Leucosolenia: An Asconoid Sponge

Introduction (YOUTUBE)

Phylum Porifera contains the most primitive of multicellular animals, called sponges. They are usually referred to as 'pore bearers', as their body walls contain tiny pores that are basic Structures in their functional activity. The organization of sponges shows certain features to a degree not apparent in any of the other metazoan animal groups. Especially, the cell types and gross morphology are not at all comparable with other Metazoa. This led to Place the sponges in an isolated branch of Melazoa, the Parazoa, whereas all the remaining Phyla of multicellular animals are combined in the branch Eumetazod. Biology of sponges can best be understood by the study of a simple asconoid type. Leucosolenia is one of the simplest asconoid sponges.

Leucosolonia

Leucosolenia (Gt., leukos, white + solen, pipe), as the name implies, has a pipe-like body. It is an asconoid sponge which represents the simplest and most primitive type of structural pattern. It is usually said to be the olynthus type as well, as its body organization resembles the olynthus stage in the ontogeny (developmental history) of certain other sponges, like Scypha.

Systematic Position

Systematic Position (YOUTUBE)

Phylum Porifera
Class Calcarea
Order Homocoela
Genus Leucosolenia

Occurrence

Leucosolenia: occurrence (YOUTUBE)

Leucosolenia is small, delicate, sessile, branching, colonial and marine sponge. It is found growing in shallow water, below low-tide mark, on seashore rocks, boulders and jetties. It does not live in calm water but is found abundantly where wave action is intense. It is very sensitive to external conditions and will die if removed from its habitat. About 100 species occur all over the world. The common species are L. botryoides, L. complicata and L. variabilis.

External Morphology

Leucosolenia: morphology (YOUTUBE)

The colony of Leucosolenia is whitish or yellowish in colour. It consists of radially symmetrical, vaseshaped, vertical, hollow and tube-like individuals or cylinders, united at their bases by irregular horizontal tubes and attached to the substratum through adhesive - discs. The upright individuals or cylinders may reach up to 25 mm in height. The surface of each tube-like individual bears minute pores called ostia (singular, ostium) or incurrent pores. The pores lead into a central spacious cavity, the paragastric cavity or spongocoel (Gr., spongos, sponge + koilos, cavity). it opens to outside through a large circular opening, the osculum, situated at the free terminal end of the tube.

Body Wall (Histology)

Leucosolenia: BodyWall (YOUTUBE)

The thin body wall, which encloses the spongocoel, is relatively simple. It consists of two cellular layers, the outer pinacoderm and inner choanoderm, with a non-cellular mesenchyme in between.
1. Pinacoderm. The body is covered externally by epidermis or pinacoderm. This is a single layer of thin and flat polygonal cells, the pinacocytes (Gt., pinako, plank +kytos, cell). It ensures protection to the internal organization of body.
Pinacocytes are hexagonal in surface view with thin margins and a bulging central part containing a nucleus.
The margins show contractility, so that the sponge can increase or decrease slightly in size.
Within the body wall are special, large and tubular cells, called pore cells or porocytes. They are supposed to be modified pinacocytes. Each porocyte contains a central canal-like space, communicating with the outside as well as the spongocoel. These spaces are called ostia or dermal pores or incurrent pores. These permit water to flow room outside into the spongocoel.

2. Choanoderm.
The spongocoel is lined internally by gastrodermis or choanoderm. It consists of a single layer of flagellated collar cells, the choanocytes (G., choane, funnel + kytos, cell). A choanocyte is an ovoid cell with its free end bearing a transparent contractile collar. It surrounds a single long flagellum which arises from a basal granule or kinetosome. The nucleus lies at the base or apex of its cell body. Protoplasmic processes of the cell body are embedded in the mesoglea. Choanocytes are used in feeding and water within the animal's body for ensuring the flow of water within the animal’s body by beating of their flagella.

3.Mesenchyme.
In between pinacoderm and choanoderm is present non-cellular mesenchyme.

It is secreted by both body layers. It consists of a gelatinous matrix of protein, also called mesoglea. It contains several types of freely wandering amoeba-like cells or amoebocytes, and minute skeletal elements of CaCO3, called spicules or sclerites.

(a) Amoebocytes.

Amoebocytes are of many types depending upon the shape of their pseudopodia and function. Large-sized primary amoebocytes with blunt pseudopodium and large nucleus are the archaeocytes. These contain much RNA and they carry all the functions essential for the life of sponge. They are self-replicating and also capable of giving rise to all other types of amoebocytes (totipotent). Scleroblasts are skeleton forming amoebocytes. They are called calcoblasts as they form calcareous spicules. Thesocytes are with rounded pseudopodia and have reserve food material. Chromocytes carry colour pigments and are responsible for colour of sponge. Gland cells secrete slime. Cells with thin branching pseudopodia are collencytes forming a sort of con- nective tissue and probably nerve cells. Myocytes are contractile thin cells, present around osculum and work as a sphincter.

(a) Spicules.

These skeletal elements, small or large, are formed of crystalline calcium carbonate Needle-like spicules are monaxons contain while some are tetraxons with four rays. Some the tetraxons secondarily become triradiate due to the loss of one ray. Spicules remain embedded within giving mesenchyme, though many of them protrude rocytes through pinacoderm and impart roughness to the arming sponge's body surface. All spicules orient in the same direction.

Canal system

ostia spingocoel and osculum together form a canal system which is characteristic of all sponges. Canal system of Leucosolenia is of ascon type. It is the simplest type of canal system found in sponges. Water enters directly through ostia into the central spongocoel, which is lined by choanocytes, and leaves through osculum.

PHYSIOLOGY

Leucosolenia: physiology (YOUTUBE)

1. Locomotion and behaviour. Leucosolenia

is incapable of locomotion. It is supposed to possess local contractile powers that appear to be mostly restricted to the region of osculum. Reactions to stimuli are very slow and responses are seen several minutes after the application of stimulus.

2. Water current. Vital life processes of a sponge are dependent upon a continuous uninterrupted flow of water through its porous body. This is essential because they are sessile and have no other means of getting food and oxygen or getting rid of wastes. Water current is caused by constant

beating of flagella of millions of choanocytes. Water enters spongocoel through ostia and exits through osculum. Flow of water is controlled by the closing and opening of ostia.
Flow of water through a sponge can be demonstrated by adding carmine particles to water containing a living sponge. These particles are seen to enter body of sponge through ostia and pass out through osculum. The water current brings food and oxygen and removes excretory as well as reproductive elements.

3. Digestion. Food consists chiefly of plankton, i.e., microscopic animals and plants and organic particles. Choanocytes capture and digest the food. Amoebocytes receive the partly digested food particles from choanocytes, complete digestion and distribute the digested food from cell to cell by diffusion. Amoebocytes digest food intracellularly within their food vacuoles. The reaction of food vacuoles is at first acidic and later alkaline. Undigested residue is eliminated by the amoebocytes into spongocoel.

4. Respiration: Respiration, involving exchange of O_2 from sea water and CO_2 produced within the living cells, is accomplished by diffusion.

5. Excretion. Elimination of metabolic wastes (cheifly NHs) also takes place by diffusion through the general surface of body.

Reproduction and Development

Leucosolenia: Reproduction and Development (YOUTUBE)
Leucosolenia: Reproduction and Development Asexual (YOUTUBE)

Leucosolenia reproduces asexually as well as sexually.

1. Asexual reproduction. Leucosolenia reproduces asexually by branching and budding.

(a) Branching. New horizontal branches arise from stolon, grow over rocks, and give rise to new erect vase-shaped cylinders. When an upright branch or cylinder attains sufficient size, its top breaks through as an osculum.
Regeneration is also common and a complete individual or colony will grow from almost any broken piece of sponge.
(b) Budding. This is accomplished by evagination of body wall near the base of a vertical tube in the form of a bud. The bud grows in size and breaks off an osculum at its free end, thus becoming an additional individual of colony.
This may again bud off new individuals.

2. Sexual reproduction.

Leucosolenia is monoecious, i.e., male and female reproductive cells or gametes are formed in the same individual. No special gonads are formed. Sperm and ova are derived from archaeocytes by

gametogenesis. Sperms are released into sea water and they make their way into another sponge to a region of a mature ovum. Some workers believe that sperms are transported to mature ova by amoebocytes.

3. Development.

Ovum is fertilized by a sperm within maternal body wall forming a diploid zygote. The zygote undergoes equal and holoblastic cleavage developing into a hollow blastula, called coeloblastula. Its wall consists of a single layer of narrow, elongated, columnar and flagellated cells. At the posterior pole of larva occurs a group of large, rounded, granular, non-flagellated cells. These are believed to be archaeocytes which form all future archaeocytes and reproductive cells of sponge. These granular cells later wander into the cavity of embryo. Some of the adjacent flagellate cells also lose their flagella, become amoeboid and pass into the internal cavity. The larva now reaches a stage corresponding to the planula larva of coelenterates. It is termed stereogastrula or parenchymula and consists of an external layer of flagellated cells and an inner mass of amoeboid cells. It has no mouth opening. Parenchymula swims freely for some hours. Then it becomes fixed by its anterior pole and develops into a flat plate with an irregular outline. Most of the amoeboid cells migrate to external surface, passing between flagellated cells, and form the pinacoderm and mesenchyme. Flagellated cells, thus enclosed, become the choanocytes. A central cavity or spongocoel appears which increases in size, becomes lined by choanocytes and opens to outside by an osculum. Certain non-flagellated cells in the wall of sponge, or porocytes, become perforated to form in current pores or ostia. Monaxon and triradiate spicules are secreted by the scleroblasts of modified amoeboid cells. Within a few days of its attachment, the larva is converted into the adult asconoid sponge.

Question

» Long Answer Type Questions

1. Give an account of the structure, physiology and reproduction of an asconoid sponge studied by you.
2. Describe, with suitable diagrams, the development of Leucosolenia.
3. Draw a labelled diagram of the L.S. of Leucosolenia
4. What are sponges? Describe the cellular organization of Leucosolenia.
5. Briefly describe the structure and life history of Leucosolenia.
6. Write short notes on (i) Choanoderm, (il) Coeloblastula, (fi) Osculum, (iv) Ostia, (V) Parenchymula, (vi) Pinacoderm.

» Short Answer Type Questions

1. What is amoebocyte found in mesenchyme of Leucosolenia? Write its various forms and their functions.
2. Describe the ascon type of sponge.
3. What is a choanocyte? Relate its structure to its function.
4. Describe the various histological elements found in Leucosolenta.
5. Give the structure of pinacoderm in Leucosolenia.
6. Give the structure of choanoderm in Leucosolenia.
7. Describe the development and structure of parenchymula larva in Leucosolenia.

» Multiple Choice Questions

1. Leucosolenia is
   (a) fresh water colonial sponge (b) marine and solitary
   (c) solitary (d) colonial and firmly attached to the substratum

2. Leucosolenia is
   (a) sessile (b) marine
   (c) colonial (d) all of these

3. Which is not known to occur in Leucosolenia
   (a) respiration (b) egestion
   (c) asexual reproduction (d) locornotion

4. The free-swimming larva of Leucosolenia is
   (a) stomoblastula (b) amphiblastula
   (c) stereoparenchymula (d) olynthus stage

5. Which type of canal system is found in Leucosolenia?
   (a) ascon (b) rhagon
   (c) leucon (d) syconoid

6. In sponges food is ingested by
   (a) scleroblasts (b) choanocytes
   (c) porocytes (d) pinacocytes

7. Digestion of food in Leucosolenia takes place:
   (a) in the spongocoel (b) in the amoebocytes
   (c) in the choanocytes (d) first in choanocytes and then in the amoebocytes

8. The internal skeleton of Leucosolenia is formed of calcareous:

(a) monaxon (single-rayed) spicules
(b)monaxon and tri-radite (three-rayed) spicules
(c) tri-radiate and quadri-radiate (four-rayed) spicules
(d) monaxon, tri-radiate and quadri-radiate spicules

9. The principal cell types present in the body wall of Leucosolenia are the:
(a) pinacocytes, porocytes, choanocytes, amoebocytes
(b) pinacocytes, choanocytes, amoebocytes, nephrocytes
(c) choanocytes, nerve cells, amoebocytes, nephrocytes
(d) choanocytes, porocytes, nephrocytes, amoebocytes

10. The common bath sponge is
(a) Leucosolenia (b) Euspongia
(c) Sycon (d) Spongilla

11. Gametes in Leucosolenia are derived from
(a) archaeocytes (b) choanocytes
(c) porocytes (d) amoebocytes

12. Spicules of Leucosolenia origin from:
(a) calcoblast (b) thesocyte
(c) trophocyte (d) archeocyte

13. Nutrition in Leucosolenia is
(a) intracellular (b) extracellular
(c) both (d) none

14. The chief excretory product of Leucosolenia
(a) ammonia (b) urea
(c) uric acid (d) none

15. In Leucosolenia the sperm and ova develop from
(a) monocyte (b) amoebocyte
(c) archaeocyte (d) gland cells

16. Young stage of Leucosolenia is
(a) coeloblastula (b) parenchymula
(c) olynthus (d) stomoblastula

ANSWER

1.(d) 2. (d) 3. (d) 4. (c.) 5. (a) 6. (b) 7. (c) 8. (d) 9. (a) 10. (b) 11. (a) 12. (a) 13. (a) 14. (a) 15. (c) 16. (C)