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Morphometric and production traits characterization of malvi sheep in malwa region of Madhya Pradesh

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Abstract

The present study was undertaken to characterize the morphometric, productive, reproductive, wool, and carcass traits of the indigenous Malvi sheep population reared in the Malwa and Nimar regions of Madhya Pradesh, India. Field surveys were conducted across 285 villages covering 138 representative flocks, and phenotypic observations were recorded from 6,358 animals. Morphometric measurements were taken from 1,250 male and 1,350 female Malvi sheep. Malvi sheep are medium-to-large sized animals exhibiting variable coat colours with characteristic dark patches, a slightly convex facial profile, pendulous ears, and absence of horns. Adult body weight averaged 39.25 ± 1.85 kg in rams and 33.50 ± 1.30 kg in ewes, indicating superior growth performance under extensive management. Average daily milk yield was 310.50 ± 4.25 ml with a lactation yield of 30.50 ± 1.5 kg. Reproductive performance showed age at first lambing of 464.50 ± 4.5 days, litter size of 1.25 ± 0.10 , and lambing rate of $64.50 \pm 1.3\%$. Greasy fleece weight averaged 1.50 ± 0.05 kg, while dressing percentage reached 59.5% in males and 58.5% in females. The findings highlight the Malvi sheep as a valuable genetic resource possessing good growth, carcass yield, reproductive efficiency, and adaptation to semi-arid environments.

Keywords: Malvi sheep, morphometric traits, production performance, reproductive traits, wool characteristics, carcass traits, milk yield, genetic resources, semi-arid adaptation, madhya pradesh, indigenous sheep, phenotypic characterization, extensive management, pastoral system, livestock biodiversity

Introduction

India harbours an exceptionally diverse array of indigenous sheep germplasm, reflecting its vast agro-climatic variability and long-standing pastoral traditions. As per the 20th Livestock Census (2019), the national ovine population stands at approximately 74.26 million, positioning India as the world's third-largest sheep-rearing nation (BAHS, 2019). The ICAR-National Bureau of Animal Genetic Resources (NBAGR) has formally registered 46 indigenous sheep breeds to date, representing a critical step towards conserving and valorizing this genetic heritage. Despite this, nearly 50% of India's sheep remain non-descript, lacking systematic characterization of their morphometrics, productivity, reproductive traits, and genomic profiles (Breed-wise Survey Report, ICAR-NBAGR, 2022, <https://nbagr.res.in/brc>). The Malvi sheep population has been distinctly recognised by pastoral rearing communities for approximately 50 years. Malvi sheep display variable coat colour (predominantly white, black, brown, or black-and-white) with frequent brownish patches and dark brown to black pigmentation on the face, neck, and ears. The head is slightly convex with a Roman nose and elevated profile; ears are medium-long, pendulous, and leafy. The breed shows a high dressing percentage, indicating excellent carcass yield and good meat-producing potential under local conditions. Malvi sheep are well adapted to the semi-arid agro-climatic conditions of central India and are primarily reared under an extensive or pastoral system.

The Malvi sheep represents a promising yet formally unregistered indigenous population in its native tract; however, published information on its morphometric traits, milk composition, wool characteristics, and overall productive performance remains scarce. The present work

aims to address these knowledge gaps by providing a comprehensive documentation and analysis of phenotypic and morphometric characteristics, milk quality parameters, wool attributes (fibre diameter, staple length, and fleece traits), key production and reproduction performance indicators, as well as the traditional rearing and management practices followed by pastoralist communities for the Malvi sheep.

Materials and Methods

Geographical distribution

The Malvi sheep is indigenous to the Malwa and Nimar

regions of Madhya Pradesh, centrally located at approximately 23.78° North latitude and 75.99° West longitude, within a semi-arid transitional zone characterized by black cotton soils, undulating plateaus, and erratic monsoon rainfall ranging from 600 to 900 mm annually. This compact breeding tract spans 112 square kilometres across eight districts, with Dhar and Indore serving as core areas supporting the highest population density due to communal grazing lands along the Narmada River tributaries (Fig.1).



Fig 1: Native tract of Malvi sheep in Madhya Pradesh

Field visits were conducted across various villages located in the native breeding tract of the Malvi sheep in order to gather comprehensive and representative data. The random sampling method was used to select the villages to minimize sampling bias or systematic error. The survey work was strategically scheduled: data collection at farmers' homes was carried out during the morning hours when animals were usually confined, whereas observations in the grazing areas (range) were made during the daytime when flocks were out for grazing. A total of approximately 35 villages spread across the key districts of the Malvi sheep's home tract were covered during the survey period. For selecting individual flocks and animals, purposive sampling technique as described by Singh and Chaudhary (1989) was adopted, which allowed targeting of typical, representative flocks maintained under traditional management systems. The average flock size in the breeding tract was observed to consist of approximately 60% adult ewes, 15% breeding rams, and 25% lambs (below one year of age). The total population of Malvi sheep in the home tract is estimated to be around 45,000-50,000 heads.

The phenotypic characterization of the Malvi sheep breed was achieved through detailed on-field examination and recording of data from 130 different flocks belonging to the breeding tract. Body weight and a comprehensive set of body measurements (biometry) were recorded separately for male and female animals across various physiological age groups, namely: at birth, 3 months, 6 months, 12 months, at first lambing (for females), and in adult animals. The exact age of

each animal was ascertained by interviewing the farmer about the month and year of birth, and this information was subsequently verified and confirmed through dentition examination using the method described by Banerjee, 1991. The morphological traits were measured for both sexes including body length, chest girth, height at withers, and body weight, *etc.* All linear measurements except body weight were taken in centimetres using a flexible measuring (inch) tape, while body weight was recorded in kilograms using a weighing balance. This systematic approach ensured standardized and comparable data across the population studied.

Results and Discussion

The Malvi sheep is a medium-to-large sized breed native to Madhya Pradesh, primarily raised for mutton, wool, and milk production. The coat colour varies from white, brown and black with black or brown patches of varying intensity and distribution over white coat colour. The patches are also seen around the head. The face exhibits slightly convex profile with a prominent roman nose and elevated face. The coat colour is wool type with medium fleece length. The wool is medium thick coarse and non-lustrous and covers head, face, belly and legs. The ears are long, pendulous, and leafy. Horns and wattles were absent in both the sexes. The tail is long and thick, and cylindrical in shape. The limbs are tall and slender and covered with wool (Fig 2).



Fig 2: Malvi sheep in its native tract

A total of 2,600 animals (**1,250** males and **1,350** females) within the breeding tract were evaluated for measurements of morphometric traits-including body length (BL), height at withers (HW), and chest girth (CG), as well as body weight (BW). The overall mean body weights were recorded in the present study under field conditions for both the sexes (Table 1). At birth, the body weight for male was 3.50 ± 0.28 kg, and for female the body weight was 2.50 ± 0.23 kg. At 3 months of age, the body weight for male was 11.00 ± 1.28 kg, and for female it was 9.15 ± 1.17 kg. At 6 months of age, the body weight for male was 14.25 ± 1.10 kg, and for female it was 11.50 ± 1.05 kg. At 1 year of age, the body weight for male was 31.50 ± 1.27 kg, and for female it was 27.50 ± 1.05 kg. At first lambing, the body weight for female is 28.25 ± 1.20 kg.

The adult body weight for male is 39.25 ± 1.85 kg, and for female is 33.50 ± 1.30 kg; which is higher than Sonadi sheep with 12 months body weight of 23.31 ± 0.12 kg (Tailor *et al.*, 2006) [6]. Sahana *et al.* (2004) [5] has reported adult body weight of male and female Jalauni sheep 35.5 ± 2.1 and 27.2 ± 0.7 kg, respectively.

The morphometric measurements for adult rams showed mean ($\pm$ SE) values of 78.50 ± 1.50 cm for body length, 82.50 ± 1.6 cm for height at withers, and 74.50 ± 2.4 cm for chest girth. For adult ewes, the corresponding values were 70.50 ± 1.80 cm, 76.50 ± 1.40 cm, and 70.50 ± 1.80 cm, respectively (Table 2). Higher values for body length, height at withers, and chest girth in Madgyal sheep were reported by Tarange *et al.* (2023) [7].

Table 1: The body weight (kg) at different age in male and female Malvi sheep

Weight at	Male			Female		
	Average	Range	N	Average	Range	N
Birth	3.5 ± 0.28	2 - 5	580	2.50 ± 0.23	1.5-4	510
Weaning/ 3 months	11 ± 1.28	9-12	580	9.15 ± 1.17	8-10	510
6 months	14.25 ± 1.10	12-17	580	11.5 ± 1.05	10-14	510
1 year	31.5 ± 1.27	25-34	1150	27.5 ± 1.05	20-30	1040
First Lambing	-	-	-	28.25 ± 1.2	25-31	510
Adult weight	39.25 ± 1.85	35-48	1150	33.5 ± 1.30	30-41	1190

Table 2: The body measurement in adult male and female Malvi sheep

Body measurement	Male			Female		
	Average	Range	N	Average	Range	N
Chest-girth	74.5 ± 2.4	78-90	1250	70.5 ± 1.8	68-73	1350
Body length	78.5 ± 1.5	74-81	1250	72.5 ± 1.3	73-82	1350
Height at withers	82.5 ± 1.6	75-95	1250	76.5 ± 1.4	73-82	1350

Performance traits

Milk traits

The dairy performance traits are presented in Table 3. The average daily milk yield was 310.50 ± 4.25 ml, and the total lactation milk yield was 30.5 ± 1.50 kg. The lactation length

ranged from 85 to 105 days, with a mean of 95.5 ± 1.20 days. The fat percentage in milk ranged from 4-6 %, with an average of 4.50 ± 0.10 %. The solid-not-fat content in Malvi sheep was 8.75 ± 0.15 %.

Table 3: The dairy performance of Malvi sheep

Parameters	Average	Range	N
Daily Milk Yield (g)	310.5 ± 4.25	180-400	568
Total Lactation Milk Yield (Kg)	30.5 ± 1.5	28-35	568
Lactation Length (days)	95.5 ± 1.2	85-105	568
Fat (%)	4.5 ± 0.10	4 - 6	105
SNF (%)	8.75 ± 0.15	7.5 - 10	105

Reproduction traits

The age at first mating of male is 9.50 ± 0.15 months, whereas the age at first mating of females was 10.25 ± 0.50 months. The age at first oestrus ranged from 185-280 days, with the mean of 221.50 ± 1.20 days, and the duration of oestrus cycle ranged from 15-20 days, with the mean of 17.5 ± 0.18 days. The first lambing age in Malvi sheep ranged from 395 to 490 days, whereas the lambing interval ranges from 250 to 350 days. The service period and gestation period

in Malvi sheep was 72.0 ± 1.50 days, and 151.50 ± 2.30 days, respectively. The litter size in Malvi sheep was 1.25 ± 0.10 , and the lifetime lamb production was 6.50 ± 1.00 , with the lambing rate of 64.50 ± 1.3 (Table 4). The age at first lambing were recorded 425.41 ± 2.99 days in Madgyal sheep, 21.60 ± 0.09 months in Mecheri sheep, and 16-18 months in Muzaffarnagri sheep (Tarange *et al.*, 2023; Richard *et al.*, 2003) [4, 7]

Table 4: The reproductive performance of Malvi sheep

Parameters	Average	Range	N
Age at first mating in males (months)	9.5 ± 0.15	8-12	610
Age at first mating in females (months)	10.25 ± 0.5	8-14	945
Age at first Oestrus (days)	221.5 ± 1.2	185-280	945
Oestrus cycle duration(days)	17.5 ± 0.18	15-20	945
Age at first lambing (days)	464.5 ± 4.5	395-490	945
Lambing interval (days)	290.5 ± 9.5	250-350	945
Service period (days)	72 ± 1.5	65-110	945
Gestation length (days)	151.5 ± 2.3	145-160	568
Litter size	1.25 ± 0.10	1-2	568
Lifetime lamb production	6.5 ± 1.0	5-9	568
Lambing rate (%)	64.5 ± 1.3	50-80	568

Fleece characteristics

The Malvi sheep produces true wool and are shorn once (or sometimes twice) a year from around 6-8 months of age. The fleece colour varies from white, black, and brown. In a population of 280 sheep, greasy fleece weight averaged $1.5 \pm$

0.05 kg (range 1-4 kg). Clean fleece weight averaged 1.3 ± 0.02 kg. The staple length averaged 4.1 ± 0.03 cm, while the fibre diameter averaged 23.5 ± 0.8 µm (range 20-27 µm). The medullation percentage averaged 54.5 ± 1.2 (Table 5).

Table 5: The fleece characteristics of Malvi sheep

Trait	Average	Range	N
Greasy fleece weight (kg)	1.5 ± 0.05	1-4	280
Clean fleece weight (kg)	1.3 ± 0.02	1-4	280
Staple length (cm)	4.1 ± 0.03	2-7	280
Fibre diameter (micron)	23.5 ± 0.8	20-27	280
Medullation (%)	54.5 ± 1.2	50-59	280

Carcass characteristics

The carcass characteristics was done on a total of 148 Malvi sheep (92 males and 56 females). Males were slaughtered at an average age of 305.25 ± 5.5 days, while females were slaughtered later, at 352.5 ± 7.5 days. At slaughter, male sheeps exhibited a higher average body weight (26.5 ± 1.05 kg) compared to females (23.5 ± 1.08 kg). Carcass weight followed a similar pattern, with males yielding an average of

14.5 ± 0.80 kg and females 13.5 ± 0.7 kg. Dressing percentage was slightly higher in males (59.5 ± 1.5) than in females (58.5 ± 1.7), although the difference was not substantial (Table 6). The dressing percentage is higher to Hassan sheep and Mandya male lambs (Kumar *et al.*, 2022), who has reported the dressing percentage of most indigenous sheeps between 45-50 % (Jain *et al.*, 2005) [2].

Table 6: The carcass characteristics of male and female Malvi sheep

Traits	Male			Female		
	Average	Range	N	Average	Range	N
Age at slaughter(days)	305.25 ± 5.5	280-330	92	352.5 ± 7.5	300-350	56
Weight at Slaughter (kg)	26.5 ± 1.05	18-30	92	23.5 ± 1.08	15-28	56
Carcass weight (kg)	$14.5 \pm .80$	12-18	92	13.5 ± 0.7	11-16	56
Dressing %	59.5 ± 1.5	55-65	92	58.5 ± 1.7	50-60	56

Pelt characteristics

The pelt characteristics in Malvi sheeps were recorded separately for foetuses (n = 52) and lambs (n = 58). The average pelt weight of foetuses was 210.5 ± 3.5 g, with a

range of 150-300 g, whereas lambs exhibited markedly higher pelt weight, averaging 520.0 ± 5.2 g (range 415-615 g). Pelt length showed a pronounced increase from foetal to lamb stage; foetal pelts measured 4.8 ± 0.03 cm on average, while

lamb pelts averaged 15.5 ± 0.4 cm. Similarly, pelt width was considerably greater in lambs (5.3 ± 0.5 cm) compared to foetuses (3.3 ± 0.01 cm). These findings highlight the rapid post-natal growth and development of the pelt in Malvi sheep,

with lamb pelts being approximately 2.5 times heavier, more than three times longer, and 1.6 times wider than those of near-term foetuses (Table 7).

Table 7: The fleece characteristics of Malvi sheep

Trait	Foetus			Lamb		
	Average	Range	N	Average	Range	N
Pelt weight (g)	210.5 ± 3.5	150-300	52	520 ± 5.2	415-615	58
Pelt length (cm)	4.8 ± 0.03	5-7	52	15.5 ± 0.4	12-18	58
Pelt width (cm)	3.3 ± 0.01	2-5	52	5.3 ± 0.5	4-9	58

Conclusion and recommendation

The Malvi sheep, is a non-descript population, widely distributed across a Malwa and Nimar region of Central India. Malvi sheep are well adapted to the semi-arid agro-climatic conditions of central India and are primarily reared under an extensive or pastoral system. It is a valuable indigenous genetic resource combining good growth, carcass yield, reproductive efficiency, and adaptability; its wool and pelt production. In view of its economic importance, widespread farmer acceptability, and remarkable adaptability to harsh agro-climatic conditions, the population merits comprehensive scientific investigation to fully characterise and exploit its productive and adaptive attributes.

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Conflict of interest

The authors declare that they have no conflicts of interest regarding the publication of this manuscript.

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