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Integrating batch pyrolysis and fractional condensation (2D MFR) to get high-value products from biomass

Mohammad Hossain
ICFAR – Western University, fberruti@uwo.ca

Chiara Barbiero
Western University, Canada, cbarbier@uwo.ca

Ian Scott
Agriculture and Agri-Food Canada

Franco Berruti
ICFAR – Western University

Cedric Briens
ICFAR – Western University

Integrating Batch Pyrolysis and Fractional Condensation (2D MFR) to get High-value Products from Biomass

Mohammad Hossain, **Chiara Barbiero**, Ian Scott, Franco Berruti, Cedric Briens

Institute for Chemicals and Fuels from Alternative Resources
Western University

icfar

Canada

High-Value Products from Biomass

Solvent extraction:

- Expensive
- Time consuming
- Not environmental friendly

Traditional pyrolysis is much cheaper, easier and safer **but**:

- Complex liquid mixtures
- Thermally unstable products → distillation is difficult

Objectives

Develop a better process combining:

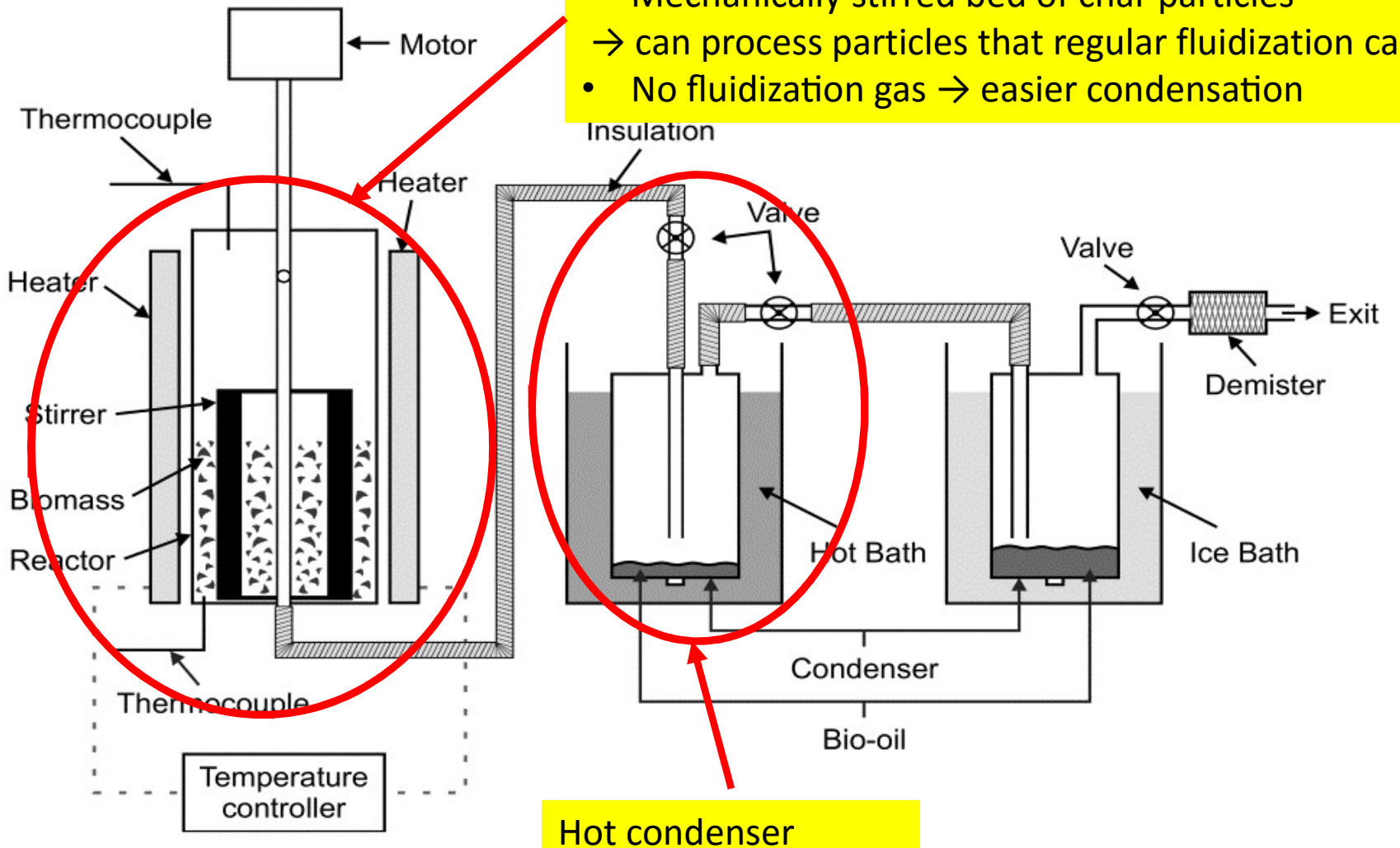
- Batch pyrolysis
- Fractional condensation

- Apply the technology to:
  - Tobacco leaves
  - Tomato plant waste
  - Spent coffee grounds
  - Lignin

Experimental Setup

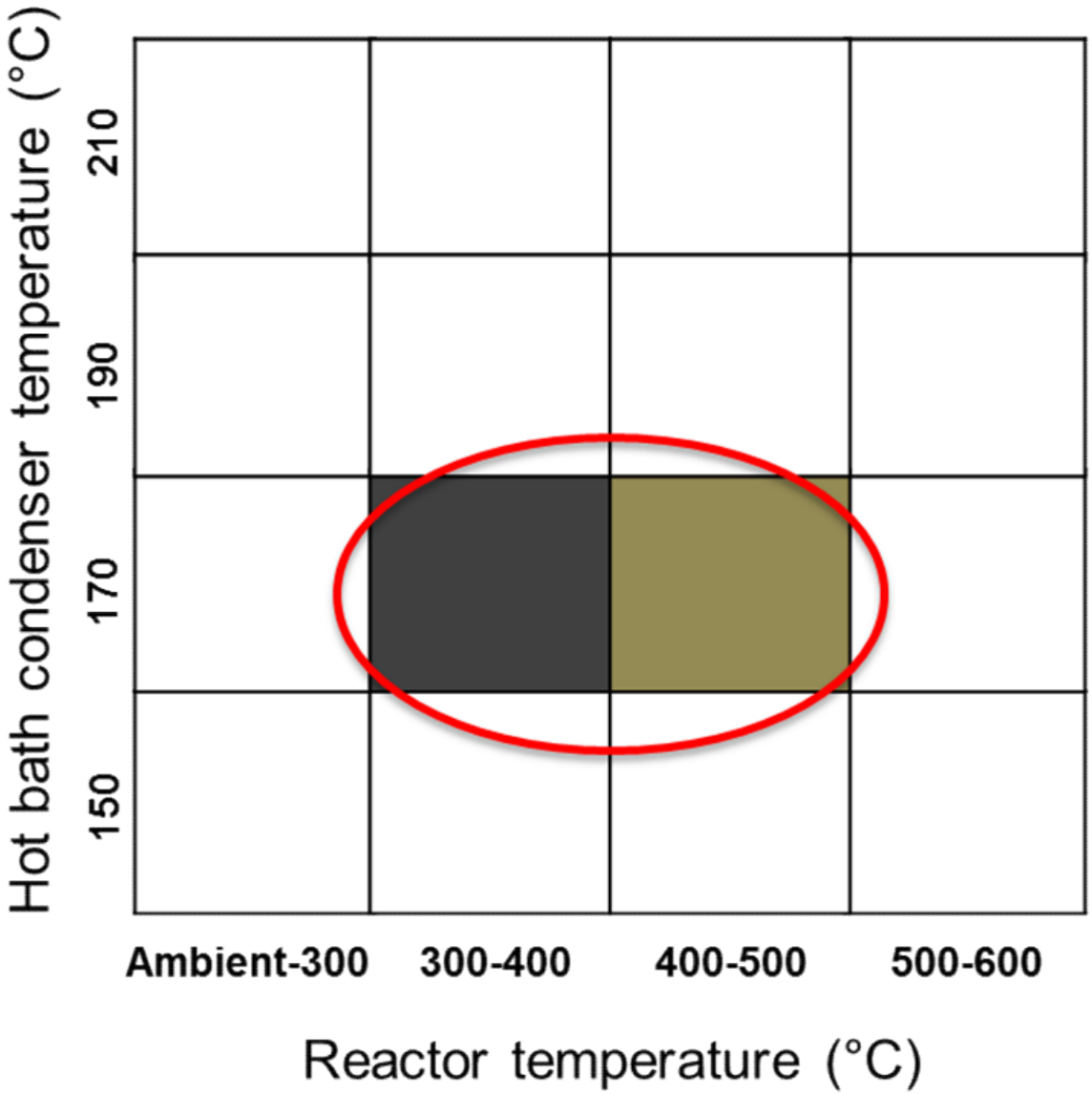
Mechanically Fluidized Reactor (MFR):

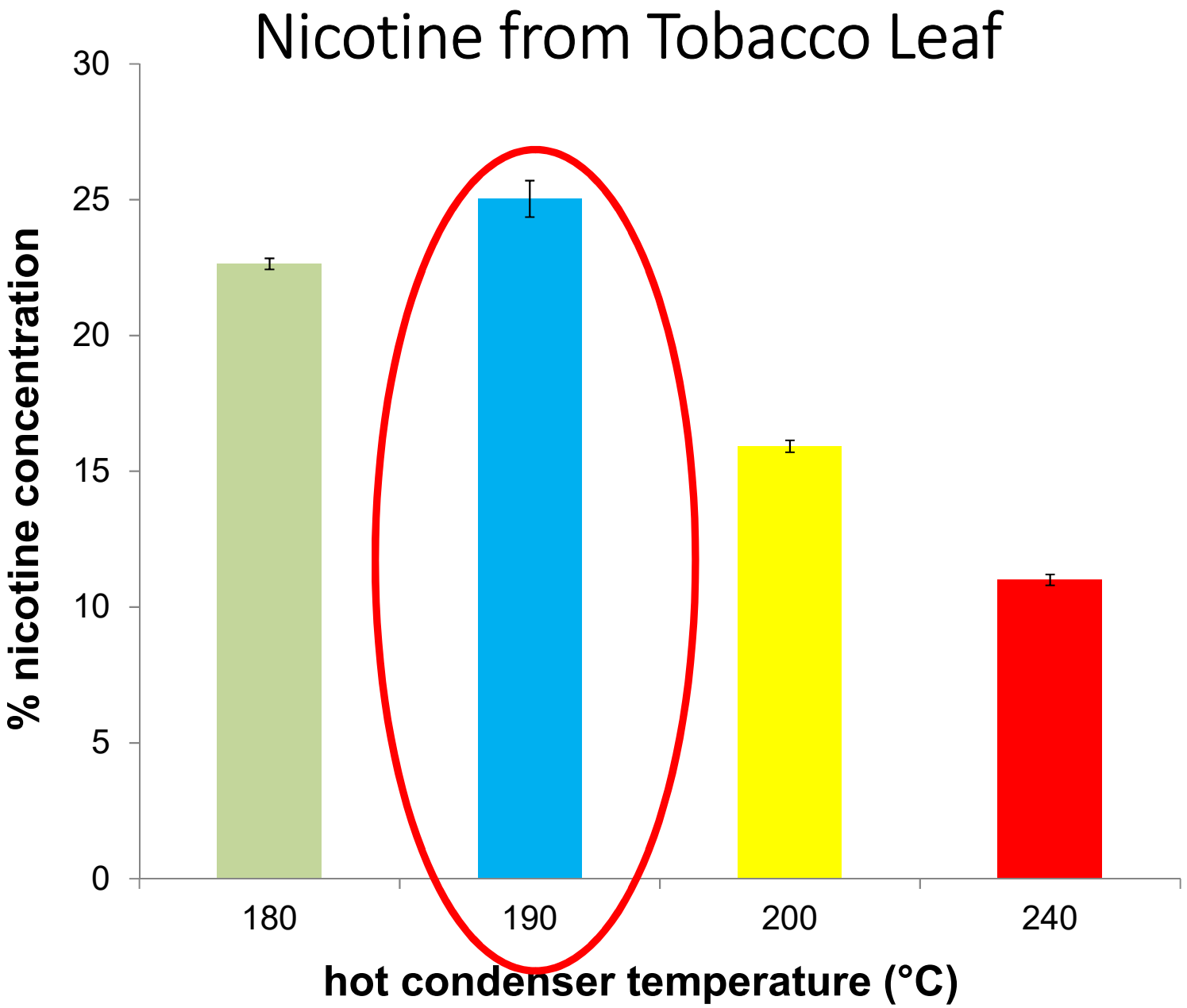
- Mechanically stirred bed of char particles
  → can process particles that regular fluidization cannot
- No fluidization gas → easier condensation



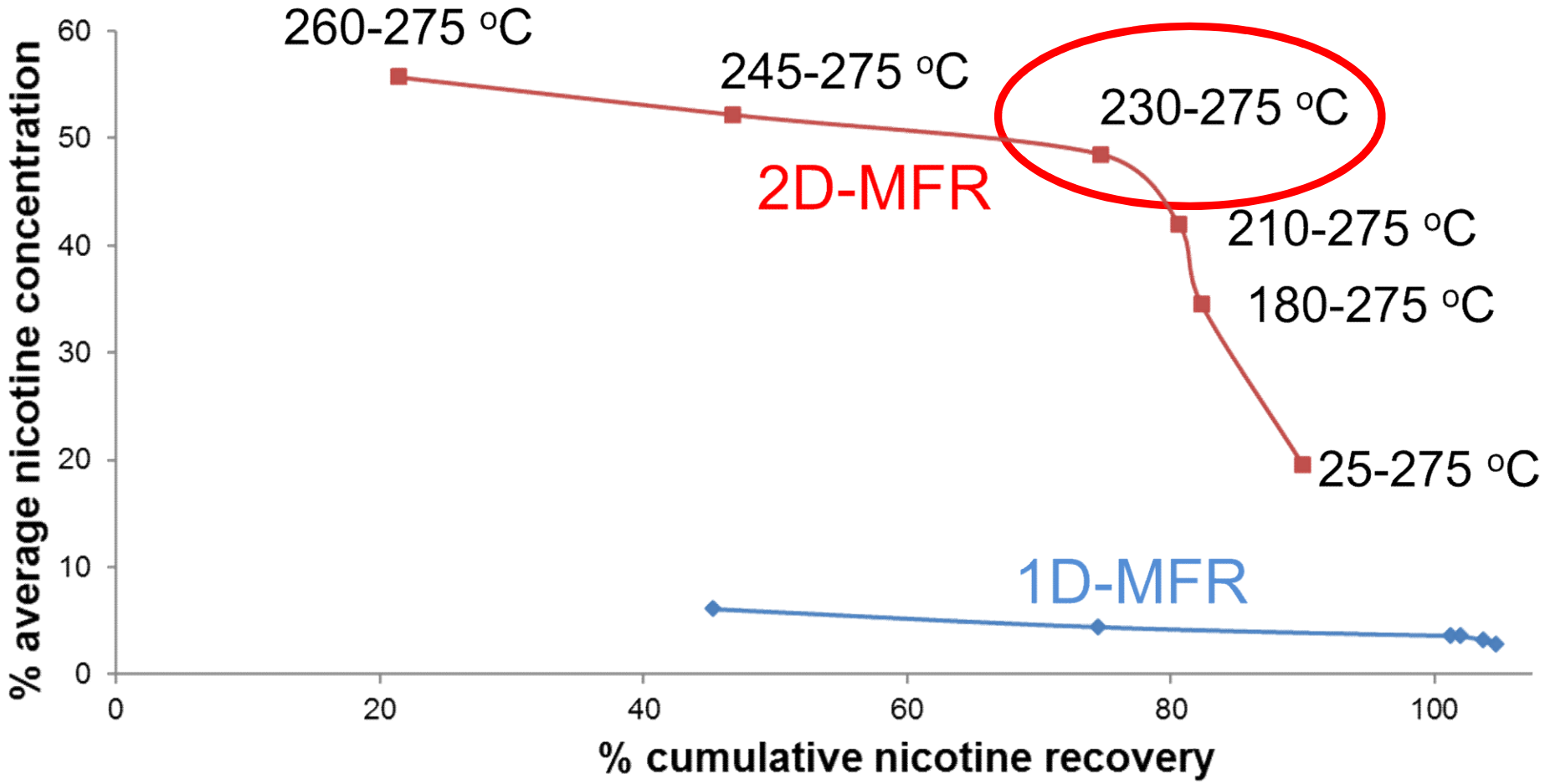
Hot condenser
for valuable products

Concept


Hot bath condenser temperature (°C)
210
190
170
150
Ambient-300
300-400
400-500
500-600
Reactor temperature (°C)


Nicotine from Tobacco Leaf
30
25
20
15
10
5
0
% nicotine concentration
180
190
200
240
hot condenser temperature (°C)

Nicotine from Tobacco Leaf

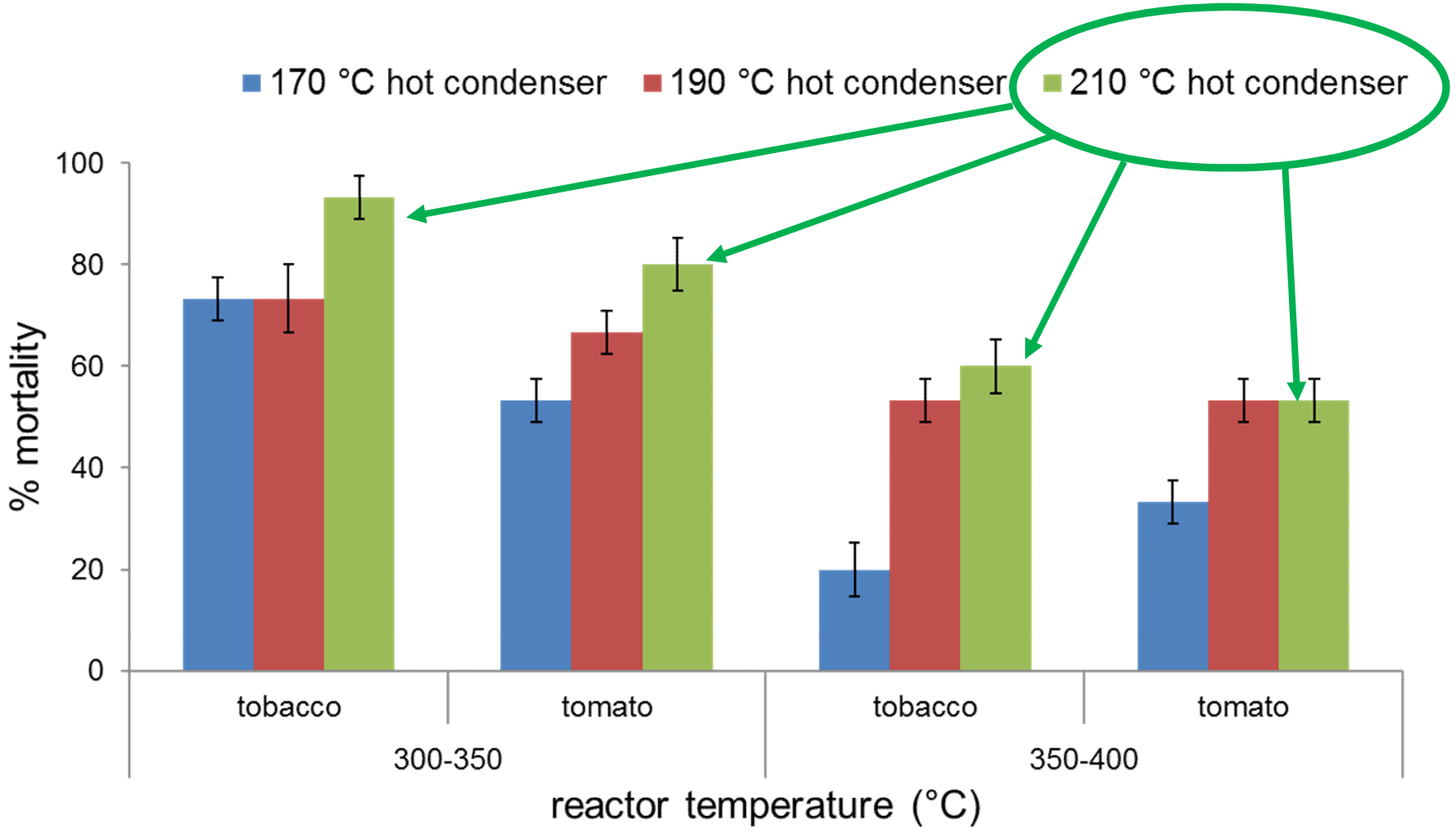


Pesticides from
Tobacco leaf and Tomato plant waste

Colorado potato beetle (CPB)

Assay: % of beetles killed by bio-oil

Pesticides from Tobacco leaf and Tomato plant waste

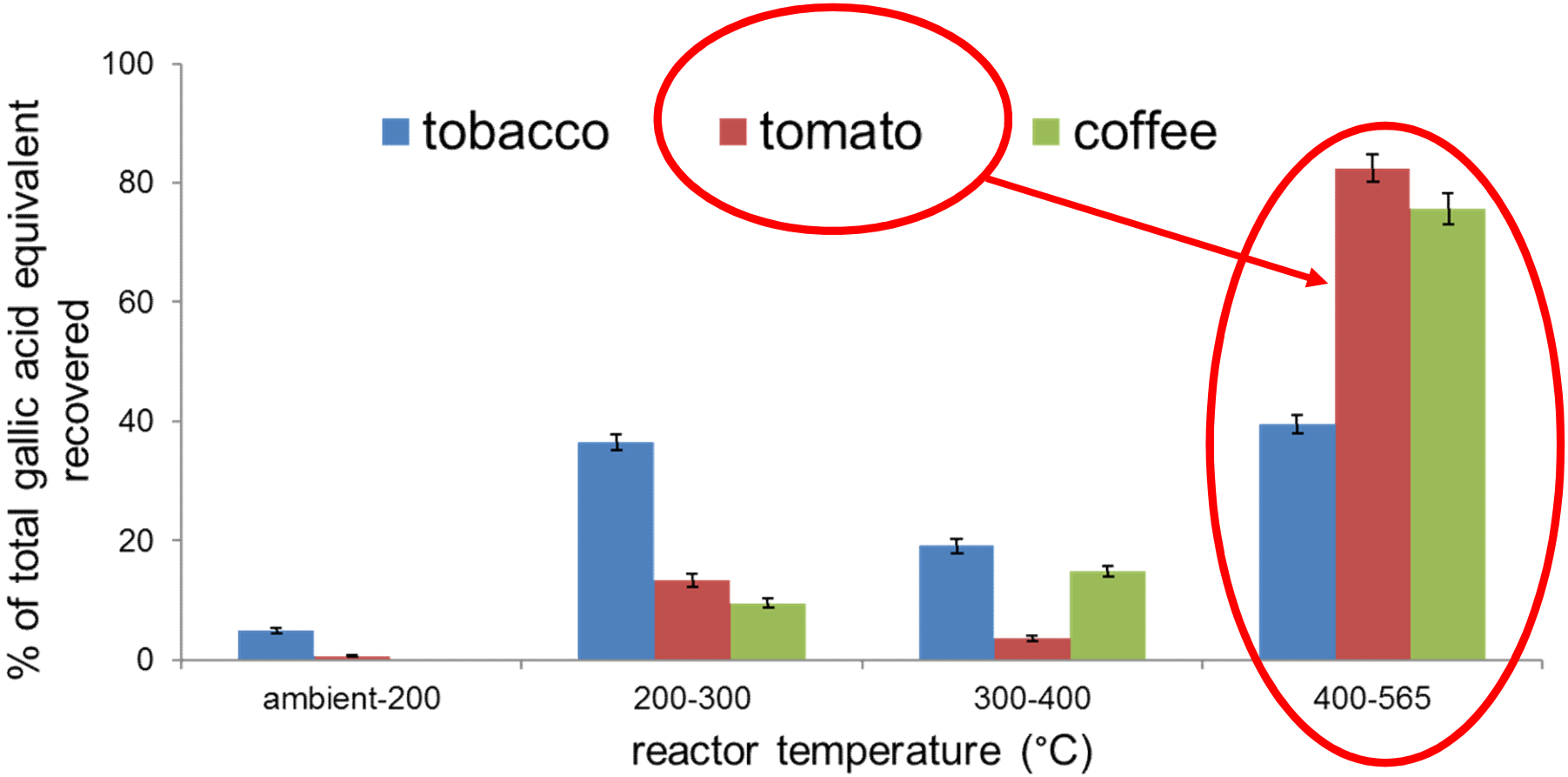


Pesticides from Tobacco leaf and Tomato plant waste

Reactor temperature cuts (°C)	LC_{50} (mg/g)	
	Tobacco	Tomato
300-350	2.1	2.2
350-400	2.5	2.8

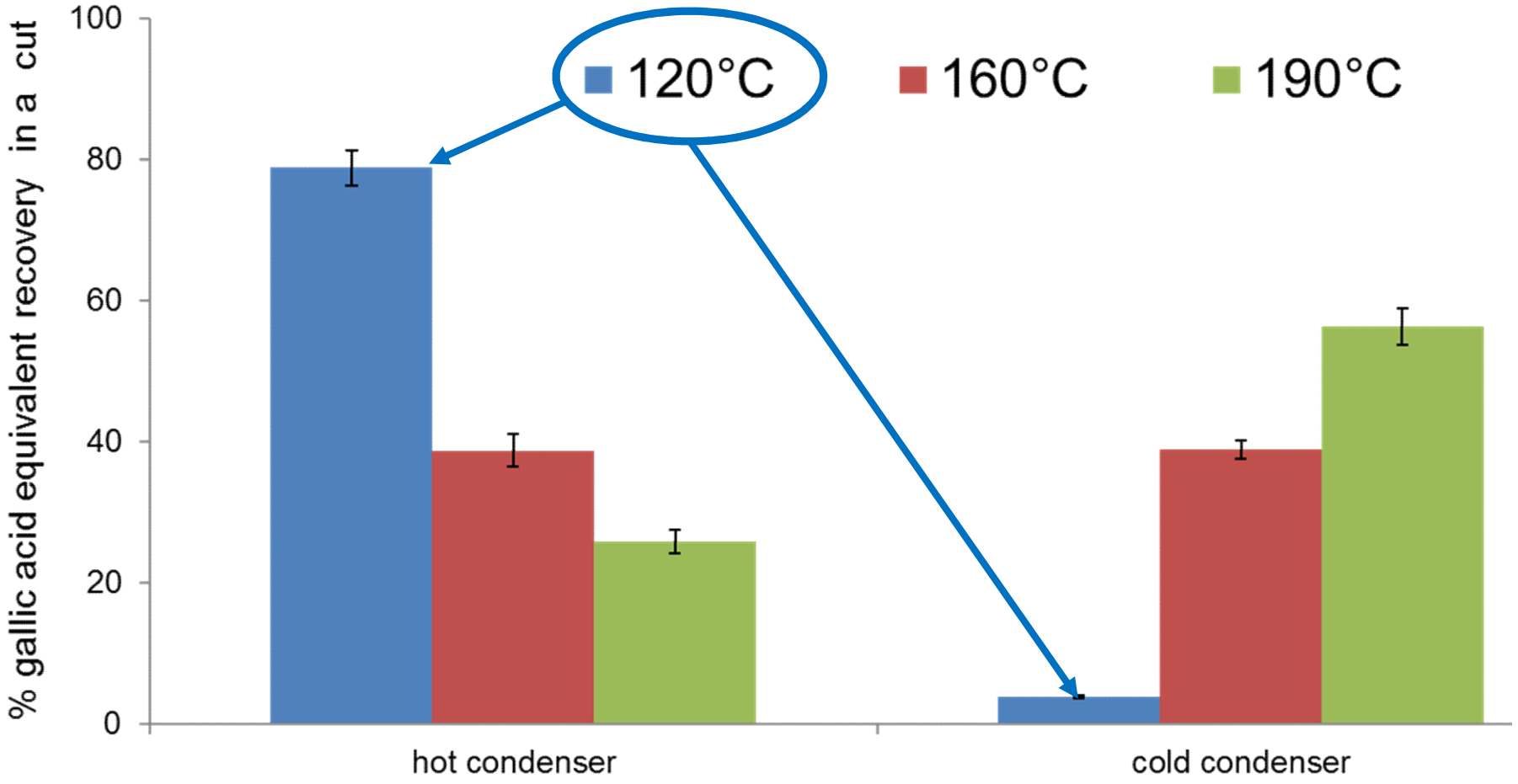
LC_{50}: concentration of bio-oil for 50% mortality

Anti-oxidants from
Tobacco leaf, Tomato plant waste & spent Coffee grounds



Gallic acid is a strong anti-oxidant used as standard

Anti-oxidants from Tomato plant waste



Reactor temperature: 400-565 °C

Conclusions: Biorefinery applications