



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

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ABSTRACT

The present study was conducted on a total of 68 Tharparkar cattle (*Bos indicus*) at Cattle and Buffalo farm (Indian Veterinary Research Institute) from December 2016 to April 2017. The objective was to study the effect of skin and coat characteristics like coat colour, coat score (CS) coat thickness, hair density, hair length, hair diameter and weight of hair coat on growth (live body weights at birth, 3, 6, 12, 18 and 24 months of age) and milk production (Lactation lengths, lactation milk yield) traits. Physiological parameters studied were skin temperature (ST), rectal temperature (RT) and respiration rate (RR). Animals were divided into 2 groups: light grey (LG) and dark grey (DG), on the basis of coat colour. Higher average body weights were found in light grey animals at 3, 6, 12, 18 and 24 months of age. An increase in coat score (higher coat score implies rough, long and a more wooly hair coat) tended to have a negative effect on body weight gain as well as on milk production. The average previous lactation yields of LG were higher than DG group. Cattle with lower hair densities (<400 hair/cm²) had higher milk yields than with higher hair densities (>400 hair/cm²). Considering the results of the present study, it can be concluded that skin and coat characteristics can be used as a potential selection tool to improve growth and production potential of cattle especially in tropics.

Key words: Coat score, Coat thickness, Hair density, Skin temperature, Tharparkar

India is the highest producer of milk in the world with a per capita availability of milk being 355 grams per day with an annual growth of 6.37% (DADF annual report 2017). However, various factors like the low milk yield of indigenous cattle due to the shortage of feed and fodder, lower growth rates due to harsh summers, lack of elite male germplasm and low reproductive efficiency still hamper the growth, productive and reproductive potential of indigenous animals. Various characteristics related to the coat of animals have been correlated with growth and milk production in animals and the results have indicated that coat characteristics like coat color, coat type, coat score, etc, are closely related with these performance traits. Lee *et al.* (2016) concluded that the cows that have longevity in the tropics must have greater ability for evaporative cooling and this was probably coupled with hair coat color and the physical characteristics of the hair. According to Da Silva (2000), the morphological characteristics of the skin (color,

thickness) and of the hair coat (thickness, number of hairs per unit area, diameter of the hairs, length of the hairs) influence the ability of cattle to exchange heat with the environment and thus are of importance in relation to productive and reproductive performance of animals. Researchers are of the opinion that genetic selection of cattle for a more appropriate hair coat for hot and humid environments should be encouraged (Lee *et al.* 2016).

MATERIALS AND METHODS

Data collection and management: Data from 68 Tharparkar cattle (*Bos indicus*) born/purchased between 2001 and 2016 were obtained in a selected commercial Tharparkar herd (Indian Veterinary Research Institute). Animal categories were male and female calves, heifers, lactating cows and dry cows (ages from 0.6 to 16.25 years), respectively. The animals were housed in sheds provided with paddocks. The daily milk yield of each lactating animal was recorded in morning and evening. The information regarding growth and milk production was collected during the study as well as from various records (growth registers, livestock registers, milk recording registers, history sheets etc.).

Classification and recording of data: The following skin and coat characteristics were studied: coat colour (CC), skin colour (SC), hair diameter (D), hair length (L), hair density

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($\bar{n}$), coat thickness (T_C), skin thickness (T_S), weight of hair coat (W) and coat score (CS). Hair samples were collected between December 2016 to April 2017. Hair samples were collected from an area of 1 cm² from dorsal, lateral, ventral and head areas of each animal. Coat colour and skin colour were recorded visually. Coat and skin thickness were measured by digital calipers. A digital micrometer was used to measure hair diameter (μ m) of the same hairs used for hair length measurements. For hair length and hair diameter, ten 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 thickness was measured at three different locations (brisket, point of shoulder and flank) of the body and final value was arrived at by taking the mean of these three values. Coat score was measured as per the method given (Table 1) by Turner and Schleger (1960). The growth traits included in the present study were: Birth weight, live body weights at birth 3, 6, 12, 18 and 24 months of age while as milk production traits included were: Previous lactation lengths (PLL), previous lactation milk yields (PLMY) and Milk yield per day during the course of study (YPD). The standard statistical analytical procedures were adopted for the analysis of the generated data under study using standard methodology with SPSS 17 version using relevant model.

RESULTS AND DISCUSSION

It was observed that the hairs of ventral area were the longest and the hairs of head were the shortest. In terms of hair diameters, the hair of head were the thickest while as the thinnest hairs were found on dorsal and lateral areas. The highest hair density was on head whereas dorsal area had the least hair density. It was also observed that young animals possessed a slightly thinner coat with higher hair

densities as compared to the older animals. The hair length was found to be maximum during the months of March and April. The hair diameter, hair density and weight of hair coat were highest during the months of December and January (winter). Similar results were seen by Maia *et al.* (2005) who studied physical hair coat properties of Holstein cows under various circumstances and found that the length of hair was longer in March and April (spring) and the average density of hair coat was high in February and March. Pan (1964) found that Sahiwal cattle showed shortest hair length at belly area, but Jersey cattle showed shortest hair length at forehead and longest hair length at belly. The higher hair densities in younger animals can partly be attributed to the nature's mechanism to prevent hypothermia (as young animals are more sensitive to low temperatures).

Effect of coat colour on growth and physiological parameters: Tharparkar cattle under study were divided into 2 groups viz, light grey and dark grey, on the basis of hair coat colour. It was observed that animals with lighter hair coat performed better in terms of body weight gain (growth) as compared to dark coloured cattle. Higher average body weights were found in light grey animals at 3 (WT3), 6 (WT6), 12 (WT12), 18 (WT18) and 24 (WT24) months of age ($P \leq 0.05$) (Table 2). Similar effects of coat colors on weight gain were studied by Finch *et al.* (1984) who found that overall light steers gained more weight than dark ones ($P < 0.01$). This higher growth rate may be attributed to the proper heat dissipation and heat reflection from lighter coat which reduces heat stress in animals.

Lower values of physiological parameters and higher growth rates in light coloured cattle could be due to better thermoregulation and comparatively lesser heat stress as compared to dark coloured cattle (Table 2). A similar study carried out by McManus *et al.* (2011) looking at physiological traits in the same groups of sheep showed that white Santa Inês sheep had lower heart and breathing rates and rectal temperatures than the other groups and showed better heat adaptation than darker breeds.

Effect of coat score on growth: An increase in coat score (higher coat score implies rough, long and a more wooly hair coat) had a negative effect on body weight gain. Highest body weights were observed in animals with a coat score value of 1 while as the lowest weight gains were observed in animals with a coat score of 4. Birth weight (BWT) was neither statistically different in light or dark coloured cattle nor in animals with different coat scores (Table 3). These results were in agreement with Turner and Schleger (1960) who reported that for each one point increase in hair coat thickness, there was an estimated 11.2 kg loss in average daily gain. Similarly, Sleekness of coat (thin and uniform

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

Coat score	Description
1	Extremely short hair 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 6 th score class, with greater hair length.

Table 2. Effect of coat colour on physiological parameters and live body weights

Coat colour	ST (°C)	RT (°C)	RR (bpm)	BWT (kg)	WT3 (kg)	WT6 (kg)	WT12 (kg)	WT18 (kg)	WT24 (kg)
LG	29.7±0.30	38.2±0.30	35.35± 3.25	27±5.00	70.5± 7.50	105±12.00	180.5±22.50	245±27.50	320±26.50
DG	30.4±0.20	38.8±0.20	48.4±4.55	21±4.00	52.5±4.50	80±10.00	142±14.75	200±12.00	270±23.00

Table 3. Effect of coat score on live body weights

Coat score	BWT (kg)	WT3 (kg)	WT6 (kg)	WT12 (kg)	WT18 (kg)	WT24 (kg)
1	25±3	75±5	115±6	196±12	265±15	350.5±21
2	22±4	60±3	100±4	170±6	235.5±11	300±14
3	20±2	50±4	83±6	151±11	217±6	285±7
4	19±3	42±5	74±2	137±8	195±11	260.5±9

coat) was shown to be associated with a high growth rate in young stock (Yeates 1955). A coarser hair coat (higher coat score) impedes the loss of heat and therefore, increases heat burden of the animal resulting in decreased growth rates.

In former studies in the tropics where the thermal effects on performance of both coat colour and type were examined simultaneously, variation in coat type (coat score) was the more significant factor influencing growth (Schleger 1962, 1967; Peters, Horst and Kleinheisterkamp 1982).

Effect of coat colour, coat score and hair density on milk production: The average previous lactation lengths of LG group were longer than that of DG group and similar results were seen in case of average previous lactation yields (Table 4). On studying the effect of coat score on lactation length and lactation milk yield, it was found that coat score possessed negative correlation with milk yield similar to that with body weight (growth).

Average previous lactation lengths were found to be inversely correlated with coat score which was also true for average previous lactation milk yields, i.e. animals with lower values of coat score had higher lactation lengths and yields. Hair density had a significant effect on milk production (Total lactation milk yields). Lactating cattle with lower hair densities (<400 hair/cm²) had higher milk yields than in cattle with higher hair densities (>400 hair/cm²). It was observed that the milk yield of cattle was affected both by coat colour as well as coat score and the differences were significant ($P \leq 0.01$) for both the hair coat characteristics (Table 4). It has been observed in previous studies that correlation between coat score and milk yield is of the same order (inverse) as that observed between coat score and rate of gain (Turner and Schleger 1960).

Table 4. Effect of coat colour, coat score and hair density on lactation length and lactation milk yield

Coat colour	PLL (days)	PLMY (kg)
LG	257.5±114	1965.5±210
DG	197.5±48	1120.75±160
<i>Coat score</i>		
1	288.5±75	1979.5±120
2	265±54	1634±79
3	240±37	1216±118
4	186±65	856±87
<i>Hair density (hair/cm²)</i>		
<400	269.33±74	1876.41±295
>400	192.54±63	1131.58±326

Therefore, it might be assumed that this represents a constant relationship between coat type and thrift whether the index of performance is body weight in growing animals or milk yield in lactating animals.

Thickness of the coat did not have a significant effect on daily milk yield of lactating cattle in the present study. Average daily milk yields did not differ statistically between cattle with coat thickness between 7 mm (5.37 kg/day) and 10 mm (5.71 kg/day).

On studying the effect of coat colour on physiological parameters in lactating cattle, it was found that light coloured cattle had lower values of ST, RT and RR than dark coloured cattle during the course of the study. The milk yield per day was higher in light coloured cattle as compared to light coloured cattle. This increased milk yield can be partly due to better thermoregulatory ability, due to more reflection of heat from lighter surfaces (as evidenced by lower values of RT, ST and RR) (Table 5).

Table 5. Effect of coat colour on physiological parameters and daily milk yield

Coat colour	ST (°C)	RT (°C)	RR (bpm)	Milk yield/day (kg)
LG	29.98±0.22	38.2±0.2	30.5±4.5	9.22±2.05
DG	31.35±0.30	38.8±0.2	48.5±3.5	6.12±0.54

The difference in the rectal temperature of light coloured animals and dark coloured ones was 0.6°C, which may not seem to be substantial. However, body temperature in cattle can vary only from 38.5°C (normal) to 42.7°C (when death occurs) (Brody 1948), a range of only of 4.2°C. Core body temperature is tightly regulated such that even a small increase above 39°C is negatively correlated with milk production (Silanikove 2000). Previous researches have indicated that animals with lighter coats reflect more light (Silva *et al.* 2003) and absorb between 40% and 50% less radiation than those with dark coats.

Coat colour studies in Angus cattle have revealed that white cattle sweated more and had lower body temperatures than black-coated animals (Gebremedhin *et al.* 2008). Hansen (1992) conducted a study where he divided Holstein cows into two categories: greater than 70% white or greater than 70% black, and the white cows had slightly lower body temperatures and greater milk yield, regardless of whether they were under shade or no shade conditions. The higher milk productions were observed in Holsteins with white hair coat (Becerril *et al.* 1993; Maia *et al.* 2005). Lee (2016) found that white cows had higher milk production over black cows but this was not statistically different. Hansen (1992) reported a greater depression in milk yield for black cows (3.3 kg) in no shade environment over white cows (1.5 kg) and attributed this to the higher body temperatures for the black animals. Alava (2009) found that the slick haired cows averaged 164 days in milk (DIM), ranging from 45 to 253 DIM, while the normal haired cows averaged 160 DIM, ranging from 56 to 226 DIM. However, certain

studies have reported that coat characteristics do not affect milk production in cattle. A study in Arizona by Rundle (1986) concluded that first lactation production was not related to or not influenced by hair coat color. King *et al.* (1988) suggested that white cows did not have significantly higher 305 day milk yield in milk production than mixed or black cows.

Certain skin and coat traits have a marked effect on the growth and milk production potential in cattle. Coat score, coat colour and hair density were shown to have maximum effects during the present study. Animals with light colour of coat, lower coat scores and lower hair densities were seen to perform better in terms of live body weight gain and milk production and at the same time having higher lactation lengths. This could partly be attributed to the fact that light coloured cattle had lower values of skin temperature, rectal temperature and respiration rate which indicates better thermoregulatory ability and lesser heat stress in these animals as compared to dark coloured cattle. 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 colour and coat score is feasible. There are many studies (including the present study) which suggest that skin and coat traits can be used as potential tool to improve growth and milk production potential in cattle.

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