Studies on muzzle pattern and inheritance of muzzle dermatoglyph in Sahiwal cattle

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Introduction

The nature has immense potentiality to create life on this earth. All the living organisms having unique features of similarities and differences do not have exact copy of the same that is no two individuals are exactly alike. There are certain features in the body framework, which may be characteristic to that individual viz. thumb and finger impressions of human beings. Similarly cattle and dairy animals possess distinct impression patterns in their muzzle. The muzzle of bovine has some linear features with specific pattern, which have been observed in the muzzle prints and sketches.

The science of such features with specific pattern on the skin is known as dermatoglyphics. When skin of muzzle is studied for characteristic features, it is known as muzzle dermatoglyphics. Muzzle dermatoglyphics could play a major role in identification of bovine animals. Recent reports on this aspect indicate that it would play a vital role and may serve as efficient tool for identification and correct breed differentiation. Sahiwal is one of the important milch breed of cattle in Indian subcontinent and little work has been done to study the complex features of their muzzle and its characteristic features in the offspring.

Therefore, in view of the available information, the present study has been planned with the objectives to study muzzle patterns of Sahiwal breed and its inheritance.

Material and methods

Muzzle prints of Sahiwal cattle were collected from the Bull Mother Experimental Farm, College of Veterinary Science & Animal Husbandry, Anjora, Durg (Chhattisgarh State). Overall a total of 576 prints were taken from 192 animals following 'modified cyclostyle ink procedure'. Out of three complete and clear muzzle prints best one print of each animal was selected for dermatoglyphic analyses.

Muzzle print analysis

The dermatoglyphic analyses based on different patterns and their distribution in respective groups of animals in this study were performed in accordance with the classification of Mishra, S., Tomer, O.S. and Kalm, E. (1996a).

Abbreviations

GAS Grooved category, Alternate Simple pattern ridge arrangement
GAC Grooved category, Alternate Compound pattern ridge arrangement
GASC Grooved category, Alternate Simple and Compound pattern ridge arrangement
GRWP Grooved category, Ridge distributed Without Pattern
GPCV Grooved category, Pattern ridge arrangement from the top of Central Valley
GOBA Grooved category, Beads with no pattern
NAS Non-grooved category, Alternate simple pattern ridge arrangement
NASC Non-grooved category, Pattern with simple and compound pattern ridge arrangement
R non-grooved category, simple pattern Ridge originating from same point (radiating type)*

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NRWP Non-grooved category, Ridge distributed Without Pattern
SAS Special category, Simple ridge pattern
SASC Special category, combination of Simple and Compound ridge

Results and discussion

Different patterns of muzzle obtained in Sahiwal breed

During muzzle print analysis, it was often observed that some animals do contain groove at the centre of the muzzle while others do not. The muzzles based on presence and absences of grooves were grouped into grooved and non-grooved categories respectively according to the classification of Mishra, S., Tomer, O.S. and Kalm, E. (1996a). This finding is quite similar to the results reported by Pandey (1979). Apart from the two main categories, a very unlike pattern which was neither similar to grooved nor to non-grooved categories was also observed. Such muzzle prints were extremely different from others and were kept into third category called special category (Mishra, S., Tomer, O.S. and Kalm, E. (1996a)). The distribution of animals based on the categorical classification revealed maximum occurrence of animals into grooved category than the non-grooved and special categories. Out of 192 experimental animals, 152 animals (79.15 per cent) were directly classified into grooved category (Figure 1), 37 (19.25 per cent) and 3 (1.56 per cent) animals were classified into non-grooved (Figure 2) and special categories (Figure 3) respectively (Table 1). Thus, the categorical distribution of patterns indicated presence of very few animals in special category. Mishra, S., Tomer, O.S. and Kalm, E. (1996a) found these values as 58.3 per cent, 41.0 per cent and 0.69 per cent for grooved category, non-grooved and special categories respectively in the study of a mixed population of different breeds. In this study, the difference in the frequencies of grooved category and non-grooved category was higher. This difference was relatively lower as observed by Mishra, S., Tomer, O.S. and Kalm, E. (1996a). However in the present investigation the incidence of special category was comparatively higher.

Patterns of the muzzle

Beads distribution and pattern ridge arrangements on the muzzle play an important role in designing patterns on the muzzle. Most of the patterns on the muzzle were formed due to arrangement of the pattern ridges and 90.60 per cent of the muzzles of the animals were directly classified on the basis of pattern ridge arrangement only. Whereas, the classification based on ridge distributed without pattern as well as pattern formed only by beads were available in 8.32 per cent and 1.04 per cent respectively of the muzzle of animals (Table 2). Thus, in 90.60 per cent cases, the pattern ridge arrangement was strictly responsible for the development of the patterns on the muzzle. However, Mishra, S., Tomer, O.S. and Kalm, E. (1996a) observed that it would be possible to classify the animals into different patterns on the bases of pattern ridges, distributed ridges and beads. They had obtained 89.70 per cent, 5.81 per cent and 3.82 per cent patterns based on pattern ridges, distributed ridges and beads respectively. The animals with no specific arrangement of the characteristics on the muzzle were lesser than 1 per cent in their study. The findings of the present investigation were at par with those observed by Mishra, S., Tomer, O.S. and Kalm, E. (1996a). However, little variations were observed in the patterns based on distributed ridges and beads. The grooved, non-grooved and special categories were further classified into 6, 5 and 3 patterns respectively where 4 out of 6 pattern classes of grooved category were perfectly based on pattern ridge arrangement. In non-grooved category, only 3 patterns were completely based on pattern ridge arrangement. The patterns of special category were only due to unspecific arrangement of the ridges. Some animals, which did not have common or specific arrangement of the pattern ridges on the muzzle due to absence of it, were classified on the basis of ridge and bead distributions. Two types of pattern ridges were observed. These were the simple and compound pattern ridges. The compound pattern ridges were wider and highly intercepted than the simple ones. This was similar to the findings of Pandey (1987) where he classified the muzzle on the basis of simple and compound ridges. The patterns of each category are discussed separately under following sub-heads.

Patterns of grooved category

Alternate Simple pattern ridge arrangement (GAS)

Around 50.00 per cent animals were classified into this pattern, which was very high when compared with other patterns (Table 3). However, the same was 51.83 per cent in a study with different cattle breeds (Mishra, S., Tomer, O.S. and Kalm, E. (1996a)).

Alternate Compound pattern ridge arrangement (GAC)

Simple pattern ridges were completely absent in this category. Only 5.73 per cent animals showed the presence of this pattern **(**Table 3**)**. However, Mishra, S., Tomer, O.S. and Kalm, E. (1996a) found only 0.33 per cent animals to have this pattern which was very infrequent in the population.

Pattern with simple and compound pattern ridge arrangement (GASC)

The percentage of this pattern observed in Sahiwal population was 11.45 per cent (Table 3). However, this pattern was absent in Black & White breed of cattle, whereas, only 2, 3, 2, 4 and 1 animal of Tharparkar, Sahiwal, Karan Swiss, Karan Fries and Red & White breeds respectively had shown the appearance of such pattern. Overall percentage of this pattern in the population of mixed animals was 1.99 (Mishra, S., Tomer, O.S. and Kalm, E. (1996a)).

Ridge distributed without pattern (GRWP)

In present study, 5.20 per cent animals showed this type of pattern (Table 3). Whereas, overall 1.83 per cent animals had shown the presence of this pattern and the same pattern was not observed in Red & White and Black & White cattle. However, in Tharparkar, Sahiwal, Karan Swiss and Karan Fries breeds only 1, 2, 4 and 4 animals, respectively exhibited this pattern (Mishra, S., Tomer, O.S. and Kalm, E. (1996a)).

Beads with no pattern (GOBA)

In present study, the frequency of animals under this pattern was 1.04 per cent (Table 3). But it was observed in 2.16 per cent animals of mixed population studied by Mishra, S., Tomer, O.S. and Kalm, E. (1996a). This pattern was not seen in Red & White and Black & White cattle. The central valley was present and divided the muzzle into right and left halves. This pattern was also reported by Trofimenko (1989), where he classified such pattern as 'granular pattern'.

Pattern ridge arrangement from the top of central valley (GPCV)

The percentage of this pattern obtained in this Sahiwal population was 5.73 (Table 3). In contrast to it, only 1 animal out of 602 was reported to contain such pattern in Karan Swiss breed (Mishra, S., Tomer, O.S. and Kalm, E. (1996a)). Most of the pattern ridges were arranged on the top or end point of the central valley and few pattern ridges had shown their origin from either side of the central valley.

Patterns of non-grooved category

The patterns of non-grooved category are discussed under following headings.

Alternate simple pattern ridge arrangement (NAS)

In present study on Sahiwal cattle, the frequency of animals under this pattern was 10.93 per cent (Table 3). Whereas, Mishra, S., Tomer, O.S. and Kalm, E. (1996a) observed this pattern in all the breeds of their study except Tharparkar and around 20.26 per cent animals exhibited this pattern, which was lesser than half of the percentage of animals belonging to the alternate simple pattern ridge arrangement of grooved category.

Simple pattern ridge originating from same point (radiating type - R)

Mishra, S., Tomer, O.S. and Kalm, E. (1996a) reported that this pattern appeared in all the breeds except Sahiwal, and around 14 per cent animals were directly classified into this pattern. However, in the present study 3.12 per cent animals showed the appearance of this particular pattern in their muzzles (Table 3).

Pattern with simple and compound pattern ridge arrangement (NASC)

Only 2.08 per cent animals were found to contain this pattern (Table 3). However, Mishra, S., Tomer, O.S. and Kalm, E. (1996a) reported this pattern found in lesser number of animals of Karan Swiss, Karan Fries, Red & White and Black & White cattle, whereas it was not observed in Tharparkar and Sahiwal cattle and only 1.33 per cent animals were found to have this pattern.

Ridge distributed without pattern (NRWP)

The animals contributing to the presence of this pattern were 3.12 per cent (Table 3). However, Mishra, S., Tomer, O.S. and Kalm, E. (1996a) reported that 3.98 per cent animals of their study contained the same pattern however in Sahiwal it was absent.

Patterns of special category

Lesser than 2 per cent animals showed the patterns of special category whereas the occurrence of the same pattern was 1 per cent as observed by Mishra, S., Tomer, O.S. and Kalm, E. (1996a). They also reported that the special category had three main patterns i.e., muzzle containing simple ridge, containing compound ridge and the combination of simple and compound ridges. All these patterns were found in Karan Swiss breed, though the number of animals was one in each pattern. Very few animals of Karan Fries breed containing pattern formed by simple ridge were observed. The patterns of this category were not found in other breeds. Only 0.33, 0.17 and 0.17 per cent animals exhibited the presence of simple ridge, compound ridge and the combination of simple and compound ridge patterns, respectively (Mishra, S., Tomer, O.S. and Kalm, E. (1996a)). This indicated presence of such patterns only in crossbred population. However, in the present study no animal was found to have only compound ridge. Only 0.52 and 1.04 per cent animals exhibited simple ridge and the combination of simple and compound ridge patterns respectively (Table 3).

The peculiarity of the patterns of special category was distinct due to irregular arrangement of ridges on the muzzle. The ridges had no specified arrangement as it occurred in case of various patterns of grooved and non-grooved categories. Mishra, S., Tomer, O.S. and Kalm, E. (1996a) divided the special category into three patterns on the basis of types of ridges present on the muzzle. Only simple ridges were present in "simple ridge pattern" of special category. Whereas, the patterns "compound ridge" and "combination of simple and compound ridge" contained only compound ridges and combination of simple and compound ridges, respectively. However, in this study only "simple ridge pattern" (SAS) and "combination of simple and compound ridge" (SASC) were observed.

As compared with the earlier findings of different patterns of muzzle reported by Mishra, S., Tomer, O.S. and Kalm, E. (1996a), it was found in this study that out of 14 reported patterns two patterns i.e. NOBA (Non-grooved category, Only Beads are Available) and SAC (Special category, Compound Ridge) were not observed in Sahiwal.

The inheritance of muzzle dermatoglyph

A total of 60 out of 192 animals were selected to study the inheritance of muzzle impression. The animals selected under study were divided according to dam-daughter relationship. Therefore, it was not possible to have all the 12 observed patterns due to small population size. In the dam group, only 7 patterns of muzzle were obtained. Within the dam population, some dams had calves of two generations while the others had calves of only one-generation. In fact, the muzzle impression of the calves of two generations of the same dam added a significant dimension in the analysis of dam-daughter muzzle prints. Therefore, these data of different generations also helped in finding the generation effect on the muzzle prints.

It was evinced that the GAS (Grooved category, Alternate Simple ridge) pattern was more frequent pattern in dam population as 14 out of 29 dams contained the same pattern. However, they had the calves of two successive generations as well i.e. 10 in previous and 14 in the present generation (Table 4).

In the present generation, almost 57.14 per cent calves had the GAS pattern, which was similar to the patterns of their dams. The same pattern also exhibited in the calves of previous generation and almost 80 per cent of them had pattern similar to their dam. Therefore, on an overall basis, almost 66.67 per cent of calves resembled the same pattern of their dams (Table 4).

However, the GAC (Grooved category, Alternate Compound ridge) pattern of dam on overall basis was found in 33.33 per cent calves only (Table 4).

In case of GASC (Grooved category, Alternate Simple and Compound ridge) pattern, 57.14 per cent calves of the present generation had the same pattern, which was similar to their dam. However, in the calves of previous generation the similarity was only 25 per cent.

Overall similarity of muzzle pattern between dam and their calves was observed in 45.45 per cent cases (Table 4).

Only one dam exhibited GPCV (Grooved category, Pattern ridge arranged on the top of Central Valley) pattern in her muzzle. However, 2 out of 3 calves contained the same pattern and other single one differed by containing GAS pattern in her muzzle.

The calves of present generation had shown the presence of SAS (Special category, Simple ridge) and GAC pattern in their muzzle while the dam of these calves had exhibited GRWP (Grooved category, Ridge distributed Without Pattern) pattern in her muzzle.

In case of NRWP (Non-grooved category, Ridge distributed Without Pattern) pattern, it was observed in dam and her offspring. However, NAS (Non-grooved category, Alternate Simple pattern ridge arrangement) pattern was observed in 3 dams but none of their offspring showed this type of muzzle pattern.

In category wise inheritance, on an overall basis 80 per cent calves showed the similarity with their dams whereas, in grooved category it was 85.36 per cent and in non-grooved category it was 25 per cent.

It was revealed that some patterns of the dams had higher resemblance with their calves. As it is known that some of the reported patterns were based either on simple ridges or compound ridges or in combination of both ridges. In present investigation the ridges of such pattern did not show any specific inheritance as the patterns based on simple ridges either converted to patterns, which are based on compound ridges such as GAC and GASC vis-à-vis the inverse conversions were also noticed.

In generation wise comparison, it was observed that same dam had produced two distinctly different kinds of patterns on the muzzle of their calves in two successive generations. A little similarity was observed within the calves of different generations and it was also found that the calves having a particular pattern in the previous generation had not shown any trend in the present generation in the conformation of pattern and had a probability of becoming any pattern of the reported 14 patterns.

In this context, earlier finding can be mentioned relevantly where Trofimenko (1989) reported a remarkable inheritance of pattern in the dermatoglyph of the naso-labial plate of cattle. If the parents had a particular pattern, it is transmitted to more than 75 per cent of their progenies. A genetic correlation of 0.84 and 0.62 between the muzzle patterns in sire-son and dam-daughter pair was observed respectively. However inheritance of muzzle prints in sire-son and dam-daughter pair needs further investigation for obtaining more information.

Sire effect may be another factor which was not studied in the present investigation due to their non-availability.

Table 1: Category wise distribution of animals

S. No.	Name of the category	Animal (%) in present study	Animal (%) Mishra *et al*., (1996a).
1	Grooved category	79.15	58.30
2	Non-grooved category	19.25	41.00
3	Special Category	01.56	00.69

Table 2: Bases of classification of animals on muzzle characteristics

Classification of animals based on muzzle character	Animal (%) in present study	Animal (%) Mishra *et al*., (1996a).
Pattern ridge	90.60	89.70
Bead	01.04	03.82
Without pattern	08.32	05.81

Table 3: Available patterns in Sahiwal breed and the per cent of animals under each pattern

S. No.	Name of the particular patterns observed in Sahiwal breed	Animal (%) In present study	Animal (%) Mishra *et al*., (1996a)
1	Grooved category, GAS pattern	50.00	51.83
2	Grooved category, GAC pattern	5.73	00.33
3	Grooved category, GASC pattern	11.45	01.99
4	Grooved category, GRWP pattern	05.20	01.83
5	Grooved category, GOBA pattern	01.04	02.16
6	Grooved category, GPCV pattern	05.73	00.17
7	Non-grooved category, NAS pattern	10.93	20.26
8	Non-grooved category, R pattern	03.12	13.79
9	Non-grooved category, NASC pattern	02.08	01.33
10	Non-grooved category, NRWP pattern	03.12	03.98
11	Special category, SAS pattern	00.52	00.33
12	Special category, SASC pattern	01.04	00.17

Table 4: Some muzzle patterns and their inheritance

S. No.	Name of particular muzzle pattern of dam	Percentage of similarity with the offspring		
		Present calves	Previous calves	Overall
1	Grooved category, GAS pattern	57.14	80	66.67
2	Grooved category, GAC pattern	50.0	33	33.33
3	Grooved category, GASC pattern	57.14	25	45.45
	Total patterns		80.00	
	Grooved pattern		85.36	
	Non-grooved pattern		25.0	

Figure 1: Only beads are available (Grooved category)

Figure 2: Ridge distributed without pattern (Non-grooved

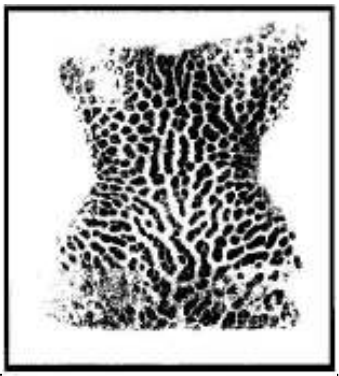

Figure 3: Special category simple and compound ridge

Conclusion

The entire animal population of Sahiwal breed was distributed into 79.15 per cent in grooved category, 19.25 per cent in non-grooved category and 1.56 per cent in special category.All the animals were classified according to pattern based on pattern ridges, pattern based on beads and without pattern into 90.60, 1.04 and 8.32 per cent respectively.

Only 12 patterns out of 14 reported muzzle patterns were seen in present population and they were GAS, GAC, GASC, GRWP, GPCV, GOBA (Grooved category, Only Beads are Available), NAS, NASC (Non-grooved category, Alternate Simple and Compound pattern ridge arrangement), R (simple pattern ridge originated from the same point- Radiating type), NRWP, SAS and SASC (Special category, Simple and Compound ridge) patterns.

The frequencies of these available patterns were respectively 50, 5.73, 11.45, 5.20, 1.04, 5.73, 10.93, 3.12, 2.08, 3.12, 0.52 and 1.04 per cent in this population under study**.**

On an overall basis, almost 66.67 per cent of calves resembled the same pattern of their dams.

In generation wise comparison, it was observed that same dam had produced two distinctly different kinds of patterns on the muzzle of their calves in two successive generations. In category wise inheritance, on an overall basis 80 per cent calves showed the similarity with their dams whereas, in grooved category it was 85.36 per cent and in non-grooved category it was 25.00 per cent.

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