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Effect of coat characteristics on milk production and milk composition traits in Tharparkar cattle

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Abstract
The present study was conducted on a total of 24 Tharparkar cattle (*Bos indicus*) at Cattle and Buffalo farm (Indian Veterinary Research Institute. The objective was to study the effect of coat characteristics like coat colour, coat score coat thickness etc. on milk production and milk composition traits. Animals were divided into 2 groups: light grey (LG) and dark grey (DG), on the basis of coat colour. Light coloured and thin coated cattle produced more milk with higher values of milk fat, protein, milk solids etc. ($p< 0.01$). Coat score (higher coat score implies rough, long and a more wooly hair coat) had an inverse relationship with milk production as well as composition ($p< 0.01$). Cattle with lower hair densities (<400 hair/cm^2) had higher milk yields ($p< 0.05$) than with higher hair densities (>400 hair/cm^2). Other coat characteristics like weight of hair coat, hair diameter etc. did not show any significant effect either on milk yield or milk composition. From the present study, it can be concluded that skin and coat characteristics can be used as potential selection tools to improve production potential of cattle especially in tropics.

Keywords: Coat score, Tharparkar, hair density, coat thickness

1. Introduction
Animal husbandry is an integral part of Indian agriculture. Cattle and buffaloes are important contributors to our national economy. India has 41 registered cattle breeds which thrive in different agro-climatic regions. Major milch breeds include Sahiwal, Red Sindhi, Tharparkar and Gir. Tharparkar is an important indigenous milch breed (*Bos Indicus*) with lyre –horns. The animals are very well adapted to desert conditions due to their capacity to thrive on poor quality forage and high heat tolerance. The composition of milk from dairy animals is of major interest to milk producers, processors and consumers because of its health related issues and also market demand [1]. It directly affects the economy of milk production as well as the economic condition of dairy farmers, though the composition of milk has received little attention in breeding programs [2].

Various traits related to the coat of animals have been correlated with milk production. Coat characteristics including coat color, coat type, coat score etc. are closely related with the milk production traits. The morphological characteristics of the skin (color and thickness) and of the hair coat (thickness, number of hair per unit area, diameter of the hair, length of the hair) regulate exchange of heat with the environment and thus are important with respect to the overall productive performance of animals [3]. It was found that the phenotypic correlation of skin and coat traits with economically important traits of growth, milk production and reproduction were mostly significant [4]. The information on milk composition and genetic and non-genetic factors influencing milk constituents traits in Indian dairy cattle especially in Tharparkar is meager [2]. It has been reported that the components of the milk are affected by hot weather and there is a reduction in milk protein due to heat stress. Since, coat traits are closely related with the maintenance of body temperature and occurrence of heat stress, therefore, it is suggested that these traits may also affect the milk quality and composition of dairy cattle. Therefore, the objective of the present study was to ascertain the effect of various coat characteristics on milk production as well as milk composition.

2. Materials and Methods
The coat traits studied were: coat colour (CC), hair density (ρ), coat thickness (T_C), weight of hair coat (W) and coat score (CS).

Hair samples were collected from an area of 1cm^2 from different locations of the body. Animals were divided into 2 groups: light grey (LG) and dark grey (DG), on the basis of coat colour which was recorded visually. Coat thickness was measured by digital calipers and a digital micrometer was used to measure hair diameter (µm). For hair length and hair diameter, twenty longest and thickest hairs of a sample were taken, respectively. Hair density was measured by direct counting of all the hairs present in a sample. Coat score was measured as per the basic method [5] (Table 1).

Monthly milk yields (kg) were taken from the daily milk yield register. For analysis of milk samples, 5 ml of fresh milk was collected in well cleaned and autoclaved plastic sample bottles. Total fat, total protein, lactose, total solid and SNF was estimated by using Lactoscan Milk Analyzer. The analysis of data was done by taking all genetic and non-genetic effects simultaneously in the model using standard statistical analytical procedure with SPSS software (version 2017).

Table 1: Hair coat scoring system (Turner and Schleger, 1960)

Coat score	Description
1.	Extremely short hair extremely short and closely attached to the skin
2.	Very short coat bearing short and coarse hairs which are lying flat
3.	Fairly short and smooth-coated, fairly coarse, easily lifted
4.	Fairly long not completely smooth, coat easily ruffled
5.	Long hairs distinctly long and lying loosely; predominantly coarse
6.	Wooly hairs erect, giving a fur-like appearance
7.	Very wooly i.e. a more extreme expression of 6th score class, with greater hair length.

3. Results and Discussion

In Tharparkar cattle, coat thickness, coat score and coat colour showed highly significant ($p< 0.01$) positive correlations while as hair density showed significant positive correlation ($p< 0.05$) with the milk yield (Table 2) during overall study period (120 days milk yield). Similar results were obtained for milk composition parameters (Table 3).

It was observed that cattle with lighter and thinner coats had higher milk yields which may be partly due to their better ability to evaporate and to tolerate heat stress and therefore, the effect on the milk production was minimum. On the other hand, dark coloured cattle had considerably lower yields which indicates that coat colour may affect production potential of an animal. Similar results were observed in other studies and it was found that white cows had higher milk production over black cows but this was not statistically different [5]. Similarly, a greater depression in milk yield for black cows (3.3 kg.) in no shade environment over white cows (1.5 kg.) and it was attributed to the higher body temperatures for the black animals [6]. The results of the present study are in agreement with other studies which reported that milk yield in predominantly (> 70%) white-haired cows tended to be higher than in predominantly black cows [7]. Study of the effect of coat colour on physiological parameters in lactating cattle revealed that light coloured cattle had lower values of skin temperature, rectal temperature and respiration rates than dark coloured cattle, which indicates the better thermoregulatory ability of light coloured cattle [4]. Both coat score and hair density showed an inverse relationship with the milk yield. Cattle with higher coat score (thicker and longer hairs) and higher hair density (more number of hair per unit area) produced a lesser quantity of milk during the study period (Table 2). Thicker and denser hair coat impedes the transfer of heat. The resistances to heat exchange that affect the ability of an animal to regulate its body temperature and therefore, leads to more heat stress. Heat stress leads to a decrease in milk production mainly due to a decreased feed intake. It is estimated that the increase of every 1°C in air temperature above thermo-neutral zone causes 0.85 kg reduction in feed intake, which causes ~36% decline in milk production [8]. The reason for reduced milk production is the negative energy balance as the animal tries to maintain homeostasis to avoid hyperthermia [9]. It was reported that the slick-haired cows averaged 164 days in milk (DIM) ranging from 45-253 DIM, while the normal-haired cows averaged 160 DIM ranging from 56-226 DIM [10].

Table 2: Effect of different Coat traits on 120 day milk yield (study period)

Coat colour	120 days milk yield (kg)	p- value
LG	400.01±17.39	< 0.01
DG	332.75± 8.78	
Coat score		
1	379.78±5.89	< 0.01
2	334.55± 7.59	
3	297.21± 11.08	
Hair density (hair/cm^2)		
<400	388.65±18.85	< 0.05
>400	331.78±13.26	
Coat thickness		
<10mm	393.76±11.95	< 0.01
>10mm	345.09±8.39	

It was observed that coat traits affected milk composition significantly. Lighter and thinner coloured cattle produced milk with higher values of Fat, protein, lactose, total solids and solid-not-fat as compared to dark coloured cattle. Coat score and hair density showed an inverse relationship with milk composition parameters (Table 3). This may be due to the better ability of the light and thinner coated cattle to dissipate body heat. In lactating Holstein cows transferred from an air temperature of 18 to 30° C, milk fat, solids-not-fat and milk protein percentages decreased by 39.7, 18.9 and 16.9%, respectively [11]. Similar reduced values in milk constituents were reported in other studies [12, 13, 14, 15]. It has been confirmed that fat and protein percentages declined between 8 and 37 °C and protein to fat ratio decreased at temperatures above 29 °C. Heat stress was found to reduce the protein and fat content [16].

Table 3: Effect of different Coat traits on milk composition parameters

Coat colour	Total Fat	Total Protein	Total lactose	Total solids	Total solid-not-fat	p- value
LG	5.43±0.23	2.71±0.07	4.31±0.13	12.77±0.30	7.33±0.11	< 0.01
DG	4.96.±0.43	2.22±0.12	4.06±0.08	10.56±0.35	5.69±0.17	
Coat score	Total Fat	Total Protein	Total lactose	Total solids	Total solid-not-fat	
1	5.25±0.43	2.68±0.03	4.27±0.13	12.56±0.33	7.31±0.11	< 0.01
2	4.98.±0.36	2.31±0.16	3.91±0.11	10.43±0.35	6.25±0.12	
3	4.05.±0.11	2.09±0.12	3.65±0.32	9.96±0.28	5.56±0.22	

Hair density (hair/cm^2)	Total Fat	Total Protein	Total lactose	Total solids	Total solid-not-fat	
<400	5.43±0.23	2.71±0.07	4.31±0.13	12.77±0.30	7.33±0.11	< 0.05
>400	4.96.±0.43	2.22±0.12	4.06±0.08	10.56±0.35	5.69±0.17	
Coat thickness	Total Fat	Total Protein	Total lactose	Total solids	Total solid-not-fat	
<10 mm	5.59±0.08	2.87±0.14	4.41±0.13	12.69±0.21	7.11±0.18	< 0.01
>10 mm	4.47.±0.39	2.19±0.22	3.98±0.46	10.43±0.28	5.94±0.43	

Heat stress reduces milk protein, milk fat, solids-not-fat (SNF) in dairy cows. Further, heat stress reduced milk fat, protein and short-chain fatty acids while it increased the long chain fatty acids in the milk [17]. In summer, decreased milk protein, lactose and fat values were recorded. The declined protein concentration during heat stress may be due to the specific down thermo-regulation activity of mammary protein synthesis. In an experiment carried out on the response of Holstein heifers to heat stress, it was observed that there is a reduction in percentages of total protein, fat, casein, lactose, lactalbumin, short and medium-chain fatty acids, IgG and IgA [17]. Elevated temperature and humidity can reduce the ability of cattle to dissipate excess heat which can ultimately lead to heat stress and associated physiological changes such as reduced milk fat and protein. Heat stress can increase body temperature which may affect the fat synthesis of the mammary gland [17].

4. Conclusion

Certain coat traits like coat score, coat colour and coat thickness have a marked effect on the milk production potential and milk composition in cattle. Animals with lighter coat colour, lower coat scores and thinner coats were seen to perform better in terms of milk production and milk composition. This could partly be attributed to the fact that light coloured cattle tolerate heat stress better than dark coloured cattle due to better thermoregulatory ability. This is especially important in case of tropical countries like India, where ambient temperatures are very high and therefore, selection of animals on the basis of coat characteristics is feasible. This can result in better performance in terms of milk yield and therefore, will increase the profitability of animals. Therefore, these coat characteristics can act as potential selection tools with respect to climate conditions and can determine the suitability of various breeds of cattle to different climatic regions which will in turn enhance the milk production potential of cattle.

5. References

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