



**GROUPE DE RECHERCHE
EN ECO-EXTRACTION
DE PRODUITS NATURELS**

Eco Extraction

CCCM – Avignon 12-13 Avril 2017



GREEN or ECO - EXTRACTION

Ecologic



Economic



Competitiveness



Int. J. Mol. Sci. **2012**, *13*, 8615-8627; doi:10.3390/ijms13078615

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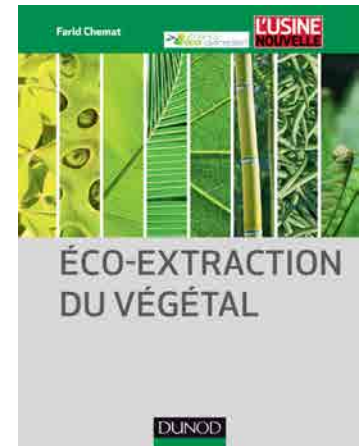
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Review

Green Extraction of Natural Products: Concept and Principles

Farid Chemat ^{1,*}, Maryline Abert Vian ¹ and Giancarlo Cravotto ²



SPECIFIC EQUIPEMENTS

Green Extraction of Natural Products

Ultrasound Extraction Reactors

Lab reactors
Hielscher UIP 1000 (20kHz, 1000W) 1 L or 40 L per h
REUS (25 kHz, 200 W, 3 L)

Pilot Plant
Hielscher (20kHz, 4000W) 1000 L per h
REUS (25 kHz, 800 W) 30 L

Microwave Extraction Reactors

Lab reactors

NEOS-GR
High-Pressure Microwave Reactor for Microwave Fluid-Extraction and Heating (HME)

Pilot Plant

Green Solvents

Solvent free extraction

H₂O

Green solvent

CO₂

Supercritical fluid

Natural solvent

Vegetable oil
Alcohol

Eco-solvent

Glycerol,
Limonene

Petroleum sourced
volatile organic solvent

Methanol, Hexane

COSMOthermX
Version C30_1301
©2013 COSMOlogic GmbH & Co. KG

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Computational Chemistry and Fluid Thermodynamics

Compressed Fluid as Green Solvents

EQUIPEMENT REALISATION : Examples

Overcoming technology limitations by creating devices for our research and education



From primary school
to Master degree

SOCIETE Legallais
Fournitures pour laboratoires



MILESTONE
HELPING
CHEMISTS

GREEN Extraction Team: Technology Readiness Level ?

GREEN

Manufacturers & Platforms
(Milestone, PEEV,...)

INDUSTRY
(LabCom, FUI, Patents)

Knowledge Development

Technology Development

Business Development

TRL1

TRL2

TRL3

TRL4

TRL5

TRL6

TRL7

TRL8

TRL9

Basic technology
research

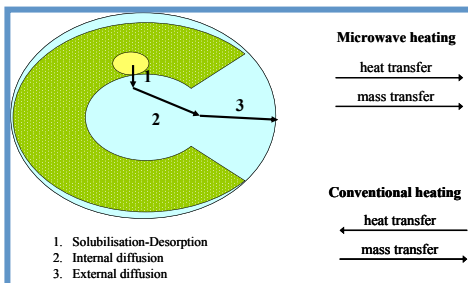
Research to
prove feasibility

Technology
demonstration

Technology
development
and prototypes

Pilot plant and scale up

Market launch and
commercialisation



WHAT IS THE FUTURE OF GREEN EXTRACTION ?

From Concepts to Research, Education and Economical opportunities



**GNP International NETWORK
FROM PLANT TO MOLECULE
UNTILL MARKETS AND REGULATIONS**

**GNP CONGRESS
GERMANY 2018**

ISO Standard and Label

**Recycle Waste to Ingredients
Innovation: Process, Solvent,
procedures and applications**

