



## Histological Study of Ostrich Skin after Biopsy

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### Abstract

**Objective-** To investigate histological structure of Ostrich skin was done. Ostrich leathers are of exotic leather types, which are in increasing demand due to their outstanding natural gain patterns formed by large feather follicles on the leather surface.

**Animals-** Ten mature ostriches were selected from ostrich breeding center in Jupar, Kerman, Iran, all of which were in good shape and healthy condition.

**Procedure-** For this study, some samples of ostrich skin were made from ostriches aged about 1 year old. 0.5 \* 0.5 cm sample of different areas of skin was made and kept in 10% formalin solution for 7 days; then, the samples were taken out. Routine histological techniques were done and 6 micron-thickness sections were cut. The sections were stained with standard Haematoxylin and Eosin (H&E) and masson trichrome and Periodic acid-Schiff(pas). The histological study was done using a light microscope and the photographs were taken for detailed illustration of the results.

**Results-** Microscopic studies showed that the skin consisted of 2 different layers as epidermis and dermis. Epidermis consisted of the following different groups of cells, from depth to surface: basal cell – granular cell – chondrocyte shape cells and keratin cells. Dermis consisted of a dense connective tissue with both regular and irregular fibers in which the irregular part was near the epidermis.

**Conclusions and clinical relevance-** The results of this study suggested that ostrich's skin in either dermis or epidermis is very different from other domesticated animals; and the development of dermal connective tissue makes this skin a good model for studying wound healing and skin grafting.

**Key words:** Ostrich, skin, Histology.

### Introduction

Ostrich leathers are of exotic leather types, which are in increasing demand due to their outstanding natural gain patterns formed by large feather follicles on the leather surface.<sup>1</sup> Approximately, 700,000 ostrich skins are introduced to the global market every year, out of which 300,000 are obtained from South Africa. It is evident that ostrich skins have a small share of market compared to the nearly 330 million hides and 850 million skins, which constitutes the raw material for leather industry in the world.<sup>1</sup>

Leather industry produces a range of indispensable consumer goods including footwear, garments, handbags and luggage.<sup>2</sup>

Indeed, while production of leather and fur products decreased between 1975 and 1992 in developed countries, it increased in the developing world from 4.4% (1975–1985) to 5.3% (1985–1992) (14).and this trend was expected to continue.<sup>3</sup> Small economies like Kenya and Ethiopia may not affect global business cycles and the specific factors for improving leather industry, such as enhancing value-addition to the leather production process, encouraging uptake and effective use of cleaner technologies to improve product quality and diversifying finished leather products, respond to policy entrepreneurship by various stakeholders involved in leather industry.<sup>2</sup> Behzat Oral Bitlisli conducted a study and found that neck, leg and back sides of ostrich skins differed physically and chemically from each other. In terms of area and strength characteristics of leathers, back and leg sides were appropriate for upper leather production whereas neck sides could be used for accessories.<sup>4</sup> He found that ostrich skins were heavier than sheep and goat skins but lighter than calf and cattle hides.<sup>4</sup> This work aimed to detect some characteristics of ostrich skins which were valuable for leather industry.

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## Materials and methods

Ten mature ostriches were selected from ostrich breeding center in Jupar, Kerman, Iran, all of them were in good shape and healthy condition.

The ostriches were obtained from a slaughterhouse for getting samples from the skin of body, back of head and between two eyes. These samples were transmitted to Histotechnic Laboratory of Veterinary Faculty.

Their heads were kept in 10% formalin solution for 7 days and this formalin was changed every day. The samples were cut into 1\*1 cm very carefully in order not to be hurt at dermal layer. They were placed in 10% solution of neutral-buffered formalin which consisted of 10 volumes of commercial formalin (40% formaldehyde in water) and 90 volumes of phosphate-buffered water for 24 h; then, their formalin solution was changed and, after fixation, 1 cm segment was dissected from each part and sections of 6 micron thickness were prepared from the samples through routine histological techniques. Then, all of the samples were numbered and put in the tissue process system.

The sections were stained with standard Haematoxin and Eosin (H&E), masson trichrome (for the connective tissue) and Periodic acid-Schiff for protein granules. The histological study was done using a light microscopy and the photographs were taken for detailed illustration of the results.

## Results

Microscopic studies showed that skin consisted of two distinguish layers; first one was epidermis in the surface and second one was dermis. These two layers had different structures as:

### Epidermis

It consisted of four types of cells from bottom to up: stratum germinativum consisted of cuboidal and a polyhedral or granular cell. And then a single layer look liked chondrocyte cell they are clusters and become spherical isolated from each other in compartment called chondrocytes. The latest one consisted of flattened cells, in which nuclei were degenerate and final processes of keratinization happened, and they were transformed to the stratum cornea (Fig 6).

### Dermis

The dermis had a dense connective tissue and was clearly observed in masson trichrome staining. Two models of fibers were visible. They were both collagen and elastic. (Fig.1,3,6)

#### Histological Explanation of Head Skin:

In this portion of skin, there was clear separation between two layers of epidermis and dermis.

In most of the body surface, those parts which were normally covered, the epidermal layers were very thin. As above The stratum germinativum consisted of cuboidal and an polyhedral or granular cells. The following layer was flattened and very similar to chondrocyte (Fig.3). Externally, the stratum corneum

consisted of several keratinized cells. The outermost strata tended to break away from the surface in flakes and gave rise to the dry scurfy appearance of the skin.

Value of epidermis thickness in the feather's follicle area was very thin (Fig.1). Stratum basal consisted of basophilic nucleus and very little cytoplasm. The line between epiderm and derm was not very folded.

The dermis consisted of dense connective tissue and was clearly observed in staining. Two models of fibers were visible; both of them were collagen and elastic. All areas of dermis were made up of dense connective tissues; but definitely, in its deep part (about one forth of thickness of total tissue), the dense regular connective tissue was visible and they were parallel to skin surface. At the dermal-epidermal junction, the basal layer of cells were placed on the basal lamina, consisting of a thin layer of fine filamentouce.<sup>5</sup> (Masoltsy 1969) in dermal layer, the dense connective tissue in masson trichrome were green and pink. Also, there were many vessels which were small arteriols.

### Nerves:

The mutual nerves were in the dermis. There was a circular shape. (Fig.4) on the line between papillar and reticular, there was an organization which gave the corpuscle a cross-sectional appearance, like that of an onion. One of them was between two follicles and was so large. It had small arteriol and was right on top of papillary region. It was ladder-like cross-striation in routine haematoxin and eosin preparations. (Fig.5)

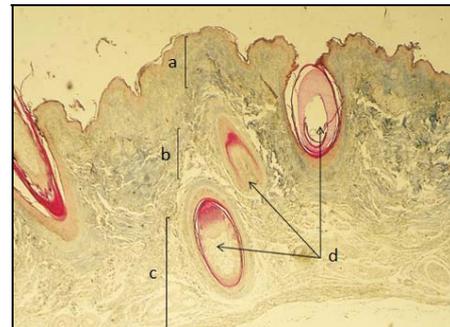


Figure 1- Epidermis and Dermis-mason trichrom x40  
a:Epidermis b:Dens irregular connective tissue c:Dens regular connective tissue d:Feathers follicle

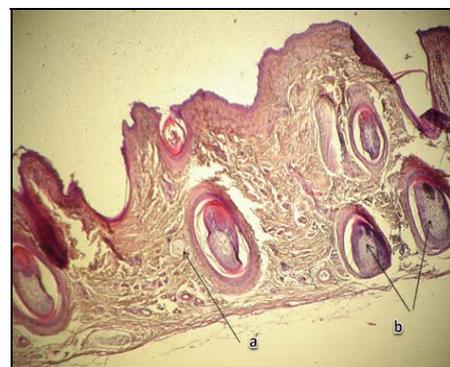


Fig 2: Epidermis and Dermis-H&E- x40  
a: Sebaceous gland b:Feathers follicle

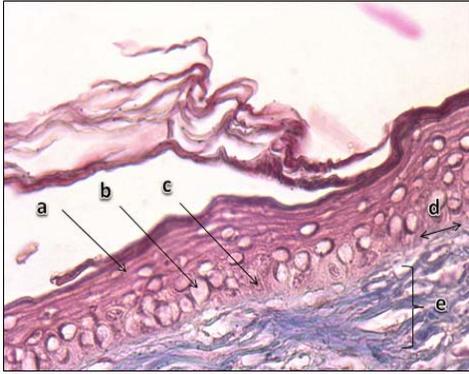


Figure 3 –Different Portion of Epidermis and Dermis-masson trichrom - x400 a:Granulosa layer b:chondrocyte c:Basal cell d: Basal layer e:Dermis

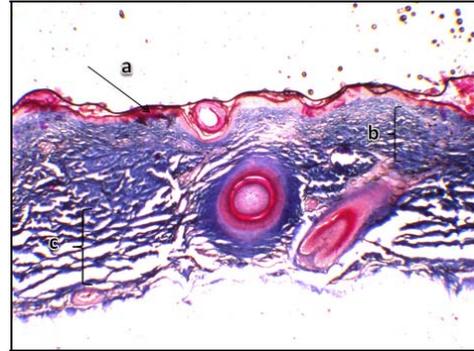


Fig6- Epidermis and Dermis-masson trichrom-x32 a:Epidermis b:Dens irregular connective tissue(papillary layer) c:Dens regular connective tissue(reticular layer)

### Discussion

#### Epidermis

The stratum germinativum consisted of cuboidal and an polyhedral or granular cells. In the outside, there is usually a single transitional layer of flattened cells in which the nuclei degenerate and final processes of keratinization take place. Externally, the stratum consists of several strata of flat keratinized cells. The outermost strata tend to break away from the surface in flakes, giving rise to the dry scurfy appearance of the skin:

Cane and Spearman (1967)<sup>6</sup> described four layers in the epidermis as:

a: A basal germinal layer

b: A layer of larger polygonal-shaped prickles cells with swollen nuclei and prominent nuclei. "Prickles" are projection of the cell surfaces where desmosomes join adjacent cells together (Spearman 1971).<sup>7</sup> No melanocyte was observed in this study like the results of Cane and Spearman (1967) while it was seen in mammals<sup>8</sup>.

C: A layer of more flattened cells with smaller nuclei and without keratohyalin granules constituting a transitional zone where final slugs of keratinization occur.

D: (stratum corneum) consisted of flattened cells without stainable nuclei and joined together, mainly at their lateral edges, to form thin keratinized lamellae.

Basal cell layer, granule cell layer and keratinization cell layer were clearly seen with H&E (like 2-4-7-8).

But, no lucidum cell layer<sup>5</sup> which was seen in mammals was observed (4-2).

In a layer, there were many chondrocyte shaped cells. They looked like large and circular with the nucleus in a part of cell (Fig.3). Thus far, there has been no report about this issue in mammals (4-2-7)

And yet, there is no report in avians.<sup>5</sup>

In dermis, there were two layers: dense regular connective tissue and dense irregular connective tissue in mammals and avians.<sup>5, 8, 9</sup>

The great point was the difference between papillar and reticular, which was very clear. The papillar area was right

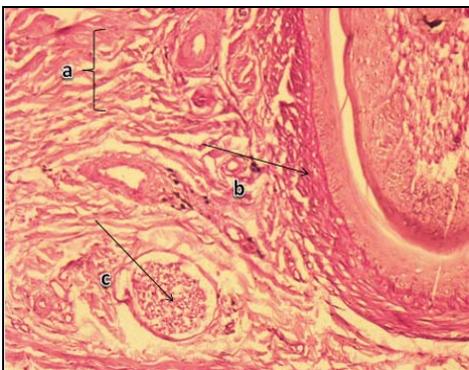


Fig 4 – Dermis –PAS- x100 a:Dens irregular connective tissue(papillary layer) b: Feathers follicle c:Krause's corpuscle

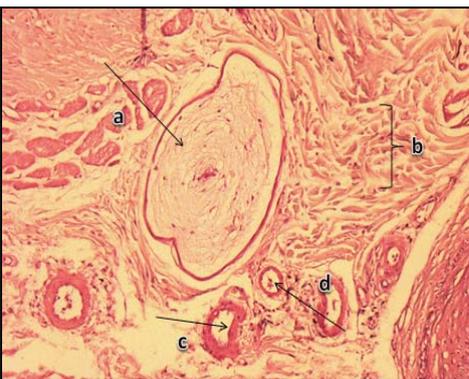


Figure 5 – Dermis – H&E- x100 a:Pacinian corpuscle b:Dens regular connective tissue c:Duct of sweat gland d:Arteriole

after epidermis with little fold on the border. It consisted of dense irregular connective tissue (Fig 6).

Reticular area was in the below (this region is used for leather making), is made up of dense regular connective tissue and is parallel to the surface.

While human skin is developed from cells, leather is developed from collagen fibers with a few laid-in elastic fibers. Collagen fibers ultimately make up finished leather goods since other components are removed during tanning. Bovine leather collagen is formed from amino acids, which connect together to form tropocollagen long chains. There are amino acids in the composition of bovine leather collagen in m mole/g.<sup>10</sup>

A triple helix of 5 angstroms in diameter and 280 nm in length is formed from three molecular chains. A microfibril is formed from 5 of the triple helix chains and, in turn, microfibrils connect to form a subfibril.

Approximately, 7000 molecular chains of tropocollagen form a bundle of about 1000 angstroms in diameter, which join to make the collagen fibers that are visible with the microscope. Collagen fibers have no particular length or preferred direction and thus entangle to form a three-dimensional fiber network or structure.<sup>10</sup>

#### Corpuscle

Two kinds of corpuscle were visible in this section: pacinian corpuscle and raus's corpuscle.

Bloom and Fawcett stated in their book that, "There is an organization which gives the corpuscle a cross-sectional appearance, like that of an onion. The nerve and its surrounding lamella are enclosed in a thin connective tissue capsule." This explanation is correctly similar to what was observed in pacinian corpuscle.

In another place, they said that, " raus's end bulbs are small, more or less spherical bodies found in the papillary layer in the dermis." The axon of the myelinated nerve enters the corpuscle and branches repeatedly in its interior. These corpuscles bear some resemblance to pacinian corpuscle but are much smaller. Many odors of branching of the axone are its most distinctive features.

### Acknowledgements

The authors would like to thank Professors Ali Asghar Mozaffari for his contribution and revision of this manuscript.

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## مطالعه بافت شناسی پوست بعد از بیوپسی

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**هدف-** هدف از انجام این مطالعه مشخص کردن ساختمان میکروسکوپی پوست شترمرغ بود چون چرم شترمرغ از انواع خاصی است که روز به روز بر طرفداران آن اضافه میشود از ویژگیهای این حیوان تحمل خوب شرایط اقلیمی و از خصوصیات چرم آن حضور برجستگیهای بزرگ مربوط به فولیکولهای بزرگ پر در سطح چرم است.

**حیوانات-** تعداد ۱۰ قطعه شتر مرغ بالغ از مرکز پرورش شترمرغ واقع در ناحیه جویبار از توابع استان کرمان انتخاب شدند و تمامی آنها در وضعیت خوبی از نظر سلامتی بودند.

**مواد و روش کار-** برای انجام این مطالعه نمونه‌هایی از نواحی مختلف پوست در ابعاد  $0/5 \times 0/5$  سانتی متر جدا و در محلول فرمالین ۱۰٪ قرار داده شدند و پس از یک هفته نمونه‌ها خارج و بر طبق روشهای متداول آزمایشگاه بافت شناسی مقاطع ۶ میکرونی از آنها تهیه و روی لام قرار داده شد و به روشهای هماتوکسیلین و ائوزین و همچنین تری کروم ماسون رنگ آمیزی گردیدند و سپس به وسیله میکروسکوپ نوری مطالعه شدند و تصاویری برای ارائه‌ی نتایج مشخص تهیه گردید.

**نتایج-** نتایج میکروسکوپی مشخص نمود که پوست شترمرغ به‌طور مشخص از دو لایه اپیدرم و درم تشکیل شده است. در مطالعه‌ی اپیدرم این گروه‌های سلولی از عمق به سطح دیده میشوند: سلول‌های های بازال - سلول‌های دانه‌دار - سلول‌های شبیه کندروسیت و سلول‌های شاخی و ناحیه درم تشکیل شده از بافت همبند سخت منظم و نامنظم که الیاف نامنظم در نزدیکی اپیدرم قرار گرفته‌اند.

**نتیجه‌گیری و کاربرد بالینی-** در این مطالعه مشخص گردید که پوست شترمرغ چه در قسمت اپیدرم و چه در قسمت درم تفاوت‌های زیادی با پوست پرندگان اهلی دیگر دارد و تکامل ساختارهای همبندی در قسمت درم قابلیت‌ها به پوست این حیوان داده که ارزش مطالعه به عنوان یک مدل برای ترمیم زخم و پیوند پوست را دارد.

**کلمات کلیدی-** شتر مرغ، پوست، بافت شناسی.

