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A Fine Breed of Horse

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G.T. Road By Pass, P.O. Box No. 129, Karnal-132001 (Haryana) India

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PREFACE

Equines, the odd toed ungulates, comprising horses, mules and donkeys form an important draught and riding animals. For centuries, the horse has been a most faithful companion of man. Horses also have special place in Indian history as most important riding animal for important solders in war, in sports and other ceremonial purposes. There are six define breeds of horses and ponies in India. Among these breeds, Marwari and Kathiawari have Arabian type conformation while others are similar to Mongolian ponies in their features. Majority of these breeds are on the verge of extinction because of increased mechanization, higher cost of maintenance, reduced avenues of road transport and other pack activities.

The Kathiawari breed is one of the most popular breed of Indian horses, considered to have originated in Kathiawad region of Gujarat. There were strong cavalries of Kathiawari horses with several erstwhile rulers in the princely states of Kathiawad region in 19th century. More damage was done during British period when they have brought Thoroughbred horses and replaced local Kathiawari and other breeds in the army establishments. However, in recent years these horses have lost their place because of various economical constraints.

During recent years, there is growing concerns regarding purity of breed and people often confuse between Marwari and Kathiawari breed unless they see them from close. There is an urgent need to evaluate these horses for their breed characteristics, so that the horse owners as well as commercial studs can maintain the breed standards Due to close herds a d limited availability of breeding stallions with the horse keepers, there is an increased risk of increased level of inbreeding. To obtain pure stallions for breeding purposes, there is need to establish the nucleus studs in the main breeding tract and to circulate the stallions for maintaining pure parental stock. The first step to overcome these problems is to define standard breed characteristics of the Kathiawari horses. Authors have conducted the sample surveys on Kathiawari breed and recorded some authentic information on breed characteristics from the livestock fairs and animal shows held in different parts of India including in Saurashtra region of Gujarat. We have also done work on DNA characterization using molecular markers that would be useful to understand the complete genetics of this horse breed vis a vis other breeds.

We convey our sincere thanks to the Director, NBAGR, Karnal for providing the facilities. Thanks are due to Kathiawari Horse Society, Gondal for providing help in blood sample collection for DNA studies. We are thankful to Sh. Moti Ram, Institute Photographer for helping in taking photographs from different shows.

Authors

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Introduction

The horse is one of the earliest domesticated species of livestock, adopted by man for company, riding, sports, transport and as pack animal. Horses appear to have been domesticated first in the Neareast i.e. Central Asia or Persian region more than 3000 Years B.C. India has also been known as land of horses in ancient past. Horses had special place in Indian mythology and was considered as symbol of prosperity of the kingdom when they were used in wars. However, in recent years, this important species have lost their utility because of greater mechanization and availability of other kinds of sports. India has six distinct breeds of horse's viz. Kathiawari, Marwari, Spiti, Zanskari, Manipuri and Bhutia. Gujarat State is the homeland of famous 'Kathiawari' breed of horse. Kathiawari is considered to be a noble breed whose heritage is said to have come from Alexander the Great (356 - 323 BC) when he originally landed in India. Arabian blood was later introduced by the Mogul emperors and again later by the British via Bombay. The Kathiawari horse is from the Kathiawar Peninsula, an area framed by the Gulfs of Kutchh and Khambat on India's north western coast. It is also found in Maharashtra, Gujarat, and southern Rajasthan. Together with the Marwari its northern neighbour in Rajasthan is regarded as indigenous to the subcontinent.

Indian breeds of horses are lean and smaller in built, girth and height as compared to thorough breeds. As a result they require much less feed and fodder. The hair coat is not as dense as we have a warm climate. The ear points are pointed and meet, especially in Marwari and Kathiawari breeds that is often a point of dispute between them. The hoof diameter is much less and the pastern and fetlock joints are very flexible. As a result of this, our horses show a natural much higher capability of clearing obstacles while cross country riding. Horses of Indian breeds are very spirited and respond to commands very promptly after they recognize the rider's capability. They are very intelligent and the rider establishes a very friendly rapport with his steed after some time.

For endurance and stamina, nothing will beat Kathiawari horses. They are perfectly adapted to the environment in India. Kathiawari are famous for their endurance, endearing qualities and affection. In this monograph, the basic information on Kathiawari horses have been included from our preliminary surveys in the Kathiawari horse breeding tract and several livestock and horse shows. The information from other published and unpublished sources on this important horse breed has also been reviewed. The genetic analysis of the breed was also done using cytogenetic and molecular genetic markers. This manuscript will be useful to the person engaged in equine breeding, students and masses in general.

Origin and History of Domestication

The origin of this breed are not recorded with concrete evidences, it can be said that this breed came in to prominence well before the time of Mogul Emperors (1526-1857) as native stock. This breed may be a mixture of several local horses existed in the provinces down the western coast as far as Maharashtra and later bred with Arabian horses brought by the Muslim invaders from Turkey and other Central Asian countries. According to the superintendent of Gaekwad Contingent in 1880 suggested that the Kathiawari breed might have evolved from the wild horses of Kathiawar (a sort of Quagga, Bombay Gazette, Kathiawari, foot note, page 97). This stock is also considered to have descended from breeds such as the Kabuli and Baluchi, which came from the north and were related to the steppe and desert horses further to the west and northwest. These breeds often have curved ears and a "dry" head, like the Kathiawari, and some share its pacing ability. In the Mogul period, and later under the British rule, Arabian horses were imported from the Arabian Gulf and the Cape of South Africa and might have used for upgrading of this breed.

In the 17th and 18th centuries, the princely families of various erstwhile states in the Kathiawar Region have evolved this 'Kathiawari' breed by breeding the indigenous stock with the 'Arab' stallions to fulfill their sporty needs. Kathiawari breed of horses is said to have originated from the

important Arab stallions, via ship load of which once got wrecked on the west coast of India. Some State of old Kathiawar province took special interest and care in the development of this breed. Due to their sustained efforts, present Kathiawari breed of horse has been developed. Traditionally, the princely houses bred these horses selectively; each specialized in its own strain, which was usually named after a foundation mare. Twenty-eight such strains are still recognized (Table 1). In these noble households the horses were looked upon as favored pets and acquired a reputation for being intelligent, docile, and affectionate.

Table 1. Diversity in Kathiawari horses as per their place of origin

Name	Origin	Name	Origin
Manki	Dhasa in (Bhv.)	Phulmal	Ratadka
Chamardhal	Gadhda	Resham	Somsar
Ful-Mal	Bhadla	Vandri	Bagad
Changi	Chotila	Lakhi	Kherva (Patdi)
Vangli	Vagad kathis of Dhasa	Lash	Darva(Gondal)
Harni	Paliad	Dhel	Babra
Tajan	Bhadli	Hiral	Mania (Junagadh)
Redi	Jasdan	Rampasa	Halvad
Bhutdi	Sarvala Kathis	Mal	Bhada
Jabad	Jetpur	Mani	Kundran
Kesar	Bhimora	Patti	Bhadla
Moran	Anandpur	Singali	Lakhtar
Akhadial	Anandpur	Vijali	Vanda
Beri	Mulimevasa	Akhadial	Anandpur

Source: http//:www.Kathiyavadihorse.com

The breed is still highly regarded in its native area. Early in the 19th century the "Original Kattywar" horse was stated to be superior to all others as a cavalry mount and was used by Marathas and British cavalry. Today it is employed by police forces throughout India. The Kathiawari Horse

Breeders' Association operates a register and puts on annual breed shows. At Junagadh, the Government of Gujarat supports a stallion station and a small brood mare band, and the services of selected stallions are made available to villagers for nominal fees.

Geographic Distribution

The best breeding area is Panchal in central Saurashtra including Chotila, Paliad, Anandpur, Bhimota and Jasdan. All the requirement of successful horse breeding are found in Panchal area, which has favourable soil for hoof formation, hilly tracts for development of muscles, running streams of pure water, nourishing grasses and hot and dry climate. The main breeding tract of the Kathiawari horse is the Saurashtra region of Gujarat, which comprises of Junagadh, Amreli, Bhavnagar, Rajkot and Surendranagar districts (Fig.1).

Fig. 1. Geographical distribution of Kathiawari horse

Demographic Distribution

There were a total 14,381 horses in the Gujarat State as per the Livestock Census (1997). Out of this 7,586 were of Kathiawari breed and rest of 6,795 were of Marwari breed. Kathiawari being a prominent breed of horse in Gujarat State, but the numbers of breeder have no data of the breed. Department of Animal Husbandry, Govt. of Gujarat had undertaken the study of breed characteristics of Kathiawari breed. The maximum number of Kathiawari horses was present in Bhavnagar followed by Surendranagar and Amreli districts. The minimum number of horse population is in the district of Porbandar and Junagadh.

The survey and study of breed characteristics of Kathiawari horses was undertaken in the seven districts of Saurashtra tract viz. Jamnagar, Rajkot, Surendranagar, Bhavnagar, Amreli, Junagadh, Porbandar and part of Ahemdabad district. Different categories of horses exist in Gujarat. The total of 1601 horses was surveyed in the State, which comprised of 109 stallions, 1034 mare and 458 foals. The percentage distribution of the same was 6.81, 64.58 and 28.61 %, respectively. The major horse population exists in Bhavnagar followed by Surendranagar and Amreli district. The lowest horse numbers observed were from Porbandar and Jamnagar districts (coastal districts). Out of the total number of horse surveyed at government, commercial and at individual farms, the percentage distribution was 3.06, 2.12 and 94.82, respectively.

Ownership

Most of horses are reared by individual farmers in the Saurashtra region. Breeding of mare is performed predominantly by privately owned stallions. Few breeders prefer services of Government stallion, probably due to the fact that there are only 14 stallion services centers operating in State. Nevertheless, the Junagadh district is maintaining highest number of commercial farm of purebred Kathiawari horses.

Management Practices

Information on the management practices adopted by farmers for rearing Kathiawari horses in their main breeding tract were collected by interviewing the farmers using structured questionnaire at Horse show Jasdan, Rajkot. Body measurements of adult and young horses were recorded from these horse shows. It was observed that 97.88% horses maintained by individual breeders vs. 2.12% horses were owned by commercial farms. The similar system of Kathiawari horse management was reported by farmers at Pushkar Animal Fair in 1999. We also recorded some data on Kathiawari horses from its main breeding tract in the Junagarh, Amreli, Gondal and Rajkot in present areas of Saurashtra region of Gujarat. We have also used the data on different management practices recorded by the State Animal Husbandry Department of Gujarat State during a state wide survey carried out in this breed of horse.

The Kathiawari horses are reared in three types of management systems, namely stall-feeding, range -management and mixed type of management. The percentage distribution of horses according to rearing system was 69.71, 15.05 and 15.24 %, respectively. It was observed that the maximum number of horses was reared under stall-feeding system.

Feeding

The stallions are fed around 2.5 to 3.0 kg of concentrate, 12-15 kg of green fodder and 12-15 kg of dry fodder in the field conditions. The mares are fed at rate of 1.5 to 2.0 kg, 10-12 kg of greens and 12-15 kg dry fodder per day. The foals are fed at rate of 1.0 to 1.5, 12.0 to 15 kg and 10.0 to 12.0 kg per day of concentration, green fodder and dry fodder, respectively. All the horses are given some concentrate ration and varying quantity of green and dry fodder. In rural areas, the stall feeding is practiced by 80% of the farmers and rest (20%) follow both pasture grazing during day time and some concentrate at night at home. Half of the farmers put their horses on work for 4-6 hrs daily, while 40% for 1-3 hrs and 10% for more than 6 hrs. The

farmers supply normally fresh drinking water which they take themselves to their horses once in a day (10%), twice daily (50%), thrice daily (30%) and four times a day (10%). The majority of the horse breeders have adopted free watering access practices.

Housing pattern

The horses are housed in permanent as well as temporary structures. The percentage distribution was 38.29 and 61.71, respectively. It seems that majority of Kathiawari horses are housed in temporary type of housing. In the field condition majority of Kathiawari horses are kept in temporary houses. Among the holding practices, the maximum horses are maintained individually followed by group of 4 to 6 and there are very few large scale holdings also.

Health management

The immunization programme is followed by some of the horse owners, in Kathiawari horse breeding tract. The percentage of vaccination was 12.05 in the tract. Distribution of vaccinated animal in percentage was stallion 22.94, mare 12.19 and foal 9.17. The deworming practice is adopted in 462 out of 1601 horses. The total percentage of deworming was 28.86 %. The maximum deworming was carried out in Bhavnagar district followed by Ahemdabad and Junagadh. Deworming as health control measures are practiced by the limited number of horse's owners. On an average around four hours exercise / work per day usually is given to horses. The average exercise and work performed per day was around four hours.

Breeding practices

Breeding practices are normally is followed in two ways viz. (1) through Government stallion and (2) through private stallion. Under the present system more number of mares are bred from the privately owned stallions where they charge fee from the owner of the mare in heat. Around 30 percent of mares are covered by stallions maintained by Government studs. In

majority of the cases, the mare is bred by natural service and only in few cases; A.I is practiced, especially at organized government farms. Majority (80%) of the farmers adopted natural breeding and few (20%) The majority (80%) of the farmers disposed of their horses by selling while 20% died. The age of disposal was 4-5 years (60%) because of higher price fetched and rest for 10-15 years due to old age.

Reproductive Performance

The average age at first fertile service is 1658±79 days. Average age at first foaling is 1989±80 days (Table 2). Means of herd life and productive life are 6499±650 and 4546±596 days respectively. The mean of total foals during lifetime is 4.93±0.52 and range from 1 to 10. The means of male and female foals during lifetime are 2.29±:0.37 and 2.61±0.27 respectively. Male foals range from 1 to 7 and females foals from 1 to 5. The average gestation period is 333.58±1.76 days which varies from 325.82 to 343.27 days from 5th to 8th parity. The average service period is 257.23±46.49 days that ranges from 101 in 10th to 412 days in 8th foaling. The average foaling interval is 597.76±49.70 days and range from 457 in 10th to 753 days in 8th foaling.

Table 2. Reproductive parameters of Kathiawari horse breed

Age groups	Male	Female
Age at Puberty (Days)	1435±65	1265±54
Age at first service(Days)	1832±87	1658±79
Gestation period (Days)		333.58±1.76
Age at first foaling (Days)		1989±80
Service period (Days)		257.23±46.49
Foaling interval (Days)		597.76±49.70
Average productive life(Days)		4546±596
Average herd life(Days)		6499±650
No of foaling in life time per mare		10

Fig. 2. Kathiawari stalion

Fig. 3. Kathiawari mare

Phenotypic description

They are hardy animals with good bone and easy action. They are well known for their pace, speed and endurance. The Kathiawari are very attractive, especially those of smaller stature. These animals have good proportionate body. The limbs are light of bone by western standards but the breed is inherently sour. Like most breeds with a desert background, the Kathiawari is resistant to heat and can survive on minimal rations of feed and water.

Less well-bred animals show signs of the degeneration typically associated with hot, dry areas and poor soil. They often have sharply sloping quarters and weak, poorly shaped hind legs. The breed has the innate ability to perform the reveal, which is a swift, very comfortable lateral pacing gait. This shows that these horses have some connection with pacing horses from areas bordering Pakistan's northwest frontiers; such as Turkistan, Afghanistan, and the desert regions of northern Iran.

Body colours

The most interesting colour is dun, often with a definite dorsal list and distinctive "zebra" bars on the legs. This is a primitive coat pattern, and may suggest a link with the Tarpan. There are as much as 19 colour

and colour patterns in Kathiawari horses have been recorded, of these, English names and local name in parenthesis are : Albino (Bago), Grey (Rozo), Iron Grey (Melo Rozo), Dapple Grey, (Galdar Rozo), Flea-Bitten (Magad Rozo), Brown-Bay (Kalo Kiyado), Bay (Kiyado), Bay With Black Points (Kali Ganthe Kiyado), Dun (Makdo), Dun (Soneri Makado), Skew Bald (Lal -Bavado), Pie-Bald (Kado Bavado), Chestnut (Ghero Kathai), Chestnut (Hardo), Chestnut (Soneri Bago), Palomino (Melo Bago), Cream (Dudhiya Bago), Blue Roan (Jambudiyo), Strawberry Roan (Mavdo)

The most prominent body colour in Kathiawari horses is chestnut followed by bay (body chestnut, foreleg up to knee and fetlock are black, hairs of tail and neck are black. However, gray (complete white colour) and dun (light chestnut) are not uncommon. There are varieties of colour observed in horse population of the State viz. bay, roan, dunn, black, grey, chestnut and skew bald, pie bald. It appears that the major numbers of Kathiawari horses are of bay colour followed by chestnut and skewbald. Black colour is very rare in this breed.

The stallions are of different colours. The maximum stallions are chestnut followed by bay colour. The mares also possess various body coat colours.

The majority of mares are of bay colour followed by Chestnut and Grey. The least numbers of mares observed having are piebald colour. Amongst foal bay colour is prominent followed by chestnut and skewbald, which is in keeping with adult population.

Among the total number of horses, Panchkalyani horses are most prevalent in the district of Surendranagar followed by Bhavnagar and Amreli. The breeders of the Surendranagar district have strong preference for Panchkalyani horses. Porbandar district has least number of Panchkalyani horses followed by Ahemdabad district.

Amongst the marking of head the star, strip and snip is most commonly observed followed by star alone as well as star blaze and snip. Marking of head particularly strip type is least prevalent in the breed in present survey.

Markings

Besides coat colour, markings also play a major role in horse identification and descriptions. Many of the horses have some white markings, normally on the head or legs, but white marks elsewhere on the

Fig. 5. A typical colour mark on face of Kathiawari mare

body are also described while registering a particular horse. Markings may be natural or acquired. These are: star (a white marking on forehead is called a star whether it is exactly star shaped or not), stripe (a narrow white line running down the face is stripe), blaze (broad white band covering almost the whole of forehead between the eyes and running down to muzzle), white face (entire face is white) has been shown in fig. 6 in a Marwari horse. Snip is a small white mark between nostrils.

Body size and conformation

Kathiawari horses look very elegant, shapely and majestic. The head of the Kathiawari is like that of the Arab horse. In its general outline, the Kathiawari resembles the Arab.

There are three major types of forehead shape in these horses viz. concave, flat and convex. The distribution of forehead shape was 60.03, 35.60 and 4.37 per cent respectively. The majority of horses have concave type of forehead followed by flat. Among the stallion the percentage of these type of forehead were 60.55, 29.36 and 10.09, respectively; while in mare 61.80, 35.20 and 3.00, respectively and in foal 55.90, 37.99 and 6.11, respectively.

The face of Kathiawari horses is of concave profile. Face is dry and short, triangular from pole to forehead and small muzzle, big nostrils. The edge of nostril is thin, small and fine. They have long neck, short leg and squared quarters. They have broad forehead and large expressive sensitive eyes. Tail is long but not bushy, curved well and touching to the ground. The foot is round and broad. Generally Kathiawari horses have sickle hocks.

The majority (98.17%) of horses possess erect type of ear. It is distinctive in appearance, and notable features including the highly mobile ears, which curve inwards to touch each other at the tips and can move easily through 360°. The curving ears are a much-prized feature, and in the past they were often cultivated by breeders to the detriment of more important points. The tips of the ears tend to meet towards the centre of the pole. The tip of the ears touching each other is the predominant feature of breed.

Three types of eyes are noticed in Kathiawari horse viz. small, medium and large. Kathiawari horses having medium size of eye were observed to be largest in number.

Moderate type of back is commonly observed in Kathiawari horses. The moderate type of back is very common in Kathiawari horses. The majority of the stallion and mare has length of tail between 120 cms to 150 cms while that of foal was 90 cms to 120 cms.

Biometrical Measurements

Body measurements were recorded through field survey by Gujarat State Animal Husbandry Department and results for Stallions, mares and are foals presented in Tables 3, 4 and 5 respectively.

Table 3. Body measurements of Kathiawari Stallion

Measurements (Cm)	No.	Mean± S.E	Range
Height cm	94	147.23±4.19	141-160
Girth	97	165.31±4.19	151-180
Length	51	180.10±12.23	151-200
Length of Neck	89	81.52±4.79	71-90
Bbetween Knee to Fetlock	101	26.09±3.13	21-40
Length of Ear	108	12.59±4.30	7-20
Length of Back	85	77.24±9.48	61-100
Between Fetlock to Coronet	109	12.98±4.03	5-20
Between Eye and Nostril	105	26.71±3.79	21-40
Width of Chest	95	29.63±5.01	21-40
Length of Forehead	79	21.58±4.77	16-30
Diameter of Hoof	68	16.03±3.06	5-30

Based on Report of AH Department, Gujarat State Government

Table 4. Body measurements of Kathiawari Mare

Measurements (Cm)	No.	Mean± S.E	Range
Height	1009	144.73±6.25	131-160
Girth	984	164.35±9.14	141-190
Length	645	18.,00±11.12	151-200
Length of Neck	967	79.50±8.11	61-100
Between Knee to Fetlock	959	25.57±2.33	21-40
Length of Ear	1026	14.03±2.97	6-20
Length of Back	821	74.66±7.23	61-90
Between Fetlock to Coronet	1023	13.65±3.42	4-20
Between Eye and Nostril	986	26.69±3.75	11-50
Width of Chest	1017	30.59±7.16	11-30
Length of Forehead	842	21.82±4.66	8-30
Diameter of Hoof	851	14.86±2.74	4-48

Based on Report of AH Department, Gujarat State Government

The average height of Kathiawari stallion is 147.23±4.19 cm, whereas that of female is 144.13±6.25cms. The heart girth in stallion and mare was 165.31±. 4.19 and 164.35± 9.14 cm, respectively. Body length in male and female animals were 180.10± 12 73 and 180.00± 11.12 cm, respectively. It may be seen that there is hardly any difference in the biometry of stallion and mares of identical age.

Breed differences were significant for all the body measurements excepting hip width, height at knee and face width. Kathiawari horses had smaller body, shorter in height and lower_ heart girth as compared to Marwari horses. The average paunch girth was 159.4±l.7 and 173.3±3.2 cm for Kathiawari and Marwari horses respectively. Kathiawari horses had smaller tail (without switch) as compared to Marwari horses. Hip width is larger in Kathiawari horses as compared to Marwari horses.

Table 5 Body measurements of Kathiawari Foal

Measurements (Cm)	No.	Mean± S.E	Range
Height	440	140.27±7.95	121-160
Girth	379	154.29±9.80	131-170
Length	374	172.49±11.16	141-190
Length of Neck	432	72.15±9.73	41-90
Between Knee to Fetlock	438	25.27±3.57	11-40
Length of Ear	486	13.46±3.62	6-20
Length of Back	395	66.42±8.43	41-80
Between Fetlock to Coronet	450	11.42±4.80	6-20
Between Eye and Nostril	446	26.14±4.86	11-40
Width of Chest	432	27.82±6.08	11-40
Length of Forehead	378	19.79±5.00	11-30
Diameter of Hoof	415	14.04±4.82	6-30

Based on Report of AH Department, Gujarat State Government

Height at hock and knee were smaller in Kathiawari horses than the Marwari horses but the differences were nonsignificant for height at knee. Kathiawari horses had shorter ear and face as compared to Marwari horses. Face width was almost similar to Marwari breed. Sex effects were only significant for ear length, indicated that stallion had longer ear as compared to mare. The interaction of breed x sex was only significant on height at hock. The Marwari male were higher at hock as compared to other three groups.

However, the body measurements of male and female horses were markedly different as recorded by authors at Pushkar Animal fair (Table-6). This could be due to the reason that stallion were brought to the show may be of better conformation than the general group of mares in the show. Further the age difference between the males and females could not be ruled out.

Table 6: Body Measurements (cm) of Horses at Pushkar Animal Fair

Av. Age(Year)	2.5	2.0	Adult male	Adult female
Heart girth	155.0	146.0±0.57	170.2±:0.74	153.4±0.45
Paunch girth	146.0	142.0±0.88	164.1±:0.63	157.3±0.54
Body length	125.0	123.7±0.71	143.4±1.30	134.1±0.64
Ht at withers	150.0	147.0±0.66	153.8±:0.76	151.7±0.45
Height at sacrum	140.0	138.3±0.71	146.4±0.87	144.0±0.53
Ear length	15.0	15.3±0.44	16.4±0.43	16.1±0.31
Head length	51.0	47.3±0.62	53.4±0.63	49.1±0.52
Head breadth	19.0	17.7±0.43	21.4±0.57	19.3±0.37

Genetic Characterization

Genetic Characterization at the morphological and genetic levels is the first step towards formulating breeding policies and prioritizing the breeds for conservation in an effective and meaningful way. The cytogenetic profile is important to know the genetic stability of the breed as well as to know profile of genetic disorders that limits the reproductive potential of the animals. Recently an array of DNA based markers has been developed to carry out studies of genetic variation in horses. Among these, microsatellite are considered by many to be the most suitable marker system for evaluating breeds for genetic diversity, owing to their abundance in the mammalian genome, high level of polymorphism, codominant inheritance and genetic bottleneck to the population if any. This data can also help in knowing the level of inbreeding in the population.

Cytogenetic profile

The diploid count in the Kathiawari breed has been confirmed to be 64. The chromosomal complement has 13 pairs of metacentric / submetacentric chromosomes and 18 pairs of acrocentric chromosomes. The X chromosome was a large submetacentric while the Y chromosome was acrocentric. The

relative length of each chromosome has been estimated along with the centromeric index. Thirteen pairs of metacentric/ submetacentric were classified on the basis of their arm ratios. The metacentric/ submetacentric chromosomes were grouped as Group A containing four chromosomes of which the q/p ratio was between 2.20 -2.50. The next eight pairs were classified in Group B called metacentric or near metacentric chromosomes with q/p ratio between 1.20-1.50. The 13th pair of chromosome was sub-telocentric in which the arm ratio was 4.0. The 18 pairs of acrocentric chromosomes were classified as Group D chromosomes. The X chromosome was submetacentric and contributed 5.23 % to the genome. The Y chromosome was small acrocentric and contributed 1.41 % to the genome but was not the smallest of the acrocentrics.

Nucleolar organizer region: The metaphase spreads were stained with silver nitrate in the presence of a colloidal developer for the revelation of the r-DNA cistrons. Twenty metaphase spreads were screened per animal. The metaphase spreads were counter stained with Giemsa for half a minute. Six chromosomes (Three pairs) were found to be positive for NORs. Out of these pairs one is largest amongst the non acrocentric chromosome on which the NORs were present on the short (P) arm of the chromosome. The other two pairs belonged -to the acrocentric chromosomes and NORs were present near the centromeric regions of the chromosomes. These chromosomes were 28th and the smallest pair of the autosomes (pair no.31). The NORs varied between 3-6 chromosomes per metaphase spread. Most often only 4-5 NORs were visible. The presence of NORs on chromosome no 28 seem to be most variable.

Sister chromatid exchanges: The whole blood cultures were set up from twelve animals (8 males and 4 females) of Kathiawari breed *(Equus caballus) following* the routine laboratory protocol. The base analogue 5' -bromodeoxy-uridine was added to the cultures for two consecutive cell cycles. The blood cultures were then harvested following the routine

protocol. The air dried slide prepared was then processed for differential staining of the sister chromatids. The slides were then screened for sister chromatid exchanges. Sister Chromatid exchanges in Kathiawari horse (*Equus caballus*).

The mean sister chromatid exchange frequency for *Equus caballus* was found to be 4.083. The sister chromatid exchange frequency was 4.0812 for males and 4.0875 for females respectively. The whole blood cultures were synchronized with amethopterin and released with thymidine. The cultures were harvested following normal protocols. The metaphase spreads were treated with trypsin EDTA mixture for the revelation of the AT rich regions of the chromosomes. The treated metaphase spreads have been photo-micrographed.

DNA profile

The genetic characterization using 25 microsatellite primers on 50 unrelated Kathiawari horses was carried out at Anand Agricultural University, Anand. About 10 ml of blood per animal was collected aseptically into EDTA (0.5 mM, pH 8.0) coated vacutainers. The genomic DNA was isolated by standard procedure of proteinase K digestion, phenol / chloroform / isoamyl alcohol extraction and absolute ethanol precipitation. The isolated genomic DNA was stored at -20°C and working dilutions were stored 4°C. The genomic DNA was amplified by Polymerase chain reaction (PCR) using a set of 24 horse microsatellite markers. Each 25 µl reaction consisted of DNA (about 100 ng), primers (60 ng each), dNTPs (40 mM each), 10 X buffer (10 mM Tris; 50 mM KCl, 0.1% gelatin; pH 8.4) (2.5 µl), $MgCl_2$ (1.5 mM) and *Taq* DNA polymerase (0.75 units). The thermocycling conditions included an initial denaturation at 95°C for 2 min, followed by 30 cycles of 45 sec at 95°C, 45 sec at annealing temperature, and 45 sec at 72°C. A final elongation step was carried out at 72°C for 10 min.

The amplified products were resolved by electrophoresis through 7% denaturing urea-polyacrylamide gel and visualized by silver staining. The PCR product sizes were estimated by comparing the electrophoretic mobility with that of DNA size marker and previously known samples. The alleles were scored manually from the silver-stained gel. The within breed genetic variation parameters of alleles and frequencies, observed heterozygosity at each microsatellite locus were calculated using the POPGENE computer program (version 1.31), The polymorphism information content (PIC) at each locus was also calculated. The observed number of alleles ranged from 2 (NVHEQ54) to 8 (NVHEQ18, VHL20 and HMS03) with a mean (± standard deviation) of 5.04 ± 1.52 alleles per locus.

The PCR product size-range varied from 99 - 107 at locus VHL20 to 236 - 248 at locus UCDEQ425. The allele sizes and numbers observed in Kathiawari horses are in agreement with the allele sizes and numbers reported in other Indian and exotic horse breeds at these loci. The observed heterozygosity values across 24 polymorphic marker loci ranged from 0.143 (NVHEQ54) to 0.905 (AHT4) with a mean (± SD) of 0.661 ± 0.192. The allele numbers and heterozygosity levels observed across the studied loci indicate the presence of the reasonably high level of genetic variability in Kathiawari horses. The mean PIC for all loci assessed from the allele frequency data generated in the Kathiawari population was 0.59 ± 0.06, ranging from 0.123 for locus NVHEQ54 to 0.813 for locus VHL20. Except locus NVHEQ54 (Table 7).

All the loci used in this present study had PIC values sufficiently higher, pointing towards the high degree of informativeness of these markers in evaluation of genetic diversity of horse breeds. These results obtained in this study contribute to the knowledge of the genetic structure of the Kathiawari horses and may be helpful to both planners and breeders in planning breeding / conservation strategies for these magnificent animals.

Table.7 Gene frequencies, heterozygosity and PIC values for various microsatellite markers in Kathiawari Horse

Markers	Gene frequencies						O. Het	PIC
	1	2	3	4	5	6		
NVHEQ70	0.250	0.07h	0.060	0.452	0.167		0.786	0.651
HTGI4	0.202	0.238	0.155	0.405			0.762	0.665
NVHEQI00	0.131	0.6Q7	0.131	0.07			0.476	0.48
HTG04	0.060	0.310	0.548	0.060	0.024		0.571	0.532
NVHEQ82	0.107	0.47,t	0.333	0.036	0.048		0.810	0.587
HTGI5	0.298	0.667	0.036				0.524	0.385
HTG6	0.012	0.476	0.298	0.214			0.714	0.569
AHT04	0.048	0.202	0.036	0.321	0.179	0.214	0.905	0.739
HMS02	0.378	0.354	0.037	0.122	0.110		0.610	0.652
HTG07	0.333	0.071	0.595				0.500	0.447
NVHEO40	0.048	0.333	0.071	0.500	0.048		0.691	0.567
UCDEQ425	0.226	0.476	0.167	0.048	0.083		0.262	0.641
NVHEQ18	0.024	0.048	0.048	0.107	0.202	0.131	0.667	0.71
NVHEQII	0.012	0.083	0.405	0.250	0.167	0.083	0.833	0.691
LEX20	0.107	0.131	0.321	0.250	0.155	0.036	0.881	0.748
VHL20	0.107	0.083	0.048	0.191	0.226	0.107	0.833	0.813
NVHEQ21	0.202	0.1:!1	0.643	0.024			0.571	0.478
NVHEQ05	0.155	0.6'79	0.155	0.012			0.524	0.445
HMS07	0.155	0.311	0.024	0.357	0.012	0.131	0.738	0.681
HMS03	0.036	0.1(J?	0.381	0.262	0.083	0.048	0.786	0.729
NVHEQ79	0.048	0.250	0.012	0.655	0.036		0.619	0.447
NVHEQ54	0.929	0.071					0.143	0.123
NVHEQ29	0.262	0.03	0.274	0.155	0.226		0.857	0.737
ASB02	0.071	0.155	0.310	0.417	0.048		0.810	0.648

Socio-economic Utility

The working pattern of the Kathiawari horses in the State are loading, riding, sports and breeding. Around 92.25 per cent Kathiawari horses are used for riding, 3.20 per cent for sports, 3.20 per cent for load carrying. In Bhavnagar district is an exception where mostly horses are maintained for loading purpose. The other utility of these horses are in police parades and ceremonial purposes. Fig. 7 depicts Kathiawari horse in an horse show where they perform activities to entertain people.

The Indian Half-Bred was developed in India primarily at the army studs to produce suitable cavalry horses. They are descended from a cross between the native Kathiawari, oriental stock, the Australian Waler and a substantial amount of English Thoroughbred. Around the beginning of the 20th century, large numbers of Walers were imported to India for use within the Indian Cavalry and remained the principal method of transport until the start of mechanization. The army had used mostly Arab, and Arab part-bred stock for their requirements, but had then started to import the larger and more suitable Australian Waler as replacements. The Half-Bred is now produced

Fig. 6. Utility of Kathiawari horse in carriage

all over India especially at the army remount depot at Saharanpur and army stud at Babugarth. As well as in the army, the Indian Half-Bred is also widely used by the police force in the towns and especially in the rural areas. The Half-Bred can be any colour and stand between 15 and 16 hands high.

Future Considerations

The horses like other pack animals have lost their general utility in the country because of modernization of transport and a number of recreation tools. However, horses are still considered as most intelligent and faithful companions of man. As a result new avenues have been opened up. The equestrian sports and games, including Polo are coming in prominence. The importance of horses is also increased in eco-tourism. There are horse lovers in other parts of the World ,especially in USA, where they are popularizing these horses by putting sport T-shirts with logo of Kathiawari Horse breed (Fig. 7). For Kathiawari horses, such avenues are numerous and special type of horses meeting these standards should be selected. Genetic characterization can play significant role in this case.

Fig.7. Kathiawar Horse breed lovers in USA www.cafepress.com/iheartshirt/902906

Conservation Status of the Breed

The estimated population of Kathiawari horses in Saurashtra region based on Report of AH Department, Gujarat State Government of Gujarat are not more than 6500. However, some of these horses are kept by farmers in Rajasthan and Punjab. The present status of the breed is threatened and serious efforts are needed for increasing the population of the pure breeding Kathiawari horses. Government agencies have initiated some steps in this direction, however, serious efforts are required even from those organizations

Fig. 8. Kathiawari horse safari as tourist attraction

which are concerned with Equestrian sports and racecourses. Now horse safaris are attracted the foreign tourists. Fig. 8. shows a Marwari horse can organised in natural environment for tourist. There is Kathiawari Horse Breeder's Association at Gondal in Gujarat, who is organizing Kathiawari horse shows and exhibitions to popularize the horse. Such initiatives in the country would improve the situation of this important horse breed of India.

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For enquiries, please contact :
DIRECTOR, NATIONAL BUREAU OF ANIMAL GENETIC RESOURCES
(Indian Council of Agricultural Research)
P.O. Box. No. 129, G.T. Road By-Pass, Near Vasant Vihar, KARNAL - 132001 (Haryana)
Tel. : 0184-2267918 Fax : 0184-2267654 E-mail : director@nbagr.ernet.in