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# "ARNICA OF PROVENCE": AN ALTERNATIVE TO ARNICA MONTANA L.? INVESTIGATIONS ABOUT POLYPHENOLIC COMPOSITION AND ANTIOXIDANT POTENTIAL



A. montana

P. montanum

Clémentine ACHARD-BACCATI, Charifat SAÏD HASSANE, Elnur GARAYEV & Béatrice BAGHDIKIAN

Aix Marseille Univ, CNRS 7263, IRD 237, Avignon Université, IMBE, 27 bd Jean Moulin, Service of Pharmacognosy and Ethnopharmacology, Faculty of Pharmacy, 13385 Marseille, France

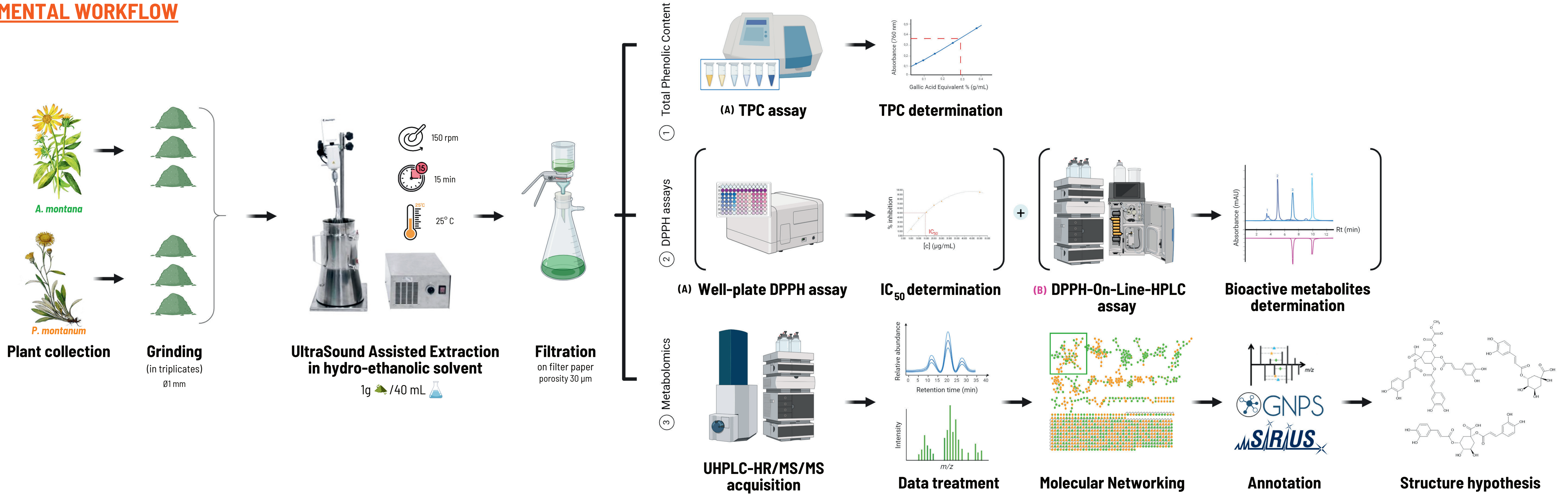
In Provence (South of France), the Asteraceae species *Pentanema montanum* (L.) D.Gut.Larr., Santos-Vicente, Anderb., E.Rico & M.M.Mart.Ort., formerly known as *Inula montana* L., is traditionally used for treating bruises, wounds, rheumatism, and muscular pain, similarly to *Arnica montana* L. It is locally referred to as "Arnica de Provence" [1, 2].

Both species mainly contain **sesquiterpene lactones and phenolic compounds**, which play a crucial role in defending against **oxidative stress**, a factor implicated in various acute and chronic diseases [3].

Due to cultivation difficulties, *A. montana* has been extensively harvested for the pharmaceutical and cosmetics industries, leading to a significant decline in wild populations. Conversely, *P. montanum*, which is easier to cultivate, could offer a viable local alternative.

This study compares the **antioxidant potential of both species** by evaluating their Total Phenolic Content (TPC) and using radical scavenging DPPH assays, including the DPPH-On-Line-HPLC assay. Additionally, their chemical composition was analyzed using UHPLC-HR/MS/MS and Molecular Networking approaches [4].

## EXPERIMENTAL WORKFLOW



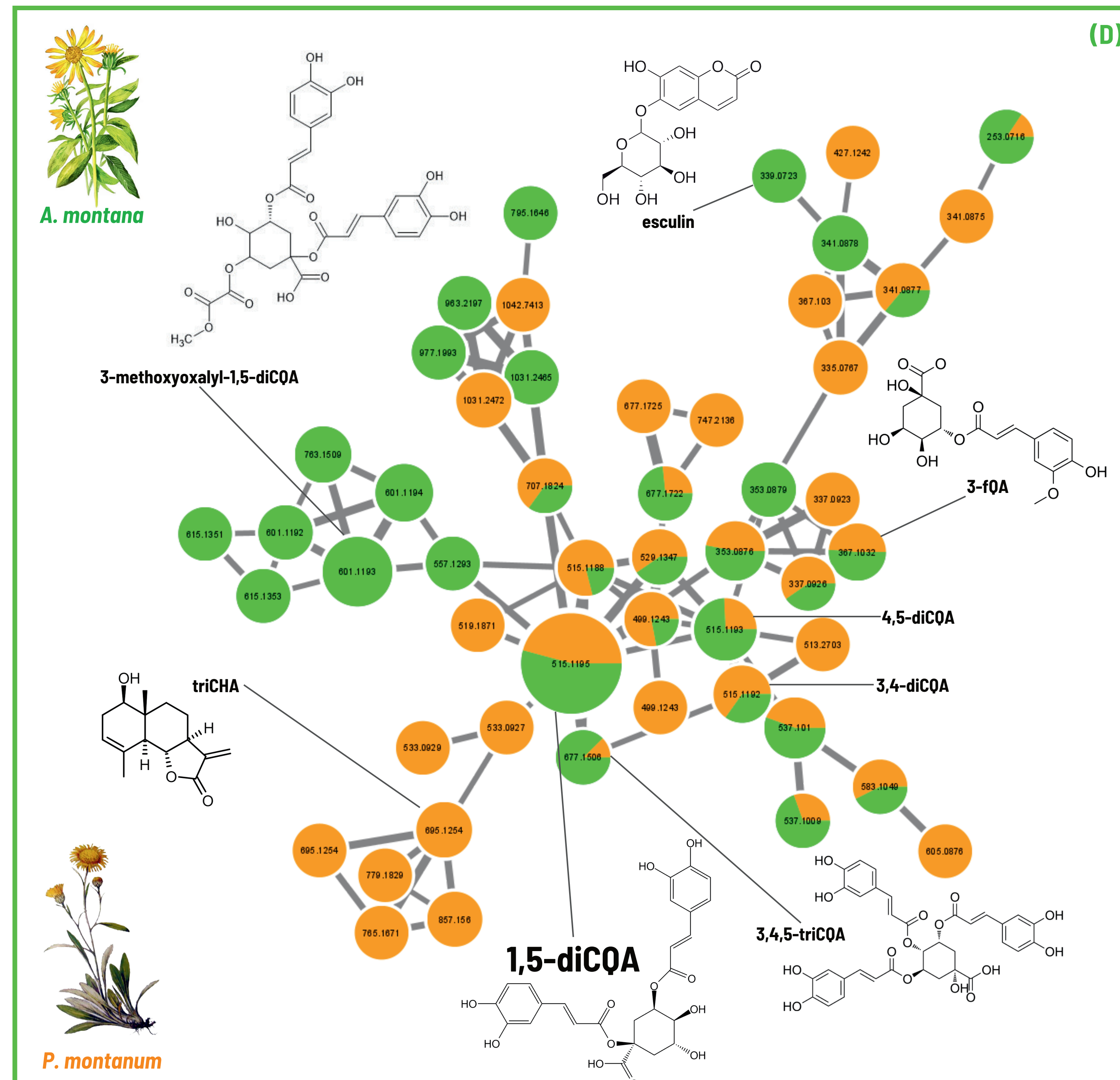
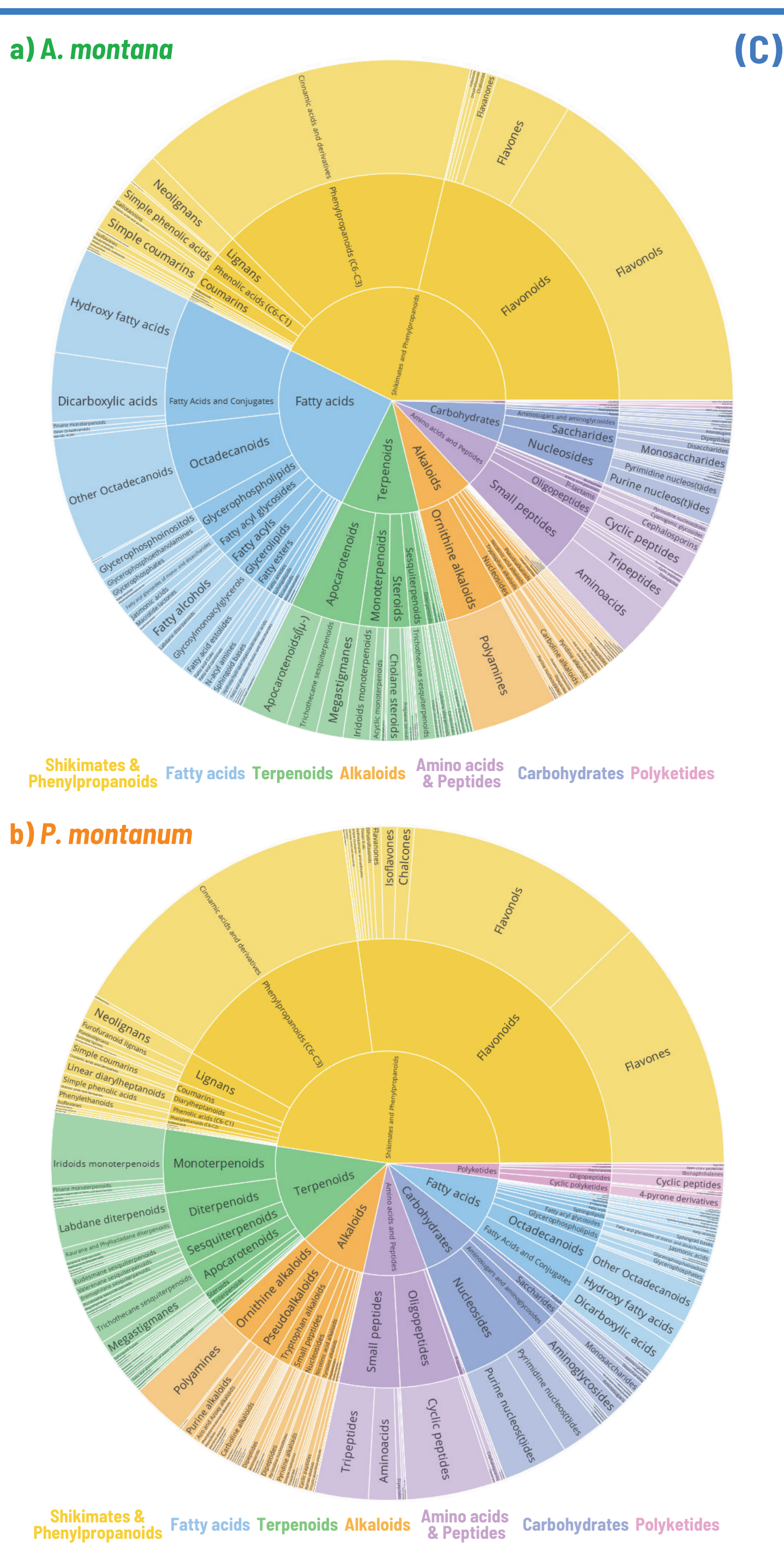
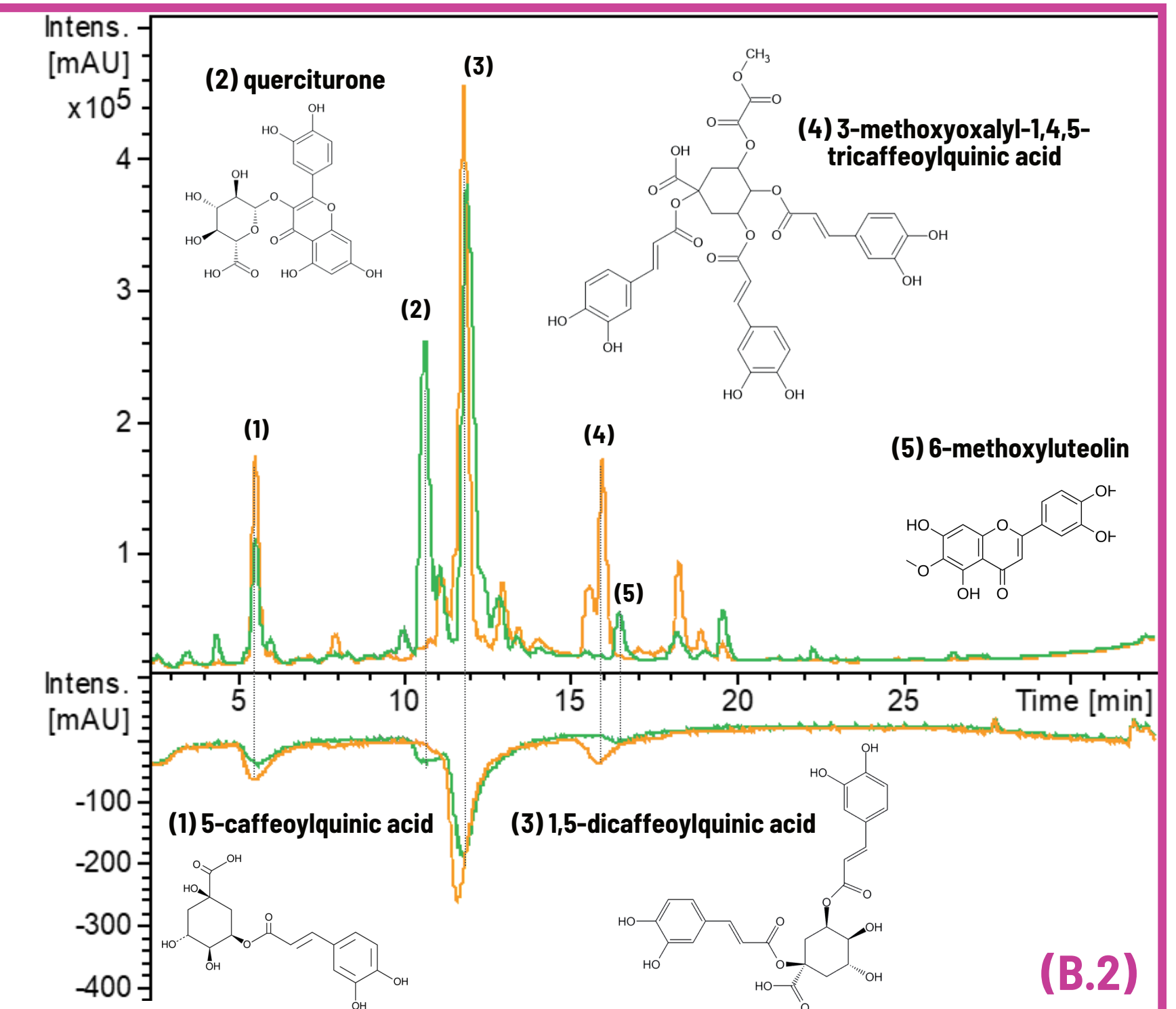
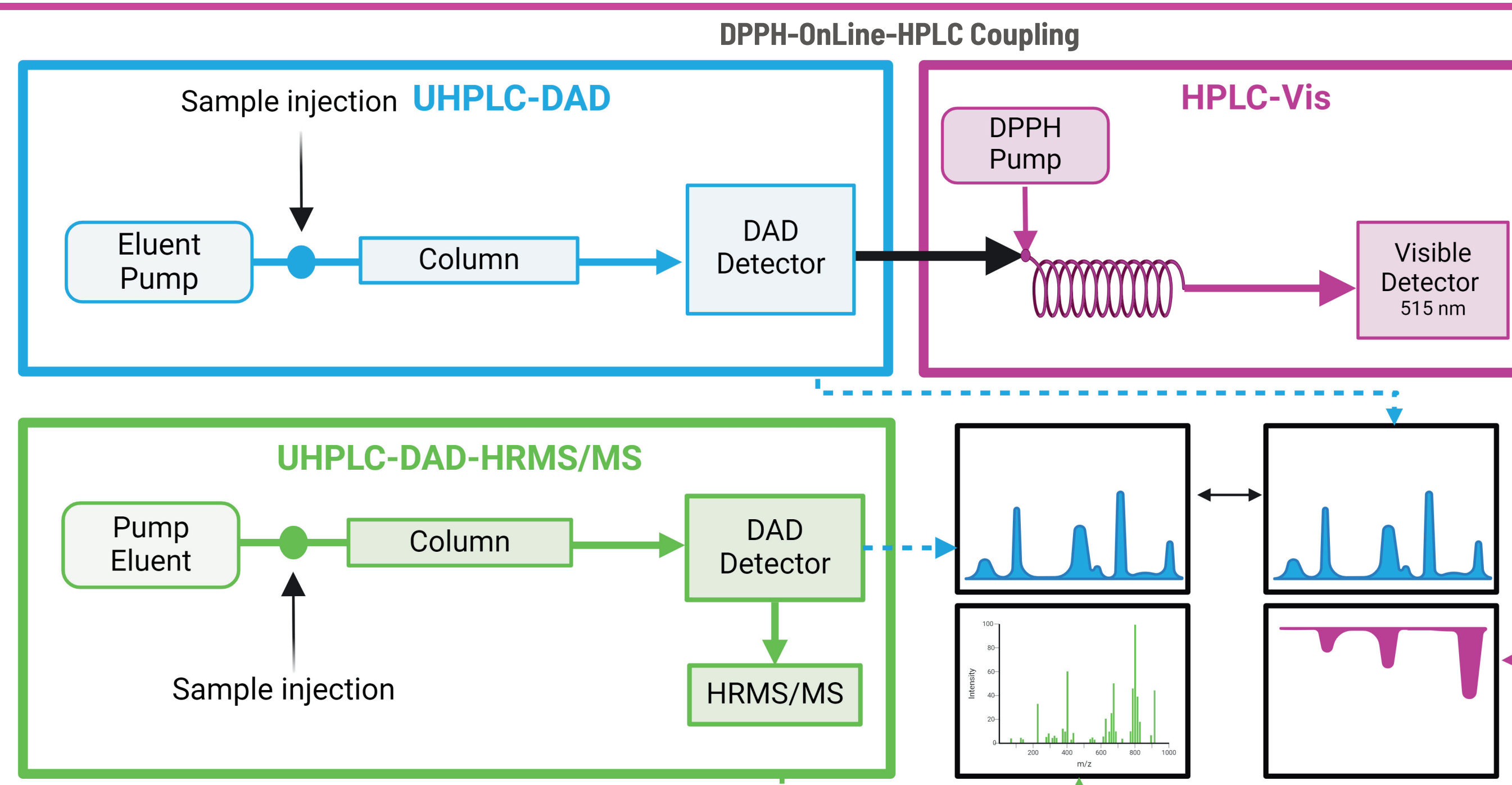
## ANTIOXIDANT ACTIVITY

### (A) ANTIOXIDANT POTENTIAL EVALUATION

- *P. montanum* TPC << *A. montana* TPC  
33.39 ± 0.46 mg GAE /100 mg Gallic Acid Equivalent vs 44.59 ± 1.63 mg GAE /100 mg Gallic Acid Equivalent
- *P. montanum* IC<sub>50</sub> << *A. montana* IC<sub>50</sub>  
23.66 ± 0.75 µg/mL vs 45.71 ± 3.05 µg/mL

### (B) ANTIOXIDANT COMPOUNDS DETERMINATION

- **Common bioactive compounds**
  - 1,5-dicaffeoylquinic acid (3)
  - 5-caffeoylquinic acid (1)
- ***A. montana* specific compounds**
  - quercitrone (2)
  - 1,4,5-tricaffeoyl-3-methoxyoxaloylquinic acid (4)
- ***P. montanum* specific compound**
  - 6-methoxyluteolin (5)



## CHEMICAL COMPOSITION COMPARISON

### (C) COMPOUNDS CLASSIFICATION ACCORDING TO CANOPUS TOOL PREDICTIONS

• Both species are dominated by metabolites from the "Shikimates & Phenylpropanoids" pathway, especially **Flavonoids & Phenylpropanoids (C6 - C3)**

• *A. montana* also showed high amounts of "Fatty acids"

### (D) CHEMICAL DIVERSITY & MOLECULAR NETWORKING

• Only **136 compounds** over 1054 were common to both species, among which **5-caffeoylquinic acid (1)** and **1,5-dicaffeoylquinic acid (3)**

• Annotations of these main antioxidant compounds were confirmed by **injection of reference compounds**

• Caffeoyl-Quinic Acid (CQA) derivatives are already known to exhibit strong antioxidant potential [5]

• Example of **CQA derivatives cluster (D)** with some annotations:

- dicaffeoylquinic acid (diCQA) isomers
- tricaffeoylquinic acid (triCQA) isomers
- feruloylquinic acid (fQA) isomers
- methoxyoxalyl-diCQA esters: *A. montana* specific group
- caffeoylhexaric acids (CHA): *P. montanum* specific group

• *P. montanum* & *A. montana* shared several CQA derivatives responsible for antioxidant activity

• The antioxidant potential of *P. montanum* is higher than *A. montana*, although its TPC is lower

• These studies demonstrated that *P. montanum* can be effectively used as a local alternative to *A. montana*



Antioxidant potential



Traditional knowledge



Local cultivable alternative



Sustainable development



Natural Cosmetics

[1] Garayev, E., Di Giorgio, C., Herbette, G., Mabrouki, F., Chiffolleau, P., Roux, D., Sallanon, H., Ollivier, E., Elias, R., & Baghdiikian, B. (2018). Bioassay-guided isolation and UHPLC-DAD-ESI-MS/MS quantification of potential anti-inflammatory phenolic compounds from flowers of *Inula montana* L. *Journal of ethnopharmacology*, 226, 176-184.  
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 [4] Breaud, C., Lallemand, L., Mares, G., Mabrouki, F., Bertolotti, M., Simmler, C., Gref, S., Mauduit, M., Herbette, G., Garayev, E., Lavergne, C., Cesari, M., Bun-Llopet, S.-S., Baghdiikian, B., & Garayev, E. (2022). LC-MS Based Phytochemical Profiling towards the Identification of Antioxidant Markers in Some Endemic Aloe Species from Mascarene Islands. *Antioxidants*, 12(1), 50.  
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