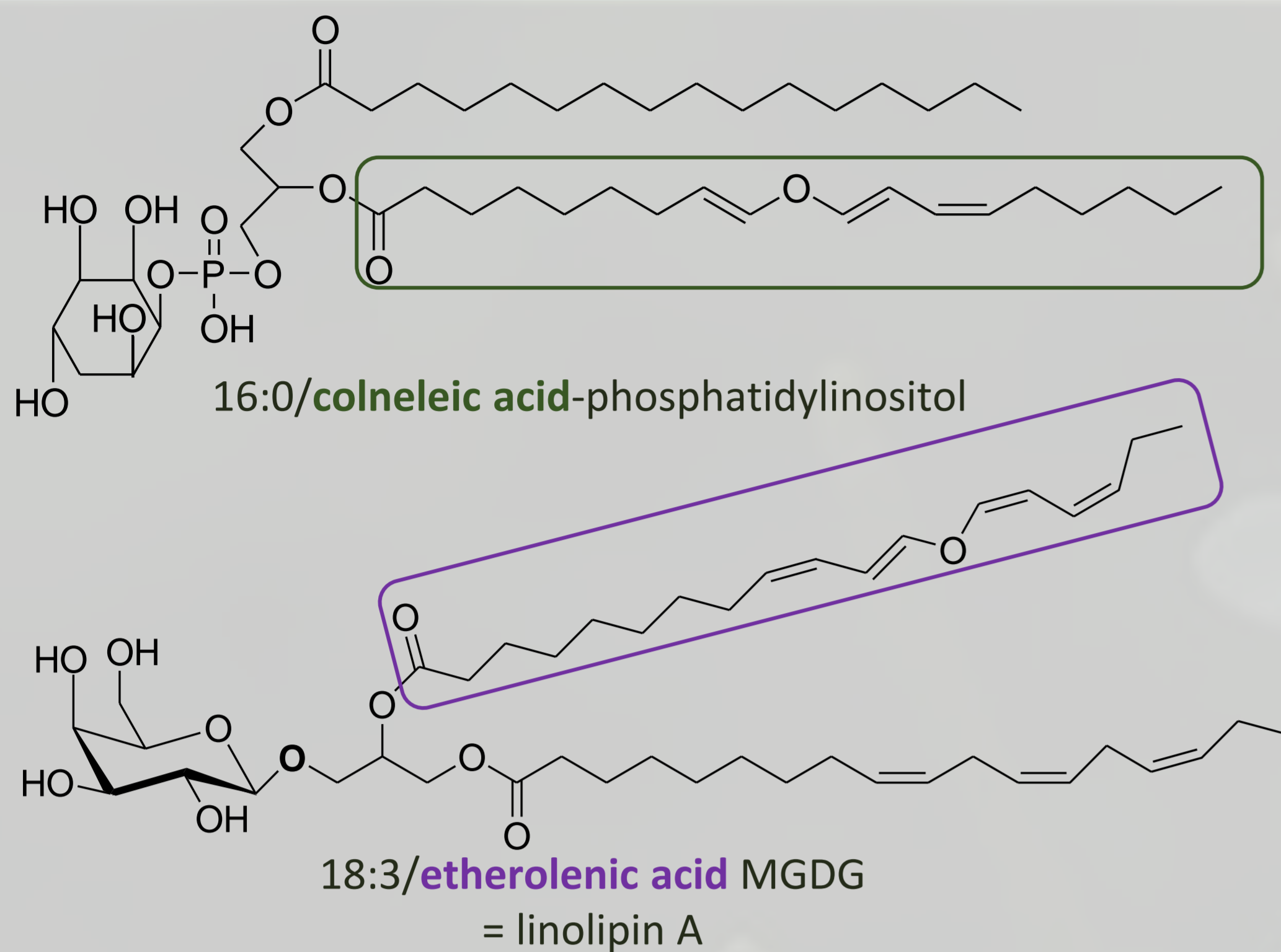


Unravelling the functions of esterified oxylipins in plant stress responses

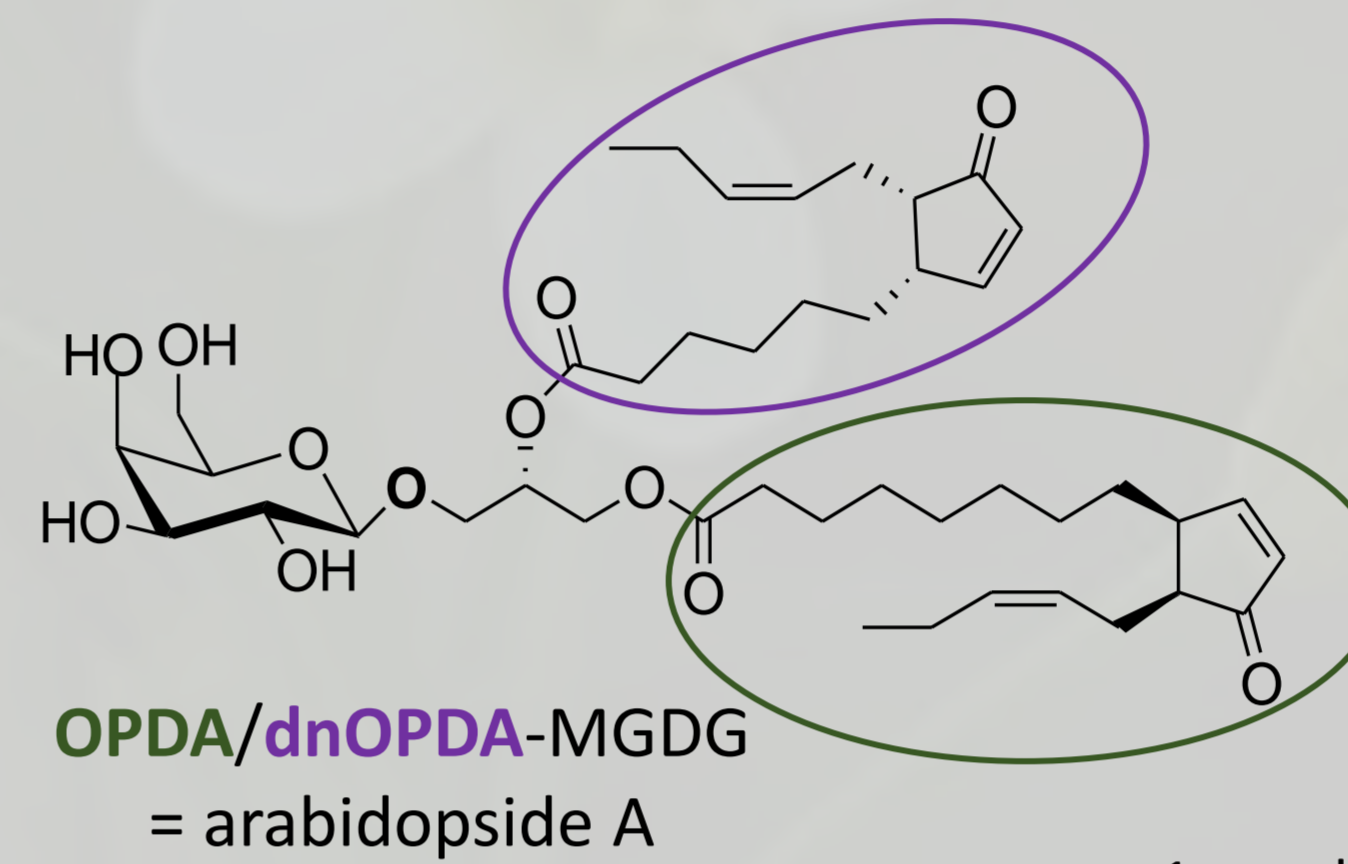
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Structure and occurrence of esterified oxylipins



Oxylipins are molecules deriving from lipid oxidation. While the most well-known oxylipins result from the oxidation of free fatty acids released from lipids, oxidation can also occur directly on their fatty acyl chains. This forms esterified oxylipins like arabidopsides, which are galactolipids containing precursors of jasmonic acid as acyl chains, (dinor)-12-oxo-phytodienoic acid ((dn)OPDA). Other esterified oxylipins notably include divinyl ethers in galactolipids (linolipins) and in phospholipids.



Plant species containing arabidopsides, stress mentioned if applicable

Plant species	Family
<i>Arabidopsis arenosa</i> ¹	
<i>A. halleri</i> ¹	
<i>A. lyrata</i> ²	
<i>A. petraea</i> ¹	
<i>A. suecica</i> ²	
<i>A. lasiocarpa</i> ²	
<i>A. thaliana</i> ^{1,2} and others	Brassicaceae
<i>A. pendula</i> ¹	
<i>Nasturtium officinale</i> ^{2,3}	
<i>Camelina microcarpa</i> ¹	
<i>Capsella rubella</i> ¹	
<i>Erucastrum canariense</i>	
<i>Neslia paniculata</i> ^{1,3}	
<i>Olimarabidopsis pumila</i> ²	
<i>Melissa officinalis</i>	Lamiaceae
<i>Cirsium averse</i> ⁴	Asteraceae
<i>Ipomea tricolor</i>	Convolvulaceae
<i>Camellia tetraccoca</i> ⁵	Theaceae
<i>Vigna radiata</i> ⁵	Fabaceae

1: mechanical wounding, 2: wounding by freeze-thawing, 3: CuCl₂ elicitation, 4: infection by foliar endophyte, 5: insect attack

While esterified oxylipins were thought to be rare, it is becoming clear that they are in fact diverse and abundant. For instance, arabidopsides have been found in numerous plants from Brassicaceae and other plant families, in various stress contexts. This suggests that they may be more ubiquitous than expected, and thus that they may have physiological functions in plants.

Esterified oxylipins in plant stress responses: the case of arabidopsides

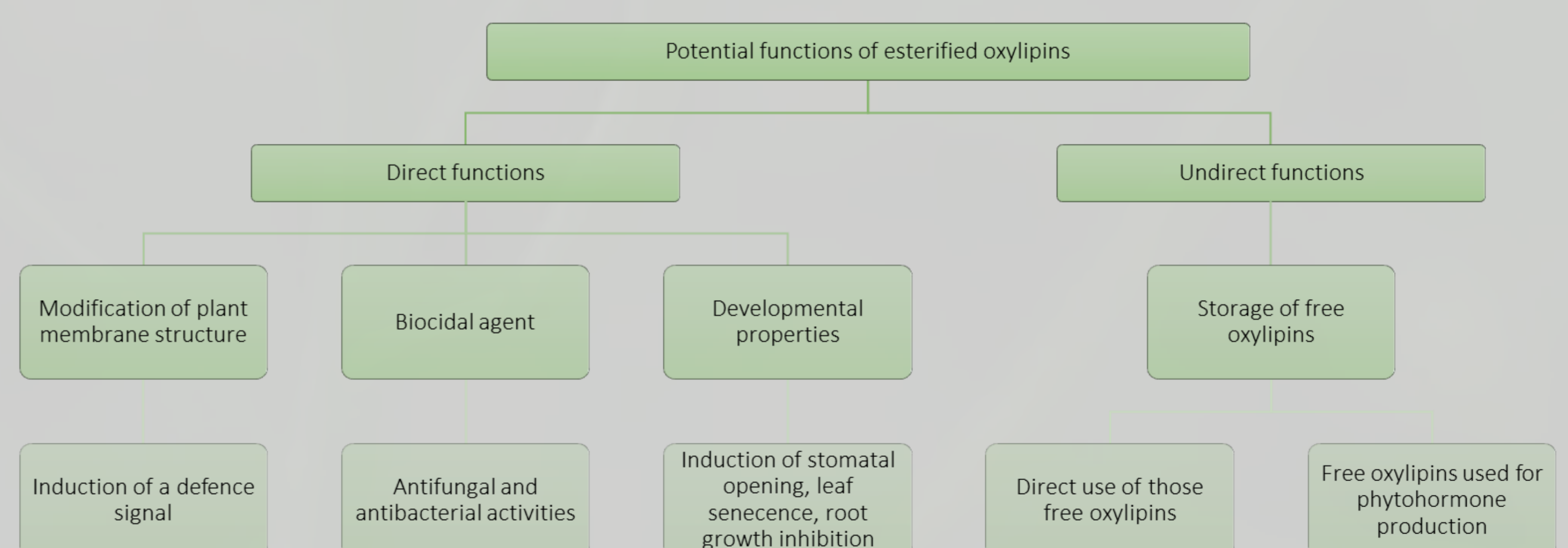
Various stress conditions have been discovered to induce the production of arabidopsides: mechanical wounding, wounding by freeze-thawing, bacterial infection by Pst DC3000 AvrRpt2, expression of AvrRpt2 and AvrRpm1, cold treatment and heat stress. Most recently, phosphate deficiency was also shown to induce the production of arabidopsides.

Because arabidopsides are produced upon various stresses, they have been suggested to play roles in plant stress responses but their mode of action remains unclear. Here, biophysics experiments highlighted that arabidopsides may act by interacting with thylakoid membranes and modifying their organisation.

Conclusion and perspectives

While esterified oxylipins are increasingly found in plants from different species in various conditions, their precise functions still need to be clarified. Among the proposed hypotheses, they could play either direct or indirect roles in plants. To unravel their functions, it is essential not only to target plant species producing them, but also to subject these plants to specific stresses and to analyse them at proper time points following stress induction.

There are therefore a number of avenues that should be explored to fully understand the benefits for plants of producing esterified oxylipins.



References

Genva M., & al. Phytochem Rev (2019) Zhang N., & al. Agronomy (2023)
Hu T., & al. Front. Plant Sci (2018) Chen Y-J., & al. EEB (2023)
Yang W., & al. Molecular Plant (2012)

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