



1. Problem and Solution proposed

Onion skin wastes (OSW) represent 10% of the onion production (104 Mt worldwide, 2020) and end up in landfills because they are not suitable for human consumption or animal feeding. OSW are a source of quercetin and pectin, a biopolymer of 1,4-D-galacturonic acid (GalA) highly demanded by the industry.

KEY ASPECTS

- ✓ Pectin has growing worldwide demand (40,000 t/y), increasing at 5% rate
- ✓ New sources of pectin and new recovery strategies are demanded

EXTRACTION

Subcritical Water, to promote the hydrolysis of onion skin wastes to extract pectin
Drawback: control of the experimental conditions which can lead to the formation of undesired degradation products

DOWNSTREAM PROCESSING

To remove the undesired products formed during the extraction, pressure-driven **membrane** processes in **diafiltration** operation mode can provide a technically feasible alternative to conventional separation by precipitation

2. Experimental Results

2.1. Subcritical Water Extraction

Raw Material

- Onion Skin Wastes (30% GalA)

Experimental Device

- ✓ Batch 500 mL extractor; 15 g OSW + 350 mL H₂O

Experimental Conditions

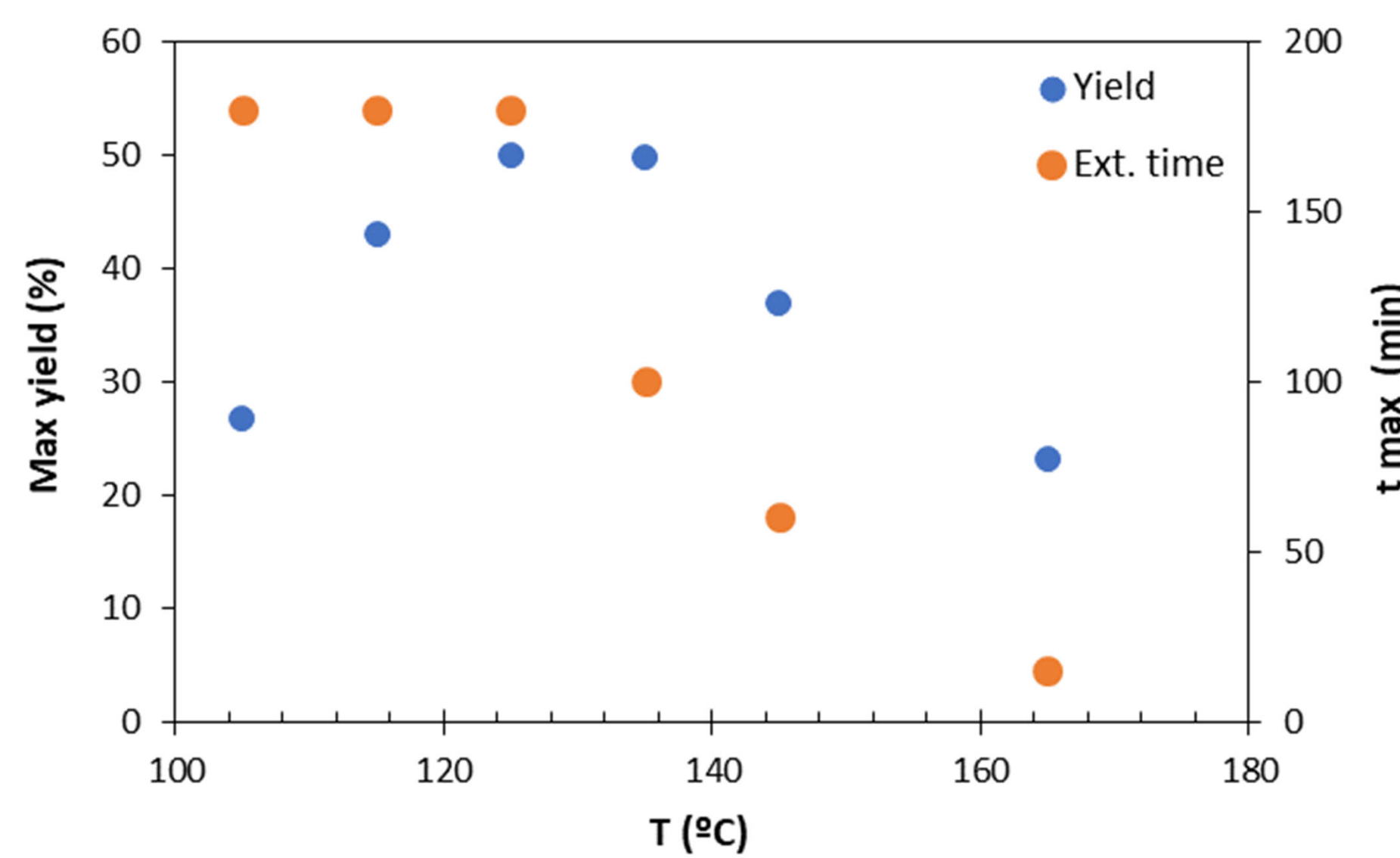
- 105 to 165 °C, at 5MPa; up to 180 min

Analysis

- **HPLC:** free sugars + degradation products (formic & acetic acid; furfural) + GalA
- **GPC:** Pectin molecular weight (MW)

Calculations:

- Pectin Yield: GalA extracted/GalA in OSW



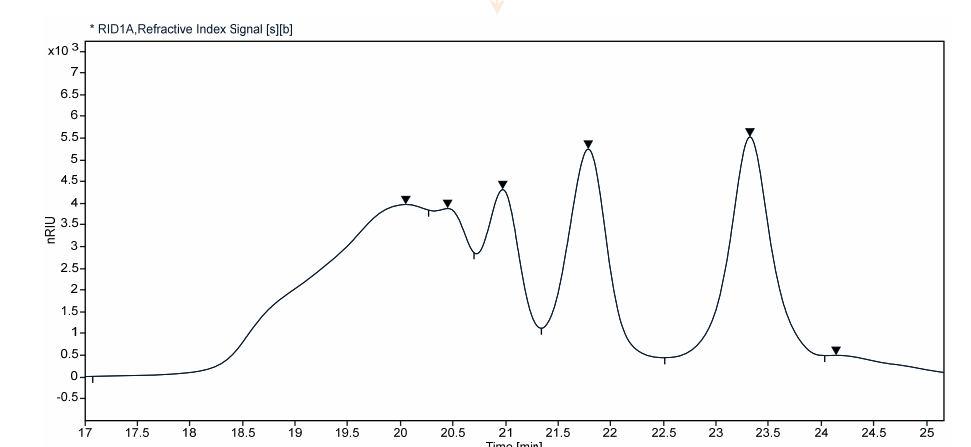
OPTIMAL CONDITIONS

135 °C, 100 min; 49.7±0.6% GalA extraction yield

135 °C OSW hydrolysate composition

	mg/L
GalA	5169±58
Free sugars	324±4
Formic acid	407±9
Acetic acid	118±6
Furfural	41±2
pH	3.76±0.06

Complex MW distribution, up to 4 families ranging 85, 35, 20 and <6 kDa



2.2. Membrane Purification

Membranes

- Multichannel 100 kDa, 128 cm²
- Ceramic, TiO₂ (Tami Industries)

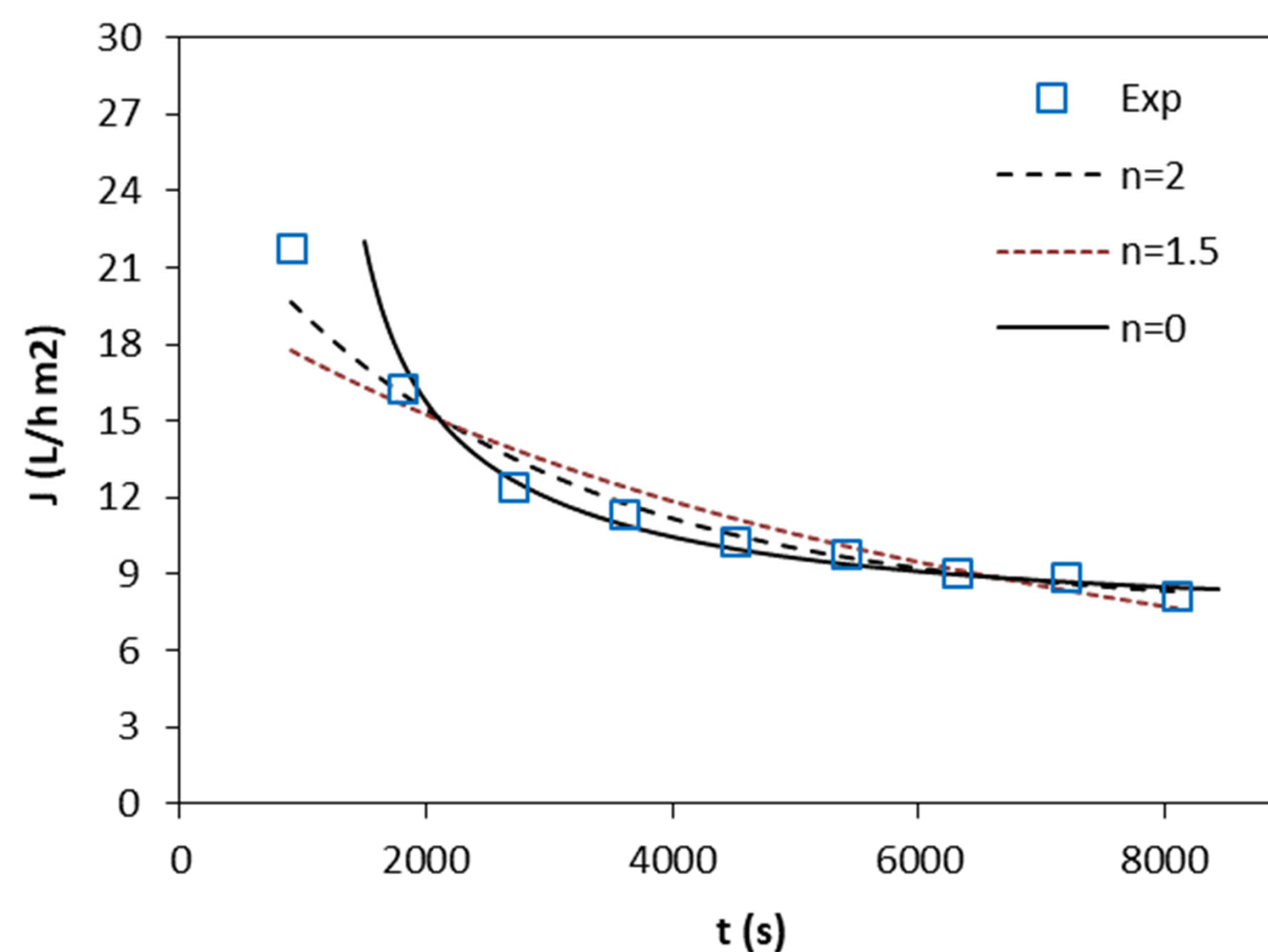
Operating Mode

- Diafiltration at 25 °C
- Diafiltration Volumes: up to 6

Fouling modelling

- Hermia's model:

$$\frac{dJ}{dt} = -k \cdot (J - J^*) \cdot J^{2-n}$$

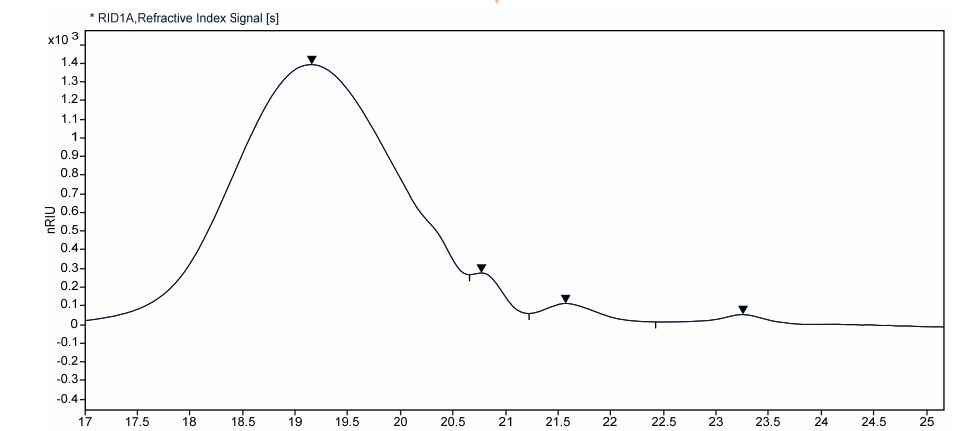


PERMEATE FLUX CURVE

J*: 9 L/h·m²; Fouling: cake layer formation (n=0)

After diafiltration process

- >99% impurities removed
- One single MW family
- >85 kDa



3. Conclusions

- The extraction of pectin was temperature sensitive, reaching a maximum at 135 °C. Pectin suffered degradation during SubW extraction (complex molecular weight distribution) and organic acids and furfural were the main impurities formed
- Downstream processing (100 kDa ceramic membrane operated in diafiltration mode) provided a successful purification: a removal >99% of the impurities and one single pectin fraction (MW> 85 kDa) was obtained