INTEGRAL VALORIZATION OF AGRO-FOOD BIOMASS THROUGH PRESSURIZED FLUIDS. CASE STUDY: BREWERY SPENT GRAIN (BSG)

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20 kg BGS / 100 L beer
4 GL beer /year in Spain

Composition

Component	% Dry basis
Extractives	**25.9 ± 0.7**
Water	24.3 ± 0.6
Ethanol	1.6 ± 0.1
Glucanes	**15.46 ± 0.24**
Starch	10.6 ± 0.3
β-glucane	0.62 ± 0.02
Cellulose	11.8 ± 0.9
Hemicellulose	**26 ± 1**
Xilane	14.8 ± 0.5
Arabinane	7.2 ± 0.4
Acetate	5.0 ± 0.4
Lignin	**17.83 ± 0.56**
Acid insoluble	13.5 ± 0.5
Acid soluble	4.33 ± 0.06
Ash	**2.92 ± 0.02**
Proteins	**17.8 ± 0.1**
Lipids	**5.9 ± 0.4**

Hydrophilic components (phenolics)

scW

Extractable valorisation

SFE

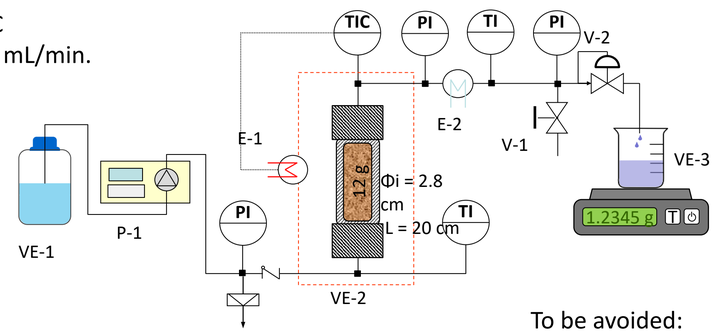
Lipophilic components

scW

Structural component fractionation

Subcritical water (scW) fractionation

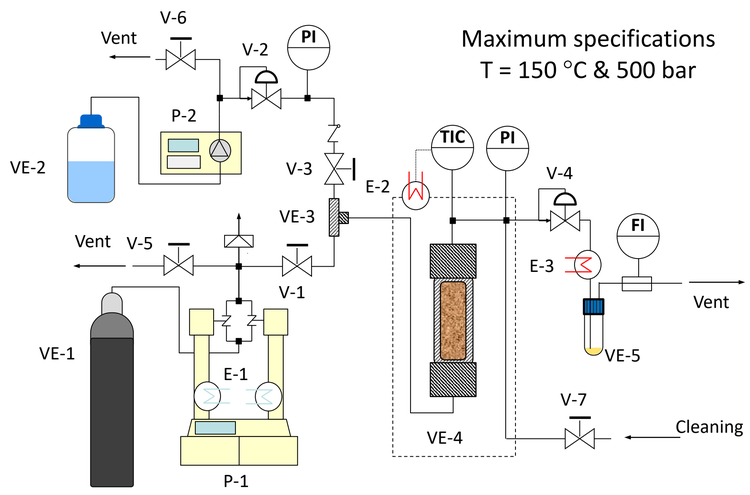
Validated:
T up to 220 °C
Flow up to 10 mL/min.

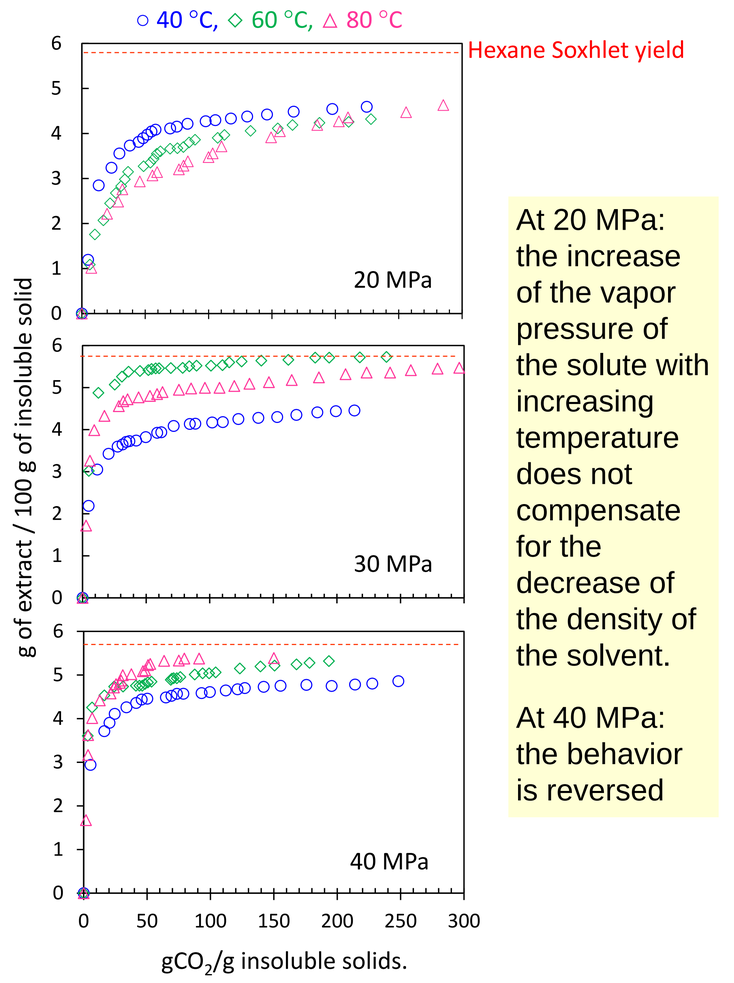


semicontinuous fix bed reactor

To be avoided:
- Solids pumping
- Very small particles

Supercritical CO_2 extraction





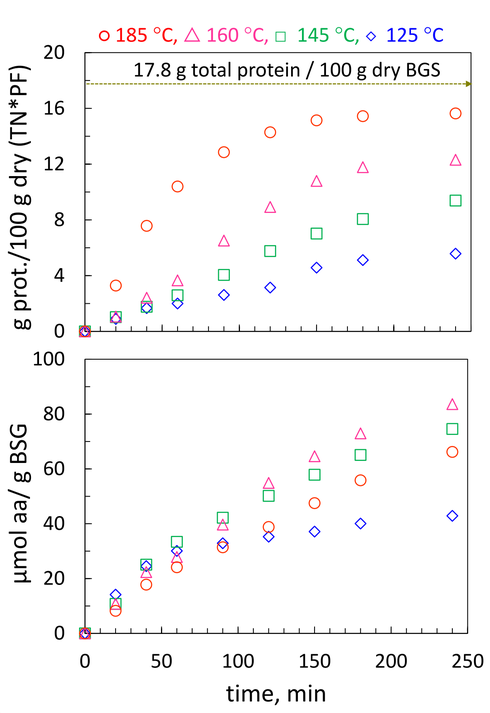
At 20 MPa: the increase of the vapor pressure of the solute with increasing temperature does not compensate for the decrease of the density of the solvent.

At 40 MPa: the behavior is reversed

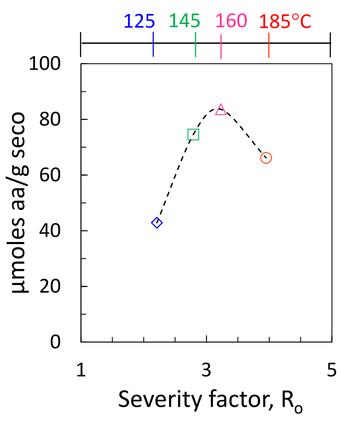
Fatty acid	Percentage
Palmitic, C16:0	24.4 ± 0.1
Stearic, C18:0	1.79 ± 0.01
Oleic, C18:1n-9	13.67 ± 0.05
Vaccenic, C18:1n-7	0.94 ± 0.01
Linoleic cis y trans, C18:2n-6	51.0 ± 0.1
α-linolenic, C18:3n-3	4.30 ± 0.01
Gondoic, C20:1n-9	0.95 ± 0.01
Cetoleic C22 1n-11	0.67 ± 0.01
Other	2.1 ± 0.1

scW proteic fraction

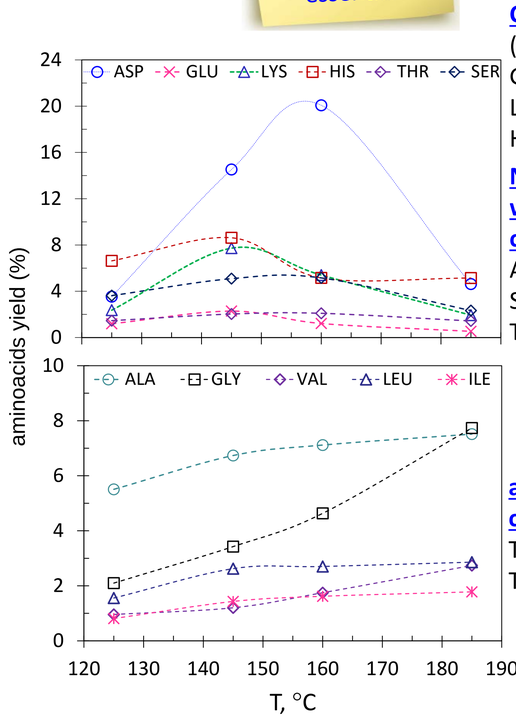
Accumulative curves of solubilized protein and sum of individual aminoacids (aa) determined by GC



Maximum due to aa degradation at R > 3.2



50.8 % of the BGS aa are essential



Charged aa (básic/ácid)
GLU
LYS
HIS
T_{max}~145 °C

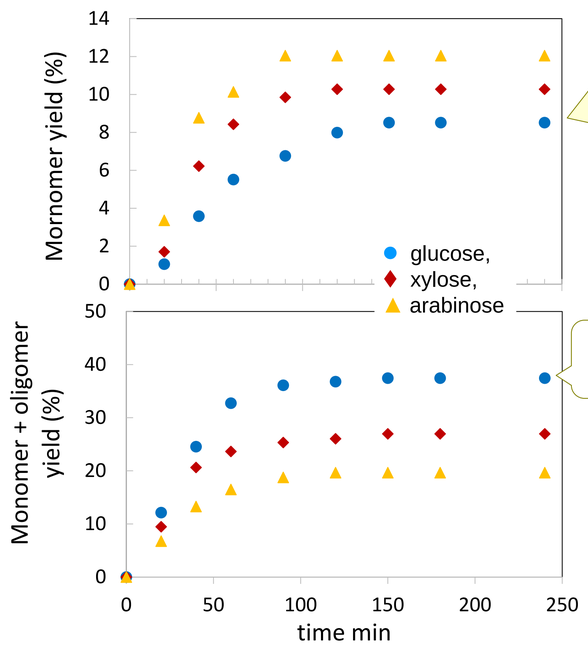
Neutral aa with polar chain
ASP
SER
THR
T_{max}~160 °C

aa with aliphatic chains
T ↑ ⇒ yield ↑
T ↑ ⇒ stability ↑

scW carbohydrates

Results obtained at 185 °C

MONOMERS AND OLIGOMERS IN THE scW EFFLUENT
Extraction-hydrolysis curves

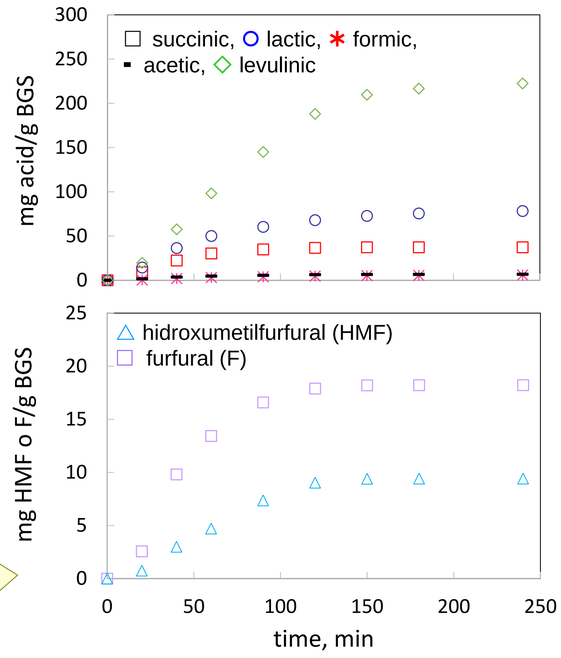


High glucose yield is obtained due to the presence of starch

Hemicellulose hydrolysis yields xylose and arabinose

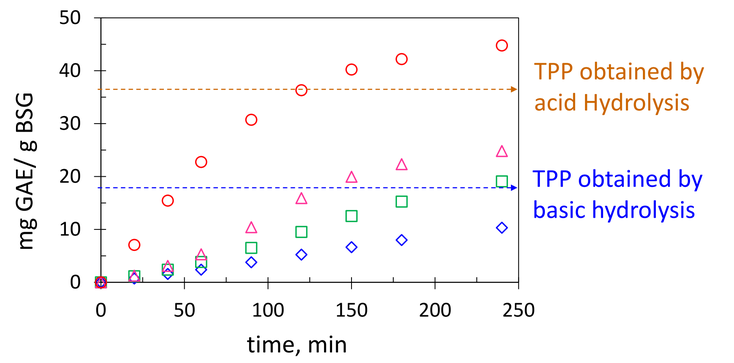
10.6 % starch

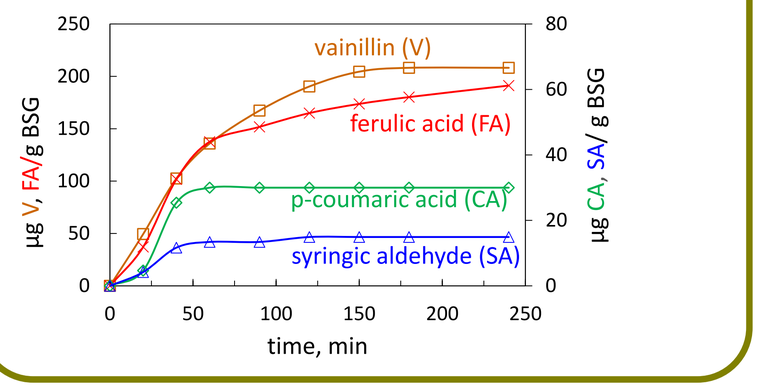
DEGRADATION PRODUCTS



High concentration of degradation products are obtained due to the high residence time

scW phenolic compounds





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