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Plant Prevacuolar Compartments and Endocytosis

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Abstract Prevacuolar compartments (PVCs) are membrane-bound organelles mediating protein traffic from both Golgi and plasma membrane to vacuoles in eukaryotic cells. Recent studies demonstrate that PVCs in plant cells are multivesicular bodies (MVBs) that merge secretory and endocytic pathways leading to the lytic vacuole, a compartment thought to be equivalent to the mammalian lysosome or the yeast vacuole. In this review, we discuss recent studies on the identity, molecular components and functional roles of plant PVCs and examine whether the plant PVC can also be claimed to be equivalent to the endosome/MVB of mammalian and yeast cells.

1 Introduction

Eukaryotic cells have a secretory pathway which is composed of several functionally distinct membrane compartments. At the same time, eukaryotes have the ability to internalize a variety of macromolecules by endocytosis, a process also involving membrane-bound organelles each with characteristic proteins. Prevacuolar compartments/late endosomes are an organelle where secretory and endocytic traffic to the lytic/vacuolar compartment merge. On the basis of precedents from mammalian and yeast cells, prevacuolar compartments (PVCs) are intermediate organelles on the biosynthetic route to the vacuole and receive cargo delivered by the *trans-Golgi* network (TGN)-derived transport vesicles (Lemmon and Traub 2000; Maxfield and McGraw 2004). Due to the lower pH in the PVC the cargo ligands dissociate from their receptors, and the receptors and missorted proteins are then returned to the Golgi apparatus for another round of cycling (Robinson et al. 2000).

Receptor-ligand complexes internalized at the plasma membrane travel through several endosomal compartments before being deposited in the lysosome/vacuole. These compartments characteristically have internal vesicles, hence the term "multivesicular endosomes or bodies" (MVB). These microvesicles appear to originate in the early or recycling endosomes (Parton et al. 1992), and have a different composition to the limiting membrane

(Griffiths et al. 1990; Kobayashi et al. 1998). Their formation is related to receptor down-regulation (Katzmann et al. 2002), and involves ubiquitinylation as a means of tagging those membrane proteins destined for degradation (Reggiori and Pelham 2001). The microvesicles and the soluble content of the MVBs are most likely delivered into the interior of the lytic compartment via direct fusion (Luzio et al. 2000; Katzmann et al. 2002).

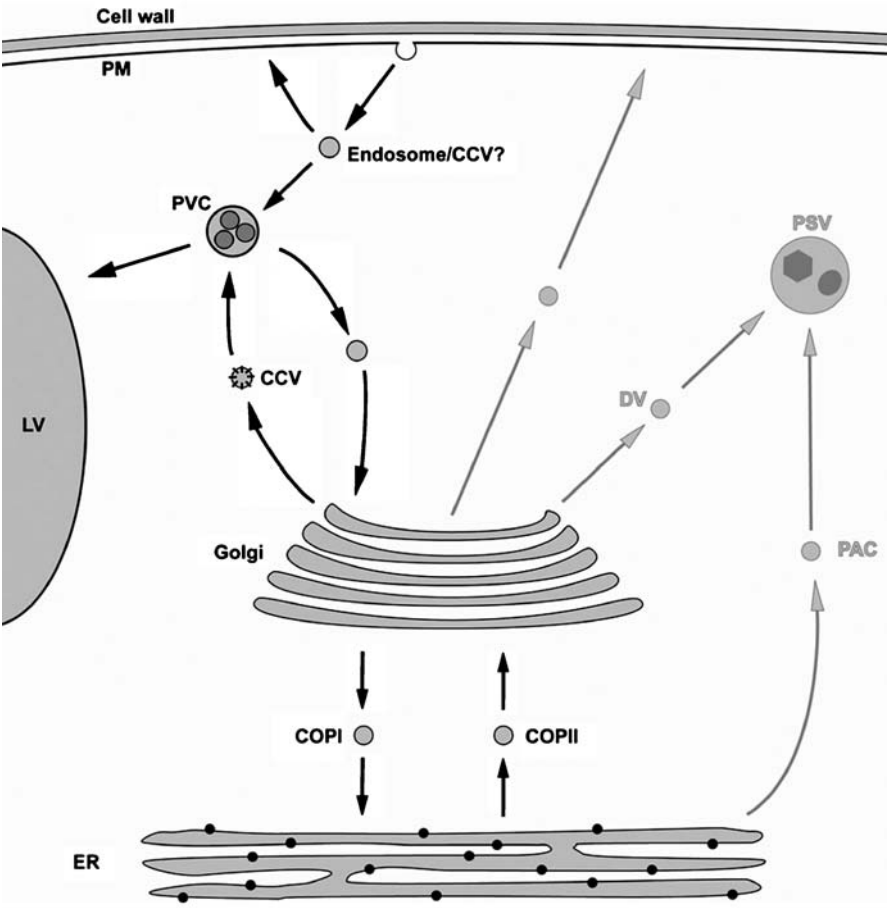

Fig. 1 Working model of protein trafficking in the plant secretory and endocytic pathways. Pathways leading to the lytic vacuole (LV) from either the Golgi or plasma membrane (PM) via a prevacuolar compartment (PVC) are thought to be mediated by clathrin-coated vesicles (CCVs) and are similar to those in mammalian and yeast cells (Jiang and Rogers 2003). In seeds, storage proteins reach protein storage vacuole (PSV) either via a Golgi-dependent pathway that is mediated by dense vesicle (DV) in pea cotyledon (Robinson et al. 1998), or via a Golgi-independent route that is mediated by precursor accumulating (PAC) vesicle in pumpkin seeds (Hara-Nishimura et al. 1998)