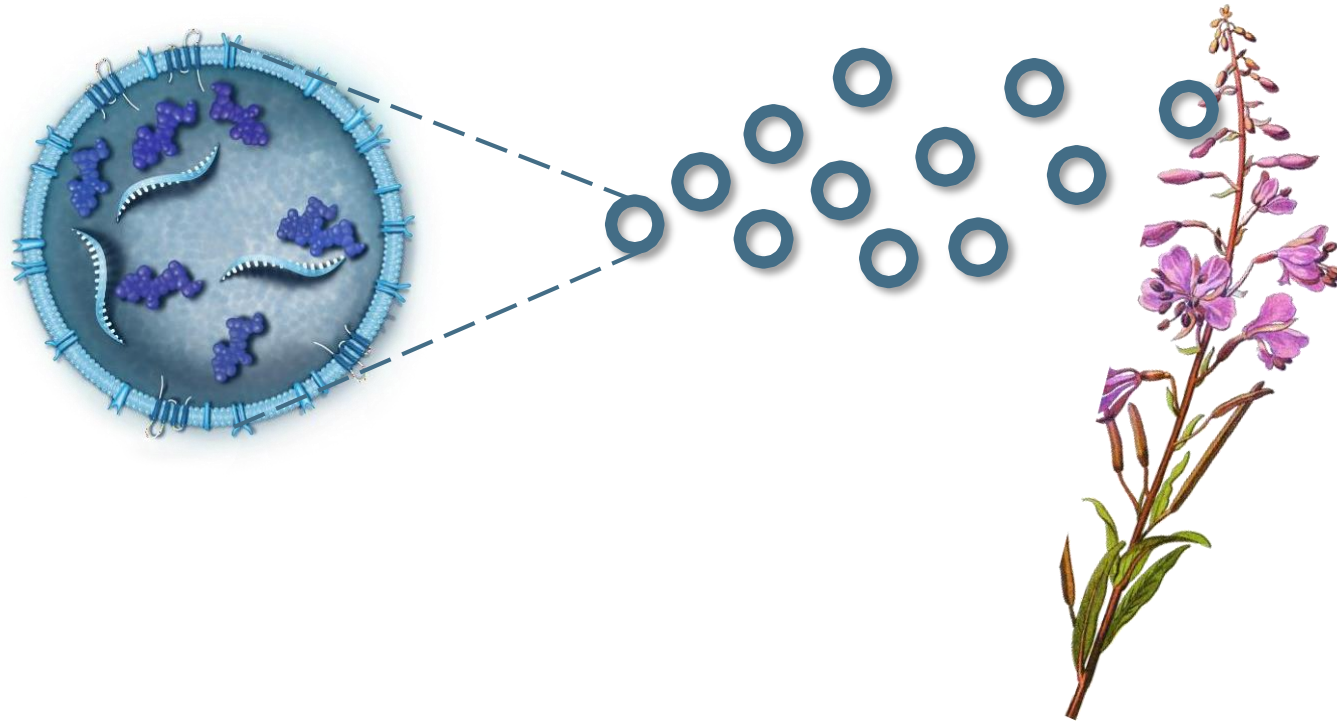


# PLANT-DERIVED EXOSOME



# Plant-Exosome

Plant derived *extracellular vesicles* materials development

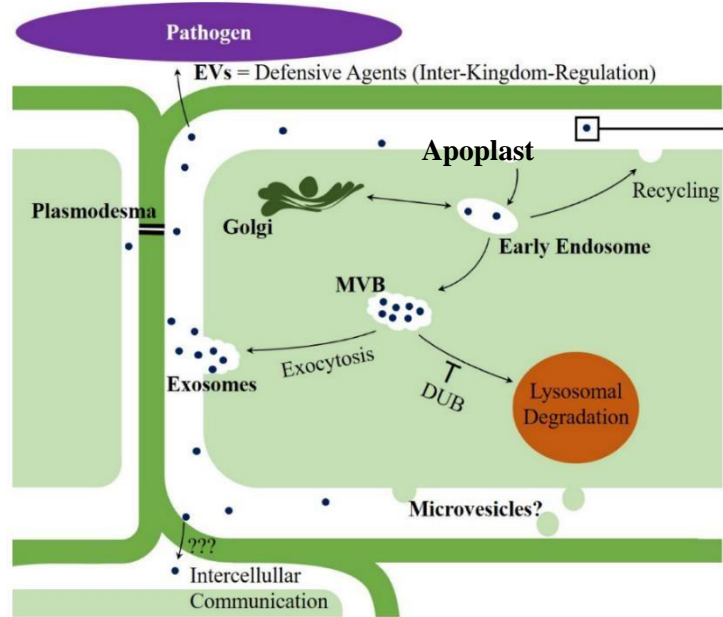


# What is plant-derived exosome

It is produced in the multivesicular body (MVB) within the cytoplasm and secreted into the apoplast, the space between the cell membrane and the cell wall. This process is involved in plant defense against pathogens, cell wall construction, and intercellular communication. Temporarily, cell wall remodeling enzymes are secreted to pass through the cell wall, and these enzymes have been discovered in exosomes

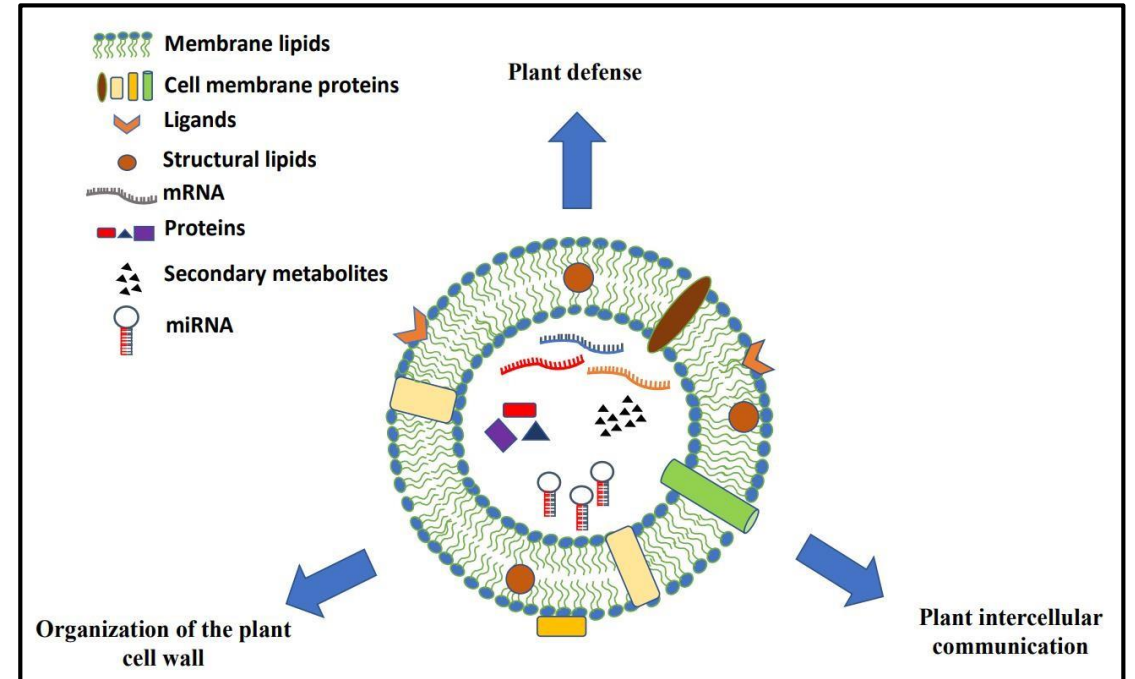
Ref. Eric Woith., et al., Extracellular vesicles-Connecting kingdoms., *Int. J. Mol. Sci.*, **2019**, 2, 5695.

[Plant-derived exosome formation process]



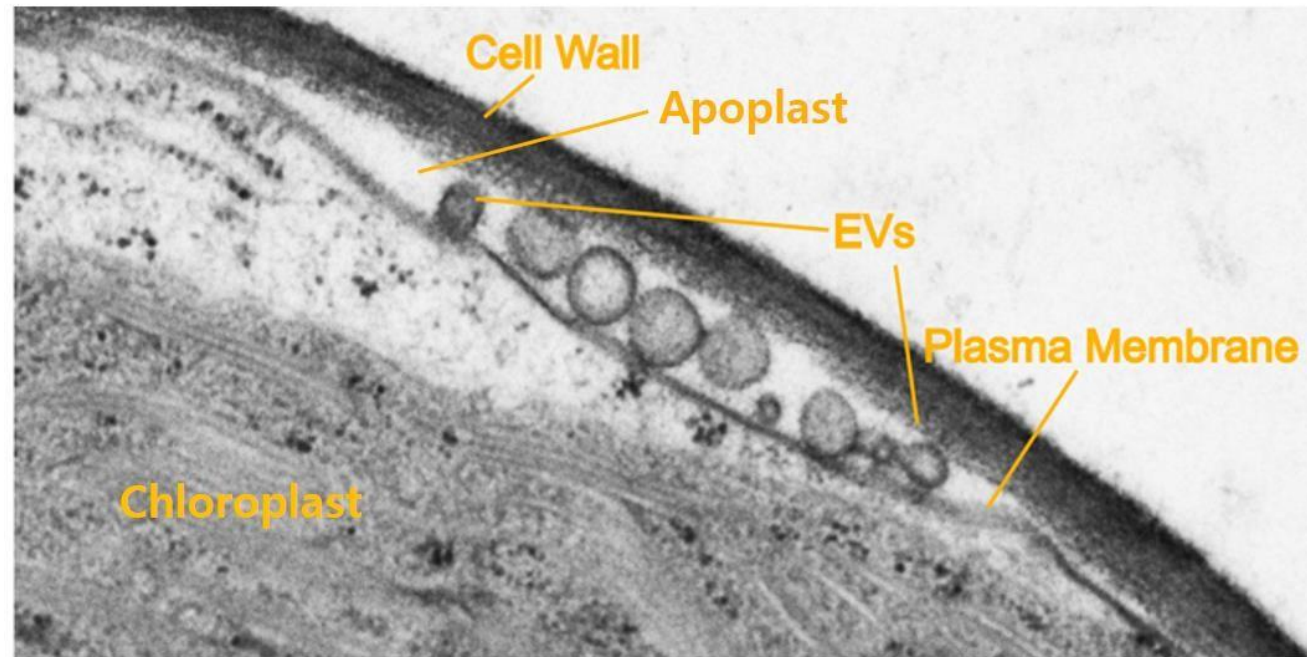
Ref. Eric Woith, et al., Plant Extracellular Vesicles and Nanovesicles: Focus on Secondary Metabolites, Proteins and Lipids with Perspectives on Their Potential and Sources., *Int. J. Mol. Sci.*, **2021**, 22(7), 3719.

[Plant-derived exosome components]



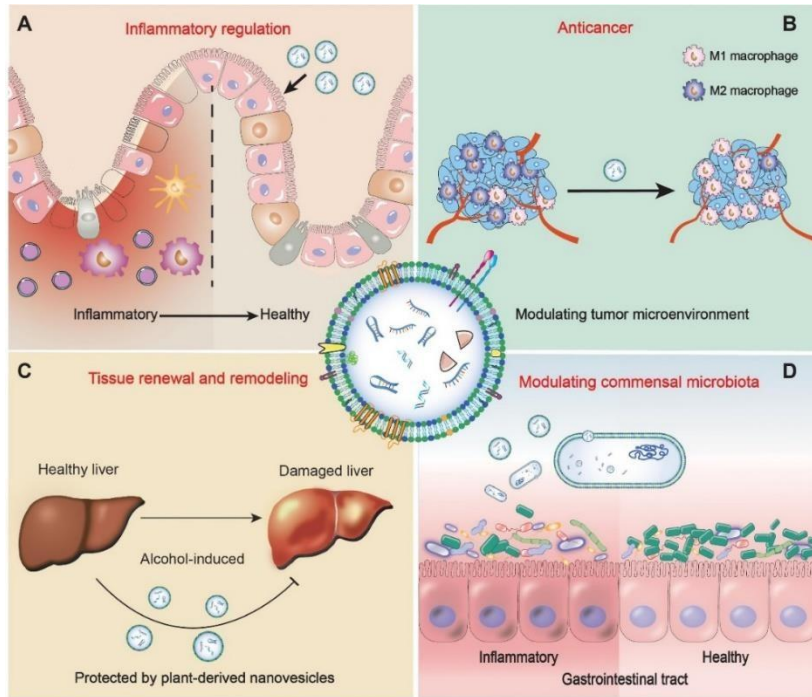
Ref. Mariaevelina Alfieri., et al. Plant-Derived Nano and Microvesicles for Human Health and Therapeutic Potential in Nanomedicine., *Pharmaceutics.*, **2021**, 13(4), 498.

Plant-derived exosomes are secreted into the apoplast, which is a free space formed by the cell membrane and cell wall in plants, playing a crucial role in the movement of nutrients and water. These exosomes can be visualized using electron microscopy (TEM), providing detailed images of their structure.



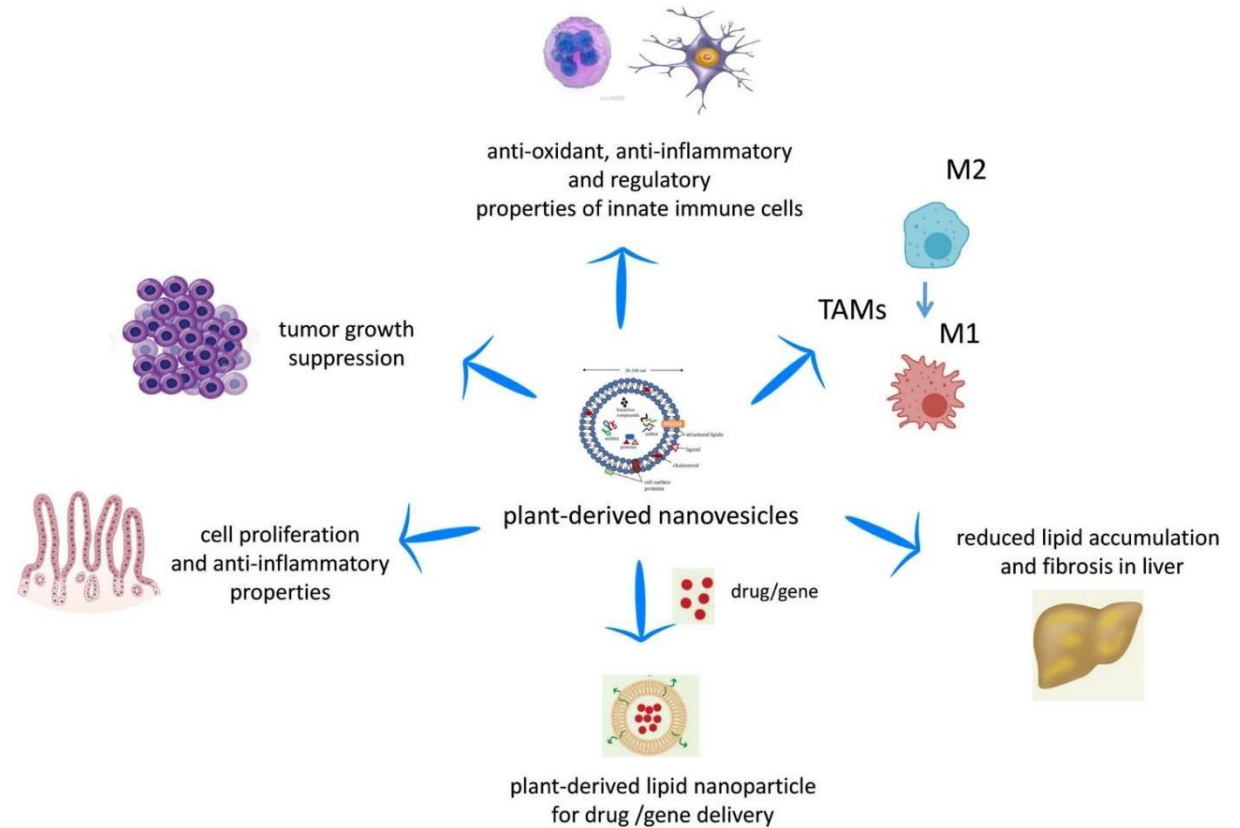
Ref. Linda Palmer, Plant Cells Shed Membrane-Bound Bubbles that Are Packed with Tiny RNA Molecules., *The plant cell*, 2019  
<https://plantae.org/plant-cells-shed-membrane-bound-bubbles-that-are-packed-with-tiny-rna-molecules/>

## Physiological functions of plant-derived exosomes



Ref. Lanlan Yu, et al., Plant-Derived Nanovesicles: A Novel Form of Nanomedicine., *Front. Bioeng. Biotechnol.*, 2020., 8:584391.

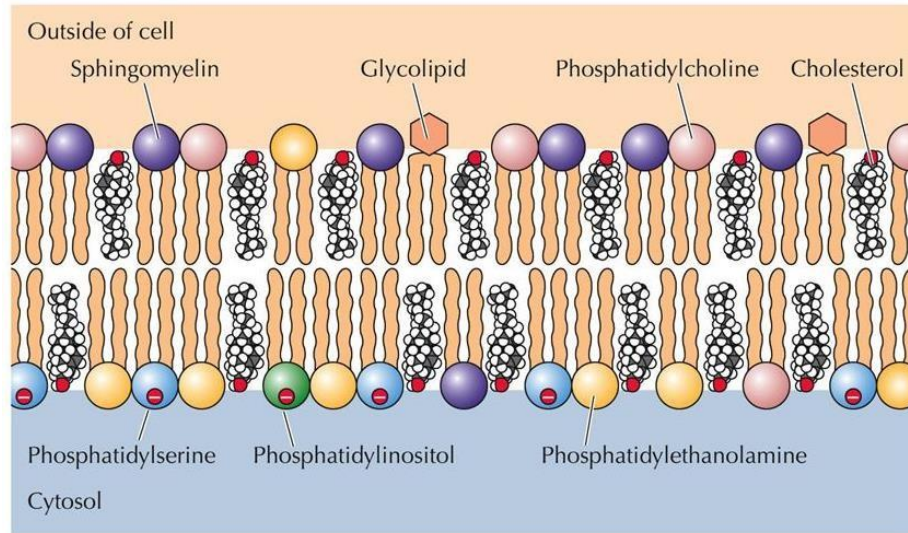
Plant-derived exosomes exhibit a variety of functions, including promoting cell proliferation, regulating inflammation, exerting anticancer and antioxidant effects, modulating the immune system, aiding tissue regeneration, and managing intestinal flora. Notably, these exosomes can serve as drug carriers without causing side effects, and they are currently the focus of numerous studies.



Ref. Sophie Rome., Biological properties of plant-derived extracellular vesicles., *Food Funct.*, 2019,10(2):529-538.



## Plant-specific, lipid composition and function



Ref. THE CELL, Fourth Edition, Figure 13.2

### 1. Grapes

1). **Phosphatidic Acid (PA)**: Acts as a cell proliferation and survival signal via the mTOR pathway. Involved in cell transformation, tumor progression, and differentiation.

### 2. Grapefruit

1). **Phosphatidylethanolamine**: Abundant in the mitochondrial inner membrane, plays roles in membrane fusion and contractile functions during cytoplasmic division.

2). **Phosphatidylcholine**: The most common phospholipid in lipids and mammalian membranes, essential for forming a strong bilayer and necessary for normal cell cycle progression.

### 3. Sunflower Seeds

1). **Phosphatidylinositol**: Located on the cytoplasmic side of the plasma membrane, it plays a role in creating and maintaining polarized membrane domains.

### 4. Ginger

1). **Digalactosyldiacylglycerol (DGDG)**: Involved in thylakoid production during chloroplast biogenesis in plants, with antioxidant and anti-inflammatory effects on Caco-2 (colon cancer cell line) cells.

2). **Monogalactosyl Monoacyl Glycerol (MGDG)**: Exhibits anti-inflammatory activity in cultured articular chondrocytes, prevents cell proliferation without affecting cell

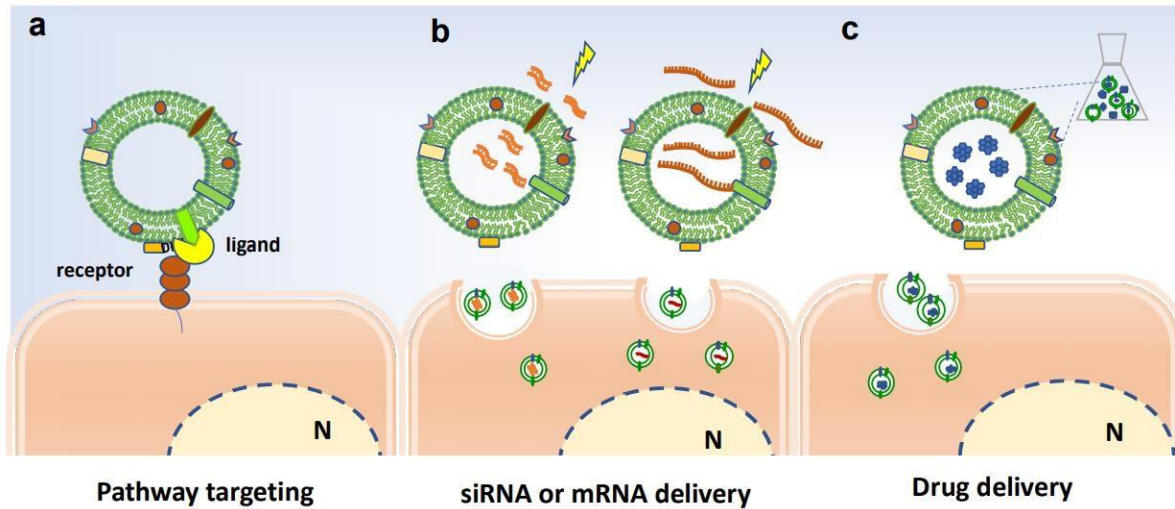
### 5. Shogaol

Anti-cancer, antioxidant, antibacterial, anti-inflammatory and anti-allergic effect

Ref. Sophie Rome., Biological properties of plant-derived extracellular vesicles., *Food Funct.*, 2019,10(2):529-538.

## Role and Advantages of Plant-Exosome

### ▪ Role of Plant-Exosome



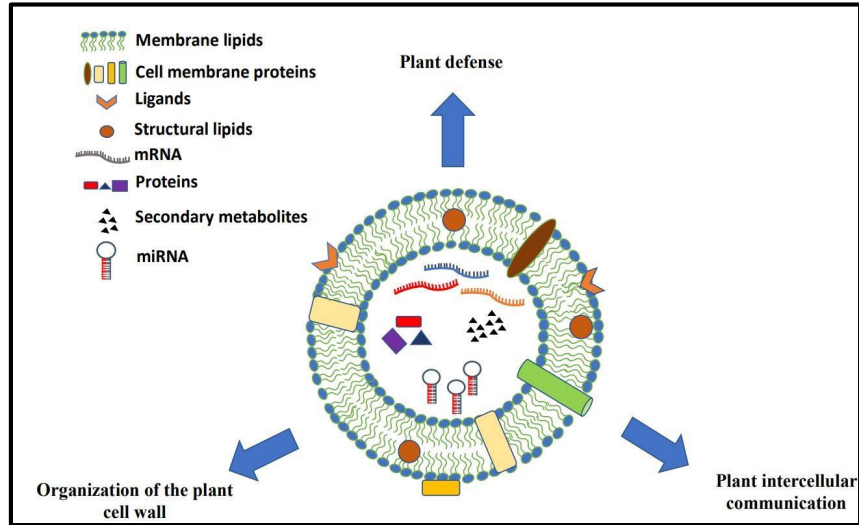
Ref. Mariaevelina Alfieri, et al., Plant-Derived Nano and Microvesicles for Human Health and Therapeutic Potential in Nanomedicine., *Pharmaceutics* **2021**, 13(4), 498.

### Advantages of Plant-Exosome

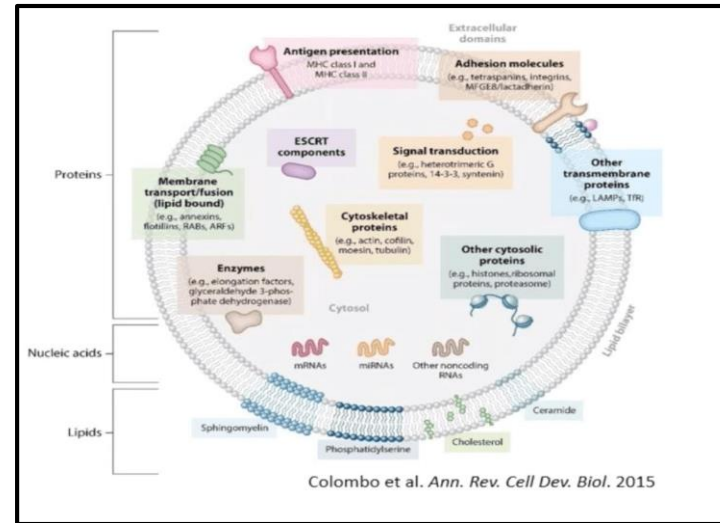
- Capable of crossing cell membranes and having biocompatibility with mammalian cells.
- Compared to synthetic nanomaterials, it does not induce an immune or inflammatory response in normal host cells.
- Does not cause toxicity, immunogenicity, or allergy problems.
- Can deliver anticancer or antioxidant factors to tumor cells, acting as carriers.

## Comparison of plant and animal-derived exosomes

### Plant cell derived Exosome



### Mammalian cell derived Exosome



Ref. Mariaevelina Alfieri., Plant-Derived Nano and Microvesicles for Human Health and Therapeutic Potential in Nanomedicine., *Pharmaceutics* **2021**, 13(4), 498

- ✓ Components within a large category such as mRNA, miRNA, Proteins, and Lipid are similar.
- ✓ However, there is a difference in the number of lipid components and proteins in detail.
- ✓ Plant-derived exosomes: Lipid composition and high amount (compared to animal cells)
- ✓ Animal-derived exosomes: Contains a large amount of protein component and quantity

There is a difference in the composition of lipids according to each plant and the functions acting on animal cells, so that the physiological activity effect of the lipid is higher than the protein component in the plant exosome