Plant oxylipins: structure-function relationships

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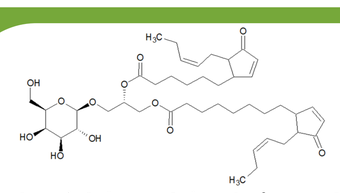
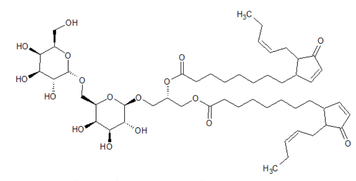
Context and objectives

Plant oxylipins produced by the oxidation of unsaturated fatty acids play important roles in plant metabolism and protection against pathogens. Recently, it has been discovered that *Arabidopsis thaliana* L. produces high quantities of oxylipins esterified to galactolipids under stress conditions. Those molecules, called arabidopsides, are produced following oxidation of monogalactosylglycerol and digalactosylglycerol found in thylakoid membranes. Moreover, arabidopsides pattern is different depending on the nature of the stress, suggesting an involvement of those molecules in plant protection responses.

The first part of this work consists in evaluating arabidopsides' abilities to interact with plant plasma membrane lipids by bioinformatics modelling methods. Indeed, after plant cell wounding, arabidopsides could be released and interact with those lipids. As this interaction was confirmed, a method will be developed to purify arabidopsides from plant.



Arabidopside A (ara A)



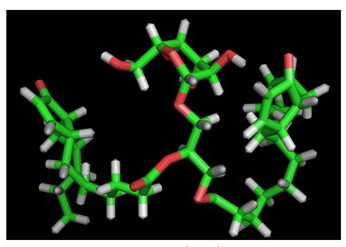
Arabidopside D (ara D)

Are arabidopsides able to interact with plant plasma membrane lipids ?

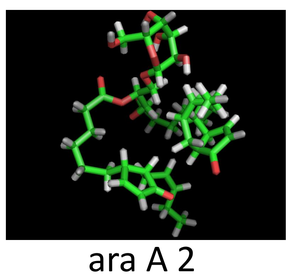
Determination of arabidopside 3D structures

3D structures are generated by an informatic tool called "**structure tree**". It calculates lowest energy structure(s) of biomolecules based on torsion axis.

- Arabidopside A

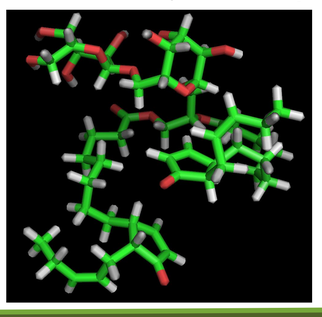


ara A 1



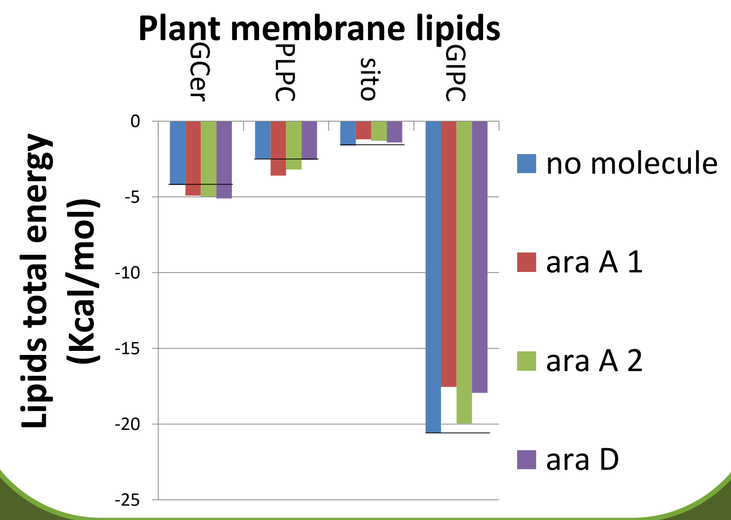
ara A 2

- Arabidopside D (ara D)



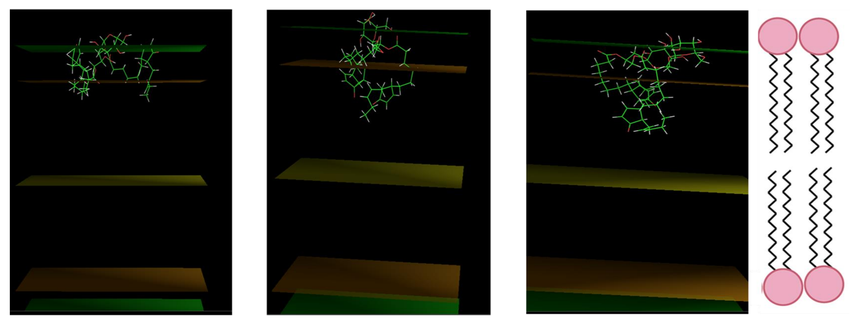
Arabidopside affinity with plant membrane lipids

The docking method **Hypermatrix** is used to surround a biomolecule positioned at an hydrophobic/hydrophilic interface by lipids. It calculates interaction energies and more stable lipid positions are chosen. This method allows to compare molecule interactions with different lipids.

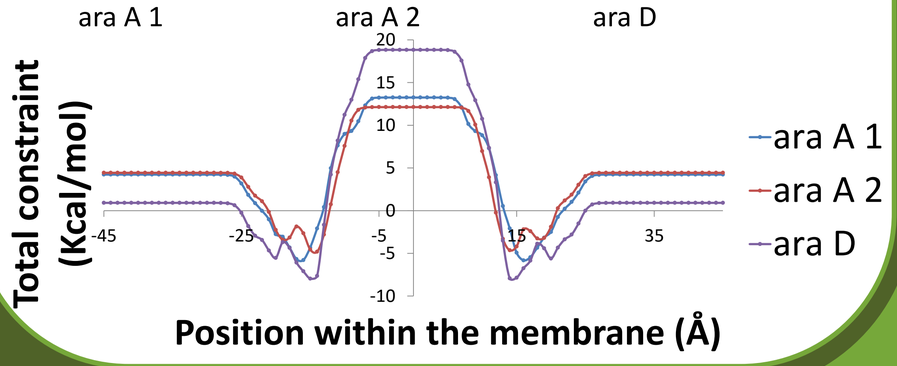


Arabidopside abilities to insert within a membrane

The method **impala** simulates the insertion of molecules in a DPPC implicit membrane. Hydrophobic effects and lipidic perturbations are summed up to obtain the total constraint.

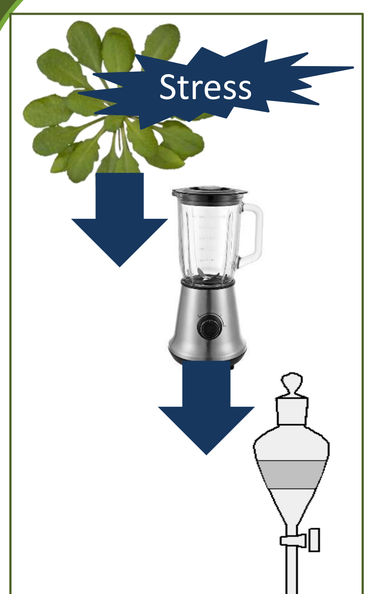


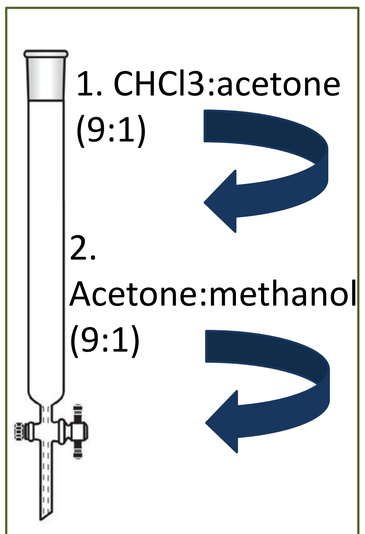
ara A 1 ara A 2 ara D



Is it possible to extract and purify high quantity of arabidopsides?

Methods





1. Apolar lipids
2. Glycolipids

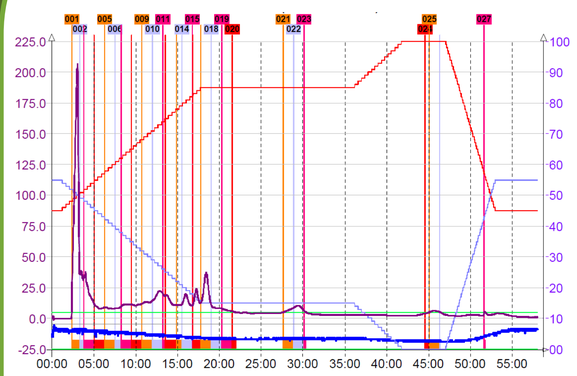
Preparative HPLC purification
-C18 column
-Acetonitril:water gradient
-UV detection

Molecules characterization

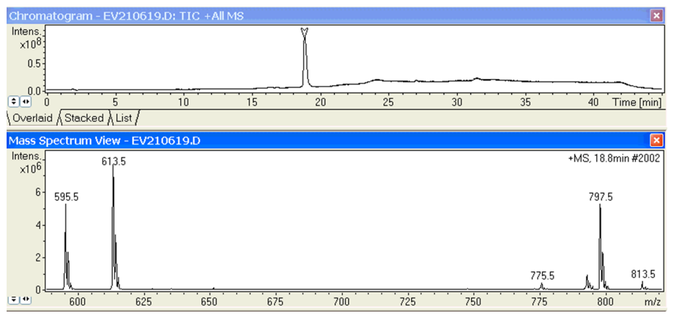
- NMR
- Mass spectrometry
- UV-visible spectroscopy

Results

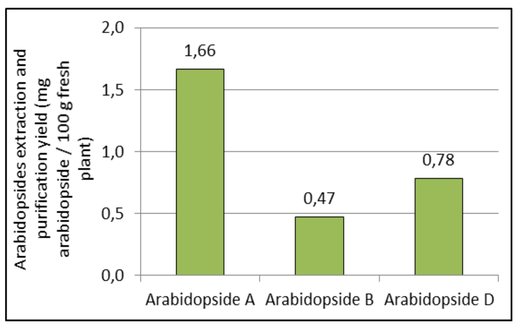
Preparative HPLC



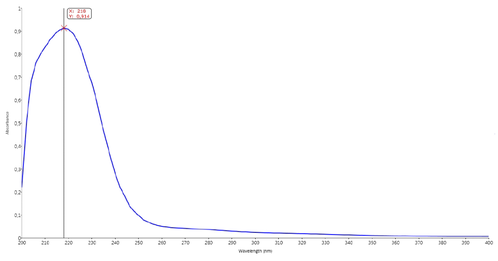
HPLC-MS



Extraction and Purification Yield



UV-visible spectroscopy



Conclusion

In this study, we showed that arabidopsides can possibly interact with plant membrane lipids and penetrate in a membrane. Consequently, after plant cell wounding, arabidopsides could be released and interact with plant membrane lipids. Such interaction could be a signal for defense mechanisms activation. Otherwise, we showed that arabidopsides can be easily extracted and purified from stressed *Arabidopsis thaliana* L. As a perspective, it could be interesting to study *in-vitro* the interaction of arabidopsides with models of membranes by biophysical methods.

Literature

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For further informations

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