PHYLOGENESIS OF SKIN ON CHORDATES AND THE DEVELOPMENTAL DISORDERS

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ABSTRACT

The skin of vertebrates has numerous and diverse derivatives, either located within the epithelial sheet itself (glands) or extending above its surface (teeth, scales, feathers, hairs, etc.). Many of them have a modular structure and constitute structural–functional units. Ontogenetically, all skin derivatives are of ectomesodermal origin, and their morphogenesis is subject to metabolic control, heterochronies (divergence in the timing of origination and development), and regulation by means of tissue interactions and molecular signaling via similar pathways.

The diversification (origination of morphological diversity) of skin derivatives within the same morphological type is explained by the development of new generations of ectomesodermal structures separated by heterochronies and regulated by changes in the gradients of molecular signaling pathways under the influence of environmental factors.

Evolutionary relationships between the majority of skin derivatives are obscure, except for teeth and glands associated with sensory organs that have evolved together with these organs. Apparently, many chordate skin derivatives (scales, feathers, hairs, and glands) originated as novelties at nodal stages of phylogeny and subsequently evolved convergently or in parallel.

INTRODUCTION

The problem of origination and diversification of skin derivatives in vertebrates is still a challenge to zoologists. The main difficulty in solving it is that, in contrast to the situation with other organ systems (musculoskeletal, nervous, excretory, etc.), it is hardly possible to trace evolutionary relationships between the derivatives characteristic of representatives of different classes.

The discussion of the problem is accompanied by the advancement of numerous hypotheses and conjectures that cannot yet clarify the evolutionary scenario concerning the origination, morphogenesis, diversification, and homology or historical divergence of these structures.

Skin derivatives are numerous and diverse. They can be divided into appendages, or structures extending above the skin surface, and glands, which lie within the skin. However, this division is obviously tentative. For example, hair and feather follicles lie in the dermal or even hypodermal layer, with only the keratinous shaft of these structures protruding outward. Glands lie within the skin but often have accompanying skin or keratinous protrusions. The same applies to keratinization. Scales, feathers, and hairs are keratinous structures, whereas glands are not keratinized.

PHYLOGENESIS OF SKIN ON UROCHORDATES

The Urochordata , also known as Tunicates and Ascidians , are more commonly known as "sea squirts."

They belong to the same phylum as the vertebrates although adults do not have a backbone.

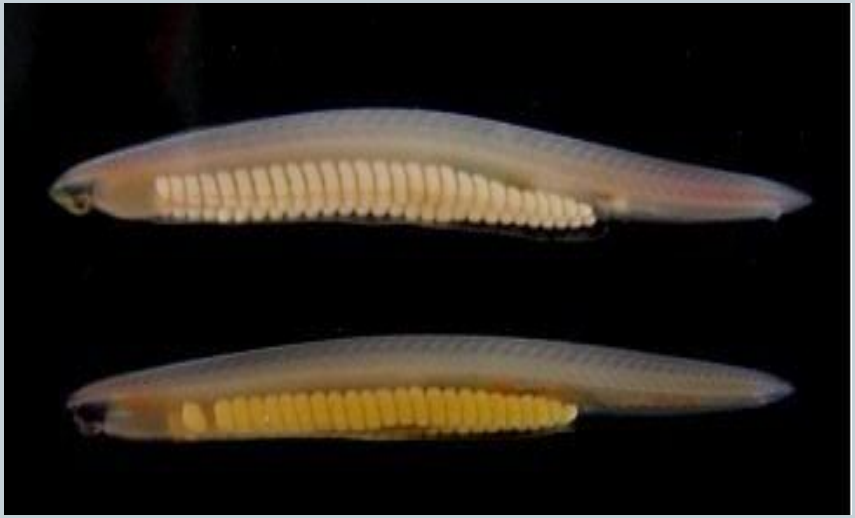
The name tunicates comes from the tunic (skin derivative) surrounding their body.

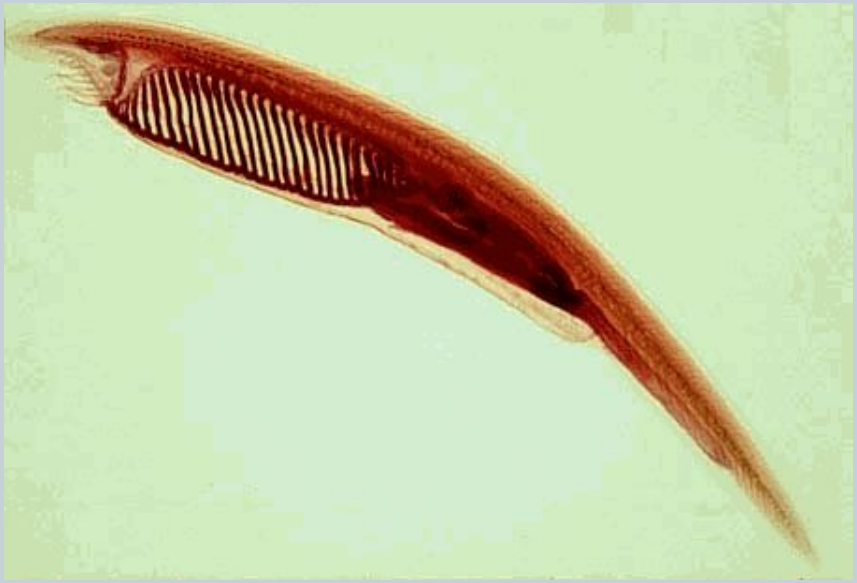
The tunic is a thick, usually opaque, covering protecting their barrel-shaped bodies from predators. It is made from a material very similar to cellulose. On the inner surface of the tunic is a thin epidermis, it is this which secretes the tunic. On the inside of the epidermis is a thicker dermis (body wall) and bands of muscles.

The tunic is composed of proteins and complex carbohydrates, and includes tunicin, a variety of cellulose. The tunic is unique among invertebrate exoskeletons in that it can grow as the animal enlarges and does not need to be periodically shed.

PHYLOGENESIS OF SKIN ON CEPHALOOCHORDATES

Cephalochordate, also called Acrania, any of more than two dozen species belonging to the subphylum Cephalochordata of the phylum Chordata. Cephalochordates and vertebrates have a hollow, dorsal nerve cord, pharyngeal gill slits, and a notochord.





In Subphylum Cephalochordata the skin of the lancelet has only two regions: the outer epidermis and the inner dermis. The epidermis is very thin and formed by single layered stratified epithelium. The dermis consists of the connective tissue, which is not well developed.

The skin is rich in sensory nerve endings that probably help produce a sense of touch and are important for burrowing. A number of cephalochordates have some photosensors near the front and back ends of their body, but in general (unlike vertebrates) they lack any eyes or organs to sense gravity.

PHYLOGENESIS OF SKIN ON VERTEBRATES

In birds, the skin is thin and dry, glands are absent, except an oil gland on the tail. The stratum corneum is keratinized.

In mammals the skin is thick, consists of epidermis, dermis and subcutaneous fiber, and enriched with glands. External epidermis is a thin layer consisting of flat cells. The corneal layer is composed of thin scale-like dead cells without nuclei.

Fish have scales and contain mucous glands, their secretion reduces water friction.
The skin of amphibians has no scales, epidermis is smooth, thin, moist and slimy covered by the film of mucus secreted by large mucous or alveolar glands.
The skin of reptiles is rough and dry without any glands because most of them inhabit hot and dry areas. Epidermis consists of external corneal and inner malpighian layers.

The human skin is the outer covering of the body and is the largest organ of the integumentary system. The skin has up to seven layers of ectodermal tissue and guards The underlying muscles, bones, ligaments and internal organs. There are two general types of skin, hairy and glabrous skin (hairless).

DISORDERS OF THE HUMAN SKIN

- Rash: Nearly any change in the skin's appearance can be called a rash. Most rashes are from simple skin irritation; others result from medical conditions.
- Dermatitis: A general term for inflammation of the skin. Atopic dermatitis (a type of eczema) is the most common form.
- Eczema: Skin inflammation (dermatitis) causing an itchy rash. Most often, it's due to an overactive immune system.
- Psoriasis: An autoimmune condition that can cause a variety of skin rashes. Silver, scaly plaques on the skin are the most common form.
- Dandruff: A scaly condition of the scalp may be caused by seborrheic dermatitis, psoriasis, or eczema.

- Acne: The most common skin condition, acne affects over 85% of people at some time in life.
- Cellulitis: Inflammation of the dermis and subcutaneous tissues, usually due to an infection. A red, warm, often painful skin rash generally results.
- Skin abscess : A localized skin infection creates a collection of pus under the skin.

- Rosacea: A chronic skin condition causing a red rash on the face. Rosacea may look like acne, and is poorly understood.
- Warts: A virus infects the skin and causes the skin to grow excessively, creating a wart. Warts may be treated at home with chemicals, duct tape, or freezing, or removed by a physician.
- Melanoma: The most dangerous type of skin cancer, melanoma results from sun damage and other causes. A skin biopsy can identify melanoma.
- Basal cell carcinoma: The most common type of skin cancer. Basal cell carcinoma is less dangerous than melanoma because it grows and spreads more slowly.
- Seborrheic keratosis: A benign, often itchy growth that appears like a “stuck-on” wart. Seborrheic keratoses may be removed by a physician, if bothersome.

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