

External Secretory Structure

These include glandular trichomes, nectary, osmophores, hydathodes and salt glands, of which hydathodes and salt glands.

Glandular Trichomes:

- These trichomes consist of a stalk with a head above. The stalk may be unicellular or multicellular and in the latter case the cells may be arranged in several rows. The head is the secretory part and may be composed of single cell (ex. *Pelargonium*) or many cells (e.g. *Callitriche*). The head is covered with a cuticle. The secretion is accumulated beneath the cuticle.
- This type is exemplified by the volatile oils like camphors, balsams, peppermint oil, resins etc. Trichomes may also secrete nectar (ex. stipules of *Vicia sepium*) and water (ex. leaves of *Hygrophila*). Several of the secretions of the glandular trichomes have role in plant defense. Some are repellent to insects. The glandular hairs of tomato and wild potato (*Solanum berthaultii*) provide resistance to aphids.
- These trichomes secrete sticky exudates that trap the aphids. Plant breeders are now trying to raise a hybrid of cultivated potato that possesses these useful aphid-trapping glandular hairs.

The glandular trichomes of insectivorous plants have specialized functions:

- (i) They secrete mucilage that is effective in trapping insects;
- (ii) They contain proteolytic enzymes;
- (iii) They have absorptive functions, i.e. the products of digestion move into the leaf through them.

Nectary:

- Nectary can be defined as a gland or part of a flower that secretes nectar to the exterior of plants. They are divided into floral and extra floral nectaries. The former is situated within the flower and is directly involved in pollination; the latter occurs on the vegetative organs and is not directly associated with pollination. The nectaries are present on the epidermis.
- They may be deeply sunken, or raised above over an outgrowth, or at the level of the organ that bears them. The tissues that compose the nectary are commonly known as nectariferous tissues. These tissues may not form any anatomically differentiated

structure – termed non-structural nectaries (e.g. on leaves of *Dracaena reflexa*, in bracts of *Sansevieria zeylanica*, on tepals of *Cattleya percivaliana* etc.).

- In some cases it is difficult to distinguish the non-structural nectaries from the surrounding tissues. The histochemical test reveals that the parenchyma cells composing the nonstructural nectaries have a high acid phosphatase activity like the anatomically differentiated ones. The nectariferous tissues may form anatomically differentiated structure termed structural nectaries, which are macroscopically recognizable also.
- It consists of stalk cells and secretory cells with cuticle. The cells of the nectary are specialized parenchyma cells that are small, thin walled and contain dense cytoplasm, dictyosomes, endoplasmic reticulum, small vacuoles and large nuclei (Fig. 11.1). The nectaries may be provided with special vascular tissues. The nectar is supplied by phloem and it accumulates between the cuticle and secretory cells.
- The nectar of non-structural nectaries is exuded through stomata. Nectar, in structural nectaries, is secreted by epidermal cells or trichomes directly to the outside. The nectar contains glucose, sucrose and fructose as major components. The followings are also recorded in the nectar of different plant species: maltose, melobiose, mucilage, proteins, phosphates, mineral ions, organic acids, oxidases, sucrose, vitamins etc.
- The non-enzymatic proteins are detected in the floral nectary of *jmijmnmjmik* etc. The lipids are reported from Jacaranda, Trichocereus etc. The nectar also contains all the essential aminoacids, which with their smell attract some of the anthophilous insects. It is suggested that nectar provides the amino acid requirements for the insects. The cells of nectaries may absorb the sugary fluid. So they possess both secretory and absorptive properties.
- The extra floral nectaries are very common in dicotyledonous and much less in monocotyledonous plants. It rarely occurs in Poaceae (e.g. *Andropogon* and *Eragrostis*). In dicots it is present on all organs, namely —in the cotyledons (e.g. *Ricinus communis*), on leaf margins (e.g. *Rosa*, *Populus* etc.), on phyllodes (e.g. *Acacia longifolia*), on pulvinus (e.g. *Thunbergia grandiflora*), on stipules (ex. *Vicia fava*) etc.

Osmophores:

- Osmophores can be defined as certain special areas on floral organs, which differ in structure from the neighbouring cells and have the fragrance producing properties to attract pollinators.

- The fragrance of a flower is due to volatile low molecular weight terpenes. ‘The fragrant materials are not exuded by the glandular trichome. This substance occurs as droplets in the cytoplasm of epidermal cells. The oil droplets of terpenes, at an appropriate temperature diffuse out of the cell in gaseous form through the cell wall and cuticles.
- As a result the fragrance is produced. In many plants certain localized cells are only involved in producing the fragrant materials. The cells differ markedly from the other normal cells situated nearby and are termed as osmophores. The osmophores secrete terpenes as the main fragrant materials. In some species belonging to Araceae the fragrant substance may contain amines and ammonia in addition to terpenes.
- The osmophores appear as flaps, cilia or brushes; they can be stained with neutral red and thus can be identified from the neighbouring cells. Osmophores are present in Asclepiadaceae, Araceae, Orchidaceae, Aristolochiaceae and Liliaceae.
- The osmophores of *Ceropegia* (Fig. 11.2) consists of an epidermal layer and two rows of isodiametric cells situated below the epidermis. The epidermis contains dense cytoplasm and the isodiametric cells are filled with starch grains. The starch disappears after the emission of fragrant materials.

Internal Secretory Structure:

- The internal secretory structures may be composed of a single cell or groups of cells. They may occur throughout a tissue (e.g. oils or enzymes) or may be localized in distribution.
- Example: castor oil obtained from the endosperm of *Ricinus*; ground nut oil extracted from the cotyledons of *Arachis*; the source of palm oil is the mesocarp of the fruit of *Elaeis guineensis*; the seed of *Carthamus tinctorius* yields safflower oil etc. Sometimes resin or oil secreting idioblasts are formed, e.g. oleo-resin cells are present in the ground tissue of the rhizome of *Zingiber officinale*, the oil cells secreting the aromatic oil occur in the phloem of *Cinnamomum zeylanicum*.

Glands and Ducts:

- They comprise a group of cells or sometimes a single cell that is readily distinguishable from the neighbouring cells and secretes a specific substance. These cells are thin walled with dense protoplasm and sometimes occur as layer surrounding a cavity, known as secretory cavity.

- The secretion is discharged and accumulates within the internal cavity. These cavities may be more or less spherical or much elongated like tubes and respectively termed as glands or ducts.

The internal cavities originate by three ways and accordingly the following three types of glands are recognized:

(i) Schizogenous glands:

These are formed by the dissolution of middle lamella, thus separating apart the cells to form cavity. Example: oil glands of Eucalyptus, the secretory ducts of *Rhus glabra*, resin duct of *Pinus* etc. This cavity remains surrounded by a ring of intact parenchyma cells, termed epithelium, which forms a well-defined boundary of the gland.

(ii) Lysigenous glands:

These glands originate by lysis of a few cells thus forming the cavity (ex. glands present in the leaves and fruits of *Citrus* sp., that are also formed schizogenously).

(iii) Schizolysigenous glands:

These glands arise by both phenomenon schizogeny and lysis, i.e. the middle lamella and some of the adjoining cells disintegrate to form cavity. Example: *Eugenia caryophyllata* where the glands are present in the floral parts that are the source of oil of clove. In contrast to schizogenous gland the lysigenous and schizolysigenous gland have no clear-cut boundary.

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