Chemical kinetics of hydrothermal conversion

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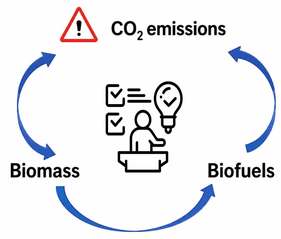
Introduction

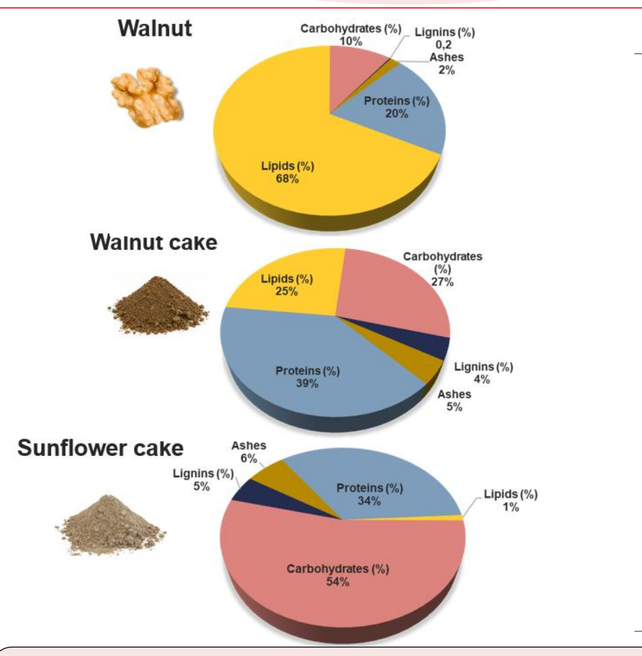
- **Agri-food residues are abundant and renewable**
- **Hydrothermal liquefaction (HTL) converts wet biomass into energy-dense bio-crude without prior drying.**



Objectives

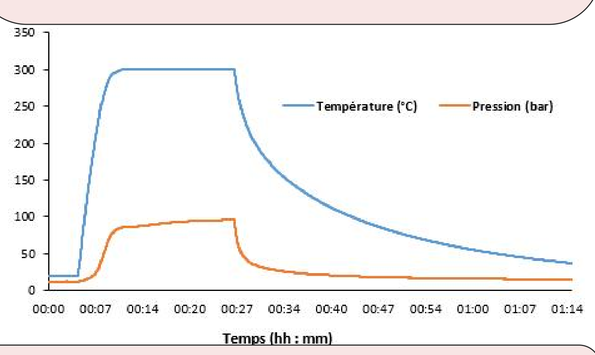
- **Understand the influence of operating parameters**
- **Understand the influence of biochemical composition on yields**
- **Identify the main reaction pathways**
- **Develop a kinetic model**

Methodology



Paramètres HTL

- **Temperature : 300 – 340 °C**
- **Reaction time : 5 – 15 min**
- **% Organic matter in the water : 15%**
- **Agitation : 600 rpm**
- **Inert gas : Azote 12 bar**

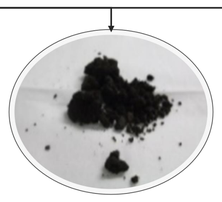


Product separation:

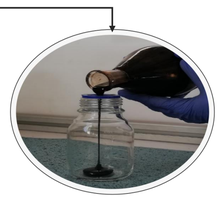
1. Gas separation **2. Filtration** **3. Aqueous phase** **4. Extraction with isopropanol** **5. Filtration** **6. Solvent evaporation**

Gas

Aqueous phase

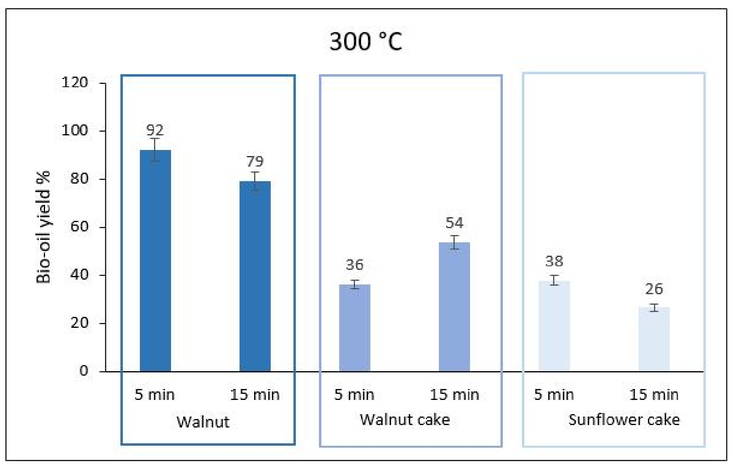


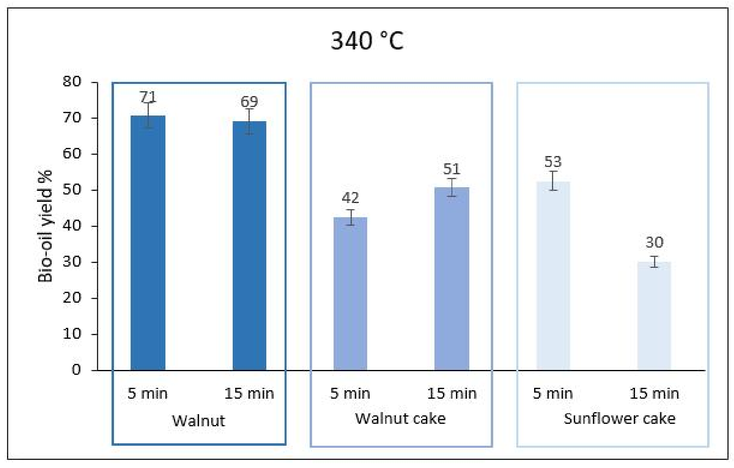
Biocrude



Bio-oil

Results



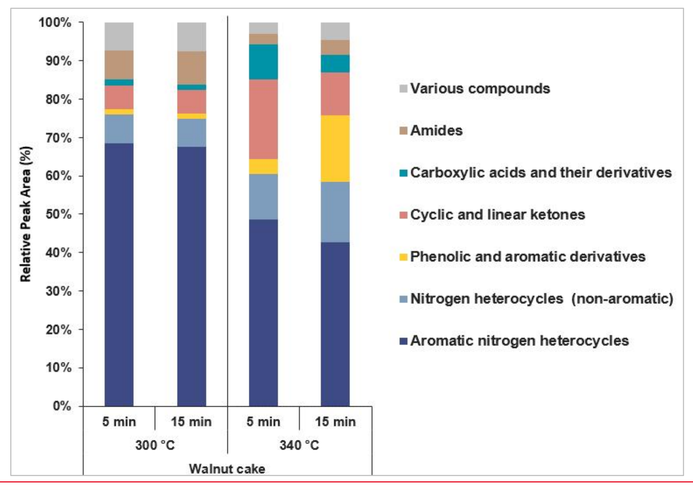


Results: impact of the biochemical composition on bio-oil yield:

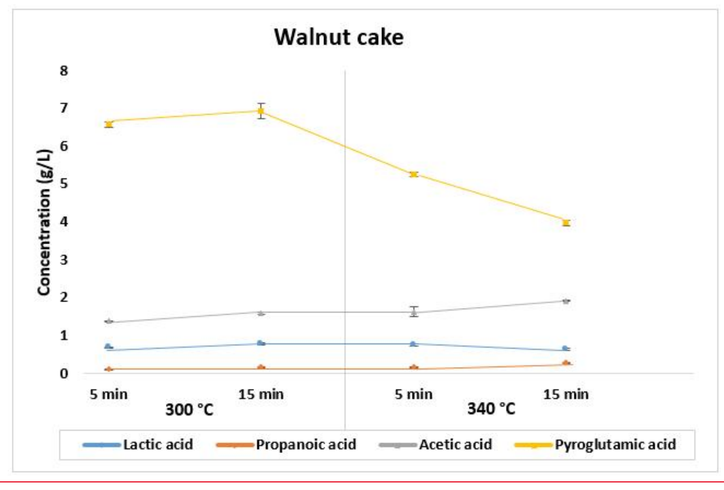
- Walnut (rich in lipids): >92% bio-oil at 300°C, 5 min
- Walnut cakes (rich in protein): 53% bio-oil at 300 °C, 15 min
- Sunflower cakes (rich in fiber): the bio-oil yield increases with temperature (340 °C)

Analysis of the aqueous phase

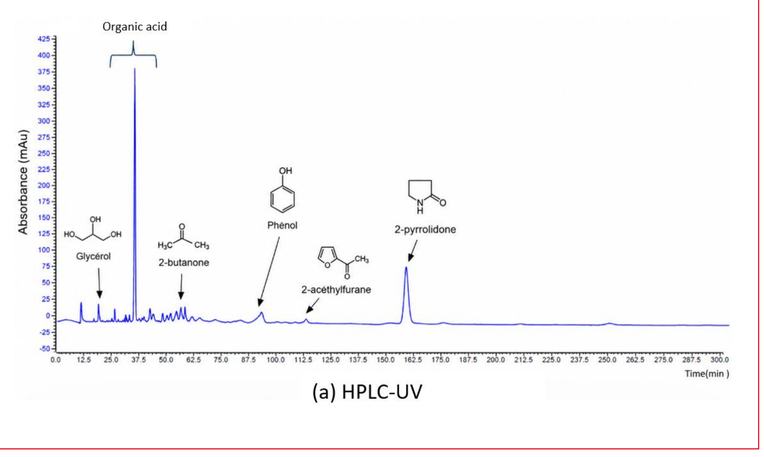
GC-MS



Ion chromatography

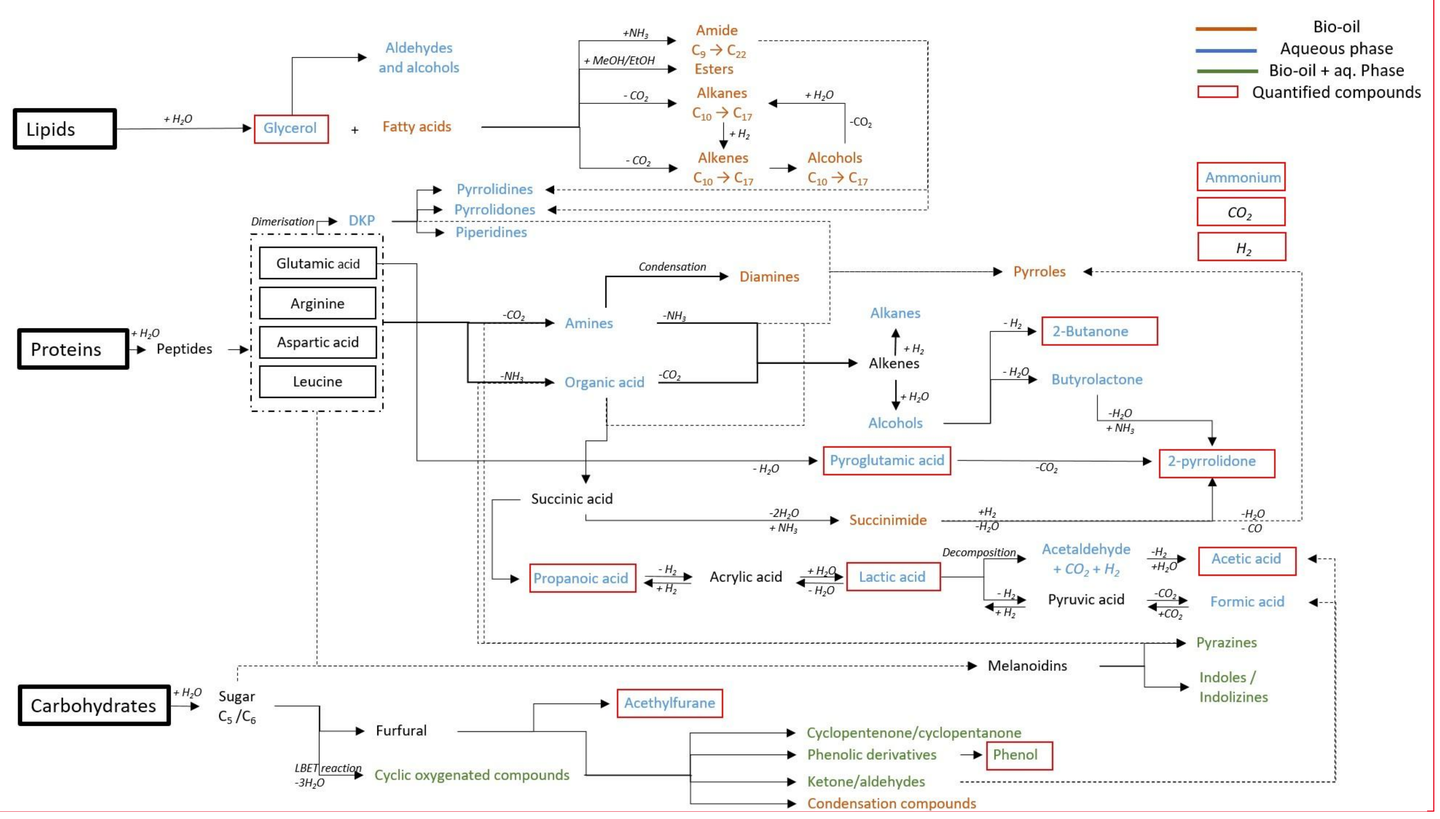


HPLC



(a) HPLC-UV

Reaction scheme



Conclusion

- Biomass composition strongly affects HTL product distribution.
- Lipid-rich feedstocks maximise bio-crude yields.
- Protein-rich feedstocks promote nitrogen transfer to the aqueous phase.

Perspectives

- Develop kinetic models for HTL conversion pathways.
- Investigate model compounds to validate reaction mechanisms.
- Integrate experimental and modelling approaches for process optimisation.