XXXV JORNADAS NACIONALES DE INGENIERÍA QVÍMICA

Salamanca, 4-6 julio 2018

Continuous microwave processing of olive-pomace for active compounds recovery

Ana Álvarez, Mª José Cocero, Rafael B. Mato*
Instituto de Bioeconomía
Departamento de Ingeniería Química y Tecnología del Medio Ambiente
Universidad de Valladolid

1

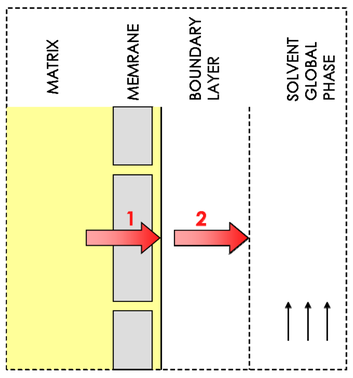
Extraction of compounds from natural products

- Raw materials: plants and residues
- Uses : medicine, food, cosmetics and pharmaceuticals

The problem: slow extraction kinetics.

1. Internal diffusion
2. External mass transfer

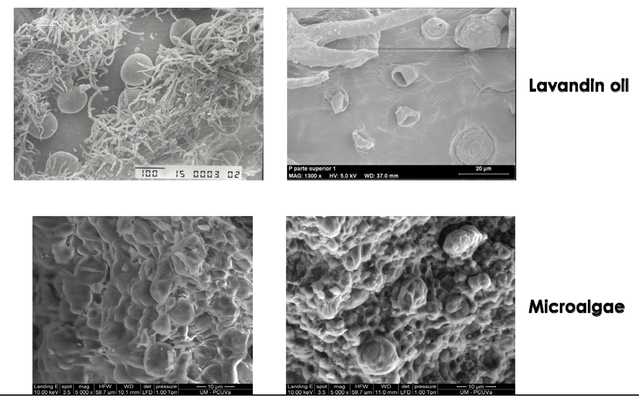
Internal diffusion: Limiting step



2

Microwave Assisted Extraction (MAE)

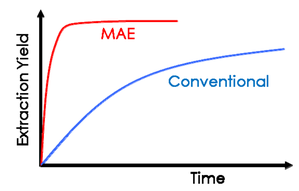
Microwaves alter the cellular structure



3

Benefits

- Shorter extraction times
- Reduction of energy demand
- Reduction of solvent in process
- Quality of extracts



Numerous papers in literature

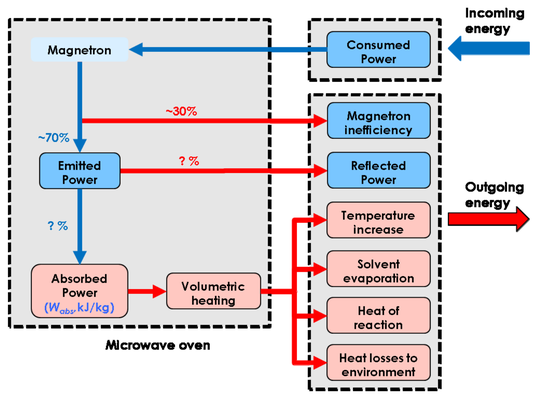
- Non-reproducible results
- Not suitable for upscale

Industrial upscale requirements

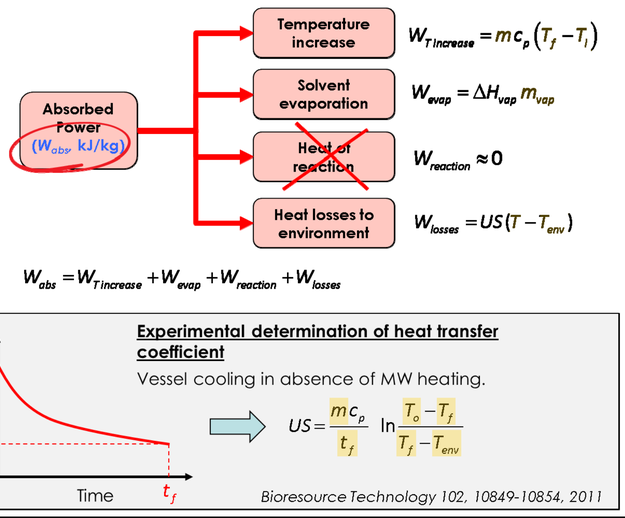
1. Correct process characterization: Specific absorbed energy
2. Expensive energy and oven → Pretreatment
3. Efficient → Proper oven design ⇦ Dielectric properties

4

1. Correct process characterization: Specific absorbed energy

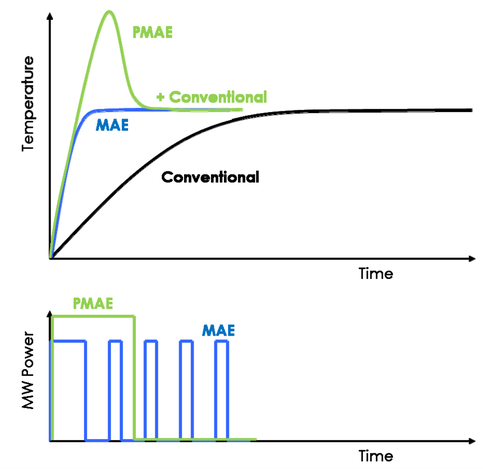


5



6

2. Expensive energy and oven → Pretreatment (PMAE)

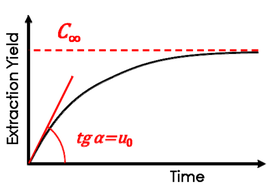


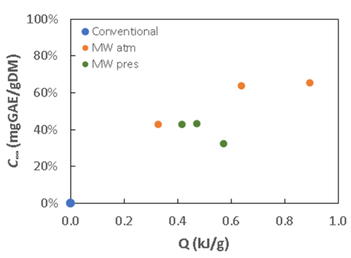
7

Extraction results

$$C = C_0 + (C_\infty - C_0)\cdot(1 - e^{-k\cdot t})$$

$$u_0 = \left.\frac{dC}{dt}\right|_{t=0} = C_{INF}\cdot k$$





SFME		
Q total (kJ/g) (kJ/g)	u_0 (mg_{GAE}/g_{DM}.s)	Δu_0 %
0.00	0.62	-
0.47	2.95	377%
0.89	1.77	185%

8

3. Efficient → Proper oven design ⇦ Dielectric properties

Dielectric constant:

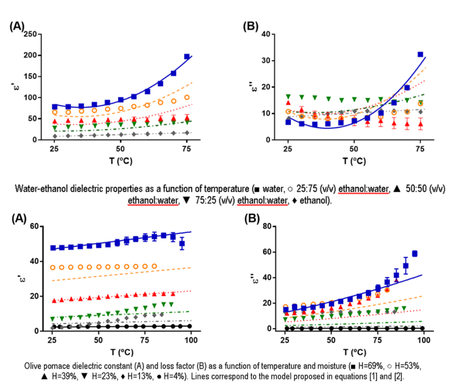
$$\varepsilon_r = \varepsilon_r' + j\varepsilon_r''$$

Loss tangent:

$$\tan\delta = \frac{\varepsilon''}{\varepsilon'}$$

Energy density:

$$P''' = 2\pi f \varepsilon_0 \varepsilon'' E^2$$



Water-ethanol dielectric properties as a function of temperature (■ water, ○ 25:75 (v/v) ethanol:water, ▲ 50:50 (v/v) ethanol:water, ▼ 75:25 (v/v) ethanol:water, ♦ ethanol).

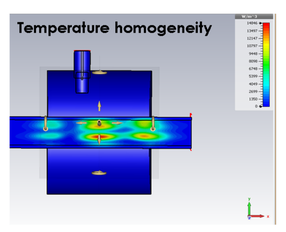
Olive pomace dielectric constant (A) and loss factor (B) as a function of temperature and moisture (■ H=69%, ○ H=53%, ▲ H=39%, ▼ H=23%, ♦ H=13%, ● H=4%). Lines correspond to the model proposed in equations [1] and [2].

Colaboration: Dr. José Manuel Catalá Civera
Instituto de Tecnologías de la Información y la Comunicación (ITACA)
Universitat Politècnica de València (UPV)

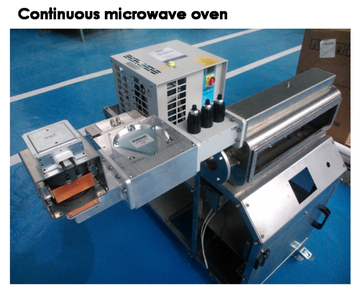
9

3. Efficient → Proper oven design ⇦ Dielectric properties

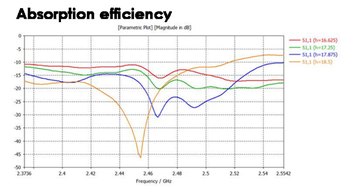
Temperature homogeneity



Continuous microwave oven



Absorption efficiency



Colaboration: Dr. Juan Monzó Cabrera
Departamento de Tecnologías de la Información y las Comunicaciones
Universidad Politécnica de Cartagena

Aknowledgements: This work was funded by Junta de Castilla y León regional project VA040U16. Ana Álvarez would like to thank Spanish Ministry of Education for her fellowship FPU13/04678.