PARASITIC ADAPTATIONS

The survival of a parasite in the body of the host depends upon its abiity to adapt to the surrounding environment at the site of its infection,this is called microenvironment. To adapt to this microenvironment, certain morphological, anatomical and physiological changes occur and because of which the parasite survives in the host. Such changes which facilitate a parasite to adapt to parasitic mode of life in the host itself arecalled parasitic adaptations.

To protect from the harmful effects of digestive enzymes , the parasite's body surface iscovered with

Cuticle (Nematodes **–** ***Ascaris lumbricoides***) or

Tegument (Flatworms – ***Taenia solium***).

Tegument of a digenetic trematode

Under light microscopy

-It appears as a generally homogenous layer about 7-16 µm thick.

-The tegument is a **syncytium,** i.e., **a multinucleated tissue with no cell boundaries.**

The outer zone of this syncytium, the **distal cyroplasm** is delineated at its surface by a **plasma membrane** measuring about 10 nm thick.

Associated with the plasma membrane is a surface coat, or **glycocalyx**, that varies in thickness according to species.

-Surface invaginations, the number and extent of which also vary according to species, serve to increase tegumental surface area, much like microvilli on the surface of human intestinal cells.

-The ability of the tegument to absorb exogenous molecules is generally proportional to the number and extent of invaginations and the number of mitochondria in the distal cytoplasm.

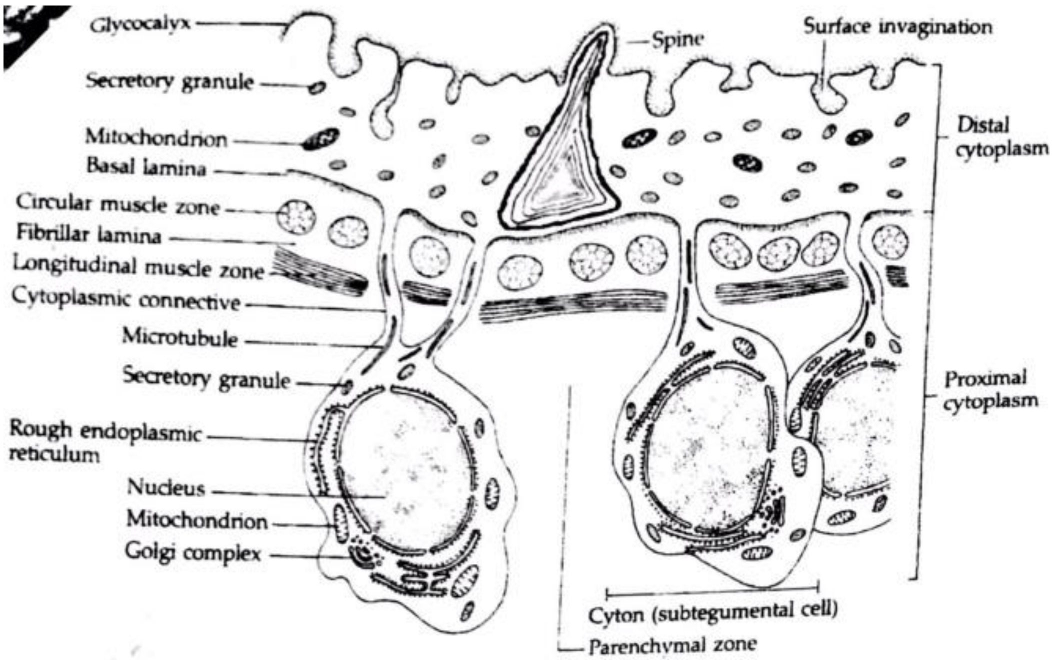
- Hydrolytic enzymatic activity in the glycocalyx facilitates the uptake of certain molecules from the environment.

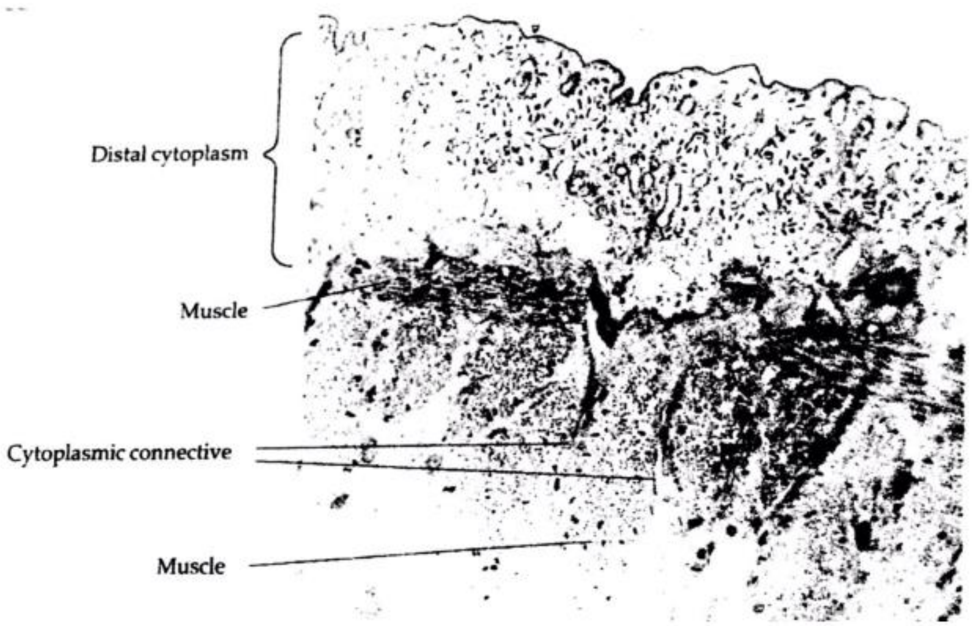
-**The glycocalyx is also a protective structure**, shielding the worm from such hostile environmental influences as antibodies and host digestive enzymes. For example, the presence of acid mucopolysaccharides in the glycocalyx is of particular significance, as such molecules are known to inhibit a number of digestive enzymes.

Their presence on the body surface may account for the ability of intestinal trematodes to resist host digestive enzymes.

Embedded in the distal cytoplasm of some species are **tegumental spines**, with bases lying just above the basal plasma membrane of the distal cytoplasm and tips projecting outward but still covered by the surface membrane. Although the function of these spines has not been firmly established, it is speculated that they may serve as ancillary **hold fast mechanisms** and/or **storage sites for certain essential molecules**. The matrix of the distal cytoplasm also contains one or two types of secretory vesicles.

The distal cytoplasm is connected to the inner, proximal cytoplasm **(cyton region)** by cytoplasmic bridges. The proximal cytoplasm contains nuclei, endoplasmic reticulum, Golgi complexes, glycogen deposits, mitochondria, and various types of vesicles. This region of the tegument is the site where materials for the repair and maintenance of the distal cytoplasm are synthesized. **The vesicles** in the distal cytoplasm are packets of substances produced in the proximal cytoplasm that continually maintain the outer plasma membrane and its glycocalyx and assist in the maintenance of the matrix and spines. The translocation of these vesicles from proximal to distal cytoplasm is facilitated by micro-tubules in the cyton region and in the cytoplasmic bridges.





-Tegument of a digenetic trematode

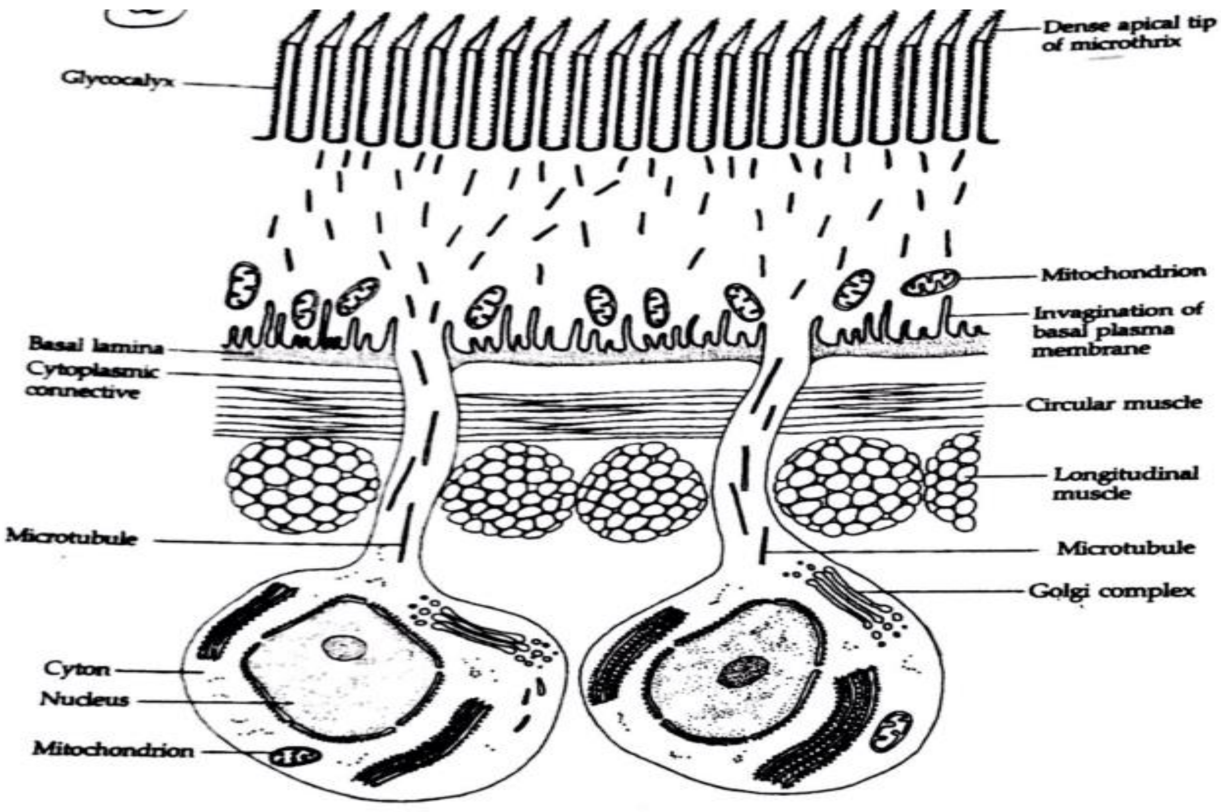
-Transmission electron micrograph of the tegument of a digenetic trematode.

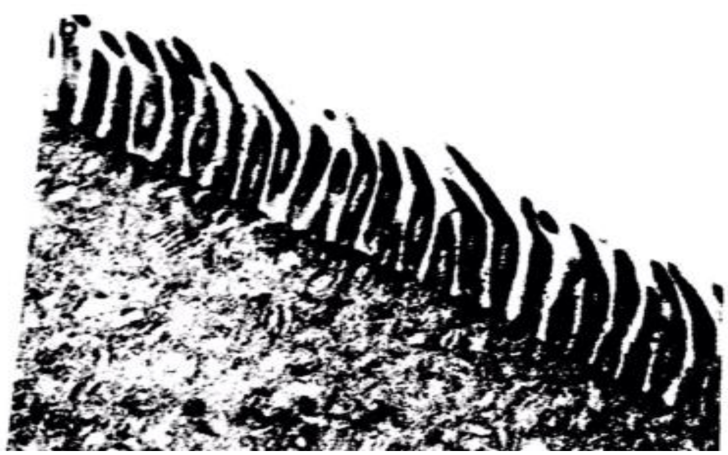
Tegumentof the tapeworms

The tegument of the tape worms is essentially similar to that of digeneans, with a few notable differences. The surface of the tapeworm tegument bears specialized microvilli, known **as microthrices** (singular, microthrix, that project from the outer membrane of the tegument) . The dimensions of these projections vary according to species and location on the strobila. Unlike typical microvilli, each microthrix includes an **electron dense, apical tip** separated from the more basal region by a multilaminar plate. When applied to the hosts intestinal epithelium, these tips provide resistance to the peristaltic movement of the intestine. With each movement of the worm, they also agitate intestinal fluids in the immediate microhabitat, thus increasing accessibility of nutrients and flushing away waste products. Covering the entire surface of the tegument is a layer of carbohydrate-containing macromolecules, the glycocalyx, that serves several important functions, among which are protecting the parasite from host digestive enzymes, enhancing nutrient absorption, and maintaining the parasite's surface membrane.

As in digeneans, the tegumental syncytium of tapeworms consists of two cytoplasmic regions, distal and proximal. The distal cytoplasm is replete with mitochondria (usually aligned in a broad, basal band), as well as several types of vesicles and scattered membranes. Glycogen granules are also present in this region in some species. The vesicles arise in the nucleated, proximal cytoplasm, or cyton , sunk deep in the parenchyma. The cyton contains. Golgin complexes, mitochondria, rough endoplasmic reticulum, and other organelles involved in protein synthesis and packaging. Proteins synthesized in the cyton are translocated via cytoplasmic connectives abetted by microtubules to the distal cytoplasm, where they maintain the glycocalyx, membranes, microthrices, and other structures.

Underlying the distal cytoplasm are two layers of muscles, collectively known as the tegumental musculature, consisting of an outer layer with its contractile fibrils oriented in a circular pattern and an inner layer with contractile fibrils oriented longitudinally.





Tegument of a cestode.

(a) The surface is covered with microthrices, each ending in thickened, spinelike cap. As is usual among parasitic flatworms, the cell bodies are secretory and produce surface coat constituents among other material.

(b) Transmission electron micrograph of the tegumental surface showing microthrices.

Cuticle of nematodes

An elastic cuticle covers the body surface of nematodes.
-The presence of **enzymes** in the cuticle indicates that it is metabolically active, not an inert covering.although the cuticle is generally smooth, various structures such as spines, bristles, Warts, punctuations, papillae, striations, and ridges may be present on it. Some of these specialized structures are sensory, while others aid in locomotion; their arrangement and position are of taxonomic importance.
-The cuticle not only covers the entire external surface, but also lines the buccal cavity, esophagus (pharynx), rectum, cloaca, vagina, and excretory pore.
It consists of four basic layers: **epicuticle, exocuticle, mesocuticle and endocuticle.**

-The epicuticle

Is a relatively thin layer and is a consistent component of all nematode cuticles. Typically, it is trilaminate with a carbohydrate containing glycocalyx. its function is largely unknown, although it is believed to act at least in part as a protect ive barrier.

-The exocuticle

Is usually composed of two distinct sublayers:
a-The relatively homogeneous external exocuticle, with no visible substructure and
b-The radially striated internal exocuticle.

The mesocutide

Is the most diverse of the cuticularlayers. It commonly consists of obliquely oriented, collagenous, fibrous sublayers that vary in number and in angular relationship to each other.
The ability of the mesocuticular fiber sublayers to shift their angles of orientation provides flexibility to the cuticle. In some nematodes, the thickness of the mesocuticle is directly proportional to the age of the worm.

The endocuricle

Is the innermost layer of the cuticle. It is also fibrous, but the orientation of fibers is not as distinct as in the mesocuticle. Often, the pattern is disorganized, with a great deal of overlapping between fibers. A basal lamina separates the cuticle from the underlying hypoder