

Integumentary System

Introduction

The covering of the vertebrates is called as integument. The integumentary system in addition to protection also acts as waterproof and bactericidal layer and controls body temperature. The integumentary system includes skin and its derivatives. The derivatives are the structures, which originate from the skin such as hair, glands, claws, horn, nails etc.

2.1 Structure of skin

The skin originates from ecto-mesoderm. The skin of rabbit is soft, dry, thick and hairy. It is the largest body organ. It separates the internal body environment from the external environment. The skin has two main layers :

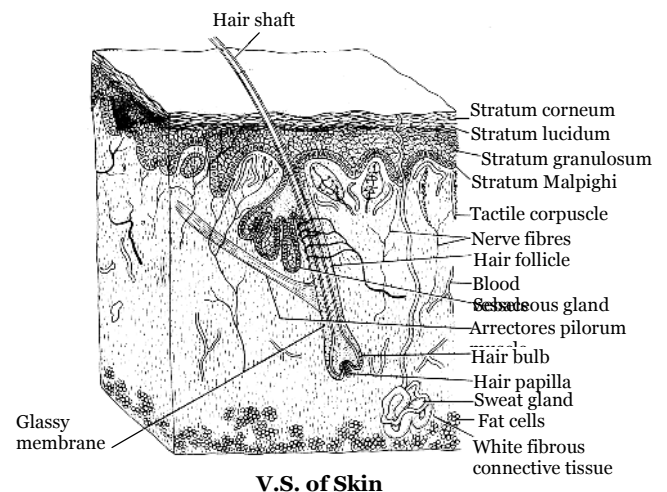
- (i) Epidermis (ii) Dermis

(i) **Epidermis** : It originates from the ectoderm and it is a stratified squamous epithelium. It is multi-layered and the layers are of five types, which are as follows.

(a) **Stratum malpighi** : It is also called as stratum germinativum. It is the innermost layer which is single-layered. It is made up of columnar cells, which are living and divide constantly to form upper layers of the epidermis. In addition, it consists of special melanocytes, which are branched. These cells contain membrane-bounded melanosomes, which synthesize melanin pigments. Some melanocytes are also found in the dermis, which are also called as melanophages.

Melanin is a black pigment which provides colour to the skin. The skin becomes colourless due to absence of melanin pigments which is called as albinism.

(b) **Stratum spinosum** : It is multilayered and also called as prickly layer. It is formed by the cells of the stratum germinativum. The cells of this layer remain interconnected with the help of hook-like processes. This layer provides strength to the skin.



(c) **Stratum granulosum** : It is also a multi-layered layer which is formed by modification of the cells of the stratum spinosum. It is also called as granular layer because it has granules of keratohyalin protein. Its cells are somewhat flat and living.

(d) **Stratum lucidum** : It includes 4-5 layers of flat and living cells. The cells are provided with eleidin protein which makes the cells translucent. It makes the skin waterproof and acts as barrier layer. In this layer, the nuclei of the cells begin to disintegrate.

(e) **Stratum corneum** : It is the outermost layer of the epidermis which consists of 8-10 layers of flat, enucleated and dead cells. It is developed maximum in the soles and palms. The cells are provided with keratin protein. The formation of the keratin protein is called as keratinization. The keratohyalin and the eleidin are the intermediate forms of the keratinization. The skin of the palms and soles in man and other primates is provided with furrows and projected lines which are called as respectively **sulci cutis** and **cristae cutis**.

(ii) **Dermis** : It originates from the somatic mesoderm or somatopleur. It is 2-3 times more thicker than the epidermis. Both the epidermis and dermis remain folded in each other. These folds are called as retepegs. Dermis is made up of mainly connective tissues and it also contains collagen fibres, yellow fibres, blood vessels, neuro-muscular cells and sensory organs. The dermis is an elastic and strong layer which forms leather. The dermis is divisible into two layers – Papillary layer and Reticular layer.

(iii) **Sub-dermis** : It is an extra layer which is situated below the dermis. It is divisible into two layers –

(a) **Stratum adiposus** : It is also called as **panniculus adiposus**. It consists of adipose tissues which store extra food and functions as heat resistant layer.

(b) **Stratum carnosus** : It is also called as **panniculus carnosus**. It consists of areolar connective tissue which connects the skin with rest of the body.

2.2 Skin glands

These glands originate from the stratum germinativum of the epidermis but they are situated in the dermis. All the skin glands are exocrine and they secrete various secretions. The mammalian skin has following glands

(i) **Sweat or sudoriferic glands** : They are coiled tubular glands which open outside directly. They secrete sweat which contains 95% water and 5% other substances (*e.g.* Lysozyme, salt, ammonia, urea etc.). The sweat lowers the body temperature and excretes excess of salts. The lysozyme found in it acts as bacteriocidal. The sweat glands in rabbit are apocrine. In human beings, most of the sweat glands are eccrine or merocrine. But the sweat glands found in arm pits, teats, eye lids are apocrine in function.

(ii) **Sebaceous glands** : They are compound alveolar glands which are formed as an outgrowth of the hair follicle. They are holocrine in function and open outside through the hair follicle. They secrete an oily substance called sebum. The sebum makes the skin and hair waterproof. The sebum has ergosterol which forms vitamin-D in presence of *UV* rays of sun-light.

(iii) **Mammary glands** : In prototheria, human beings and other primates, the mammary glands are modified apocrine sweat gland. In remaining mammals, they are modified compound alveolar sebaceous glands. Each mammary gland has a teat through which the mammary gland opens out. The area around the teat is darkly pigmented which is called as areola mammae.

(iv) **Meibomian glands** : They are modified sebaceous glands and are also called as tarsal glands. They are found on the inner side of the eye-lids. They secrete an oily substance which keeps the eyes moist.

(v) **Glands of Zeis** : They are modified sebaceous glands. They are associated with hair follicles of the eye-lashes. Their oily secretion lubricates the eye-lashes.

(vi) **Ceruminous glands** : They are modified sweat glands. They are found in external auditory meatus and they secrete ear wax which is also called as cerumen. The cerumen is a type of carbohydrate. The cerumen makes the tympanum water proof.

(vii) **Perineal glands** : It is formed by the modification of the sebaceous glands. They are also called as scent glands or inguinal glands. They are situated near the rectum in the perineum region. They secrete a pheromone which acts as sex attractant.

2.3 Hair

The hair are found only in the skin of mammals which are ectodermal in origin. The hair is situated in a hair follicle which is formed as invagination of the stratum germinativum. The base of the hair follicle is everted cup-like which encloses a hair papilla or dermal papilla. The hair papilla is made up of blood vessels and the nerves. The hair consists of two parts viz. hair shaft and hair root. The cells of the hair root divide constantly causing growth of the hair follicle. The part of the hair shaft inside the hair follicle is covered by two sheaths viz. Huxley's sheath (outer), Henle's sheath (Inner) and made up of cuboidal cells. The exposed part of the hair shaft is dead due to deposition of the keratin protein. Structurally, the hair shaft consists of three parts viz.

Cuticle : Outer most and made up of squamous cells.

Cortex : It is the outer part which contains melanin pigments. The melanin pigments are absent in the hair of rabbit.

Medulla : It is the central part of the hair follicle. The lanugo is without medulla.

2.4 Nails

Develop from epidermis and are hard cornified plates. Highly vascular dermis underlying nail is called Nail bed. The epidermis invaginates at the base of nail to form nail groove. The crescentic whitish area at the base of nail is called lunula. Finger nails grow faster than toe nails and both grow quicker in summer than in winter.

2.5 Functions of the integument

Skin is the largest **functional organ**, which performs many functions. Hence, it is called as "**Jack of all trades**".

(i) It protects the soft body organ from the germs, radiations and injuries.

(ii) It protects the body from dehydration by preventing water loss.

(iii) It controls body temperature. There is vasodilation in the skin when body temperature is high and vasoconstriction when body temperature is less.

(iv) It removes excess of water and some salts as sweat.

(v) It has abundant receptors which are sensitive to a variety of stimuli.

(vi) It helps in the formation of new cells, bones, teeth and vitamin D.

Important Tips

☞ Syncytial epidermis is found in Ascaris.

- ☞ If stratum corneum is removed from the soles of rabbit, sensation increases.
- ☞ Melanophores are situated in stratum germinativum.
- ☞ Melanoblasts occur in junction of dermis and epidermis.
- ☞ Animal having capacity of temperature regulation are warm blooded. e.g., Mammals, Birds
- ☞ Perspiration is done for cooling of the body. It maintains body temperature at constant level.
- ☞ Adipose tissue found underneath dermis helps in keeping the body warm.
- ☞ The main device of whale for keeping warm is thick blubber.
- ☞ Regulation of body temperature in a homoiotherm when the environmental temperature is high would involve dilation of blood vessels of the skin.
- ☞ Thermo-regulatory centre in mammals is located in hypothalamus.
- ☞ Nails, hooves and horns are derived from the tissue epithelium.
- ☞ Dermal scales are present in gymnophiona.
- ☞ Cloacal scent glands occur in epidermis of alligator.
- ☞ Sweat glands are absent in Ant-eaters, Sea cows, Whales.
- ☞ Musk glands are located over forehead in elephants
- ☞ The characteristic protein of the horny parts of the skin of terrestrial vertebrate's hairs, feathers, nails, hoofs is keratin.
- ☞ Paniculus carnosus muscles are responsible for moving and shaking the skin.
- ☞ The glomus in skin of man functions in thermo-regulation.
- ☞ Dog cools the body through panting.
- ☞ Otter is an endotherm.
- ☞ Spines : Spines of hedgehog, spiny anteater and porcupine are modified hair.
- ☞ Bradykinin : When body temperature rises, the sweat glands release a potent vasodilator peptide, bradykinin which dilates blood vessels to lose heat quickly.
- ☞ Sweat glands : Man lacks sweat glands on the lip borders and glans of penis. Rabbit has sweat glands only around the lips. Contrary to common belief, dog has numerous sweat glands in the hairy parts of the skin, but these do not play an important role in temperature regulation.
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- ☞ **Vibrissae (Whiskers)** : These are special long, stiff, sensory hair on the sides of the mouth in certain mammals, such as rabbit, lion.
- ☞ **Cutis Anserina** : Another term for gooseflesh.
- ☞ **Metachrosis** : Amphibians can change the intensity of their skin colour to some extent to blend with the colour of external environment. This capability is called metachrosis.
- ☞ Tanning is a process in which the epidermis is first removed by maceration and then the connective tissue fibres of dermis are rendered thick and tough by treating the dermis with tanning agents like Tannin, Alum, Chromium salts etc. Finally leather is produced.
- ☞ **Taxidermy** : Taxidermy is a process in which the whole skin, including both epidermis and dermis, is preserved by means of certain chemicals.
- ☞ Leather is derived from dermis.
- ☞ Ecdysis is removal of stratum corneum.