

Characterization of Mehsana Buffaloes in India

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Summary

Mehsana buffalo is distributed in Mehsana, Banaskantha and Sabarkantha districts of North Gujarat in India. The animals are reared for milk production. The management practices in the breeding tract were studied. The physical, production and reproductive characters were recorded. The Dudhsagar Research and Development Association located in Mehsana district has undertaken breed improvement programmes in farmers' herds by running field progeny testing and providing other animal husbandry services like artificial insemination, health coverage, etc. This has resulted in the improvement in the reproductive performance as is evident from the decrease in the average first service period by 74 days and the average first calving interval by 103 days from 1989 to 1997. Microsatellite DNA marker analysis was carried out on 25 Mehsana buffalo DNA samples using seven markers for genetic characterization of the breed. Number of alleles at different loci ranged from four to seven and heterozygosity ranged from 0.40 to 0.92.

Resumen

La raza Mehsana de búfalos se encuentra en los distritos de Mehsana, Banaskantha y Sabarkantha en el norte de Gujarat en la India. Estos animales se crían para la producción de leche. Se han estudiado las prácticas de cría de esta raza en su entorno. Se han registrado los caracteres físicos, de producción y de reproducción. La Asociación de Investigación y Desarrollo Dudhsagar, en el distrito de Mehsana, ha empezado programas de mejora de la raza con los rebaños a través de pruebas de descendencia sobre el terreno y proporcionando otros servicios tales como la inseminación artificial, la cobertura sanitaria, etc. Todo ello ha llevado a un incremento del rendimiento reproductivo ya que se ha disminuido en media de 74 días la primera monta y el intervalo entre partos de 103 días entre 1989 y 1997. Se han llevado a cabo análisis de los marcadores ADN microsatélites con 25 búfalos Mehsana con muestras de ADN, utilizando siete marcadores para la caracterización de la raza. El número de alelos en los distintos loci iban de cuatro a siete y la heterocigosis de 0,40 a 0,92.

Key words: *Mehsana buffaloes, Buffalo genetic resources, Breed characterization.*

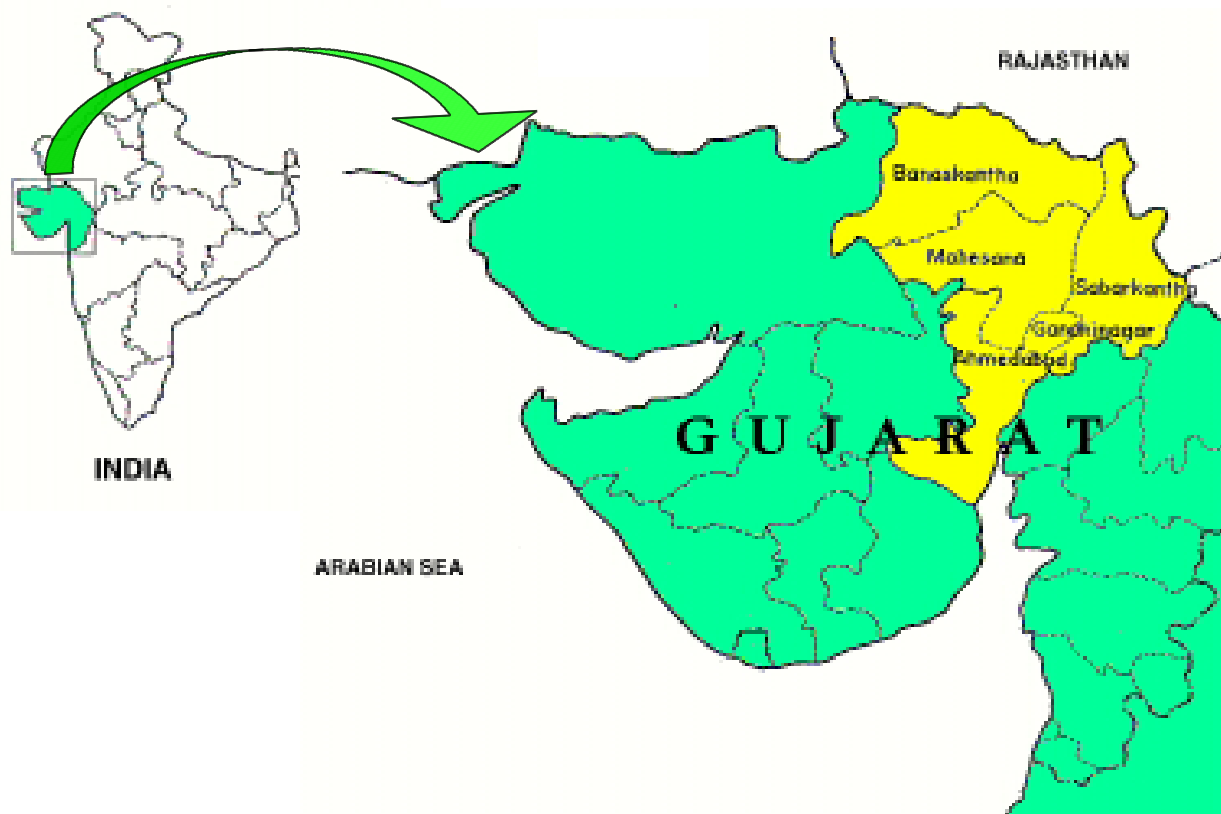


Figure 1. Breeding tract of Mehiana buffaloes.

Introduction

Buffaloes occupy an important place in the agricultural economy of India because of their adaptability to harsh climatic conditions, tolerance to tropical diseases and survival under poor feeding and management practices. The genetic diversity in buffaloes of the country is represented by ten recognized breeds of buffaloes besides several lesser-known breeds/strains comprising about 27 percent of the total bovine population in India (Gupta, 1997). Buffaloes contribute about 48 percent of the total milk production of the country (Gupta, 1997). The organized dairy sector in India is largely dependent on buffalo milk because of their contribution to total milk production, rich fat

and total solid content. Mehiana buffaloes are one of the best milk breeds of buffalo in India (Gupta, 1997) and are spread in the northern part of the Gujarat State (Figure 1). The name of Mehiana buffalo was derived from the town "Mehiana" in the North Gujarat State. Oliver (1938) described the breed for the first time. He pointed out that the characteristics of this breed are intermediate of two buffalo breeds namely Murrah and Surti. It was postulated that the Mehiana buffalo originated from the crossing of Murrah and Surti buffaloes. The skin colour is black. The body colour is not as dark as that of the Murrah and the horns are shorter and less curved. Mehiana buffaloes are well reputed for regularity in breeding, persistence in milk

and efficient milk production which is evident from the lactation length and short dry period (Singh, 1992).

To characterize Mehsana buffaloes in farmer herds phenotypically and genetically, a detailed project was jointly undertaken by the National Bureau of Animal Genetic Resources (NBAGR), Karnal and the Dudhsagar Research and Development Association (DURA), Mehsana to study the breed under farmers' herd conditions. The objectives of the study were to investigate the breed distribution, management practices under field conditions, breed performance and development of breed descriptor. Seven microsatellite markers were analysed in Mehsana buffalo to study the DNA sequence polymorphism in these marker loci.

Distribution of the Breed

The Mehsana buffaloes are concentrated in the Mehsana, Banaskantha and Sabarkantha districts of the northern part of Gujarat State (Figure 1). Animals true to the breed characteristics are observed in Mehsana, Patan, Sidhpur, Vijapur, Kodi, Kalel and Radhanpur areas. The areas experience extreme climates. The temperature in summer goes up to 40°C and in winter it is as low as 9-10°C. Rainfall is uncertain. Soil in these areas is sandy alluvial and porous, which in the southern parts merges into the black cotton soil.

Population Dynamics

The buffalo population in Gujarat State increased by 0.26 million to 1.83 million from 1983-84 to 1993-94. During this period the increase in the buffalo population in Gujarat State was 16.3 percent in comparison to 1.1 percent in indigenous cattle population. Livestock population in the districts where survey work was undertaken and in the whole Gujarat State are presented in table 1. All the three districts had higher livestock density than the average of the Gujarat State.

The Animal Husbandry Department, Government of Gujarat, conducted an integrated sample survey on livestock population and animal production and reported that the percentages of different buffalo breed populations in the whole Gujarat State were 42 percent Surti, 24 percent Mehsana, 24 percent Jafarabadi, 6 percent Murrah and 4 percent non-descript in the year 1993-94 (Report, 1985). In the Mehsana district lactating buffaloes of the Mehsana breed increased from 87.5 to 95.6 percent, while in the other two districts the population of the Mehsana breed declined from 81 to 45 percent in Banaskantha and 57 to 42 percent in Sabarkantha from 1983-84 to 1993-94. In Gujarat State lactating and breedable Mehsana buffaloes declined by 1.1 and 2.8 percent respectively, during this period.

Table 1. Livestock population ('000) and their density in 1992.

District	Cattle	Buffalo	Sheep	Goat	Livestock density per 1 000 hectare
Mehsana	295	630	36	189	1 409
Banaskantha	438	452	215	456	1 326
Sabarkantha	436	459	47	306	1 773
Gujarat State	6 786	5 241	2 025	4 228	1 000

Table 2. Population of total breedable and lactating Mehsana buffaloes in the native tract.

Districts	1983-84		1993-94		Trend (%)	
	Lactating	Breedable	Lactating	Breedable	Lactating	Breedable
Banaskantha	97 485	159 595	49 996	100 053	-38.5	-37.3
Mehsana	189 941	298 553	224 660	329 820	18.7	10.7
Sabarkantha	70 745	111 125	58 245	91 667	-17.6	17.9
Whole Gujarat State	440 006	689 380	435 157	670 170	-1.1	-2.8



Figure 2. Mehsana female buffalo.

Physical Characteristics of the Breed

The Mehsana buffalo is a medium-sized docile animal with a low set deep body. The forehead is wide with a slight depression in the middle sloping towards the base of the horns. The horns are generally sickle shaped and curved upwards and then bend downwards. The neck is long and well set on the shoulders. It is massive and dewlap is almost absent in males. The chest is deep with broad brisket. The legs are medium to short length with clean and broad bones. The barrel

is long and deep, with well-sprung ribs. In females, the fore quarters are light while the hind quarters are wide and heavy giving a wedge shaped appearance. The back is straight and strong with pelvic joints higher than the withers. The navel flap is very small. The tail is of medium thickness and long with black or brown switch. The skin is thin, pliable and soft and generally black. The hair is rough and scanty. The average adult body weight varies from 365 to 455 kg in females and about 500 kg in males.

The udder is well developed and well set and in good milking animals it is carried well behind. The teats are fairly thick, long and



Figure 3. Mehsana bull.

pliable. The milk vein is prominent. The photographs of a female-buffalo and bull are presented in figures 2 and 3, respectively.

Management Practices

To characterize the management practices in the breeding tract 1 097 farmers from 144 villages were contacted and information was recorded on a questionnaire developed jointly by NBAGR, Karnal and DURA, Mehsana. It was observed that 25 percent of the farmers rearing Mehsana buffaloes were landless and about 33 percent of the farmers were illiterate. The survey conducted revealed that most of the men and women spent about two hours a day in animal husbandry works like grazing, chaffing, cleaning, feeding and milking. Both male and female family members spent equal time in animal rearing activities. Eighty percent of farmers usually cleaned the udder and teats of the buffalo and 18 percent of farmers cleaned the animals completely.

Utility of the Breed

About 7.5 percent of farmers reared buffaloes for milk production and 44 percent for both milk and breeding purposes and only one percent of farmers reared buffaloes for both milk and ploughing. Farmers who kept buffaloes for breeding represented only 1.5 percent of the total surveyed. About 65 percent of farmers sold Mehsana buffaloes to businessmen who took the animals to Mumbai and Ahemadabad for milk production. These businessmen sent them for slaughtering after completion of lactation. This factor may be one of the reasons for the decrease in the Mehsana breed population in Gujarat State (Table 2).

Animal Housing

The majority of farmers (87 percent) tied their animals throughout the day and night. Forty-eight percent of farmers used open houses and 42 percent of farmers preferred both the open and closed type of sheds for their animals. In about 75 percent of cases, the farmers' and animal houses were separate

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and in the rest of the cases the animal houses were part of the farmers' own house. About 96 percent of animal houses were well ventilated, however, proper drainage facilities were available in only 23 percent of byres.

Calf Management

More than 93 percent of farmers allow female calves to suckle milk throughout the lactation period, however, the male calves were generally weaned within a week of calving. Dehorning was practiced by only 6 percent of farmers and 87 percent of farmers dewormed.

Wallowing once a day was followed by the majority of farmers. Photographs of Mehsana buffalo calf and the unique milking practice followed in the breeding tract are presented in figures 4 and 5 respectively.

Feeding

More than half (58 percent) of farmers did not take animals for grazing. Out of those who took their animals for grazing, the majority (84 percent) adopted seasonal grazing. Stall-feeding was practiced by 75 percent of farmers and both stall feeding and grazing by



Figure 4. Mehsana buffalo calf.

22 percent. Concentrate feed was provided separately by 83 percent of farmers while 17 percent of farmers provided it along with fodder. The concentrate was fed at the time of milking by 88 percent of farmers and the rest of the farmers fed concentrate at anytime. Green fodder is available mostly during the rainy season. Dry fodder includes mainly bajra (*Pennisetum typhoides*), jowar (*Sorghum vulgare*) and wheat (*Triticum aestivum*) straw.

Breeding

Out of the farmers surveyed, 98 percent were maintaining Mehsana buffaloes, one percent Murrah and one percent other breed or non-descript buffaloes. About 51 percent of farmers adopted artificial insemination (AI), 9 percent natural service (NS) and 40 percent

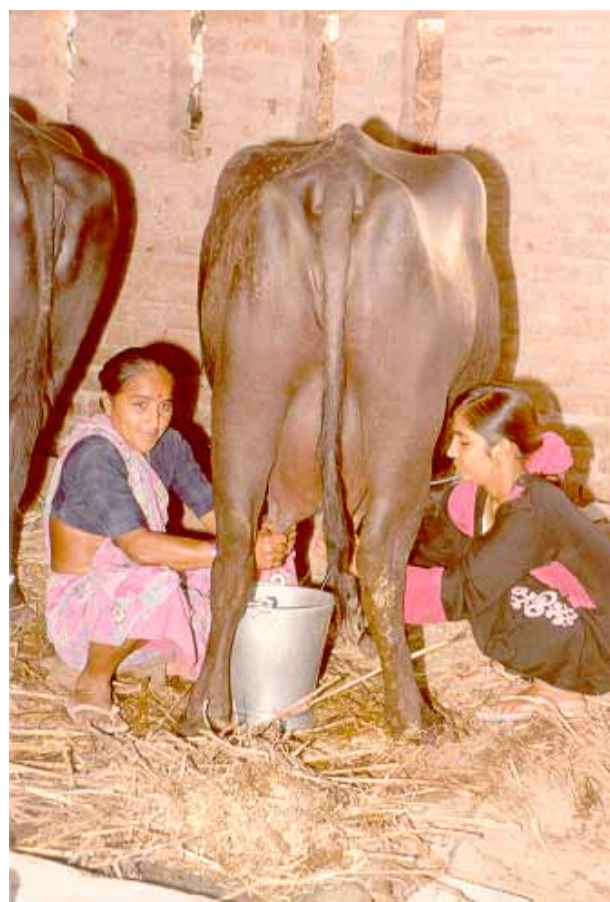


Figure 5. Unique milking practice in breeding the tract

both. Frozen semen was used in 96 percent of cases for AI. It was observed that about 75 percent of buffaloes conceived after two services. The high rate of adoption of AI with frozen semen and good conception rates was due to the service provided by DURA, Mehsana in the breeding tract.

Productive and Reproductive Performance of Mehsana Buffaloes

Production and reproductive performance of Mehsana buffaloes from 1989 to 1997 maintained at DURA, Mehsana are presented in table 3. Progeny testing in Mehsana buffaloes in field conditions has been conducted by DURA since April 1985. A total of 107 bulls in eight batches was tested. The results of five batches are available. The maximum sire indices in terms of daughters' 305-day milk yield was 2 297 kg. The performance over different years (Table 3) showed significant improvement in reproductive traits, i.e. service period and calving interval.

Genetic Characterization of Mehsana buffaloes Using Microsatellite Markers

Microsatellite DNA markers are extensively being used for animal biodiversity typing worldwide. Microsatellites or simple sequence repeats are the tandem iterations of DNA which are two to six bases in length. Due to their levels of variability, ease and reliability of scoring, neutrality with regard to selection, co-dominant inheritance and short length, microsatellite DNA markers are being widely used for genetic diversity analysis, genome mapping, QTL identifications, genetic distancing, etc. Moreover, these can be easily typed using PCR. At present no microsatellite DNA markers have been reported specifically for buffaloes. A battery of cattle microsatellite DNA markers was identified at NBAGR,

Karnal which showed polymorphism in bubaline genome (Navani *et al.*, 1999). These selected markers are being utilized for the characterization of the Mehsana buffalo breed. Blood samples were collected from unrelated animals from different villages in the breeding tract. A male cattle sample from the Haryana breed was used as a positive control. The DNA was isolated using phenol:chloroform extraction and the ethanol precipitation method (Sambrook *et al.* 1989).

PCR was carried out on 100 ng of genomic DNA in a 50 ml reaction for 25 animals. The reaction mixture consisted of 200 mM of dNTPs, *Taq* polymerase buffer, 1 unit of *Taq* DNA polymerase and 4 ng/ml of each primer. PCRs were carried out using a

PTC-200 PCR machine (MJ Research). The PCR protocol involved an initial denaturation at 95°C for two minutes, followed by 30 cycles of 92°C (one minute), 55°C (45 sec) and 72°C (one minute). A final elongation step of ten minutes was carried out at 72°C. The annealing conditions were similar to those reported for cattle (Kemp *et al.*, 1995). At the end of the reaction, 5 ml of stop dye (95 percent formamide, 0.25 percent bromophenol blue and 0.25 percent xylene cyanol) was added and 10 ml of PCR products were loaded onto a two percent agarose gel, electrophoresed and stained with ethidium bromide. The gel was visualised over UV light after ethidium bromide staining. The positive loci were loaded on

Table 3. Average year-wise production and reproductive performance of Mehsana buffaloes.

Traits	1989	1991	1993	1995	1996	1997
Age at first service (months)	22.20±0.26 (235)	23.18±0.17 (526)	24.54±0.17 (418)	25.49±0.20 (204)	24.87±0.20 (247)	24.70±0.24 (216)
Age at first conception (months)	29.1±0.53 (162)	29.0±0.34 (335)	33.1±0.27 (521)	34.2±0.35 (289)	32.2±0.38 (284)	34.3±0.36 (281)
Age at first calving (months)	36.0±0.59 (58)	40.7±0.43 (244)	42.0±0.28 (467)	44.0±0.37 (248)	44.4±0.39 (246)	42.8±0.37 (298)
First service period (days)	254±29 (47)	268±15 (171)	250±10 (351)	271±11 (222)	232±10 (259)	180±7 (272)
Overall service period (days)	254±29 (47)	265±12 (231)	243±8 (504)	220±8 (443)	215±7 (481)	173±5 (497)
First calving interval (days)	521±20 (41)	545±13 (136)	517±9 (241)	501±10 (171)	490±9 (188)	418±6 (112)
Overall calving interval (days)	521±20 (41)	545±12 (180)	521±6 (636)	499±8 (315)	477±6 (331)	420±5 (180)
First lactation length (days)	305±2 (56)	308±1 (217)	299±2 (442)	301±1 (205)	300±1 (264)	300±2 (275)
Overall lactation length (days)	304±2 (57)	307±1 (289)	300±1 (606)	303±2 (424)	300±1 (504)	297±1 (491)
First 305-day milk yield (kg)	2 093±52 (57)	1 892±23 (225)	1 914±19 (457)	1 951±23 (259)	2 004±21 (323)	1 972±23 (333)
Overall 305-day milk yield (kg)	2 096±51 (58)	1 964±23 (302)	1 988±17 (628)	2 128±20 (522)	2 153±18 (615)	2 147±20 (605)
First lactation fat %	609±0.1 (56)	6.9±0.1 (216)	6.9±0.1 (442)	7.0±0.1 (205)	7.1±0.1 (264)	7.1±0.1 (275)

Figures in the parenthesis are number of observations.

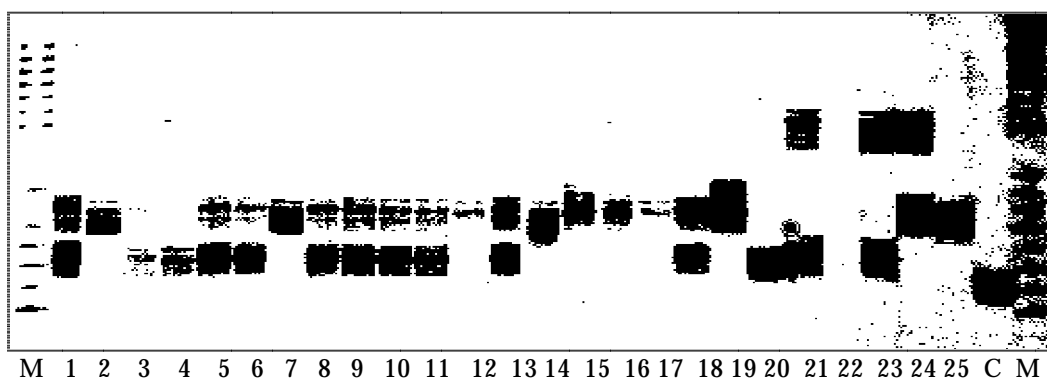


Figure 6. Silver stained representative gel of locus ILSTS052 'M'- marker, 'C'- cattle control

Table 4. Number of alleles, heterozygosity and allelic ranges of seven microsatellite loci in Mehsana buffaloes.

Sl. No.	Locus	Primers (5'-3')	No. of Alleles	Heterozygosity	Allelic Range
1	ILSTS017	F-GTCCCTAAAATCGAAATGCC R-GCATCTCTATAACCTGTTCC	6	0.92	104-124 bp
2	ILSTS019	F-AAGGGACCTCATGTAGAAGC R-ACTTTTGGACCCTGTAGTGC	4	0.40	160-170 bp
3	ILSTS025	F-GTTACCTTTATATAAGACTCCC R-AATTTCTGGCTGACTTGGACC	4	0.48	116-130 bp
4	ILSTS052	F-CTGTCCTTTAAGAACAAACC R-TGCAACTTAGGCTATTGACG	7	0.84	145-180 bp
5	ILSTS056	F-GCTACTGAGTGATGGTAAGGG R-AATATAGCCCTGGAGGATGG	6	0.64	140-172 bp
6	ILSTS058	F-GCCTTACTACCATTTCAGC R-CATCCTGACTTTGGCTGTGG	6	0.88	142-174 bp
7	ILSTS061	F-AAATTATAGGGCCATACGG R-TGGCCTACCCTACCATTTC	8	0.80	136-170 bp

6 percent denaturing polyacrylamide sequencing gels (Sequi-GT system, BioRad). pGEM DNA marker and allelic ladder of GenePrint™ STR Systems (Promega) were used as a size standard. After the run was over the gel was stained with silver nitrate using a silver staining kit (Promega). The gels were documented by drying between the sheets of cellophane papers and kept for

records. The allele numbers were counted manually. The results are presented in table 4. A representative gel picture showing a polymorphic locus (ILSTS052) is illustrated in figure 6. The results revealed that cattle microsatellite markers, to start with, may be used for molecular characterization studies in Mehsana buffaloes.

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