مغزى مورفولوجيا الجلد فى أنواع الماشية المختلفه

الدكتور مجدى . فتح الله

الملخص

أخذت عينات من جلد ابقار من سلالات مختلفة وفحصت هستولوجيا فى محاولة للربط بين تركيب الجلد وكفاءة التحمل الحرارى .

أوضحت الدراسة التركيب المورفولوجى الكامل للجلد وعلى وجه الخصوص الاشكال المختلفة للغدد العرقية وأنواعها ، وكذلك كثافتها ومساحتها فى السم٢ وبالربط بين كل هذه العناصر وكفاءة الحيوان سواء فى معدل البخر أو التحمل الحرارى أمكن استخلاص الآتى :ـ

اولا ـ جلد البلدى والفريزيان انسب الظروف الحارة من الهيرفورد .

ثانيا ـ شكل ونوع الغدد العرقية وعمقها من أكثر العناصر ارتباطا بكفاءة التحمل الحرارى وبالتالى يمكن اخذها فى الاعتبار عند ادخال أبقار أجنبية فى بيئات حارة .

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SIGNIFICANCE OF SKIN MORPHOLOGY IN DIFFERENT CATTLE BREEDS

(With 3 Plates, 12 Figurs, and 2 Tables)

By

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SUMMARY

Skin biopsies of different cattle breeds were histologically examined in an attempt to correlate between skin morphology and heat tolerance.

The thickness of the straturn cornium, epidermis, and thermostate layer, and the depth of the sweat glands, sebaceous glands, and hiar bulbs were determined.

Morphological types of the sweat glands were described and illustrated by photomicrographs. The bag-shaped sweat glands predominate in the skin of Native cattle (Baladi) and half cross-breds, while the tubular and intermediate types predominate in Friesian, and $^{3}/_{4}$ cross-breds of both Friesian and Hereford. Density and dimensions of the sweat glands and their sweating surface per single gland and per square cm. were measured and calculated. Breed differences in skin structure were characterised.

The relationship between heat tolerance, evaporation rate and sweat gland density, and their secretory surface was discussed.

It was concluded that, the sweat gland type as well as its depth and sweating surface, are the most skin parameters correlated to heat tolerance.

These factors may be considered as indices for selection of European breeds introduced to subtropical countries.

INTRODUCTION

In cattle the sweat glands attain three shapes, the coiled tubular, bag-shaped and the intermediate clup-shaped. It was found that the tubular type predominates in Shorthorn cattle while the bag-shaped form predominates in Sahiwal and Sindhi cattle (NAY, 1959).

It is claimed that the apocrine type of sweat glands is most frequent in the skin of cattle (FINDLAY and YANG, 1950 ; TRAUTMAN and FIEBE-GER, 1953 ; and DOWLING, 1955). In contrast HAFEZ, BADRELDIN and SHAFIE (1955) reported that the simple merocrine form is more frequent in bovine skin than the apocrine type.

The volume and density of sweat glands are closely related to heat tolerance and are assumed to be associated with productive efficiency of cattle (WALKER, 1957 ; NAY and DOWLING, 1957 ; and BAKUMA, 1969). DOWLING (1955) and NAY and HAYMAN (1956) reported that, the sweat gland density and size are greater in Bos-indicus than those observed in B - taurus. Moreover, TANEJA (1960) found a positive correlation between the rate of evaporation and the density of the sweat glands.

It is accepted that the number of hair follicles per unit area of the skin gives an accurate estimate of the glandular density (FINDLAY and YANG, 1950 ; and HAFEZ, *et al.* 1955).

Although morphological characters of the sweat glands are of value in the study of the heat tolerance, the functional efficiency of such glands is of greater importance (NAY, 1959, and WALKER, 1960).

The aim of the present investigation is to study the correlation between the skin structure and heat tolerance of Friesian, Herefored, Native cattle and their cross-breds.

MATERIAL AND METHODS

Skin specimens were taken from 18 bulls, 2-3 years of age. Three bulls from each of the following breeds were examined ; Friesian, $^3/_4$ Friesian, $^1/_2$ Friesian, $^3/_4$ Hereford, $^1/_2$ Hereford, and Native (Baladi) cattle. These animals were bred at El-Kharga breeding farm at El-Wady El-Gedid.

Skin biopsy of an area of 2 sq.cm was cut from the midside region behind the shoulder. The area was clipped and 2 ml. of novocaine solution (2%) was infiltrated around the site of incision. The skin samples were cut into pieces of 5 × 10 mm. and fixed in 5% formol saline. Vertical and horizontal serial paraffin sections of 10 microne thick were prepared and stained with haematoxyline and eosin. The vertical sections were used for measuring the dimensions of 10 sweat glands from each specimen according to NAY and HAYMAN (1956). Considering the sweat gland as a cylinder, the average sweating surface area of the single sweat gland for each breed was calculated.

Vertical sections were also used to measure the thickness of the thermostat layer, which extends from the basement membrane of the epidermis till the deepest edge of the sweat glands. The thickness of the stratum cornium and the epidermis, the depth of the sebaceous glands, and the hair bulbs were also measured. Ten random measurements were recorded for each of the above mentioned structures.

Horizontal sections of the skin directly beneath the epidermis were used to count the hair follicles per sq.cm. which represent the number of the sweat glands. The sweat secreting surface per sq. cm. of the skin was determined by multiplying the number per sq. cm. by the average surface of the single sweat gland.

RESULTS

The hair follicle unit is considered as a hair follicle with its associated skin glands. Each hair follicle is accompanied by a sweat gland duct as shown in Plate 2, Fig. 4, and Plate 3, Fig. 3. At about 350 u from the surface, two lobes of the sebaceous glands pour their secretion through the hair follicle by two separate ducts (Plate 2, Fig. 3). At about 700-800 u lies the sweat gland near the hair bulb.. The erector pili muscle is inserted into the hair follicle just above the sweat gland and is penetrated by its duct (Plate 3 Fig. 4).

Three types of the sweat glands were identified ; the tubular, the bag-shaped, and the intermediate forms. The tubular glands which apper as long, narrow, and convoluted tubes were only found in the skin of Friesian cattle (Plate 1, Fig. 1 and 2). The bag-shaped glands, which are short with a wide diameter, predominated in the skin of Baladi cattle and in half bred animals (Plate 1, Fig. 4). Very large bag-shaped glands with greater length and width were mainly present in half cross breds. This type is rarely seen in $^3/_4$ cross-breds and pure Friesian (Plate 1, Fig. 3). Intermediate form between the previous types which take different shapes as shown in (Plate 2, Figs 1, 2 and 4) were encountered in all animals, especially in $^3/_4$ cross-breds and Friesian.

The sweat glands of all animals examined are lined by flat simple squamous epithelial cells (Plates 1, 2 and 3) The epithelial cells have flattened nuclei and surrounded by myoepithelial cells with spindle shaped nuclei as demonstrated in Plate 3, Fig. 2. In most sections the glands were filled by homogenous or occasionally fine granular substance.

TABLE 1. The Thickness of the Skin Strats and the Depth of Sweat Glands, Sebaceous Glands and Hair Bulb. (in Microns)

Breed	Thickness of Cornium	Thickness of Epidermia	Thickness of the Thermostate	Depth of Sweet gland	Depth of Sebaceous gland	Depth of Hair bulb.
Friesian	7.8 ± 0.3	34.0 ± 1.7	1308 ± 221.6	723 ± 166.4	346 ± 66.4	931 ± 183.1
3/4 Friesian.	7.8 ± 0.5	36.3 ± 1.6	1557 ± 172.3	829 ± 70.6	377 ± 87.5	1147 ± 107.8
½ Friesian.	7.7 ± 0.6	39.7 ± 2.9	1420 ± 170.5	790 ± 138.2	348 ± 44.8	1111 ± 184.7
Baladi	8.3 ± 0.6	36.3 ± 3.2	1371 ± 90.6	769 ± 151.3	361 ± 67.3	1103 ± 95.9
3/4 Hereford	6.0 ± 1.0	33.3 ± 6.5	1665 ± 31.2	888 ± 46.7	354 ± 46.2	1188 ± 85.0
½ Hereford	9.3 ± 1.9	39.7 ± 4.0	1600 ± 104.9	895 ± 46.8	449 ± 30.6	1256 ± 63.6

± Standard deviation

TABLE 2. Average Measurements of the Sweat Glands of Different Cattle Breeds

Breed	No. of Sweat gl. per sq. cm.	Diameter (micron)	Length (micron)	Surface of single sweat gland (sq.mm.)	Sweating surface (sq.cm) sq. cm of skin
Friesian	3730 ± 250	11.6 ± 4.0	579.1 ± 22.5	0.156 ± 0.01	5.8
$^3/_4$ Friesian.	3470 ± 350	81.3 ± 7.1	599.0 ± 56.4	0.154 ± 0.03	5.3
$^1/_2$ Friesian	3000 ± 170	91.7 ± 2.9	616.3 ± 13.3	0.173 ± 0.01	5.1
Baladi	2400 ± 200	95.0 ± 5.1	579.0 ± 31.2	0.172 ± 0.01	4.1
$^3/_4$ Hereford	3270 ± 250	85.2 ± 1.6	556.7 ± 29.6	0.149 ± 0.01	4.8
$^1/_2$ Hereford	2900 ± 150	104.0 ± 9.2	608.0 ± 40.9	0.200 ± 0.04	5.8

The greatest density of the sweat glands was noticed in Friesian cattle followed by $^3/_4$ Friesian, $^3/_4$ Hereford, ½ Friesian and ½ Hereford. Native cattle have the least number of sweat glands per sq. cm. (Table 2). The sweating surface of a single gland was greater in ½ Hereford, ½ Friesian and Baladi, followed by Friesian, $^3/_4$ Friesian and lastly $^3/_4$ Hereford. The sweating surface per sq.....cm. of skin ranked as follows ; ½ Herefored, Friesian, $^3/_4$ Friesian, ½ Friesian, $^3/_4$ Hereford and Baladi in a descending order.

With regard to other skin structures, as shown in table 1, the differences in the thickness of epidermis and cornium is not significant in different cattle breed. The thickness of the thermostate layer and the depth of sweat glands and sebaceous glands is the least in Friesian followed by Baladi, then $^3/_4$ Friesian cross-breds, and lastly Hereford cross-breds.

DISCUSSION

The type of the cattle sweat glands appears to be of merocrine type due to the flattened appearance of their epithelium and the absence of the apical cytoplasmic protrusion. This suggests that the sweat may be secreted either by simple diffusion or an active secretion, rather than degenerative secretion of the apocrine type. This result is in accordance with the findings of (YAMANO and ONE, 1936 ; HAFEZ, *et al.*, 1955 ; and FINDLAY and JENKINSON, 1964).

The present investigation indicated that the sweat gland density in native cattle (Balandi) is less than that of the Friesian and Hereford cattle. This fact agrees with the results obtained by SHAFIE, EL-TANNIKHY and BADR-ELDIN (1970).

However, the average sweating surface of a single sweat gland in native cattle and half cross-breds is greater than that of Friesian and $^3/_4$ cross-breds. This may be attributed to the predominance of the bag-shaped glands in the first group and the intermediate type in the second group.

In spite of the fact that the sweat gland size is greater in Baladi and ½ cross-breds, the sweating surface per unit area is less than that of Friesian and $^3/_4$ cross breds. This is attributed to the sweat gland density.

Heat tolerance and evaporation rates of these animals as shown by FATHALLA (1972) were greater in Baladi and half cross-breds (Friesian and Hereford). than that of pure Friesian and $^{3}/_{4}$ cross-breds (Friesian and Hereford). Therefore, it is obvious that the functional efficiency of the sweat glands and not its density is the determining factor in heat tolerance. This suggests that, the bag-shaped sweat glands which predominate in the Baladi and half cross-bred cattle may be more efficienct in sweat secretion than the tubular type found in European cattle skin.

with regard to the other skin structures, the thin thermostate layer and the presence of sweat glands nearer to the surface of the skin in both pure Friesian and baladi are considered of great value in facilitating water diffusion and passage to the skin surface rather than the thick thermostate layer and deep sweat glands observed in Hereford cross-breds. It is concluded that Baladi and Friesian cattle with their cross-breds have skin structures which favour efficient evaporation and greater dissipation of heat than the Hereford skin. These characteristics are of great importance in adaptability of these animals under the stress of hot climates.

It could be concluded that the shape of the sweat glands, their depth and the thickness of the thermostate layer are the most important skin structures correlated to heat tolerance and consequently can be used as an index for selection of European cattle introduced to subtropical countries.

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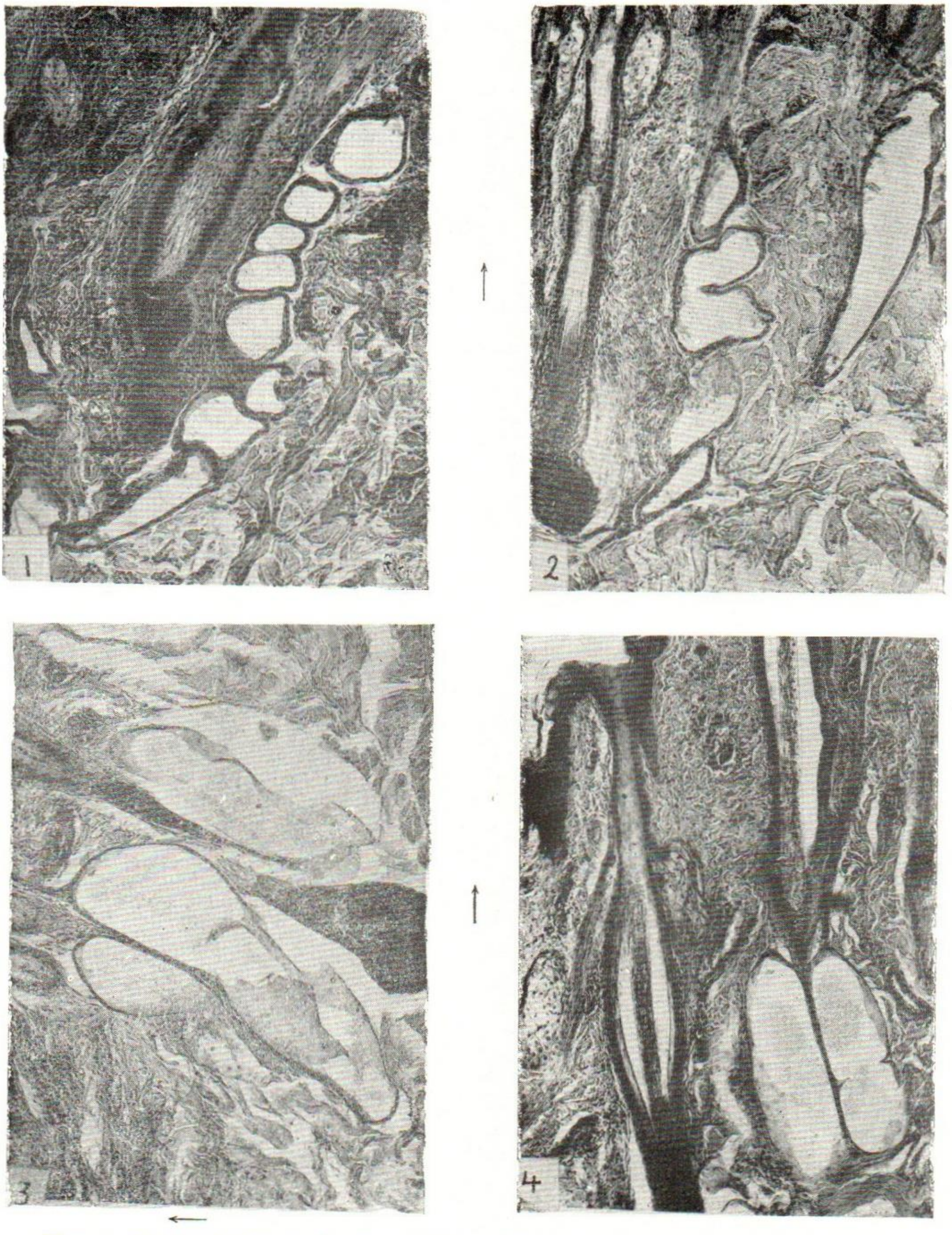


Plate 1. Fig. 1 and 2, Vertical sections in Friesian skin showing long tubular convoluted sweat glands (× 96)

Plate 1. Fig 3 and 4, Vertical sections in Baladi skin, showing large and small bag sweat glands (× 96)

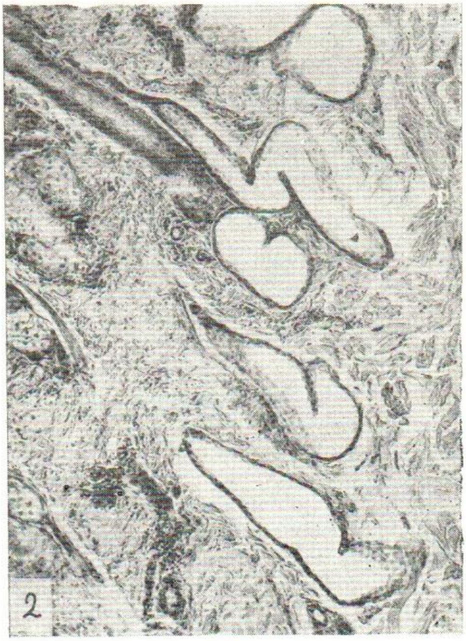
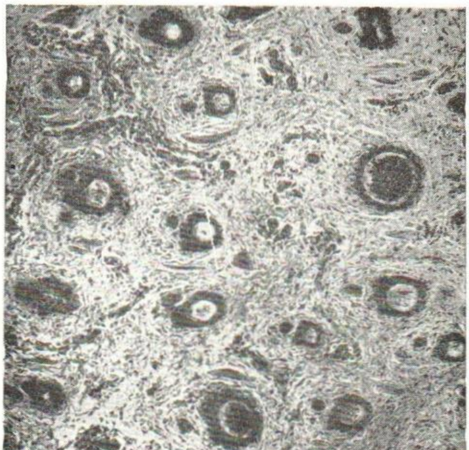


Plate 2. **Fig. 1 and 2, Vertical sections in $\frac{1}{2}$ Friesian and $^{3}/_{4}$ Friesian demonstrate different shapes of clup-shaped sweat glands, or intermediate forms (× 96).**

Plate 2. **Fig. 3, Vertical section in $\frac{3}{4}$ — Hereford skin showing sebaceous glands with their ducts attached to hair follicle (× 96).**

Plate 2. **Fig. 4, Vertical section in $^{3}/_{4}$ Friesian skin demonstrates clup-shaped sweat glands their ducts up to the surface (× 45).**



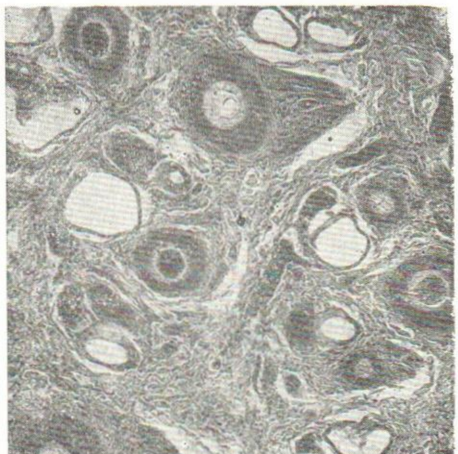


Plate 3. Fig. 1, Horizontal section in $\frac{3}{4}$ Friesian skin showing hair folicle surrounded with some sweat gland (× 200).

Plate 3. Fig. 2, Vertical section showing the structure of the sweat gland wall (× 200).

Plate 3, Fig 3, Horizontal section just below the epidermis showing hair follicles associated with sw.g. ducts (× 96).

Plate 3. Fig. 4, Horizontal section showing sweat glands, pili muscle and sw. gl. duct penetrating the muscle (× 96).