



ISSN (E): 2277- 7695  
ISSN (P): 2349-8242  
NAAS Rating: 5.23  
TPI 2021; SP-10(5): 551-555  
© 2021 TPI  
[www.thepharmajournal.com](http://www.thepharmajournal.com)  
Received: 14-03-2021  
Accepted: 24-04-2021

**Lucy KM**

Professor and Head, Department of Veterinary Anatomy and Histology, College of Veterinary and Animal Sciences, Mannuthy, Thrissur, Kerala, India

**Ashok N**

Director of Academics and Research, Kerala Veterinary and Animal Sciences University, Pookode, Wayanad, Kerala, India

**Maya S**

Professor, Department of Veterinary Anatomy and Histology, College of Veterinary and Animal Sciences, Mannuthy, Thrissur, Kerala, India

**Karthiyayini K**

Professor, Department of Veterinary Physiology, College of Veterinary and Animal Sciences, Mannuthy, Thrissur, Kerala, India

**Corresponding Author:**

**Lucy KM**

Professor and Head, Department of Veterinary Anatomy and Histology, College of Veterinary and Animal Sciences, Mannuthy, Thrissur, Kerala, India

## Histomorphological comparison of dermis in different breeds of rabbits

Lucy KM, Ashok N, Maya S and Karthiyayini K

### Abstract

Regional variation in dermis of the skin was studied in six breeds of rabbits viz., Soviet Chinchilla, New Zealand White, Grey Giant, White Giant, Angora and crossbreds. In total, 36 animals were used for the study and skin samples were collected from six adult healthy animals from each breed. Samples were collected from eight representative areas of the body viz., dorsal nasal region, pinna, dorsal neck, dorsal thorax, dorsal abdomen, ventral abdomen, perineal and carpal regions. Standard procedures were adopted for histological studies. Average thickness of the dermis varied from  $1057.75 \pm 70.65 \mu\text{m}$  in White Giant to  $2548.86 \pm 82.72 \mu\text{m}$  in crossbred animals. In all the breeds, dermis was thicker in the dorsal regions of the body and thinnest in the pinna region followed by perineal region. The papillary layer was thickest in the dorsal nasal region in all the breeds under study except Soviet Chinchilla where the perineal region showed thickest papillary dermis. Thinnest papillary dermis was seen in the pinna in all the breeds. Wide variation was noticed in the thickness of reticular dermis in different breeds. Maximum thickness for the reticular layer was observed in the dorsal nasal region in New Zealand White, Soviet Chinchilla and crossbred, dorsal neck region in Angora and White Giant and dorsal thoracic region in Grey Giant breed. Reticular dermis was thinnest in the pinna in all the breeds. Histological features of papillary and reticular dermis are also discussed in detail.

**Keywords:** Skin, dermis, structure, rabbit breeds, regional histology

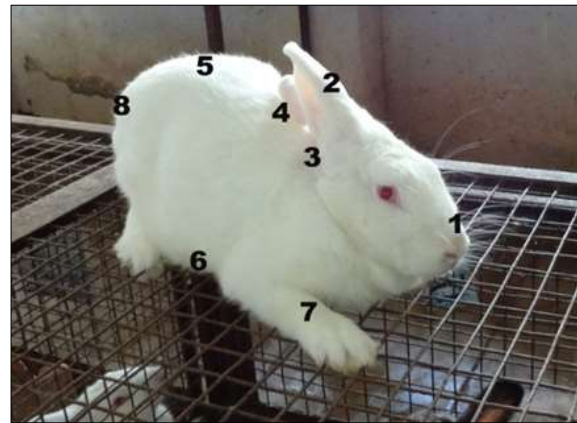
### 1. Introduction

Rabbits are being used as fancy as well as laboratory animals and provides a valuable additional source of income for farmers in the form of meat and fur producing animals. Rabbit meat is often recommended by nutritionists over other meats because it fits well with the current consumer demand for a low-fat meat with a high degree of fatty acid unsaturation and low sodium and cholesterol levels [6]. Skin is the largest organ in the body and is the barrier as well as the principal organ of communication between the animal and its environment. The skin of rabbits has unique properties and is used in fur garments, medical and cosmetic research and skin penetration studies. Structural characteristics of the skin are breed-specific and may change in different regions of the body. So far, no comprehensive comparative study has been conducted on the skin of various breeds of rabbits reared commonly in Kerala. Hence, the present work was undertaken to compare the histomorphology of dermis in selected regions of the body in different breeds of rabbits.

### 2. Materials and Methods

Histomorphological studies on the dermis were conducted on the skin of six breeds of rabbits namely, Soviet Chinchilla, New Zealand White, Grey Giant, White Giant, Angora and crossbred rabbits. In total, 36 animals were used for the study. Skin samples were collected from six adult healthy animals from each breed. Samples were collected from eight representative areas of the body viz., dorsal nasal region, pinna, dorsal neck, dorsal thorax, dorsal abdomen, ventral abdomen, perineal and carpal regions (Fig. 1).

Standard procedures were adopted for histological studies and the sections were stained using Haematoxylin and Eosin (H&E), van Gieson's method for collagen, Gomori's trichrome method for muscle and collagen fibres [2] and Verhoeff's elastic stain [9]. The morphometric and micrometric data were analyzed statistically.



**Fig 1:** Regions of the body from where skin samples collected (White giant)

1. Dorsal nasal; 2. Pinna; 3. Dorsal neck; 4. Dorsal thorax; 5. Dorsal abdomen; 6. Ventral abdomen; 7. Carpal; 8. Perineum

**3. Results and Discussion**

**3.1 Morphology**

Mean thickness of the skin, dermis, papillary dermis and reticular dermis in different breeds of rabbits used for this study are given in table 1. Average thickness of the dermis varied from  $1057.75 \pm 70.65 \mu\text{m}$  in White Giant to  $2548.86 \pm 82.72 \mu\text{m}$  in crossbred animals. Comparison of skin of eight selected regions of the body was done and the micrometric data are presented in table 2.

In all the breeds, dermis was thicker in the dorsal regions of the body and thinnest in the pinna region followed by

perineal region. Thickest dermis was noticed in the dorsal thoracic region in Angora and Grey Giant, dorsal nasal region in crossbred, New Zealand White and Soviet chinchilla and dorsal neck region in White Giant.

Two layers could be distinguished in the dermis although they blended without distinct demarcation as reported in pigs [10]. The superficial papillary or subepithelial layer was thinner, while the deep reticular layer was considerably thicker (Figs. 2 & 3). There was a significant positive correlation between the thickness of papillary and reticular dermis in all the breeds under study.

**Table 1:** Skin and dermal parameters of different breeds of rabbits

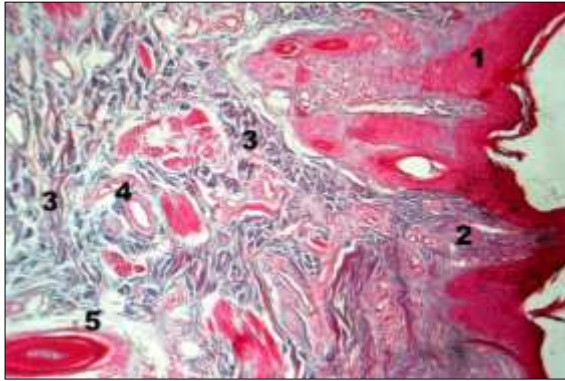
Parameters	NZW	SC	WG	GG	Angora	Crossbred
Thickness of skin, mm	$1.21 \pm 0.04$	$1.20 \pm 0.02$	$1.10 \pm 0.02$	$2.08 \pm 0.03$	$2.31 \pm 0.03$	$2.58 \pm 0.02$
Dermal thickness, $\mu\text{m}$	$1178.50 \pm 76.04$	$1138.94 \pm 83.92$	$1057.75 \pm 70.65$	$2040.67 \pm 83.91$	$2368.33 \pm 80.42$	$2548.86 \pm 82.72$
Thickness of papillary dermis, $\mu\text{m}$	$107.36 \pm 20.06$	$105.88 \pm 10.22$	$111.40 \pm 10.65$	$118.71 \pm 7.09$	$132.50 \pm 22.40$	$172.50 \pm 13.30$
Thickness of reticular dermis, $\mu\text{m}$	$1070.14 \pm 61.95$	$1030.25 \pm 88.67$	$922.17 \pm 11.54$	$1919.17 \pm 81.25$	$2244.43 \pm 102.29$	$2376.48 \pm 72.28$

(NZW-New Zealand White; SC-Soviet Chinchilla; WG-White Giant; GG-Grey Giant).

**Table 2:** Thickness of dermis in selected body regions in different breeds of rabbit,  $\mu\text{m}$

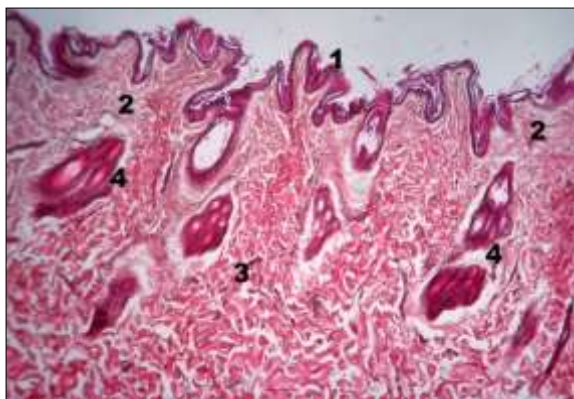
Breed of rabbit	Thickness	Dorsal nasal	Pinna	Dorsal neck	Dorsal thorax	Dorsal abdomen	Ventral abdomen	Carpal	Perineum
NZW	Dermis	$1363.33 \pm 43.56$	$420.00 \pm 3.69$	$1129.33 \pm 25.54$	$1313.67 \pm 20.60$	$1227.67 \pm 9.75$	$1117.33 \pm 12.22$	$1341.67 \pm 24.42$	$1362.33 \pm 14.98$
	Papillary dermis	$120.67 \pm 2.81$	$52.00 \pm 3.18$	$120.00 \pm 10.49$	$113.00 \pm 6.17$	$100.67 \pm 8.09$	$99.83 \pm 1.68$	$100.01 \pm 1.15$	$131.00 \pm 2.11$
	Reticular dermis	$1242.67 \pm 42.88$	$368.00 \pm 5.93$	$1009.33 \pm 29.66$	$1200.67 \pm 25.79$	$1127.00 \pm 16.31$	$1018.50 \pm 11.99$	$1240.67 \pm 23.64$	$1233.33 \pm 14.66$
SC	Dermis	$1457.67 \pm 13.94$	$278.67 \pm 4.78$	$1272.67 \pm 10.30$	$1282.00 \pm 5.16$	$1136.00 \pm 9.95$	$780.67 \pm 8.91$	$1147.33 \pm 11.32$	$1138.00 \pm 10.76$
	Papillary dermis	$126.67 \pm 2.76$	$55.33 \pm 0.84$	$84.00 \pm 1.15$	$107.83 \pm 1.38$	$120.00 \pm 1.79$	$85.00 \pm 1.24$	$102.33 \pm 3.98$	$113.33 \pm 2.40$
	Reticular dermis	$1331.00 \pm 13.09$	$223.33 \pm 4.58$	$1188.67 \pm 9.50$	$1174.17 \pm 5.95$	$996.00 \pm 10.97$	$695.67 \pm 9.36$	$1045.00 \pm 9.80$	$1024.67 \pm 11.82$
WG	Dermis	$1346.00 \pm 10.67$	$870.67 \pm 6.15$	$1396.67 \pm 4.28$	$1053.67 \pm 7.92$	$958.00 \pm 5.24$	$923.33 \pm 2.81$	$913.67 \pm 5.10$	$900.00 \pm 3.90$
	Papillary dermis	$355.67 \pm 8.25$	$85.00 \pm 0.86$	$140.33 \pm 1.41$	$94.83 \pm 1.89$	$91.33 \pm 1.33$	$90.33 \pm 0.95$	$95.33 \pm 1.23$	$86.00 \pm 1.46$
	Reticular dermis	$990.33 \pm 10.19$	$802.33 \pm 16.95$	$1256.33 \pm 5.38$	$959.33 \pm 8.08$	$866.67 \pm 5.31$	$833.00 \pm 3.53$	$818.33 \pm 4.77$	$814.00 \pm 4.76$
GG	Dermis	$2170.00 \pm 29.20$	$389.17 \pm 5.01$	$2056.67 \pm 31.44$	$2260.00 \pm 25.91$	$2160.00 \pm 17.39$	$1712.17 \pm 23.57$	$1886.33 \pm 29.17$	$959.5 \pm 5.21$
	Papillary dermis	$140.00 \pm 1.63$	$29.50 \pm 0.62$	$107.33 \pm 2.62$	$139.33 \pm 0.84$	$103.00 \pm 1.98$	$103.00 \pm 1.13$	$137.00 \pm 0.86$	$102.33 \pm 1.33$
	Reticular dermis	$2030.00 \pm 28.15$	$359.67 \pm 4.83$	$1949.33 \pm 29.66$	$2120.67 \pm 25.79$	$2057.00 \pm 16.31$	$1609.17 \pm 23.57$	$1749.33 \pm 28.79$	$857.33 \pm 6.36$
Angora	Dermis	$2521.00 \pm 19.02$	$891.68 \pm 4.59$	$2079.00 \pm 18.81$	$2580.17 \pm 4.58$	$2494.00 \pm 14.12$	$2212.33 \pm 19.59$	$2324.17 \pm 6.67$	$1817.67 \pm 9.37$
	Papillary	$280.00$	$81.33$	$138.00$	$126.5$	$138.33$	$89.33$	$91.50$	$85.00$

	dermis	± 3.76	± 1.33	± 1.93	± 0.89	± 1.20	± 2.51	± 2.09	± 0.86
	Reticular dermis	2241.00 ± 12.09	809.83 ± 4.58	2571.00 ± 18.42	2453.67 ± 4.24	2355.67 ± 13.48	2123.00 ± 17.82	2232.67 ± 5.02	1732.67 ± 9.36
Cross-bred	Dermis	2792.17 ± 9.37	418.33 ± 3.16	2565.00 ± 12.04	2411.00 ± 7.15	2507.33 ± 10.41	2418.83 ± 12.54	2534.83 ± 6.99	2259.33 ± 7.46
	Papillary dermis	235.20 ± 33.92	63.33 ± 1.43	209.33 ± 5.02	209.67 ± 3.28	182.00 ± 0.40	154.83 ± 1.22	139.50 ± 0.89	139.67 ± 0.95
	Reticular dermis	2557.00 ± 11.02	356.67 ± 2.72	2372.33 ± 8.02	2201.33 ± 5.08	2325.33 ± 12.98	2264.00 ± 12.66	2395.67 ± 7.16	2119.67 ± 6.92



**Fig 2:** Section of skin, Dorsal nasal region, White Giant. Gomori's trichrome method x 100

1. Epidermis; 2. Papillary dermis; 3. Reticular dermis; 4. Artery; 5. Hair follicle



**Fig 3:** Section of skin, Dorsal abdominal region, Crossbred. H&E. x 100

1. Epidermis; 2. Papillary dermis; 3. Reticular dermis; 4. Hair follicle

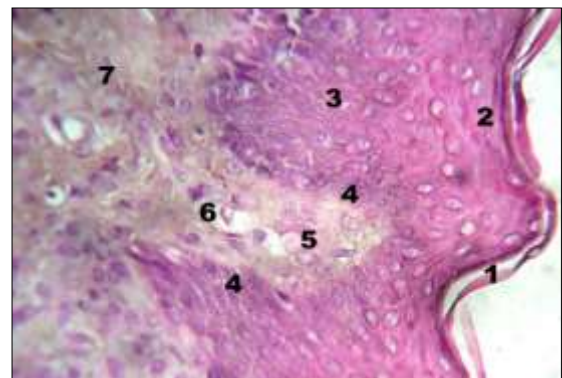
### 3.2 Histology

#### 3.2.1 Papillary layer

Micrometrical parameters of the papillary layer of dermis in all the six breeds are given in table 2. The papillary layer was thickest in the dorsal nasal region in all the breeds under study except Soviet Chinchilla where the perineal region showed thickest papillary dermis. Thinnest papillary dermis was seen in the pinna in all the breeds. Among the six breeds, highest mean value for papillary dermis was recorded in White Giant in the dorsal nasal region ( $355.67 \pm 8.25 \mu\text{m}$ ) and the lowest in Grey Giant in pinna ( $29.50 \pm 0.62 \mu\text{m}$ ). In the papillary layer, the fibres were finer and more closely arranged. This layer conformed to the contour of the stratum basalis of the epidermis. Regional variations in the epidermal thickness in New Zealand White rabbits were studied during prenatal and postnatal periods [7] and found prominent variations in the thickness of epidermis in different body regions.

The papillary layer protruded into the epidermis at certain intervals, thereby giving rise to the dermal papillae (Fig. 4).

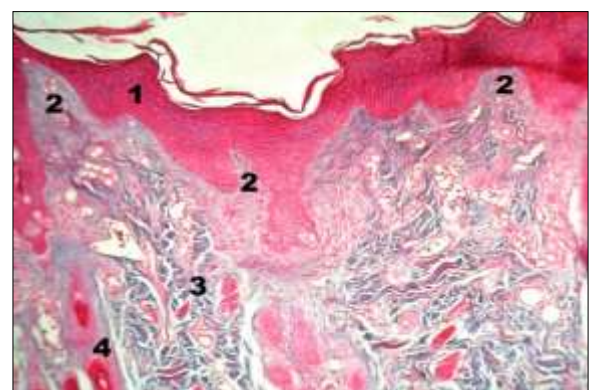
The papillary layer was made up of collagen fibres predominantly with a few elastic and reticular fibres which were embedded in an amorphous ground substance. The fine fibres of the papillary dermis interdigitated into the stratum basalis of the epidermis. Unlike the epidermis, this layer was highly vascular and large number of capillary loops could be seen in the dermal papillae (Fig. 4). Fibroblasts and macrophages were the predominant cell types in the papillary layer as reported in domestic animals [4].



**Fig 4:** Section of skin, Dorsal nasal region, White Giant. H&E x 400

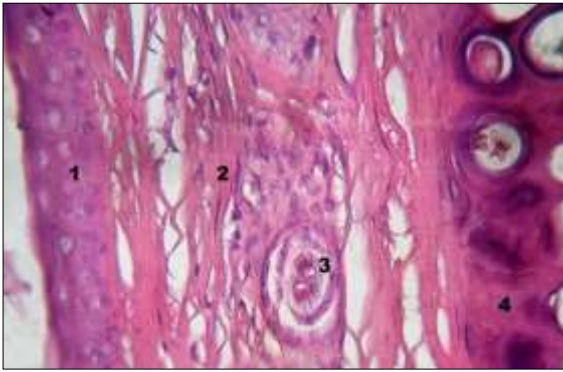
1. Stratum corneum; 2. Stratum granulosum; 3. Stratum spinosum; 4. Stratum basale; 5. Dermal papilla; 6. Capillary; 7. Papillary dermis

Dermal papillae were pronounced in the dorsal nasal and carpal regions (Fig. 5). In the other regions, the dermal papillae were less developed and practically absent in the pinna in all the breeds (Fig. 6). The papillae were small and poorly differentiated in the hairy portions of the skin in pigs<sup>3</sup>. Regional histology of papillary dermis in Large White Yorkshire pigs was explored and found that the dermis was thickest in the snout region and thinnest in the neck ventral portion and the dermal papillae were pronounced in the snout and carpal regions where mechanical demands were more [11].



**Fig 5:** Section of skin, Dorsal nasal region, White Giant. Gomori's trichrome method x 100

1. Epidermis; 2. Dermal papilla; 3. Reticular dermis; 4. Hair follicle



**Fig 6:** Section of Pinna, Soviet Chinchilla. H&E. x 400

1. Epidermis; 2. Dermis; 3. Hair follicle; 4. Hyaline cartilage

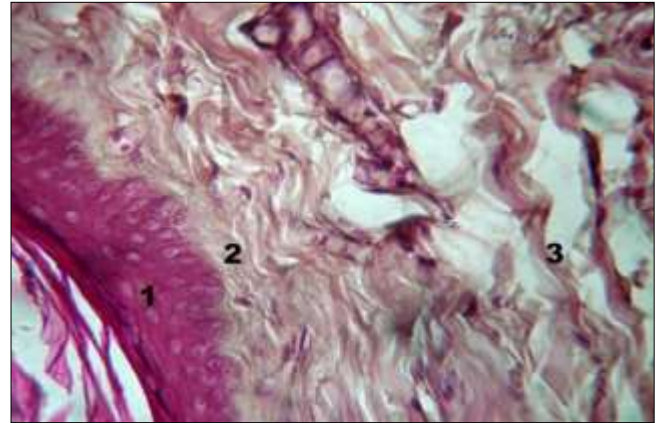
### 3.2.2 Reticular layer

Papillary and reticular layers of the dermis could be distinguished from each other by the difference in the nature and arrangement of connective tissue fibres (Figs. 2 & 3). Reticular layer consisted of large, coarse and loosely interwoven bundles of collagen fibres. The measurements of the reticular layer of dermis in various regions of the body in six rabbit breeds are given in table 2. Wide variation was noticed in the thickness of reticular dermis in different breeds. Maximum thickness for the reticular layer was observed in the dorsal nasal region in New Zealand White, Soviet Chinchilla and crossbred, dorsal neck region in Angora and White Giant and dorsal thoracic region in Grey Giant breed. Similar to that of papillary dermis, reticular dermis was thinnest in the pinna in all the breeds.

Among the six breeds, highest mean value for reticular dermis was recorded in Angora in the dorsal thoracic region ( $2571.00 \pm 18.42 \mu\text{m}$ ) and the lowest in Soviet Chinchilla in pinna ( $223.33 \pm 4.58 \mu\text{m}$ ). Histological characteristics of the skin in New Zealand White rabbit were suitable for leather industry, whereas the Angora rabbit had good hair follicle characteristics for wool production [5]. It is also reported that the overall thickness of the skin and dermal papillary layer was significantly more in the Angora rabbit than in the New Zealand White, whereas the reticular dermis was thinner in the Angora. Histomorphology and leather traits of Mecheri sheep were explored [8] and observed that the epidermis, papillary layer and reticular layer of neck region measured  $93.60 \pm 32.30$ ,  $435.10 \pm 185.80$  and  $609.50 \pm 87.20 \mu\text{m}$ , respectively.

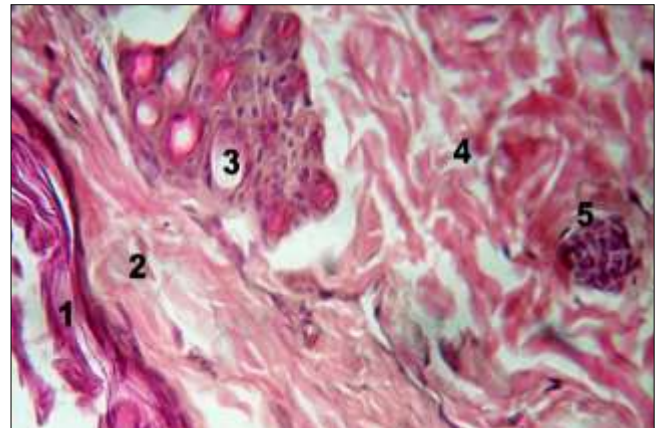
In the reticular layer, bundles of collagen fibres were arranged mostly parallel to the surface (Fig. 7) as reported in vertebrates [1]. In addition to the parallel fibres, alternate layers of collagen fibres were also observed at an angle to the former. In the carpal and perineal regions, the fibres formed irregular network (Fig. 8). Besides the collagen fibres, elastic and reticular fibres were also seen in the dermis (Fig. 9). Towards the deeper aspect, size of the collagen bundles greatly reduced and they were seen as small, thin bundles. Blood vessels, lymph vessels and nerves traversed the dermis. Many of the blood vessels formed the arteriovenous anastomoses or glomi. The cellular elements were less abundant in the reticular layer when compared to the papillary dermis. Fibroblasts, mast cells, macrophages and extravasated leucocytes were often found. Aggregations of lymphocytes were noticed occasionally (Fig. 10). Large number of receptors and nerve bundles could be noticed in the dermis (Fig. 11). Receptors of touch were nerve endings of three

types namely free, basket and encapsulated [12]. Free nerve endings ended in superficial layer of the dermis and even extended into the epidermis. They occurred in the hairy parts of the body. Basket nerve endings surrounded the hair follicles in the form of a network. They also occurred in the hairy parts of the body. Encapsulated nerve endings were found in the dermis and occurred in the hairless parts of the body.



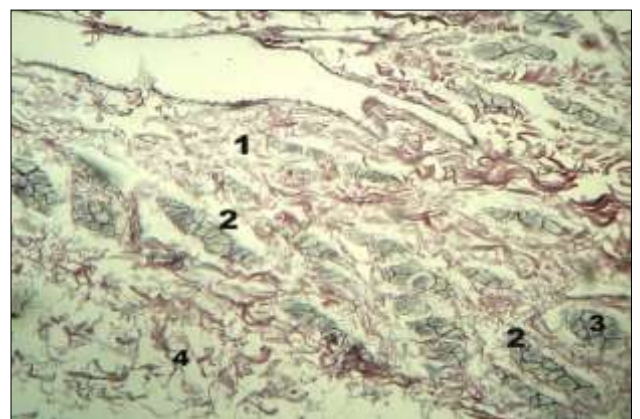
**Fig 7:** Section of skin, Dorsal nasal region, Crossbred. H&E. x 100

1. Epidermis; 2. Papillary dermis; 3. Reticular dermis with parallel bundles of collagen fibres



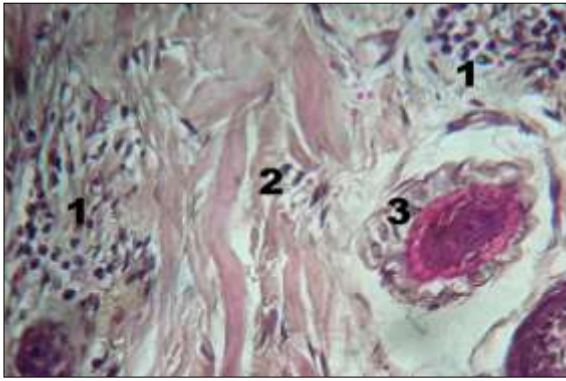
**Fig 8:** Section of skin, Carpal region, Crossbred. H&E. x 100

1. Epidermis; 2. Papillary dermis; 3. Hair follicles; 4. Reticular dermis with irregular bundles of collagen fibres; 5. Receptor



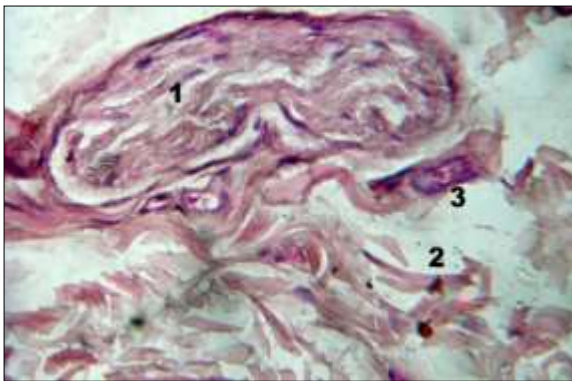
**Fig 9:** Section of skin, Dorsal thoracic region, New Zealand White. Gomori's method for reticular fibres x 100

1. Dermis; 2. Reticular fibres; 3. Adipose tissue; 4. Subcutis



**Fig 10:** Section of Pinna, White Giant. H&E x 400

1. Lymphocytic infiltration; 2. Dermis; 3. Hair follicle



**Fig 11:** Section of skin of dorsal thoracic region, White Giant. H&E x 400

1. Receptor; 2. Dermis; 3. Blood vessel

#### 4. Conclusions

The present study indicated that wide regional variation existed in the thickness of dermis in different breeds of rabbits and this can be correlated to the quality of leather obtained from each breed. The results obtained will also be useful for selecting the breed and region of the body for skin penetration studies. The results will form a basis for further physiological and pathological studies.

#### 5. References

1. Ham AW. Histology. Edn 6, JB Lippincott Co., Philadelphia 1969, 1036.
2. Luna LG. Manual of Histological Staining Methods of the Armed Forces Institute of Pathology. Edn 3, Mc Graw Hill Book Company, New York 1968, 258.
3. Montagna W. The Structure and Function of Skin. Edn 2, Academic Press, New York 1962, 454.
4. Monterio-Riviere N, Stinson AW, Calhoun HL. Integument. Text book of Veterinary Histology (eds. Dellmann HD, Eurell JA). Edn 5, Lippincott Williams and Wilkins, Philadelphia 1998, 285-312.
5. Oznurlu Y, Sur E, Ozparlak H, Celik I, Telater T. Comparative skin histology of White New Zealand and Angora rabbits: Histometrical and immunohistochemical evaluations. Journal of Animal and Veterinary Advances 2009;8:1694-1701.
6. Petracci M, Bianchi M, Cavani C. Development of rabbit meat products fortified with n-3 polyunsaturated fatty acids. Nutrients 2009;1:111-118.
7. Purushotham G, Vyas YL, Patil DB, Panchal KM, Bayani DM, Dubal SC. Regional variations in epidermal

thickness in rabbit skin (*Oryctolagus cuniculus*) during development. Indian Journal of Veterinary Anatomy 2008;20(1):35-38.

8. Purushothaman MR, Thiruvankaden AK, Karunanithi K, Balasundaram K. Skin thickness, histology and leather traits of Mecheri sheep. Indian Veterinary Journal 2010;87:60-62.
9. Singh UB, Sulochana S. Handbook of Histological and Histochemical Techniques. Premier Publishing House, Hyderabad 1996, 111.
10. Sumena KB, Lucy KM, Chungath JJ, Ashok N, Harshan KR. Morphology of the skin in Large White Yorkshire pigs. Indian Journal of Animal Research 2010a;44(1):30-35.
11. Sumena KB, Lucy KM, Chungath JJ, Ashok N, Harshan KR. Regional histology of papillary dermis in Large White Yorkshire pigs. Indian Veterinary Journal 2010b;87:908-910.
12. Weisbroth SH, Flat RE, Kraus AL. The Biology of the Laboratory Rabbit. Academic Press, Inc. Orlando 1974, 496.