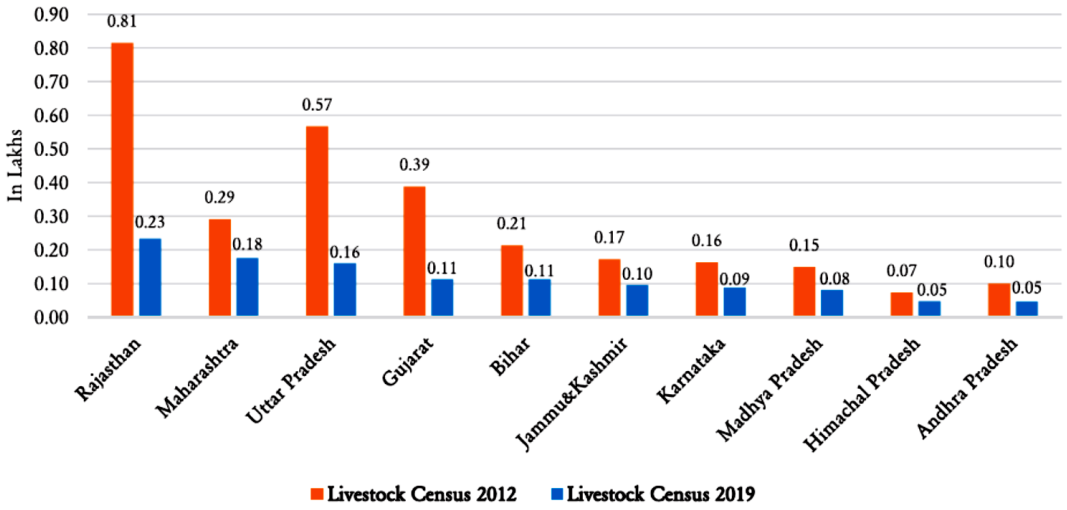

Figure 1: Donkey Population, 2012 and 2019 in Major 10 states of India (Source: Livestock census, 2020, DAHD,GOI)

Table 1: Donkey population in 10 major states (Source: Livestock census, 2020, DAHD,GOI)

S. No.	States	Population (In lakhs)2012	Population (In lakhs)2019	%Change
	INDIA	**0.32**	**0.12**	**-61.23**
1	Rajasthan	0.81	0.23	-71.31
2	Maharashtra	0.29	0.18	-39.69
3	Uttar Pradesh	0.57	0.16	-71.72
4	Gujarat	0.39	0.11	-70.94
5	Bihar	0.21	0.11	-47.31
6	Jammu & Kashmir	0.17	0.1	-44.55
7	Karnataka	0.16	0.09	-46.11
8	Madhya Pradesh	0.15	0.08	-45.46
9	Himachal Pradesh	0.07	0.05	-34.73
10	Andhra Pradesh	0.1	0.05	-53.22

Materials and Methods

Donkeys from desert districts of Rajasthan *viz.*, Barmer, Bikaner and Churu were included in the present study. Information on the performance traits and various management practices followed by donkey owners were collected by interviewing farmers using a structured questionnaire. The physical characteristics and coat colour were recorded for the donkeys included in the study. Feeding, housing and management practices adopted by donkey keepers were also recorded.

For biometric indices, data was recorded from one week old foals (8), 3 months old foals (45), 6 months old foals (36), 1 year old foals (36), 1-2 years old donkey stock (49), 2-3 years old stock (105), adult female donkeys (252) and adult male donkeys (286) for generating base line information for phenotypic characterization. Twenty two biometric indices were recorded for phenotypic characterization of the breed *viz.*, body length, height at withers, heart girth, neck length, face length, ear length, tail length without switch, tail length with switch, foreleg length, hind leg length, canon circumference foreleg, canon circumference hind leg, canon length foreleg, canon length hind leg, pastern circumference foreleg, pastern circumference hind leg, pastern length foreleg, pastern length hind leg, hoof length foreleg, hoof length hind leg, hoof circumference foreleg, hoof circumference hind leg. The data collected from three districts was pooled and mean and standard error were calculated. Data on different body measurements was statistically analyzed using SPSS 7.1 software.

Physical characteristics and coat colour were expressed in percentage/frequency. The donkey's economic importance and socio-cultural role was discussed with the donkey owners. This study was based on the information given by the donkey owners, and the breed was documented according to the perspectives of the relevant breeders.

Results and Discussions

Donkey Population

A total of 0.23 lakh donkeys were available in different districts of Rajasthan as per the 20th Livestock census 2020 and a total of 81,468 donkeys were available in different districts of Rajasthan as per the 19th Livestock census 2012. Maximum donkey population was in Barmer district (17,495), followed by Bikaner (8,712), Jaisalmer (5,846), Churu (5,063) and least in Tonk district (268) (http://animalhusbandry.rajasthan.gov.in/livestock_census.aspx). Donkey population decreased from 0.32 to 0.12 million between last two census (http://164.100.117.97/WriteReadData/userfiles/key%20results.pdf) (Table 1). But Rajasthan still ranks first in donkey population across India, containing about 23 thousand in 2019. The donkeys are used for carrying different types of load by their owners for earning their livelihood while, 10-15% donkeys are also used by shepherds/ nomadic tribes for carrying their children, old family members and household belongings from one place to other with their animal herds.

Physical Characteristics

Physical appearance of each representative of various donkey populations of Rajasthan has been depicted in Figure 2. The small light gray donkeys were prevalent throughout the desert districts of Rajasthan. These donkeys were very hardy and surefooted. Their body was well developed with fairly strong bones. The legs were thin and covered with small coarse hairs. The mane was short and stands straight up and they usually have a dorsal stripe (a stripe along their back) and a strip across the shoulders as shown in the picture (Fig. 2 A-D). They have very dominant eyebrow ridges and can be very stubborn. Lips were loose compared to horses. The tail was thin with a tasseled end called switch (Fig. 2 I-K). The tail switch was distinguishable and of darker colour than rest of the body colour in the donkeys. Mane or tail of a donkey was stiff and coarse. Zebra marking on legs and strip on back could be seen (Fig. 2 C&D). The body was solid, displaying an alert attitude, the face was convex, the ears of donkey were much longer than horse, erect and the eyes were black (Fig. 2 E-H). The back was straight and the tail was medium in length and straight and sometimes it extended beyond hocks. Neck was short. Donkeys were well adapted to the ecology of the desert area. The donkeys were docile in temperament.

Body Colour

Donkeys were having gray, white and black coat colour, accompanied by dorsal stripes on the back, spots, dark ear

markings, white muzzles, eye rings, white bellies and inner legs (Fig. 2 A-D). In similar type of study, Behl *et al*. 2016 observed that majority of the donkeys in Andhra Pradesh are predominantly of the light brown to brown coat colour with lighter bellies. The body colour pattern studied on donkeys revealed that gray (70%) and white colour (30%) are common. White colour donkeys of the desert area are mostly spotless.

Figure 2: Representative animals of different donkey population of Rajasthan showing their physical features.

Body Measurements

The biometric measurements for the young stock of donkeys at different age groups are given in Table 2. Twenty-two different biometric indices of adult male donkeys (286) and adult female donkeys (252) were recorded for generating base line information for phenotypic characterization (Table 2 and Fig. 3).

Table 2: Biometric indices of young donkeys selected from different areas of Rajasthan.

Age	Body length (cm)	Height at withers (cm)	Heart girth (cm)	Face length (cm)
One week (8)	51.62±0.75	65.62±0.97	59.25±0.98	29.37±0.97
3 months (45)	62.55±1.09	70.52±0.86	72.77±1.22	32.91±0.61
6 months (36)	72.65±1.51	79.17±1.35	83.97±1.56	35.23±0.80
1 year (36)	82.31±0.99	87.48±0.77	94.94±1.30	40.08±0.39
1-2 year (49)	85.20±1.01	91.18±1.07	98.25±1.39	42.84±0.48
2-3 year (105)	90.53±0.57	93.07±0.62	100.11±0.77	44.21±0.31

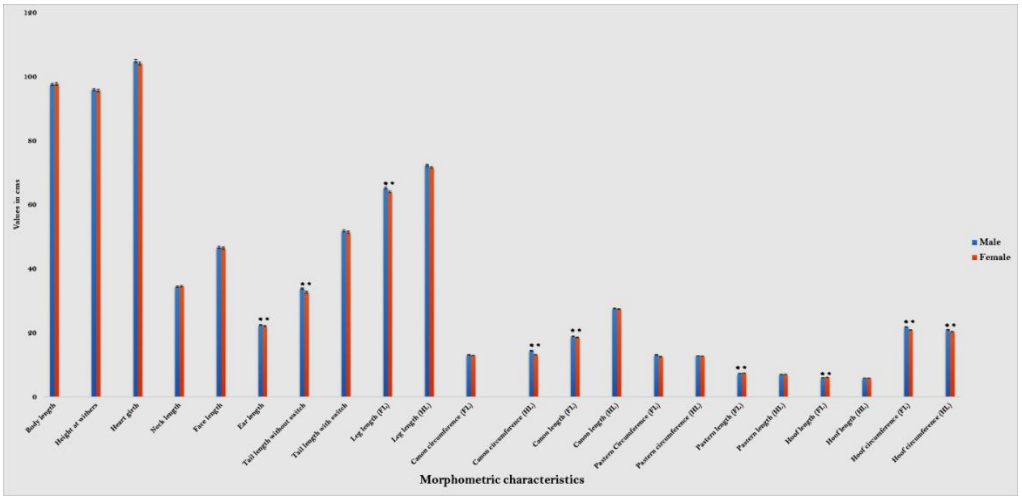

Figure 3: Different biometric indices of adult donkeys selected from desert areas of Rajasthan (Male (n=286); Female (n=252))

Young Stock

The biometric measurements for the young stock of donkeys at different age groups are given in Table 2. The donkeys of age one week, 3 months, 6 months, 1 year, 1-2 years and 2-3 years had mean heights at withers as 65.62±0.97, 70.52±0.86, 79.17±1.35, 87.48±0.77, 91.18±1.07 and 93.07±0.62 cm, respectively. The mean heart girths at these age groups were 59.25±0.98, 72.77±1.22, 83.97±1.56, 94.94±1.30, 98.25±1.39 and 100.11±0.77 cm, respectively. The body length increased with advancement of age from birth to 2-3 years of age. The body length increased from 51.62±0.75 (one week), to 62.55±1.09 (3 months) to 72.65±1.51 (6 months) to 82.31±0.99 (1year) to 85.20±1.01 (1-2 years) and 90.53±0.57 cm (2-3 years).

Adult Donkeys

For adult donkeys (538), average values of body length, height at withers, heart girth, neck length, face length, ear length, tail length without switch, tail length with switch, foreleg length, hind leg length, canon circumference foreleg, canon circumference hind leg, canon length foreleg, canon length hind leg, pastern circumference foreleg, pastern circumference hind leg, pastern length foreleg, pastern length hind leg, hoof length foreleg, hoof length hind leg, hoof circumference foreleg, hoof circumference hind leg were recorded and presented in Table 3. In all these adult donkeys, body length was significantly ($P<0.05$) higher than height at withers. In similar type of study, Singh *et al.* (2007) reported average height at withers, body length and heart girth as 92.08±0.57, 96.82±0.56 and 100.78±0.58cm, respectively. These indices reported in the present study were slightly more than reported by Singh *et al.* (2007). Body length observed was similar whereas height at withers was lower and heart girth was higher in the present study as compared to earlier report in donkeys (Pal *et al.*, 2013). Face length and ear length were 46.57±0.22 cm and 22.25±0.07 cm, respectively. These parameters were similar to earlier reports (Pal *et al.*, 2013). However, in contrast to present study, Gupta *et al.*, (2017) reported average face length of donkeys from Bihar as 50.3±0.36 cm.

Table 3: Different biometric indices (in cms) of adult donkeys selected from desert areas of Rajasthan.

Traits	Overall (n=538)		Male (n=286)	Female (n=252)
	Mean (cms)	Range (cms)	Range (cms)	Range (cms)
Body length	97.62±0.27	83-116	83-111	85-116
Height at withers	95.78±0.25	84-116	84-116	85-115
Heart girth	104.49±0.32	89-121	89-121	89-120
Neck length	34.44±0.15	28-44	28-42	29-44
Face length	46.57±0.22	38-55	38-55	38-55
Ear length	22.25±0.07	19-26	19-26	19-26
Tail length without switch	33.24±0.21	23-48	24-48	23-48
Tail length with switch	51.60±0.24	41-65	42-65	41-62
Leg length (FL)	64.66±0.23	50-78	50-78	50-76
Leg length (HL)	71.97±0.19	56-82	56-82	58-81
Canon circumference (FL)	12.96±0.06	10.5-15.5	10.5-15.0	10.5-15.5
Canon circumference (HL)	13.76±0.10	10.5-15.0	11-15	10.5-15.0
Canon length (FL)	18.66±0.07	15.5-22.0	16-22	15.5-22
Canon length (HL)	27.46±0.09	24-32	25-32	24-30
Pastern Circumference (FL)	12.78±0.06	10.5-16.0	11-16	10.5-14.5
Pastern circumference (HL)	12.74±0.05	10.5-15.0	11-15	10.5-15.0
Pastern length (FL)	7.32±0.04	6-9	6-9	6-9
Pastern length (HL)	7.01±0.04	5.5-8.5	6-8	5.5-8.5
Hoof length (FL)	5.97±0.03	4.5-7.0	4.5-7.0	4.5-7.0
Hoof length (HL)	5.81±0.04	4-7	4-7	4.5-7.0
Hoof circumference (FL)	21.34±0.08	18.5-26.0	19-26	18.5-24.5
Hoof circumference (HL)	20.62±0.09	18-25	18.5-25	18-24

(FL- Fore Leg; HL- Hind Leg)

The detailed biometric parameters for the male and the female donkeys are given in Table 3 and Fig. 3. Although, no significant difference was found between adult male and female donkeys in their biometric indices *viz.*, body length, height at withers, heart girth, neck length, face length etc. The mean heights at wither of brown type animals

are 94.57±5.24 cm and 89.82±3.36 cm in adult males and females, respectively (Behl *et al*. 2016). However, significant differences were observed between adult male and female donkeys in some of the biometric indices *viz.*, ear length, tail length, fore leg length, canon length, hoof length, canon circumference, pastern circumference, hoof circumference as shown in Table 2 and Fig. 3.

The forehead of donkeys was observed slightly convex (Fig. 2 E-H). The nasal bone was straight to slightly concave. The ears were straight and erect with slight lateral orientation (Fig. 2 E-H). The average length of ears was 22.42±0.10 in male and 22.06±0.10 cm in female donkeys. The extremities of ears were dark in colour of light brown and dark brown donkeys. The back of donkeys was strong and straight to slightly concave. The hoof circumferences of fore and hind limbs of male donkeys were 21.75±0.12 and 20.90±0.13 cm, while the hoof circumferences of fore and hind limbs of female donkeys were 20.88±0.10 and 20.30±0.11 cm, respectively. In some donkeys, tail was above the hock, in others up to hock and in few donkeys it extended beyond hocks. The tail length of male and female donkeys was 51.85±0.31 and 51.31±0.38 cm, respectively. The tail switch was distinguishable and of darker colour than rest of the body colour in most donkeys except white donkeys. Hair of donkeys were of medium length, dull in appearance and straight. The foals had long hair with glossy appearance. This base line information will be quite useful in registration of these donkeys of desert as a separate breed.

Feeding Management

In Rajasthan, donkeys were not only reared by Kumhar, Sansi and Muslim community but also by landless as well as small and marginal farmers irrespective of caste. Most of the farmers reared sheep/cattle herds to augment their income. One to four donkeys were being maintained by the sheep or cattle herders to carry the luggage while they were on grazing their sheep or cattle herds. Donkeys were left loose for grazing after work. They graze in the *gochar* or the fields not under crops. No feed supplements were being provided to donkeys which were being reared by sheep and cattle herders. Aganga *et al*. (2000) reported that donkeys seldom need any additional feed as free-range animals. The donkeys being used for carting work are raised both on grazing and stall feeding. Besides grazing, they were also supplemented with some amount of dry or green fodder (about 5kg). Some of the donkey keepers also provided about 250-500 g of concentrate per day along with 50 g *jaggery* (*gur*). Ahmed *et al.* (2008) also reported that donkeys in Nigeria were maintained with little or no feed supplementation in form of straw, house hold waste or grains. The amount of concentrate was increased when they were employed for hard work. The dry fodder mostly consisted of crop residues of bajra and jowar straw, moth (*Vigna aconitifolia*) straw, groundnut (*Arachis hypogaea*) straw, *dub (Cynodon dactylon)* and other crops grown in the region. The concentrate consisted of locally available grains mainly bajra, wheat bran and barley. The water was provided twice/thrice a day. Salt was also being provided to the carting donkeys only. Similar findings about watering and common salt feeding were reported by Pal *et al.* (2013) and Gupta *et al.* (2017). In donkeys, a great loss of salt and minerals takes place through sweat when they work as pack or cart animals which necessitates their replenishment through supply of mineral mixture and common salt on daily basis to get optimum work from the donkeys.

Housing Management

In desert districts of Rajasthan, donkeys generally were not provided any proper housing to rest. In urban and semi-urban areas where donkeys were used for pulling carts, their keepers provide housing either under tree or in sheds covered with thatched, tin roofs. Singh *et al.* (2007) also reported that about 80% donkeys were kept in groups in an open bara (wooden enclosure) without roof and proper gate. Pal and Legha (2008) also observed that 44% of mule producers of Haryana, Uttarakhand and UP provide *kutcha* thatch shed to their equines.

Health Management

Regularly grooming of donkeys, at least once a day, was reported by the donkey keepers using the donkey for pulling the cart whereas shepherd and dairymen were not adopting grooming at all. Although hoof cleaning of carting donkeys was in practice but shoeing as well as hair clipping were not common practices. Regular trimming of hoof to keep in shape is must which was lacking in arid region. There is need to vaccinate the equines as prophylactic measures. But vaccination was not in practice in any of the part in Rajasthan. The donkeys rarely suffered from any diseases as reported by the donkey keepers of the study area. The major problem in donkeys was of colic. Deworming and vaccination was not in practice in donkeys of desert districts of Rajasthan. Similar observations were also reported in donkeys of Rajasthan earlier by Pal *et al.* (2013) and in other Indian donkey

breeds by Gupta *et al*. (2017). Deworming was not in practice in donkeys reared by shepherd or dairymen. However, respondents were providing dewormer occasionally in the form of locally made masalas or using therapeutic medicines in those parts of Rajasthan where utility of donkey in pulling cart was prevalent. Pal *et al.* (2011) also reported that deworming of horses was being done as curative measures in Spiti valley, whereas deworming of equines was a common practice among the equine owners of Haryana, Uttar Pradesh and Uttarakhand (Pal and Legha, 2008).

Reproductive Performance Under Field Conditions

Information about reproductive performance was generated by interviewing the donkey keepers. Although donkeys prevailing in desert districts of Rajasthan breed throughout the year, main breeding season extends from March to October. The age at puberty of the male and female donkeys was reported as 1.5-2.0 years. The age at first service was 2.0-2.5 years. No scientific breeding or artificial insemination was in practice. Method of donkey breeding was through natural mating and donkey owners even hardly know about the pregnancy status of their donkey mares. Male and female donkeys were left loose in field when not in use so controlled breeding is not expected. In similar type of study, Pal *et al*. (2013) reported that majority of donkey keepers were not aware about the symptoms of estrus jenney and their jennies were getting pregnant themselves through the natural covering during grazing. The duration of estrus was reported as 4 -10 days. Duration of oestrus cycle was observed as 19-25 days. The age at first conception was 2-3 years. The gestation period was 12-12.5 months. Service period was 2-3 months. Foaling interval was 15-18 months. The age at first foaling was 3-4 years. The donkey mares were observed breedable up to 15 years as reported by the donkey keepers.

Although the technique of artificial insemination (AI) and semen freezing for equines under laboratory and field conditions has been standardized (Arangasamy *et al*., 2008; Pal *et al.*, 2009; Pal *et al.*, 2011; Legha and Pal, 2012), efforts need to be made to create awareness among the donkey keepers about the merits and use of AI in donkeys. Animal Husbandry Department of State Government should also take initiative for AI in equines by getting their veterinarians trained through ICAR-National Research Centre on Equines, Hisar. This technique could be utilized to provide the superior germplasm in the form of frozen semen to the donkey keepers and it will aid in augmenting reproduction and conserving the donkeys.

Conclusion

The population of donkeys in India is dwindling at a rapid pace and in this connection, it is utmost important to record, characterize the various donkey breeds present in the country and initiate necessary conservation strategies to minimize the drastic decline in their population. In this regard, a systematic and scientific generation of base line data on physical and phenotypic characteristics, feeding, housing and health management and reproductive efficiency was generated for the desert donkeys for the first time.

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Conflict of Interests

There is no conflict of interest.

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