

# MacroFuels WP2: Conditioning, pre-treatment and storage

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# Tasks

- WP 2: Conditioning, pre-treatment and storage
  - Task 2.3: Enzymatic degradation of macro-algal polysaccharides (M3-36)
  - Task 2.4: Fractionation and mild chemical treatment (M3-36)
  - Task 2.5: Purification and concentration of algal sugar syrups (M12-24)
- WP 5: Fuel suitability and by-product application tests
  - Task 5.2: Assessment of the minerals (M20-40)
  - Task 5.3: Assessment of the protein rich fraction (M20-40)

# Task 2.4

- Task 2.4: Fractionation and mild chemical treatment (M3-36)
  - 2.4.2: Mineral acid hydrolysis
  - 2.4.3: Sequential mechanical, chemical and enzymatic treatment
  - 2.4.4: Mechanical treatment

# Task 2.4.2: Mineral acid hydrolysis

- Provide benchmark to alternative hydrolysis methods
- Cut *Saccharina latissima* and *Palmaria palmata*
- Hydrolysis at 100 or 130 °C for 60 minutes
- Low acid and biomass load
  - 2, 4 or 8% (w/dw) H<sub>2</sub>SO<sub>4</sub>
  - 1:10 biomass:liquid ratio
- High acid and biomass load
  - 10 or 20% (w/dw) HNO<sub>3</sub>
  - 1:4 biomass:liquid ratio
- 100 ml scale



# Task 2.4: Acid hydrolysis (2)

- Sample analysis
  - HPAEC for sugars
  - Commercial kits (Megazyme) for mannitol, xylose and glucose
  - Kjeldahl for protein analysis
  - Dry weight (105 °C) and ash (550 °C)



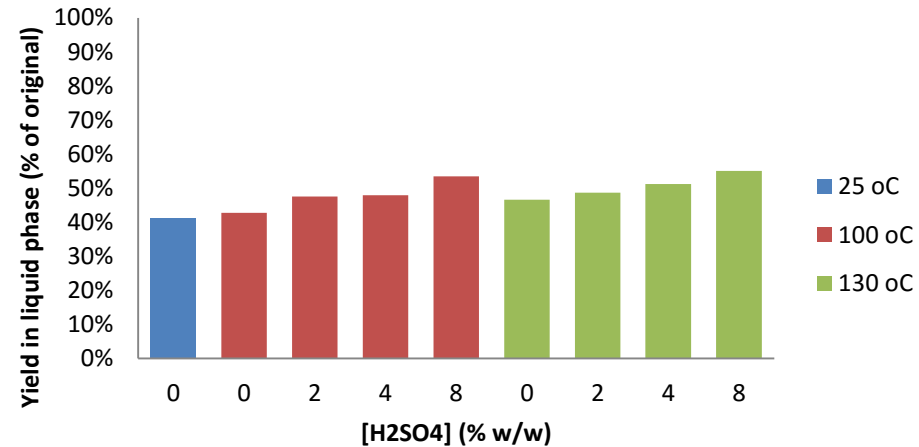
Species	Dry weight	Ash	Protein	Carbohydrates	Sulfate	Gap
	% of ww	% of dw	% of dw	% of dw	% of dw	Calculated
<i>S. Latissima</i>	84.5%	43.0%	13.3%	14.2%	3.8%	26%
<i>P. Palmata</i>	68.7%	22.0%	12.3%	58.1%	2.1%	6%

Species	Glucose	Xylose	Galactose	Fucose	Rhamnose	Glycerol	Mannitol
	% of dw	% of dw	% of dw	% of dw	% of dw	% of dw	% of dw
<i>S. Latissima</i>	5%	0%	1%	2%	0%		7%
<i>P. palmata</i>	4%	31%	15%	0%		7%	

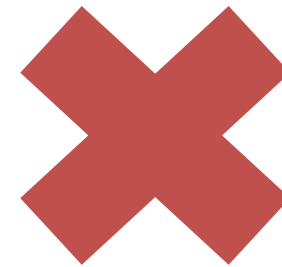
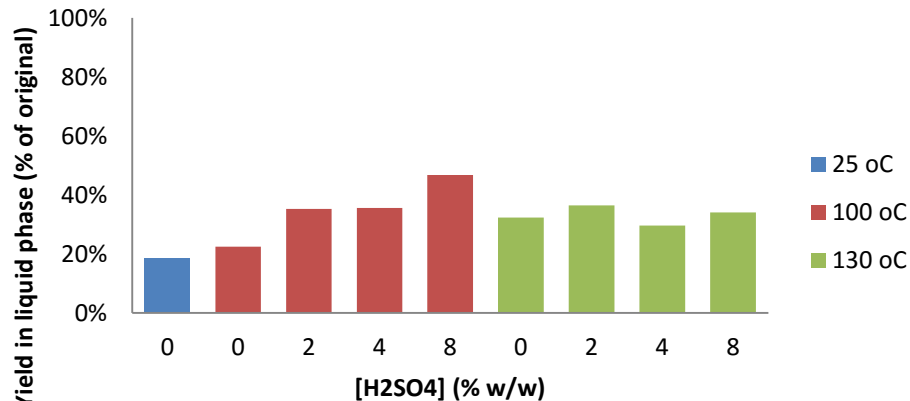
# Task 2.4: Acid hydrolysis Saccharina (low acid load)

- 1:10 biomass ratio
- 46% mannitol released (5 g/L)
- No glucose detected
- Acid effect on dw (max 55%)

### Dry weight release



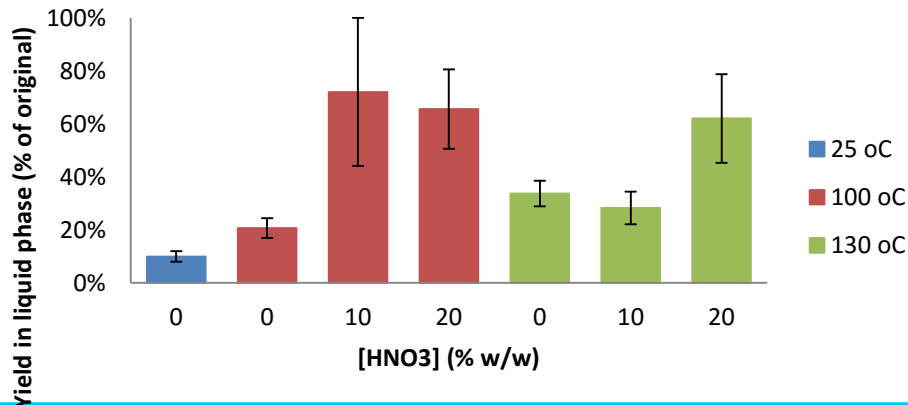
### Mannitol release



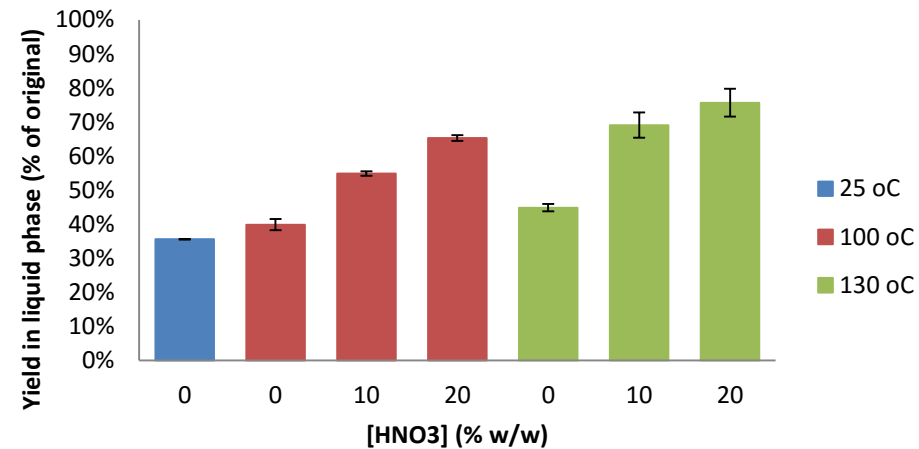
# Task 2.4: Acid hydrolysis Saccharina (high acid load)

- 1:4 biomass:liquid
- Up to 80% of dry matter hydrolysed
- Up to 60% mannitol released
- Up to 3% glucose released
- Acid effect on dw, mannitol and glucose

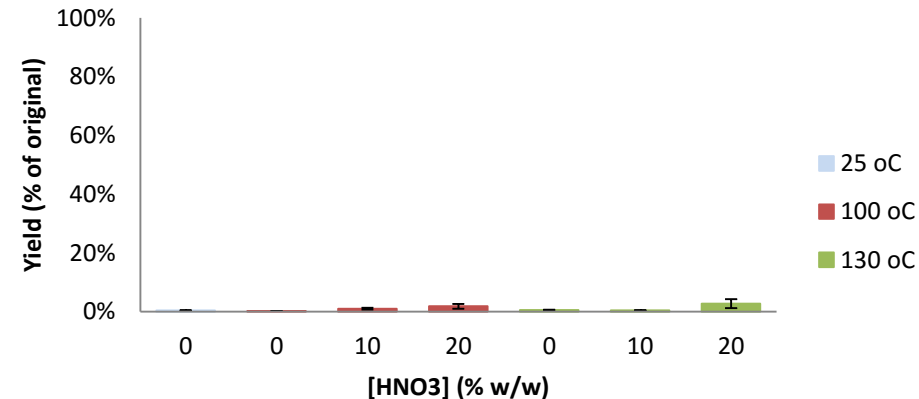
### Mannitol release



### Dry matter release



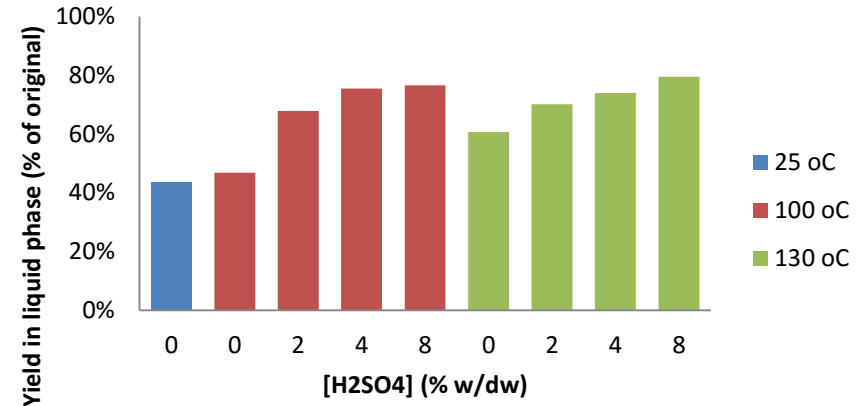
### Glucose release



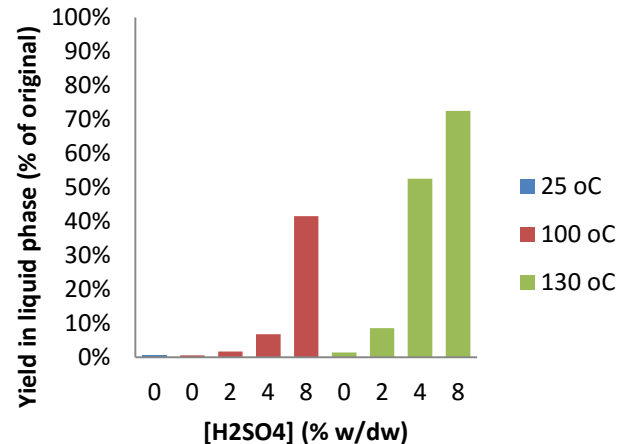
# Task 2.4: Acid hydrolysis *Palmaria* (low acid load)

- 1:10 biomass ratio
- Up to 80% dw solubilised
- 73% gal, 53% glu, 81% xyl
- 41 g/L reducing sugars

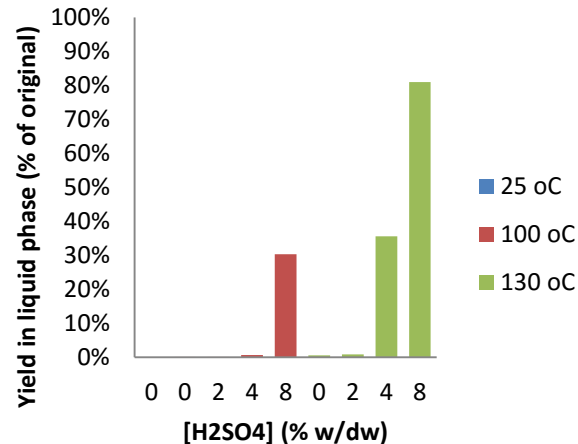
### Dry matter release



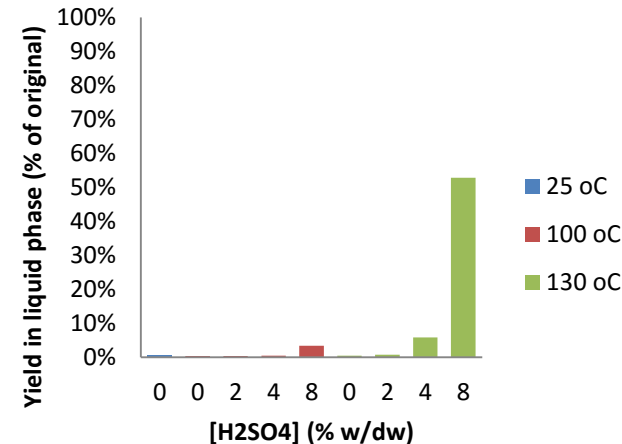
### Galactose release



### Xylose release



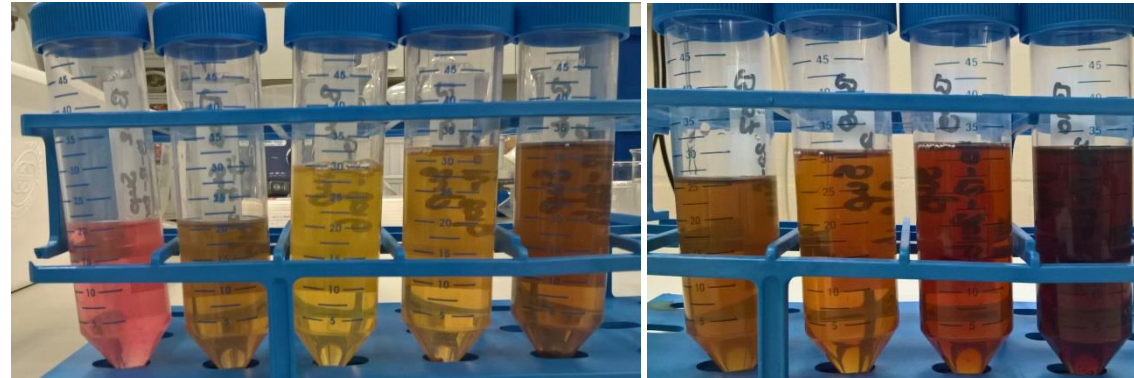
### Glucose release



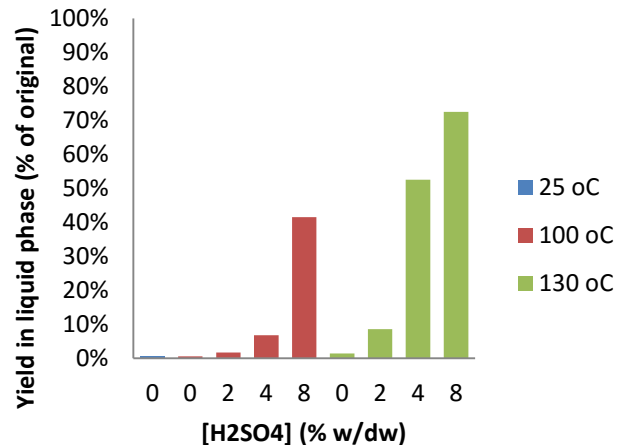


# Task 2.4: Acid hydrolysis *Palmaria* (low acid load)

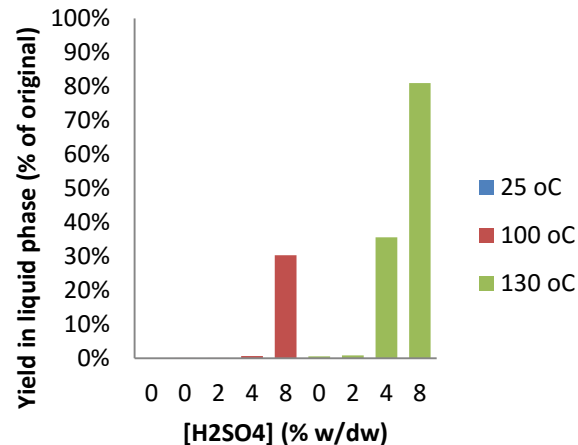
- Water release
- Colouration of liquid phase



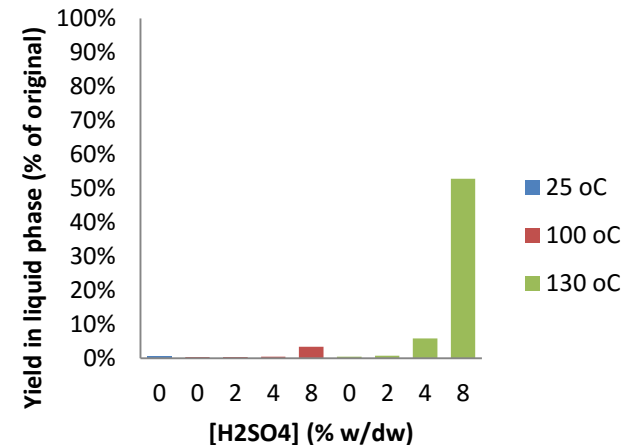
### Galactose release



### Xylose release



### Glucose release



# Task 2.4: Acid hydrolysis

- Buffering capacity in brown seaweed
- Salts? Remove by washing

Exp.	T (°C)	Acid load (HNO <sub>3</sub> wt%)	Time (min)	pH start	pH end
B93	25	0	60	7.1	7.8
B94	100	0	"	7.2	6.8
B95	"	2	"	5.3	6.0
B96	"	4	"	4.8	5.6
B97	"	8	"	3.6	3.7
B98	130	0	"	7.2	6.5
B99	"	2	"	5.3	6.0
B100	"	4	"	4.7	5.8
B101	"	8	"	3.6	5.0

# Conclusions

- Saccharina resistant to acid hydrolysis
- Reducing sugars from Palmaria easily released

# Future work

- Hydrolysis with weak acids (acetic acid, lactic acid, etc)
- Task 2.4.4 Mechanical pre-treatment (grinding, pressing, refining, extrusion)
- Task 2.4.3 Combine acid hydrolysis with washing and pressing to reduce buffering effect, and remove ash/mannitol before hydrolysis

# Acknowledgement



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