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HISTOLOGICAL STUDY OF SWEAT GLANDS OF CATTLE BREEDS OF MAHARASHTRA IN DIFFERENT CLIMATIC CONDITION

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Abstract: The present study was conducted on skin samples of 4 – 6 years of age healthy Deoni, Red kandhari, Dangi and Gaolao breeds of cattle managed under hygienic conditions on farm in different regions of Maharashtra. The skin samples, 10 of each breed were obtained surgically from loin region during winter and summer seasons separately.
The sweat glands were simple unbranched tubular glands. They were elongated baggy shaped during summer, whereas irregular shaped during winter season. The number, diameter and length of sweat glands were increased, whereas its depth decreased during summer season in all cattle breeds.
Keywords: Sweat glands, Cattle Histology.

Material and Methods

The present study was conducted in the Department of Veterinary Anatomy and Histology, College of Veterinary and Animal Sciences, Parbhani (M.S.). The experiment was carried out on 40 female cattle of 4 – 6 years of age belonging to different breeds located in different regions of Maharashtra state during winter (November - February) and summer (March – June) seasons, separately. The skin samples, 10 of each were obtained from loin region of healthy Deoni, Red kandhari, Gaolao and Dangi breeds of cattle, managed under hygienic conditions on the farm in different regions of Maharashtra state.

Tissue pieces of 5 mm size were cut to preserve in following fixatives for the histomorphological study.

1. 10% Neutral buffered formalin
2. 10% formalin
3. Bouin's fluid

The tissues fixed in 10 % neutral buffered formalin and 10 % formalin solutions were kept in fixatives for 48-72 hours and those fixed in Bouin's fluid were transferred to 70 per cent alcohol after 24 hours, as per method suggested by Drury and Wallington (1980) for tissue fixed in Bouin's fluid.

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After fixation, tissues were washed in running tap water for overnight. These were then processed for routine paraffin technique. The tissues were first passed through ascending grades of alcohol, cleared in xylene, infiltrated in three changes of paraffin (melting point 580-600C) and then embedded in paraffin by employing manual tissue processing schedule suggested by Drury and Wallington (1980).

The longitudinal and transverse tissue sections of 4 to 5 µ thickness were obtained on manually operated rotary microtome. The sections were mounted on glass slides and dried at room temperature for 24 hours and were preserved carefully for staining. The following staining methods were used for histomorphological studies.

a) Harri's Haematoxylin and Eosin stain for normal histoarchitectural study (Mukharjee, 1992).

b) Van Gieson's stain for collagen fibers (Singh and Sulochana, 1996).

c) Masson's trichrome method for collagen fibers (Luna, 1968).

d) Silver impregnation stain for Reticular fibers (Mukherjee, 1992).

e) Wilder's method for reticulin (Luna, 1968).

f) Verhoeff's stain for elastic fibers (Mukharjee, 1992).

g) Crossman's modification of Mallory's triple stain for collagen and elastic fibers (Singh and Sulochana, 1996).

h) Periodic acid Schiff's (PAS) stain for carbohydrate like glycogen, mucin and reticulin (Mukharjee, 1992).

The following micrometrical recordings were taken under simple microscope by micrometer scale after caliberation at 10X (1µ = 15.38 graduations) and 40 X power (1µ = 3.30 graduation) magnifications.

1. Depth of the Sweat gland from the external skin surface (µm)
2. Number of Sweat glands per cm2 of skin
3. Length of the Sweat gland from origin of duct to base (µm)
4. Diameter of the Sweat gland (µm)

The depth of sweat glands was measured from the surface of epidermis. The number of sweat gland per cm2 was obtained by using formula of Benjamin *et al.* (1970).

The data collected was subjected to the statistical analysis as per the standard procedure suggested by Panse and Sukhatme (1967).

Results and Discussion

During the present study, it was observed that sweat glands were of simple unbranched tubular type in all breeds of cattle and seasons. These were located at the junction of papillary and reticular layer of dermis. The secretory portions of glands were arranged with or without convolutions. The glands were lined by simple cuboidal epithelium resting on a basement membrane. A layer of elongated myoepithelial cells was observed in between lining simple cuboidal epithelium and basement membrane of glands (Plate 1).

During summer season, the sweat glands were elongated with dilated lumen and appeared baggy shaped in all breeds of cattle. It was noticed that most of the cuboidal cells of lining epithelium consisted of basally placed elongated nucleus. However, during winter season, most of the sweat glands appeared irregular shaped with narrow lumen in all breeds of cattle. The majority of cuboidal cells of lining epithelium bear centrally placed spherical nucleus (Plate 2).

The sweat gland ducts was lined by simple cuboidal epithelium with slight tortuous course. It was observed that, most of the ducts of sweat gland courses along the side of sebaceous glands or in between two sebaceous glands especially during winter season. The ducts opened in hair canal above the opening of the duct of sebaceous gland or close to epidermis in all breeds of cattle and seasons under present study (3).

The observations of the present study are in agreement with the reports made by Nay and Hayman (1956). They mentioned that sweat glands in zebu breeds of cattle were more sac like with few convolutions or none at all. Similarly Chowdhury and Sadhu (1963) reported that sweat glands were elongated sac like apocrine glands with convolutions lined by simple cuboidal epithelium in Hariana breed of Zebu cattle. Nagaraju *et al.* (2012) observed secular coiled sweat glands with large lumen lined by simple cuboidal epithelium in cattle. Nay (1959) reported tubular, baggy and club shaped sweat glands in different breeds of cattle enveloped by myoepithelial cells. Bhayani *et al.* (1989) observed baggy type of sweat glands in Kankrej cow. Monteiro-Riviere (2007) stated that secretory portion of sweat glands in ruminants was dilated surrounded by myoepithelial cells and duct of gland penetrated the epidermis of hair follicle before opening on skin.

However, Nay (1959) mentioned that sweat glands were lined by flat polyhedral cells. Similarly Samuelson (2007) and Monteiro-Riviere (2007) claimed that glandular epithelium of sweat gland of ruminants was flattened cuboidal to low columnar cells and duct was lined by stratified cuboidal cells. These variations in the lining epithelium mentioned by them may

be attributed to the breed differences. The irregular appearance of sweat gland during winter season might be correlated to their reduced functional activity leading to collapse of gland.

The average number of sweat glands per cm² are present in table 8. During the present study, significant increase in number of sweat glands was observed during summer season in all breeds of cattle. The average number of sweat glands per cm² during summer season was 808.86 ± 18.89, 825.17 ± 16.09, 797.20 ± 16.03 and 923.07 ± 20.24 whereas, during winter season it was 758.74 ± 20.29, 776.22 ± 19.90, 713.28 ± 19.56 and 818.18 ± 21.26 in Deoni, Red Kandhari, Dangi and Gaolao cattle, respectively.

The average number of sweat glands in all breeds of cattle during both seasons recorded in present study are found less than the reports made by Nay and Hayman (1956) at mid side region in Zebu and European cattle, Nay and Dowling (1957) in Zebu cross, Pan (1963) at different body region in Sahiwal and Jersey cows, Taneja (1960) at shoulder and belly region in Zebu cross and Shorthorn cattle and Mugale and Bhosle (2002) at mid side region in Deoni cattle. This variation may be due to differences in body region, breeds or seasons used in the present study.

Also, the significant increase in number of sweat glands during summer season in all breeds of cattle in present study correlates with the reports of Nay and Dowling (1957). They stated significant differences in the sweat gland density due to season and breeds.

The more number of sweat glands during summer season may be attributed to more sweat secretion from body so that, after evaporation of sweat, body will be effectively cool down in hot and dry climatic conditions during summer season of Maharashtra.

During present work, the number of sweat glands differs significantly among breeds in both seasons. However, non-significant difference was observed between Deoni and Red Kandhari cattle during summer season. Similarly, non-significant difference was recorded between Deoni and Dangi cattle and between Red Kandhari and Gaolao cattle during winter season. The maximum numbers of sweat glands were recorded in Gaolao cattle followed by Red Kandhari, Deoni and Dangi cattle during both seasons.

These variations and descending range in number of sweat glands among the breeds of present study may be due to different climatic conditions to which they belong. Gaolao cattle belongs to more hot climatic condition of Vidarbha region, Deoni and Red Kandhari cattle belongs to Marathwada region, where the climatic conditions are more or less similar whereas, Dangi cattle belongs to Nashik District where the temperature is comparatively minimum as compared to other regions of Maharashtra.

The average length of sweat glands are presented in table 1.

The average length of sweat glands in all breeds and seasons recorded under present study are within the range to those of reports made by Wang *et al.* (2012) in Thai native cattle. However, compared to present recordings Chowdhury and Sadhu (1963) in Hariana cattle, Nay and Jenkinson (1964) in British dairy cattle, Pan (1963) in Sahiwal and Jersey cattle, Barker and Nay (1964) in Jersey cattle, Jenkinson and Nay (1972) in European cattle, Jenkinson and Nay (1973) in Asian cattle and Bhayani *et al.* (1989) in Kankrej cattle reported more average length of sweat glands in their investigations.

The significant increase in length of sweat glands during summer season tends to become active and voluminous for more secretion of sweat during summer season.

In the present work, the average length of sweat glands among breeds showed non-significant variations during summer season, whereas differs significantly during winter season. However, non-significant variation was observed between Deoni and Dangi cattle during winter season. The average length of sweat glands was found maximum in Gaolao cattle followed by Red Kandhari, Deoni and Dangi cattle in both seasons.

This descending range in average length of sweat glands in these breeds may be attributed to variation in activeness of sweat gland as per the variations in climatic conditions in different regions of Maharashtra to which they belong.

The average depth of sweat glands are presented in table 2. During present work, there was a significant decrease in the average depth of sweat glands in all cattle breeds during summer seasonThe average depth of sweat glands in all breeds of cattle recorded in the present work are more or less similar to the recordings made by Chowdhury and Sadhu (1963) during winter season in Hariana cattle and Nay and Hayman (1956) in Red Sindhi and Sahiwal cow. However, Benjamin (1970) in Hereford cattle and Mugale and Bhosle (2002a) in Deoni cattle reported lower range of depth of sweat glands.

A significant decrease in average depth of sweat glands during summer season in all breeds of cattle may be because of increase in length of sweat glands during summer.

The average diameter of sweat glands are presented in table 3. The recordings of present findings during summer in all breeds of cattle are within the range of reports made by Nay and Jenkinson (1964) in some British dairy cattle, similar range of sweat glands diameter has been reported by Wang *et al.* (2012) in Thai native cattle, Jenkinson and Nay (1972) in European cattle, and Jenkinson and Nay (1973) in Asian, African and South American cattle.

However, Chowdhury and Sadhu (1963) in Hariana cattle, Pan (1963) in Sahiwal and Jersey cattle and Bhayani *et al.* (1989) in Kankrej cattle reported more range of diameter of sweat glands than the present recordings.

The significant increase in diameter of sweat gland during summer in all breeds of cattle indicated increase in size of gland for more voluminous secretion of sweat during summer.

In the present work, the average diameter of sweat glands among breeds showed non-significant variations during summer season, whereas, differs significantly during winter season. However, non-significant variation was observed among Deoni, Red Kandhari and Gaolao cattle during winter season. The maximum diameter of sweat gland was observed in Gaolao cattle followed by Deoni, Red Kandhari and Dangi in both season.

This descending order in variation of sweat gland diameter correlates with the numbers and length of sweat glands in all breeds of cattle during both season. This correlation may depicts the role of sweat gland for adoptions of animals in different climatic conditions in all breeds of cattle and season.

Table 1: Mean and SE of length of sweat glands in the skin during summer and winter seasons in Deoni, Red Kandhari, Dangi and Gaolao cattle

Length of sweat glands (µm)

Season	Deoni	Red Kandhari	Dangi	Gaolao
Summer	203.161 ± 3.45	213.621 ± 11.80	198.861 ± 6.06	229.001 ± 9.48
Winter	168.87C2 ± 5.99	185.94B2 ± 2.49	159.18C2 ± 2.29	199.17A2 ± 6.09

Table 2: Mean and SE of depth of sweat glands in the skin during summer and winter seasons in Deoni, Red Kandhari, Dangi and Gaolao cattle

Depth of sweat glands (µm)

Season	Deoni	Red Kandhari	Dangi	Gaolao
Summer	670.72A2 ± 15.86	530.30C2 ± 6.60	572.75B2 ± 8.79	540.29C2 ± 8.93
Winter	705.32A1 ± 8.77`	620.12C1 ± 4.74	657.64B1 ± 14.14	648.72B1 ± 13.29

Table 3: Mean and SE of diameter of sweat glands in the skin during summer and winter seasons in Deoni, Red Kandhari, Dangi and Gaolao cattle

Diameter of sweat glands (µm)

Season	Deoni	Red Kandhari	Dangi	Gaolao
Summer	106.631 ± 3.24	105.351 ± 2.39	103.811 ± 2.63	110.991 ± 1.87
Winter	84.97A2 ± 3.24	84.20A2 ± 1.77	72.67B2 ± 3.64	80.36A2 ± 2.59

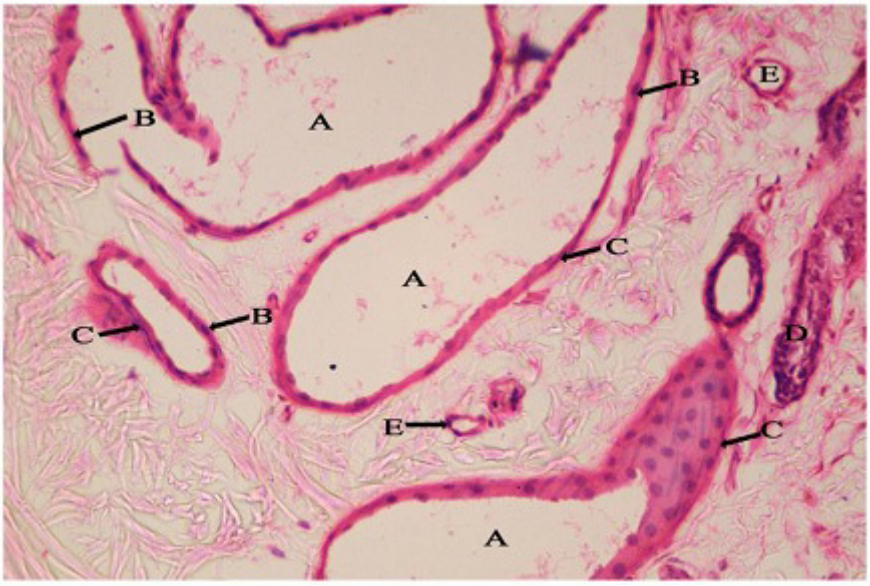

PLATE 1 : Photomicrograph of skin of Deoni cattle showing sweat glands during summer season

A) Lumen of sweat gland

B) Simple cuboidal epithelium with elongated nucleus

C) Myoepithelial cells

E) Blood vessel

(Haematoxylin & Eosin stain, X400)

PLATE 2: Photomicrograph of skin of Deoni cattle showing sweat glands during winter season

A) Lumen of sweat gland

B) Simple cuboidal epithelium with spherical nucleus

C) Myoepithelial cells

D) Hair follicle

E) Blood vessel

(Haematoxylin & Eosin stain, X400)

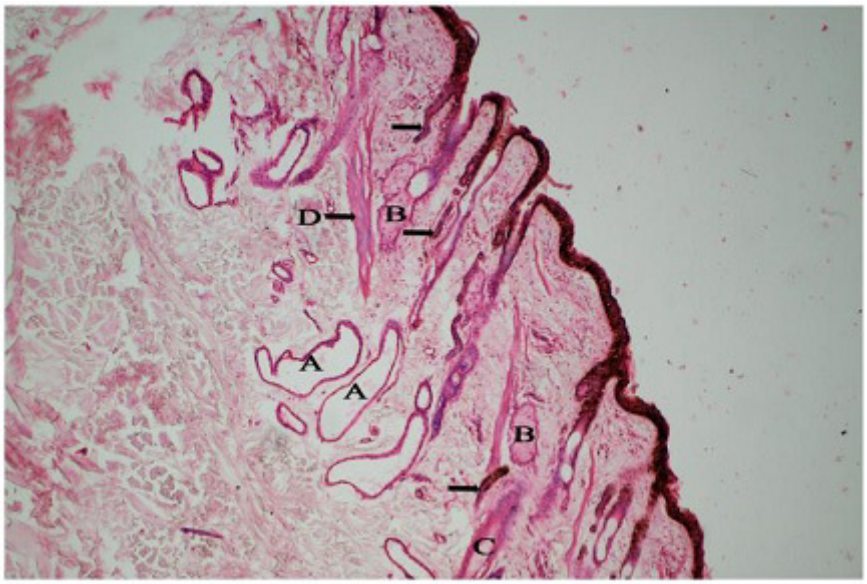

PLATE 3: Photomicrograph of skin of Deoni cattle showing sweat glands during summer season

Arrow showing of duct of sweat gland

A) Sweat gland

(Haematoxylin & Eosin stain, X100

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