Golgi Complex: Structure and Functions

In this article we will discuss about Golgi Complex that exist in all the cells of eukaryotes:- 1. Subject-Matter of Golgi Complex 2. Structure of Golgi Complex 3. Functions.

Subject-Matter of Golgi Complex:

This cytoplasmic organelle is named after its discoverer Golgi. The structure was discovered in 1898. The golgi bodies are also called lipochondria. For several years there was considerable disagreement about the existence of that organelle. Most of the early biologists believed that it was an artifact of fixation or staining procedures.

Studies with phase contrast microscopes in the early 1940s also indicated the existence of golgi bodies. The study of electron micrographs of thin sections of cells in 1950s finally proved beyond doubt the existence of golgi bodies in all the cells of eukaryotes (Fig. 6.1). The golgi apparatus does not exist in the prokaryotes.

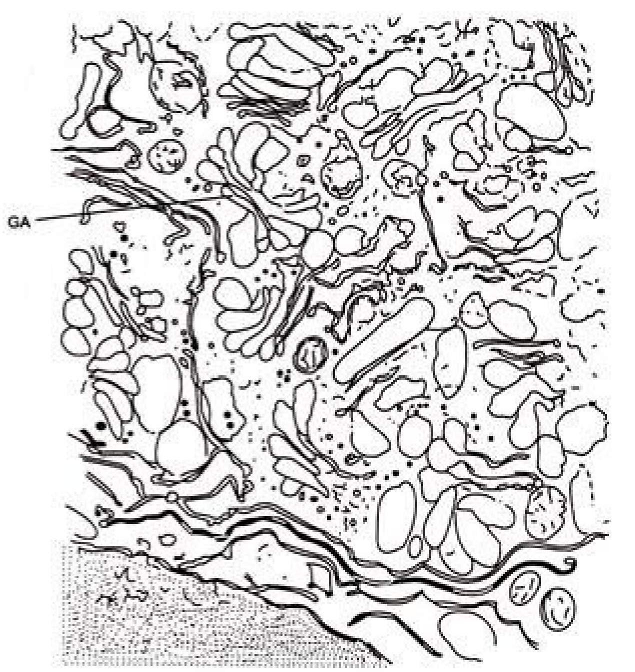

Fig. 6.1 Electron micrography of root cell of maize showing golgi bodies (GA) in ground plasm.

Structure of Golgi Complex:

The electron microscopic studies have revealed that this organelle consists of series of compactly grouped smooth contoured membrane limited vesicles of variable shapes and dimensions and variable number of small vacuoles (Fig. 6.2).

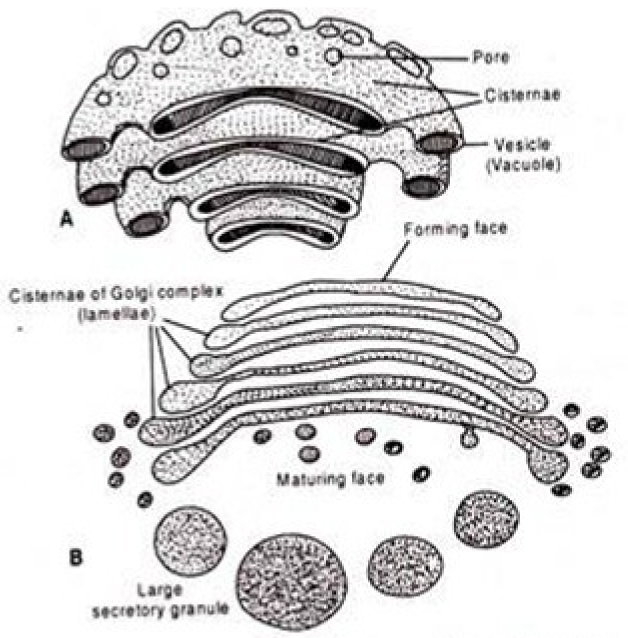

Fig. 6.2 Golgi body: A. Dictyosome, B. Dictyosome and secretory vesicles.

They are selectively stained with Neutral red stain and differ from mitochondria in staining property because they do not take Janus green stain (special stain for mitochondria). When the cytoplasm is centrifuged the mitochondria settle down first and golgi bodies afterwards.

This indicates that the golgi bodies are lighter than the mitochondria. The presence of golgi bodies in plant cells has been denied by some early cytologists, but the electron micrographs in recent years have revealed that these bodies are of universal occurrence in both plant and animal cells.

The vesicles of golgi bodies are chiefly of two types:

1. Small and spherical vesicles.

2. Broad flattened vesicles in parallel or often in semi-circular array, the cisternae (Singular— cisterna) (Fig. 6.3).

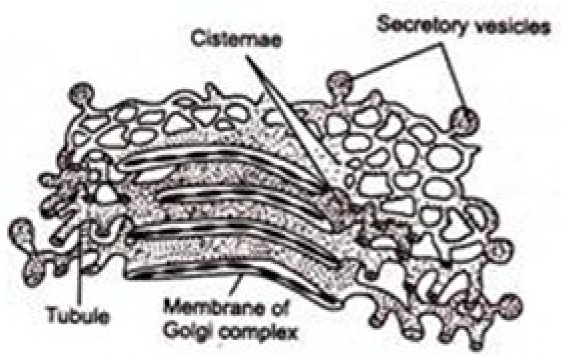

Fig. 6.3 Golgi body (ultrastructure) showing cisternae in the centre and small secretory vesicles on the surface.

The cisternae are characterized by their dilated edges. They are compactly arranged in parallel fashion. The stack of flattened cisternae or saccules is known as 'dictyosome'. The dictyosome has a polarity; its convex side forming the outer faces and concave side forming the inner face. The cisternae on the outer face are very flat and thin whereas those on the inner face or concave side are comparatively much dilated and thick.

The cisternae on the outer face react only with silver salt and osmic acid while those on the inner face do not react with silver salt and osmic acid. Thus the outer and inner faces are accordingly known as osmic or argentophilic and non-osmic or argentophobic.

The number of vesicles per dictyosome varies presumably because of different functional stages of golgi complex. The unit membrane of these cisternae is about 35 å thick, smooth surfaced, and not associated with ribosome granules.

On its outer surface the dictyosome is often bounded by canaliculae or cisternae of endoplasmic reticulum. Numerous spherical vesicles found in the vicinity of dictyosome are budded off by the cisternae at their ends. Palade (1956-58) has shown that the golgi bodies originate from smooth surfaced endoplasmic reticulum (Fig. 6.3).

The smaller vesicles are aggregated around, the stacks of cisternae. These are also bounded by membranes. The central space of vesicle is very clear but frequently it becomes condensed and appears as small granule.

Functions of Golgi Complex:

The golgi apparatuses are of usual occurrence in the secretory cells where they are involved in secretory process. In plant cells these bodies secrete mucoproteins, slime, mucilage, lipoproteins and other proteinaceous substances. Besides they also synthesize hemicelluloses and pectic group of polysaccharides especially during cell division.

In non-secretory cells the golgi apparatus is assigned some other functions. The dictyosomes release substances in the form of tiny vesicles budded from the saccules on the inner face. These vesicles having limiting membrane of their own fuse together to form secretion granules of ever increasing sizes.

These granules are generally transported to the cell boundary where their membranes fuse with plasma membrane and finally their contents are discharged out of cell by ectocytosis (Fig. 6.4).

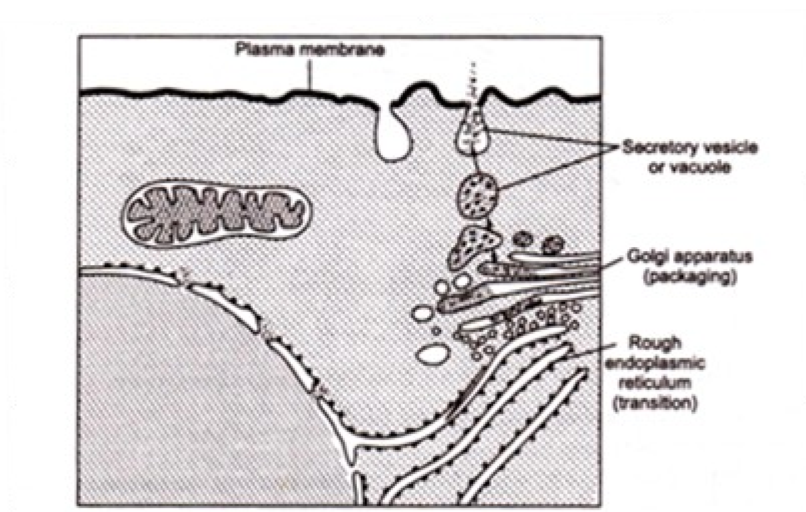

Fig. 6.4 Relation between the endoplasmic reticulum and a dictyosome *via* transition elements.

Some proteins synthesized in granular endoplasmic reticulum, particularly those which need to be coupled in varying proportions with polysaccharides to form muco or glucoproteins, pass through the cavities of the reticulum into the dictyosomes and from there they are discharged as secretion granules.

This transfer of proteins appears to take place through small vesicles budded from smooth cistemae of endoplasmic reticulum in the vicinity of dictyosomes. The loss of membranes due to the budding of vesicles on the inner face of the dictyosomes appears to be compensated by contribution of vesicles by the smooth surfaced endoplasmic reticulum on the outer face.

This indicates that new saccules are formed on the outer face of dictyosomes while the internal saccules break up into secretion vesicles.

This hypothesis is supported by the following observations:
(i) The number of saccules in dictyosome changes according to the physiological condition. (ii) The number decreases in starving cells and they completely disappear in enucleated cells.

The membranes of cisternae offer surfaces for enzymatic activities. Sometimes, the vesicles act as a system of channels collecting intracellular metabolites and fluids.