Some Histological Observation and Morphometric Measurements of the *Millivora Capenesis* Epidermis

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Abstract: This study is conducted on back skin of three female belong to *Millivora capenesis* wild animals. Histological preparations carried out to reveal the structural features of the stratum of epidermis. The skin of *Millivora capensis* was covered with keratinized stratified squamous epithelium, the mean thickness is $427.85 \pm 4.28 \mu\text{m}$. The superficial layer is stratum corneum. The basic properties of this stratum consist of dead, flattened, polygonal cells which are free from nuclei and keratin accumulate in dead cells in order to give protective feature. The mean thickness of stratum corneum is $90.5 \pm 2.44 \mu\text{m}$. Beneath the stratum corneum, there is translucent layer composed of keratin fibrils and homogenous materials which is termed Eldin. The mean thickness of stratum lucidum is $18.14 \pm 0.52 \mu\text{m}$. While the mean thickness of stratum granulosum intensive affinity to basophilic spinosum is formed from prickly cells with cytoplasmic processes like spines which represented the desmosomes. The mean thickness of both stratum basal is $55.63 \pm 1.75 \mu\text{m}$. Our histological findings revealed epidermal papillae extended to the papillary layer of dermis, and these papillae were bifurcates and some papillae fused with each other in order to give the rigidity and power to epidermis.

Key words: Histology, epidermis, skin, millivora.

1. Introduction

The skin arises by the Juxtaposition of two major embryological elements: the prospective epidermis, which originates from a surface area of the early gastrula, and the prospective mesoderm, which is brought into contact with inner surface of the epidermis during gastrulation [1, 2].

The normal epidermis is a terminally differentiated, stratified squamous epithelium. The major cells making up 95% of the total are the epidermal basement membrane toward the skin surface, forming several well defined layers during transit. Thus, on simple morphological grounds, the epidermis can be divided into four distinct layers: stratum basal or stratum germinativum, stratum spinosum, stratum granulosum and stratum corneum. The term Malpighian layer

includes both the basal and spinous cells [3, 4]. The stratum basal is a continuous layer that is generally described as only one cell thick, but may be two to three cells thick in glabrous skin and hyper proliferative epidermis. The basal cells are small, cuboidal (10-14 nm) and have large dark staining nuclei, dense cytoplasm containing many ribosome's and dense tonofilament bundles. Immediately above the basal cell layer, the epibasal keratinocytes enlarge to form the spinous (prickle-cell layer or stratum spinosum). The stratum spinosum is succeeded by the stratum granulosum or granular layer, because of the intracellular granules of keratohyalin [5]. The cytoplasm of the cell of the upper spinous layer and granular cell layer also contain smaller lamellated granules averaging 100-300 nm in size which are known as lamellar granular bodies or Odland bodies. The most outer layer of epidermis is the stratum corneum, which has lost nuclei and cytoplasmic

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organelles. The cells become flattened and the Keratin filament aligns into disulphide cross-linked macro fibers under the influence of filaggrin, the protein component of the Keratohyalin granule, responsible for keratin filament aggregation [6]. The corneocyte has a highly insoluble cornfield envelope within the plasma membrane formed by cross-linking of the soluble protein precursor, involucrin [7]. A specific epidermal transglutaminase was also synthesized in stratum spinosum [8].

The process of desquamation involves degradation of the lamellate lipid in the intercellular spaces and loss of residual intercellular desmosomal interconnection. In palmoplantar skin, there is an additional zone, also electronlucent, the stratum lucidum between the granulosum and corneum. These cells are still nucleated, and may be referred to as transitional cells.

2. Material and Methods

Three females of *Millivora capensis* are used in this study, and these animals were killed by farmers living in the agricultural regions nearby and Najaf province. The animal was 3.5-4.5 years old estimated on the basis [9]. The animals killed by guns, and the way of killing *Millivora* was carried out rapidly, through shots, and directly to the heads of animals with powerful rifle. The skin of *Millivora* is very thick and difficult to be penetrated by shots. It showed resistance to many machete blows.

The skin of dorsal area was removed after clipping hairs, and then fixed with 10% formalin for 48 h. Another histological procedures were carried out such as washing with tap water dehydration with serial concentration of graduated alcohol (50%, 70%, 90%, and 100%), clearing with xylol, embedding with wax paraffin, and making paraffin block which is cut by micrometer at thickness micrometer [7] and then stained by Hematoxylin and Eosin [10]. The diamentions and thickness of stratum of epidermis were recorded by using of Ocular micrometer.

3. Results

Millivora capensis female back skin is covered by keratinized stratified squamous epithelium which represents the epidermis, and the mean thickness is $(427.85 \pm 4.28) \mu\text{m}$ (Table 1), consisting of five strata corneum located at superficial of epidermis. The main properties of stratum corneum are consisted of dead, flatten or polygonal cells, devoid from nuclei, and the keratin is accumulated in these cells (Figs. 1 and 4). The mean thickness of stratum comeum is $(90.5 \pm 2.44) \mu\text{m}$ (Table 1). Below the stratum corneum, it is the transitional layer which is termed stratum lucidum. This layer is found in thick epidermis. The cells of stratum lucidum appear in flatten and translucent, pale cells stained via esinophilic stains in their cytoplasm. The keratin granules change in homogenous and

Table 1 Mean measurements of epidermis thickness and their stratum in the *Millivora capensis* back skin, measurements by micrometers.

Measurements	Mean	SD
Epidermis thickness	427.857	± 4.28
Stratum corneum thickness	90.5	± 2.44
Stratum lucideum thickness	18.124	± 0.52
Stratum granulosum thickness	99.285	± 2.62
Stratum spinosum and basal thickness	55.636	± 1.75
Basal cells height	2.72	± 0.20

Fig. 1 Epidermis of *Millivora capensis*.

SC (stratum corneum), SL (stratum lucidum), Sg (stratum granulosum). Hematoxylen and Eosin. 100 $\times$.

Fig. 2 Epidermis and dermis of *Millivora capensis*. SL (stratum lucidum), Sg (stratum granulosum), SS (stratum spinosum), Sb (stratum basale), Ep (epidermal papillae), and part of D (dermis). Hematoxylen and Eosin. 100 ×.

Fig. 3 Epidermis and dermis of *Millivora capensis*. Sb (stratum basale) appear as stratified cuboidal epithelium, BEp (the epidermal papillae are bifurcated), the papillary dermis contain branched arterioles BV (blood vessel). Hematoxylen and Eosin. 100 ×.

Fig. 4 Epidermis and dermis of *Millivora capensis*. SC (stratum corneum) occupies large area, while SL (stratum lucidum) occupies small area. Hematoxylen and Eosin. 100 ×.

translucent materials which are called Eledin (protein). It is similar to true keratin and there are keratin fibrils in the stratum lucidum (Figs. 1, 2, 4 and 5). The mean thickness of stratum lucidum is $(18.14 \pm 0.52) \mu\text{m}$ (Table 1).

The cellular elements of stratum granulosum are flattened cells with dense keratin granules and had intensive staining with basophilic stains. Their nuclei appear shrinkage and pyknotic nuclei (Figs. 2 and 5). The thickness of stratum granulosum is $(99.285 \pm 2.62) \mu\text{m}$ (Table 1).

Fig. 5 Epidermis of *Millivora capensis*. SL (stratum lucidum) is non-cellular. Sg (stratum granulosum) is stratified squamous (superficial) while the deep layer of Sg is polygonal-shape cells. The SS (stratum spinosum) consists of shrinkage cells (prickle-shapes). Sb (stratum basale) is stratified cuboidal. Hematoxylen and Eosin. 100 ×.

Fig. 6 Epidermis and dermis of *Millivora capensis*. F (Fusion) between two epidermal papillae, leave S (space) contains connective tissue. PD (papillary dermis) consists of collagen fibers with fibroblasts and fibrocyte. Hematoxylen and Eosin. 100 ×.

The stratum spinosum is situated above the stratum basal. The stratum spinosum cells have cytoplasmic processes which contact with each others, and these represented simple thickness located among the cellular elements of stratum spinosum. Spinosum cells are polyhedral shapes (Figs. 2 and 5). The stratum spinosum termed is prickly layer due to the appearance of desmosomes found among their cells, resulted from the shrinkage which occurs in the cells during histological preparation. The stratum basal is also called stratum germinativum. This layer is characterized by simple or stratified cuboidal or columnar epithelia resting on the undulate basement membrane (Figs. 2 and 3). Mean height of single cuboidal cells layer is $(2.72 \pm 0.20) \mu\text{m}$. The mean thickness of both stratum spinosum and stratum basal are $(55.63 \pm 1.75) \mu\text{m}$.

The *Millivora capensis* epidermis is extended into dermis as epidermal papillae (Fig. 3). Epidermis was extended into dermis as epidermal papillae (Fig. 3), these papillae are bifurcated into primary, secondary, and tertiary bifurcation. Some epidermal papillae are fused with each other (Figs. 4 and 5) in order to give power to epidermis against harmful environment. These fusions occur in the connective tissue of the papillary layer of dermis that consists of collagen fibers, fibroblasts, fibrocyte and blood vessels.

4. Discussion

Millivora capensis belongs to order carnivore, family Mustelidae, and genus millivora and species capensis. In Iraq, this wild animal distributes around agricultural areas such as Baghdad, Basrah, Diwanya and Najaf provinces, and these wild animals are omnivorous, feed on reptiles, amphibians, birds, insects (especially larvae of honey bees), and roots of plants [10]. The geographical distribution of *Millivora capensis* in the world was in Africa and south western Asia [11]. Our histological observations about epidermis of *Millivora capensis* were identical with previous study [12] on the mouse epidermis that

mentioned that the epidermis is stratified squamous epithelium consisting mainly of cells with two different origins, keratinocytes and melanocytes. Keratinocytes comprise the bulk of the epithelium, undergo keratinization and form dead superficial layers of the skin. These superficial keratinized cells continuously desquamate from the surface and are replaced by cells derived from mitotic cells in the lowest layer (basal layer). The cells population of new cells below them, as they move upward, elaborate keratin and accumulate in the cytoplasm (spinous layer, granular layer), and finally almost all cells are occupied by keratin (cornified layer). The basic functions of the mammalian skin are firstly acting as boundary between structures of the body and external environment. Secondly, it is a skin sensation. Thirdly, it is the skin and their appendages work with musculature system for locomotion. Fourthly, the mammalian skin is related to innate immune system. The previous investigations recorded on the skin rats in both sexes (male and female) pointed out that there are many factors affecting the thickness and pigmentation of skin, such as testosterone known to have an effect on skin structure [12]. This study is different from current studies [13], especially in the stratum corneum measurement. And epidermis thickness in *Millivora capensis* skin is revealed. The epidermis thickness is $(427.85 \pm 4.28) \mu\text{m}$, while Robert et al. [13] recorded the whole epidermis thickness is $(31.2 \pm 1.5) \mu\text{m}$ in the back skin of female rats, and the stratum corneum measurement is $(18.2 \pm 1.0) \mu\text{m}$. The stratum corneum acts as barriers to prevent the water loss, and due to the lipid compositions, our suggestions are in accordance with previous studies [14, 15], which mentioned that the lipid component of the stratum corneum resulted in a markedly increased membrane permeability. Our histological and morphological findings are similar to previous observations [16, 17] about epidermal cellular organization in the rodents. They noticed the different styles in the epidermis cellular organization; the main prominent signs for mammalian skin in vertical

architecture, and they mentioned that the minute style of epidermal cellular organization was noticed in the thin epidermis which was covered with the thick hair and the keratinocytes characters by low mitotic division factor.

5. Conclusions

Millivora capensis epidermis was characterized by thick stratum corneum. The dermal papillae extended to papillary layer of dermis, and these papillae fused to give rigidity and power to epidermis.

References

- [1] Goldsmith, A. 1991. *Biochemistry and Physiology of the Skin*, 2nd ed. New York: Oxford University Press, 159-60.
- [2] Breathnach, A. S. 1971. *An Atlas of Ultra Structure of Human Skin*. London: Churchill, 1-10.
- [3] Breathnach, A. S. 1975. "Aspects of Epidermal Ultrastructure." *J. Invest. Dermatol.* 65 (1): 2-15.
- [4] Odland, G. F. 1991. *Structure of the Skin in: L.A. Goldsmith (Ed.), Physiology, Biochemistry, and Molecular Biology of the Skin*. New York: Oxford University Press, 3-62.
- [5] Lavker, R. M., and Matoltsy, A. G. 1971. "Structure of Keratohyalin Granules of the Epidermis as Revealed by High Resolution Electron Microscopy." *J. Ultrastruct. Res.* 35 (5): 575-81.
- [6] Lynley, A. M., and Dale, B. A. 1983. "The Characterization of Human Epidermal Filaggrin. A Histidine-Rich, Keratin Filament-Aggregating Protein." *Biochim. Biophys. Acta.* 744 (1): 28-35.
- [7] Rice, R. H., and Green, H. 1977. "The Cornified Envelope of Terminally Differentiated Human Epidermal Keratinocytes Consists of Cross-Linked Protein." *Cell* 11 (2): 417-22.
- [8] Buxman, M. M., and Wuepper, K. D. 1978. "Cellular Localization of Epidermal Transglutaminase: A Histochemical and Immunochemical Study." *J. Histochem. Cytochem.* 26 (5): 340-8.
- [9] Galigher, A. E., and Kayloff, E. N. 1964. *Essential of Practical Microtechnique*, 2nd ed. Philadelphia: Lea and Febiger, 40-4.
- [10] Begg, K., Begg, C., and Abramov, A. 2008. *Mellivora Capensis*, in: *IUCN Red List of Threatened Species*. 1.
- [11] Baryshnikov, G. 2000. "A New Subspecies of the Honey Badger *Millivora Capensis* from Central Asia." *Acta Theriologica* 45 (1):45-55.
- [12] Hirobe, T. 1995 "Structure and Function of Melanocytes: Microscopic Morphology and Cell Biology of Mouse Melanocytes in the Epidermis and Hair Follicle." *Histol. Histopathol.* 10 (1): 223-37.
- [13] Robert, L. B., Raymond, F. S., and Elainer, R. C. 1983. "Differences in Permeability of Rat Skin Related to Sex and Body Site." *J. soc. Cosmet. Chem.* 34: 127-35.
- [14] Scheuplein, R. J., and Ross, L. 1970. Effect of Surfactant and Solvents on the Permeability of Epidermis." *J. Soc. Cosmet. Chem.* 21 (13): 853-73.
- [15] Michaels, A. S., Chandrasekaran, S. K., and Shaw, J. E. 1975. "Drug Permeation through Human Skin: Theory and *in vitro* Experimental Measurement." *AIChE J.* 21 (5): 985-96.
- [16] Mackenzie, I. C. 1975. "Ordered Structure of the Epidermis." *J. Invest. Dermatol.* 65 (1): 45-51.
- [17] Christophers, E., and Laurence, E. B. 1976. "Kinetics and Structural Organization of the Epidermis." *Curr. Probl. Dermatol.* 6: 87-106.