GROSS AND MICROSCOPIC SKIN THICKNESS OF RED SOKOTO GOAT ECOTYPES

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ABSTRACT

Gross and microscopic skin thickness of the red Sokoto goat were determined. The skin was found to contain two layers; the epidermis and the dermis, in the selected body regions (lateral neck, rump, mid-side, thigh and scrotum in males or udder in females) of the five identified ecotypes of red Sokoto goat. The epidermis contributed 1.85-3.07% while dermis contributed between 96.93-98.15% of the total skin thickness. The skin thickens with age in both males and females. However, males have a thicker skin than the females in all the five ecotypes and the skin from the dark red ecotypes was found to have greater thickness (P≤0.05) than skins from other ecotypes, with light brown coat colour skin having the least thickness. Skins with high thickness like the dark red ecotypes are most preferred in the leather industries. The thickness of the skin based on the body regions showed greater thickness at rump and least thickness at lateral mid-side. The scrotum and udder were found to be generally thin when compared with other body regions. The gross and microscopic skin thickness of the red Sokoto goat ecotypes can serve as a measure to determine leather quality

Keywords: Dermis, Epidermis, Skin, Thickness, red Sokoto goat.

INTRODUCTION

The importance of goats in the economy of developing countries is enormous. It has been found that there are breed differences in terms of the quality and quantity of meat, milk and skin production (Davendra, 1981). The red Sokoto goat has been described as an intermediate breed between the Sahel and West African Dwarf breeds based on height at withers criterion. It is estimated at about 34million and widely distributed in Northern part of Nigeria. The spread over two-thirds Northern part of the country and accounts for about 60% of the Nigerian goat's population (RIM, 1992). The breed is also found in part of Southern Niger Republic and Northern Cameroon. In Nigeria it is most common in Sokoto state, while Niger Republic it is commonest in Maradi and Tessoua (DAGRIS, 2008). Hence the name red Sokoto or Maradi goat.

Phenotypically, the characteristic features of red Sokoto goat are as follows: average height at withers of an adult red Sokoto goat is about 64cm and body weight range between 23-30kg (Robinet, 1967). The coat colour is dark red in Nigeria but lighter and occasionally almost chest nut in Maradi. The neck is short very mobile in both sexes. Ears are short and usually carried horizontally, but longer and semi pendulous in Republic of Niger. Presence of short to medium horns, tassels are rare and tail hair usually black (FDLPCS, 1992). The males are darker than females and have black stripe at the back, with beard of profuse hair but usually absent in females. Forehead is often covered with hair which is longer, bushier and darker in males than in females, with a light mane extending to the shoulder.

The ecotypes of red Sokoto goat extend outside the main centre of its distribution, the colour varies and various ecotypes are Dark red, light brown, brown, black and variegated (Umar, 2013) The red Sokoto goat produces one of the world most valuable skin, which provides leather of special quality known as Morocco leather which is superior to the skin of other breeds of Nigerian goats (Burns, 1965). The Morocco leather has been known in Europe since the 1300 century, it was sold to Europeans by Moroccan merchants who transported the fine leather across the Sahara from Mali in their slave caravans (Anon 1). In the 19th century, Europeans discovered that the true source of Moroccan leather was the red Sokoto goat from Nigeria, which serves as the source of revenue generation to the local farmers in old Northern Nigeria and the country at large. The export of skin (tanned or dried) is an important source of income in Northern Nigeria (Kwari, 2001). Therefore the aim of the study is to determine the gross and microscopic skin thickness of the red Sokoto goat ecotypes as a measure to leather quality.

MATERIALS AND METHODS

Skin sampling method

A total of 75 goat skins were obtained, 6-9 skin in each of the five groups of different coat colours (Dark red, light brown, brown, black and variegated) at various age ranging of from less than one year (<1yr), one year (1yr), one and half year (1½yr) and two years (2yrs) for the females and from less than one year (<1yr), one year (1yr), one and half year (1½yr) for males. The whole skins were purchased from Sokoto metropolitan abattoir/Danbatta Dange Shuni local government slaughter slab, from slaughtered goats that have met the morphological sampling group's criteria. Prior to slaughter the selected sites; lateral neck, rump, mid side, lateral thigh and scrotum (in the males) or mammary gland (in females) on right side of the goats were marked using permanent marker (Figure 1). Immediately after slaughter/exsanguinations and flaying, the whole skins were purchased. The skins were transported to the Veterinary Anatomy laboratory, Usmanu Danfodiyo University Sokoto. The marked areas of the skin were shaved and samples for gross and histological studies were excised using scalpel blade.

Gross morphometry of skin thickness:

This was measured using calibrated micrometer screw gauge of the selected regions (lateral neck, shoulder, lateral mid side, rump, lateral thigh and scrotum in males or mammry gland in females) of randomly selected sample goats, after the areas were shaved and skin of $1cm^2$ were obtained Skin samples of $1cm^2$ were taken from five different areas (Figure 1) on the side of goats randomly selected from the sampling groups (Yahaya and Onwuka, 1996).

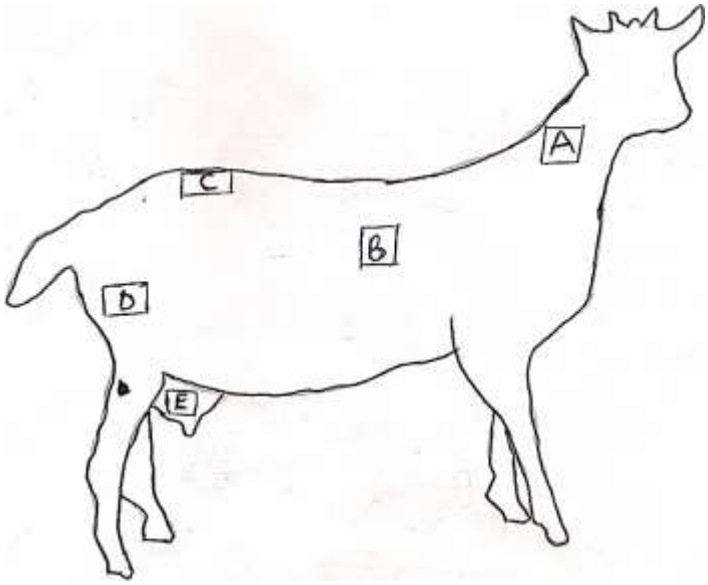

Figure 1: A sketch of the right side of a goat showing the selected sites of skin samples; A= Lateral neck, B= Mid-side, C= Rump, D= Thigh, E= Scrotum (in males) or Mammary gland (in females)

Histology (Laboratory procedure)

Skin samples collected were immediately sprayed and pinned on 5cm^2 plywood as described by Burns (1965), in order to retain as much as possible the original size and shape of the samples (Yahaya and Onwuka, 1996). The samples were fixed in 10% buffered neutral formalin and processed for light microscopy using paraffin histological techniques as described by Baker and Silverton (1985). For frozen sections, skin samples were directly taken to cryostat and sectioned. Horizontal and vertical sections at 7µ thickness were made for both techniques and at least sections of each sample type were selected per sample, they were stained with Hematoxylin and Eosin stain, mason trichome and 0.5% of polychrome methylene blue stain respectively (Yahaya and Onwuka, 1996).

Sampling for histological features

Skin thickness: This was measured using light microscope (Leca brand). Motican camera 1.3 pixel and Sony digital camera 3.0 pixel were used to capture the photomicrographs and gross pictures respectively.

Data Analysis

All data generated from the gross and histological studies were sorted out manually and tabulated, then entered into a computer using InStat 3a graph statistical package

Gross studies

The mean values obtained for the categorical traits measurements (HOW) were subjected to student t-test and ANOVA statistical methods

Histological studies

The various mean values obtained were analyzed by Analysis of Variance (ANOVA) and student t-test using Graphpad InStat, statistical package version 3.05. The test for variance and significance using Turkey multiple comparison test were at the 95% confidence level ($p<0.05$).

Data from common sites were used for comparison between the sexes, ages and body regions. Data from sex related sites scrotum (male) and mammary gland (female) were used to eliminate sex related variations of the parameters under study.

RESULTS

Gross Findings

The measurements of the fresh skin thickness at different body regions (lateral neck, rump, mid-side, thigh, scrotum and udder) of five identified ecotypes of red Sokoto goat ecotypes recorded (Figure 2 and 3). There was no significance difference ($P\leq0.05$) with respect to age. The results showed relative greater skin in the dark red ecotypes compared to the other ecotypes. This result also revealed that the males have a thicker skin than the females in all the five ecotypes. The scrotum and udder were found to be generally thin when compared with other body regions.

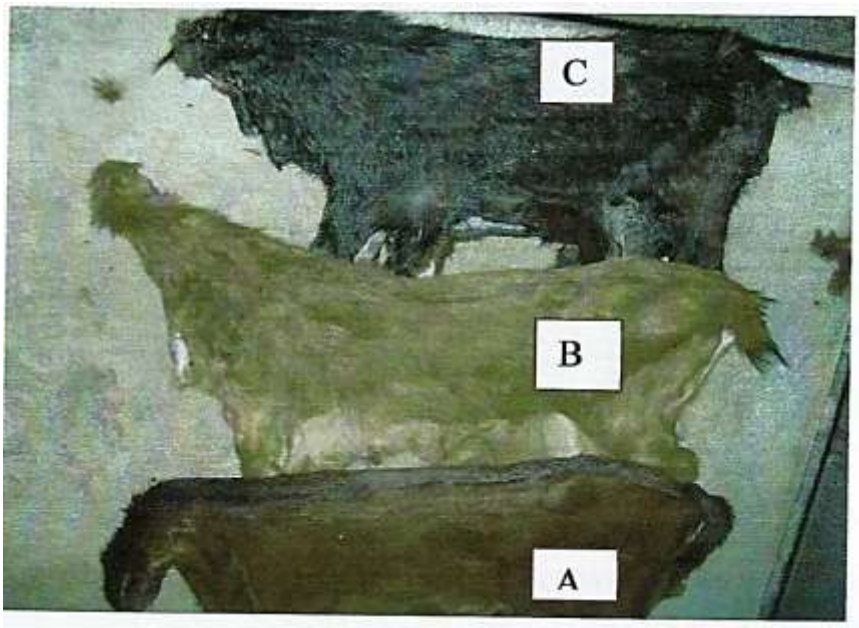

Figure 2: Fresh skin samples from dark red (A), light brown (B) and black (C) ecotypes of the red Sokoto goat

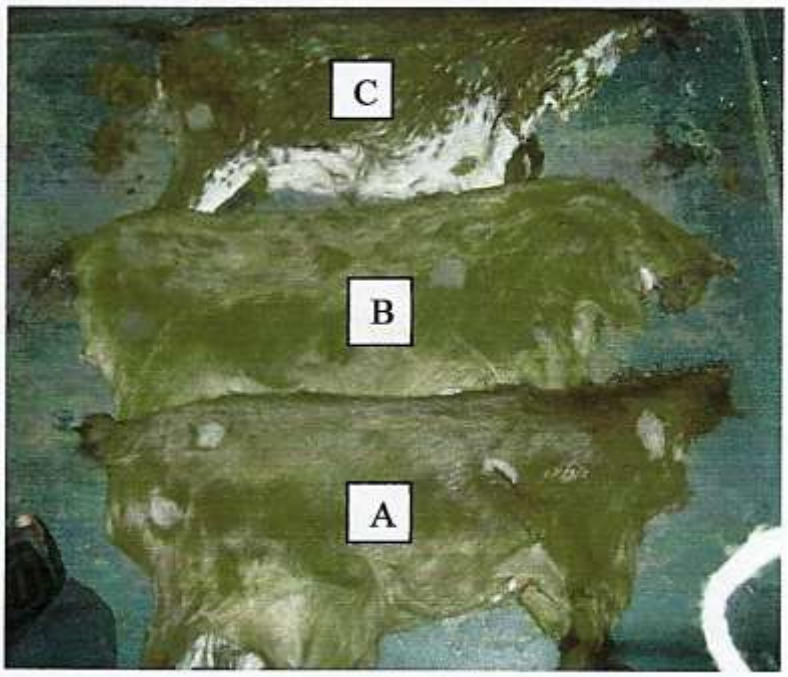

Figure 3: Fresh skins from brown (A), light brown (B), and variegated (C) ecotypes of red Sokoto goat

Table 1: macroscopic skin thickness (mm) of the five different red Sokoto goat ecotypes

Coat	Sex	Neck	Rump	Mid	Thigh	Scrotum/udder
Dark red	**Male**	1.50±0.28	1.49±0.33	1.08±0.10	1.49±0.31	0.50±0.03
	Female	1.38±0.16	1.38±0.25	1.05±0.11	1.23±0.13	0.53±0.03
Brown	**Male**	1.31±0.22	1.32±0.17	1.12±0.08	1.23±0.11	0.52±0.02
	Female	1.20±0.24	1.28±0.31	1.05±0.12	1.26±0.31	0.51±0.02
Light brown	**Male**	1.18±0.17	1.21±0.15	1.05±0.12	1.20±0.13	0.51±0.02
	Female	1.10±0.22	1.20±0.22	1.00±0.09	1.20±0.28	0.52±0.02
Black	**Male**	1.35±0.23	1.37±0.34	1.08±0.10	1.35±0.22	0.56±0.08
	Female	1.28±0.18	1.22±0.31	1.08±0.13	1.27±0.16	0.54±0.02
Variegated	**Male**	1.42±0.21	1.45±0.30	1.09±0.14	1.45±0.32	0.52±0.02
	Female	1.27±0.17	1.27±0.28	1.20±0.17	1.24±0.36	0.53±0.04

Histological Findings

The skin was found to be thicker in males than in females of the entire five coat colour goats. The results showed the whole skin thickness, epidermis which consists of four different layers (stratum basale, granulosum, spinosum and corneum) and dermis (papillary and reticular layers) (Figure 4, 5 and 6). The mean whole skin thickness (epidermis and dermis) of some selected body regions (neck, rump, mid-side and thigh), in relation to coat colours, age and sex are presented in table 2. The epidermis contributed 1.85-3.07% while dermis contributed between 96.93-98.15% of the total skin thickness. The skin thickness of the red Sokoto goat ecotypes ranges between 30.42µm-40.91µm in males and 26.77 µm-36.92µm in females. The thickness of the skin based on the body regions showed greater thickness at rump and least thickness at lateral mid-side.

Table 2: Microscopic mean skin thickness (µm) of the five different coat colour ecotypes

Coat colour	**Sex**	**Age**		
		1 year	**1.5 years**	**2 years**
Dark red	**Male**	40.46±0.13	40.91±0.21	
	Female	35.61±0.15	36.24±0.31	32.02±0.28
Brown	**Male**	30.42±0.20	40.50±0.20	
	Female	29.35±0.25	31.19±0.27	26.77±0.29
Light brown	**Male**	35.48±0.11	35.57±0.25	
	Female	31.90±0.24	32.92±0.24	36.92±0.26
Black	**Male**	32.80±0.30	34.42±0.31	
	Female	30.58±0.33	29.68±0.30	31.06±0.29
Variegated	**Male**	36.86±0.33	38.35±0.29	
	Female	36.92±0.28	31.79±0.29	32.11±0.27

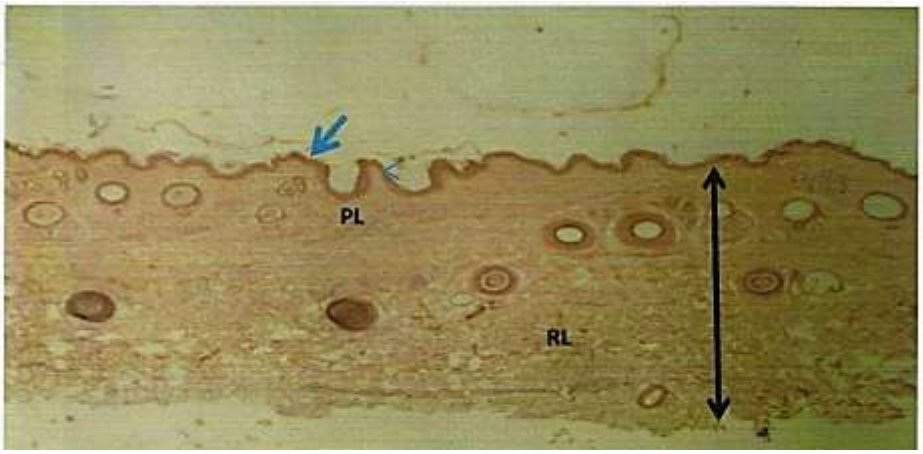

Figure 4: Photomicrograph of the neck region of the dark red Sokoto goat ecotype skin showing the layers of the skin, epidermis (blue arrow) and papillary layer (PL), reticular layer (RL) of the dermis (black arrow) H&E x40

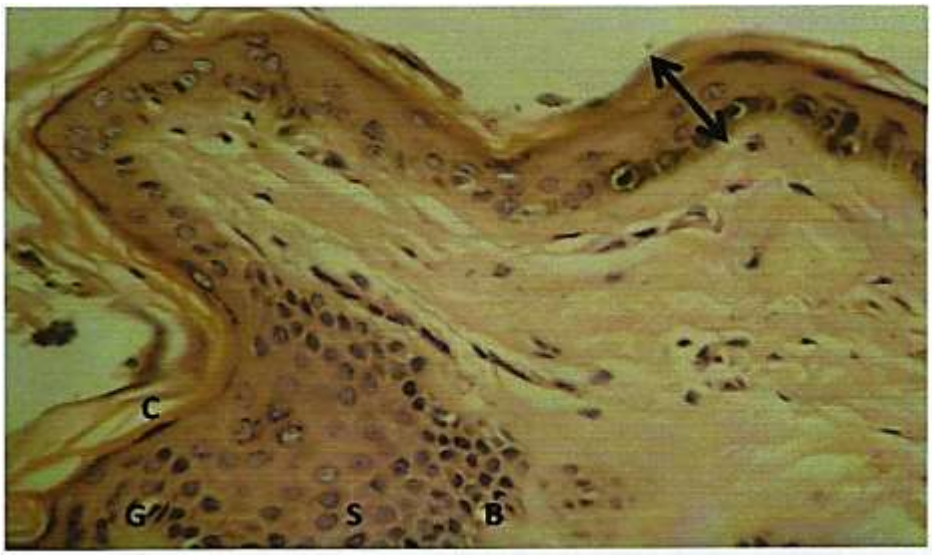

Figure 5: Photomicrograph of the dark red ecotype skin showing the epidermis (arrow) layers; basal (B), spinosum (S), granulosum (G) and corneum (C) H&E x400

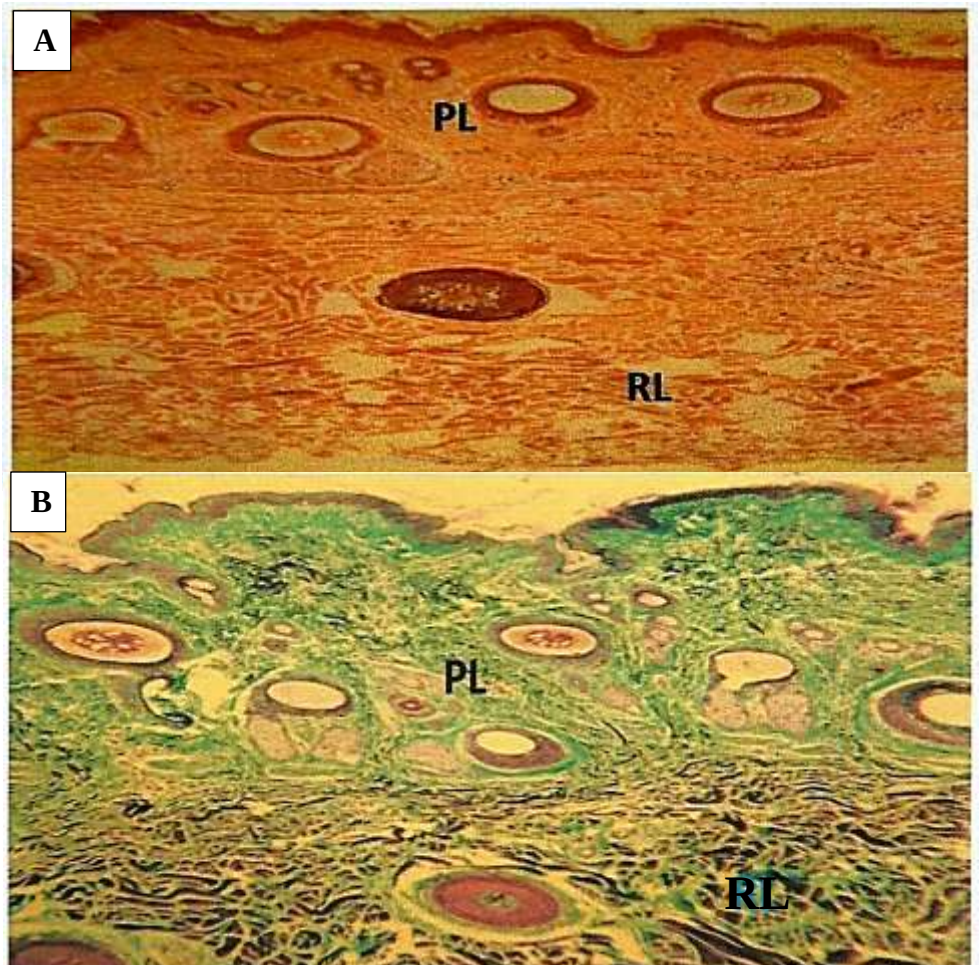

Figure 6: Photomicrograph of the brown ecotype skin showing the dermal layers; papillary layer (PL), reticular layer (RL) H&E (A) and Mason Trichome (B) (x100)

DISCUSSION

The result of skin sections showed well developed epidermis and dermis in all skin of the different ecotypes. In the present study the skin thickness was observed to be mainly due to the thickness of collagen fibres in the reticular layer, which contributes 63.56-69.31% to the total skin thickness in the five identified ecotypes. These findings agreed with the previous reports on Sahel goats with mean skin thickness of 1.79mm in adult and 1.66mm in the young, with dermis contributing 97.3% (Onwuka *et al*., 1998). In the red Sokoto goats average skin thickness was found to be 2mm in both yearlings and adults (Burns, 1965), while in West African dwarf goat, the average skin was found to range from 1.11mm-2.23mm with dermis contributing 90.6%-95.3% (Onwuka, 1983).

Similarly, the bucks at different age groups showed greater skin thickness than the corresponding females. This was earlier reported and attributed to androgen hormones in males that increases

collagen fibre production (Rnberk, 2009). While estrogen and cortisol hormones are mainly produced by the female goat decreases collagen production.

The regional micrographs of the skin shows greater thickness at rump body site that any other site. There were differences in relation to coat colour, as the skin from the dark red had greater skin thickness, while the light brown skin was found to be the least. The skin thickness increased with age in both males and females. The values obtained for skin thickness of the red Sokoto goat ecotypes ranges between 30.42µm-40.91µm in males and 26.77 µm-36.92µm in females. This does not agree with report by Burns (1965) on the red Sokoto goat and Kwari (2001) and Onwuka (1996) on Sahel goats. Raheeqa *et al*. (2013) who stated that skin thickness increased with age further reported that the dorsal part of the neck and the ventral part of thorax had the maximum and minimum skin thickness respectively in Bakerwali goat. This may be as a result of differences in method of calculating the skin thickness in the present study, or maybe inability to factor in the skin shrinkage value as suggested by Nair and Benjamin (1965). However, the skin from the dark red ecotypes was found to have greater thickness than skins from other ecotypes. Such types of skin are most preferred in the leather industries as reported by Burns (1965).

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