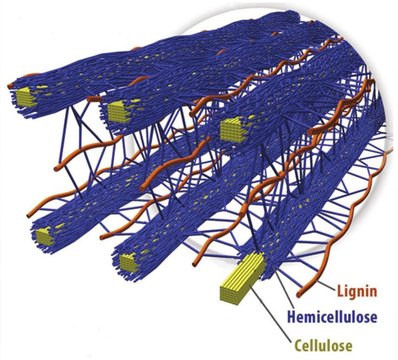
Hydrothermal liquefaction of spent coffee grounds targeting liquid biofuel intermediates

D. Liakos[1,2], K. Triantafyllidis[2], L. Chrysikou[1], S. Bezergianni[1]

[1]Center for Research & Technology Hellas (CERTH), Chemical Process & Energy Resources Institute (CPERI), Thessaloniki, Greece
[2]Aristotle University of Thessaloniki (AUTH) Greece, Department of Chemistry

Introduction



	Units	Wheat Straw
Cellulose	wt%	12.10
Hemicellulose	wt%	33.53
Lignin	wt%	31.81
Ash	wt%	1.94
Proteins	wt%	15.24

- Coffee is one of the most consumed goods (10 MT annually in last 5 years)
- Coffee → Lignocellulosic biomass → **Potential** sustainable residual feedstock

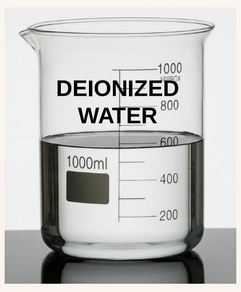
Objectives

- **Conversion:**
  spent coffee grounds → bio-crude
- **Investigation of HTL main parameters:**
  - Temperature
  - Residence Time
- **Comparison:**
  Raw – Pretreated spent coffee grounds

Methodology

SPENT COFFEE GROUNDS

SOLVENT



- Temperature: 280º – 320 ºC
- Reaction Time: 15 – 30 min
- Solid – Liquid Ratio: 1 / 10
- Compression gas: N_2 30 bar

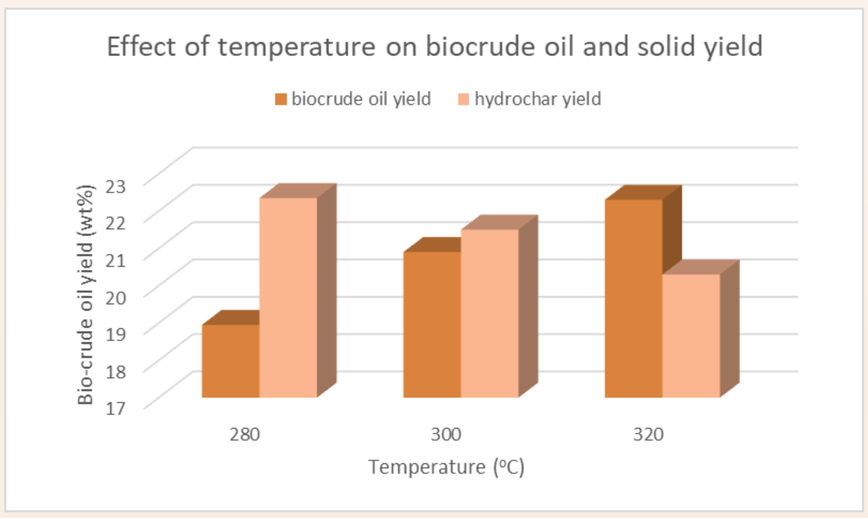
HTL

1. Filtration
2. Acetone extraction
3. Acetone evaporation

PRODUCTS

- Gas products 
- Aqueous phase 
- Bio-crude oil 
- Hydrochar 

Results & Discussion



Gas molecule	Concentration (v/v%)
Carbon dioxide (CO_2)	91.0 – 93.0
Hydrocarbons with 6 or more carbon atoms (C_6^+)	0.1 – 0.3
Ethane (C_2H_6)	0 – 0.12
Methane (CH_4)	6.5 – 7.3
Hydrogen (H)	0 – 0.5

Results from pretreated spent coffee grounds after lipid removal

- Biocrude oil **yield 20 – 23 wt%** and solid yield 20 – 22 wt%

Lipid extraction leads to:

1. lower oil yield 2. higher optimal temperature

Temperature Increase:

- Increased oil yield (from 19 to 23 wt%)
- Decreased solid yield (from 22.3 to 20.3 wt%)

Residence time had minor effect in biocrude oil yield

GC-FID analysis of gas products:

- Main gas product is **CO_2**
- Except for CO_2 some light hydrocarbons are also traced

Methane (Main HC molecule) – Ethane – C_6^+

Conclusions

1) Spent coffee grounds can be used as feedstock for oil production
2) Optimal temperature and time: 320 ºC and 15 min
3) Gas product contains CO_2 and some light organic molecules
4) Next step: raw spent coffee grounds HTL investigation

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References

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CPERI Chemical Process and Energy Resources Institute
Hydro Hydroprocessing Group
ARISTOTLE UNIVERSITY OF THESSALONIKI