



# Eco-extraction de coproduit à l'aide de technologies innovantes et de solvants verts

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Qualité sensorielle



Structure de l'aliment

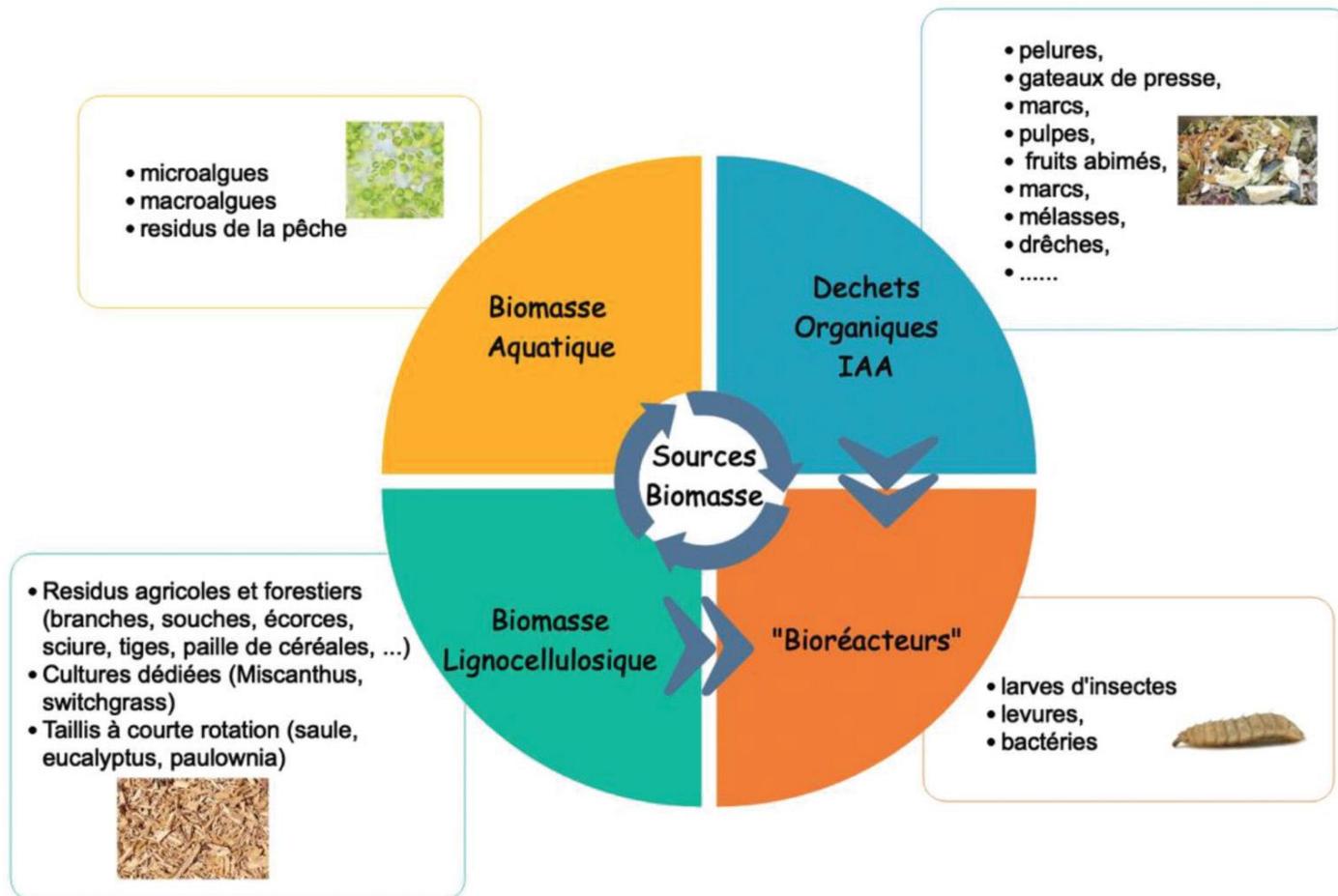


Technologies et procédés agroalimentaires

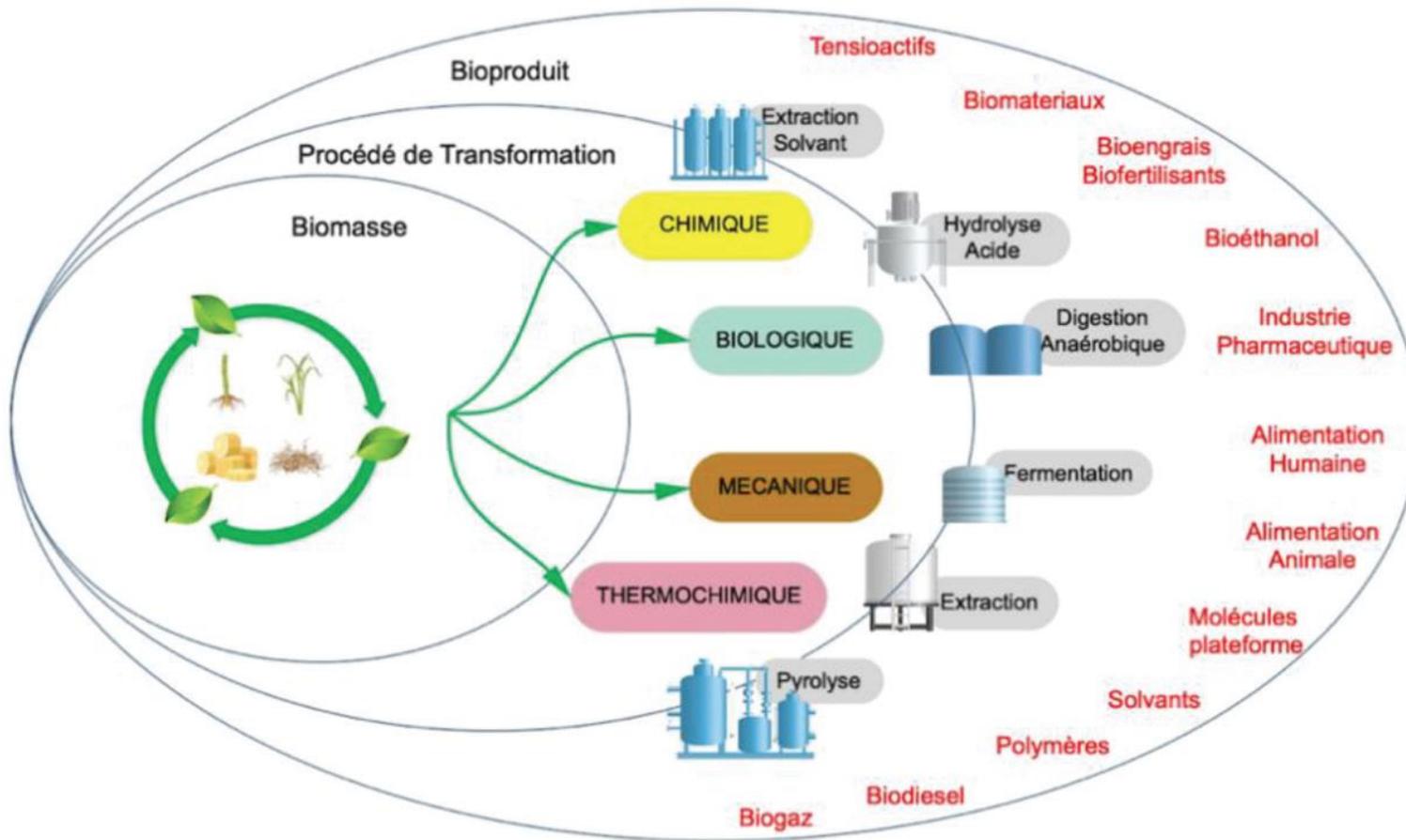


Qualité nutritionnelle et effets sur la santé

# Gisement renouvelable de biomasse

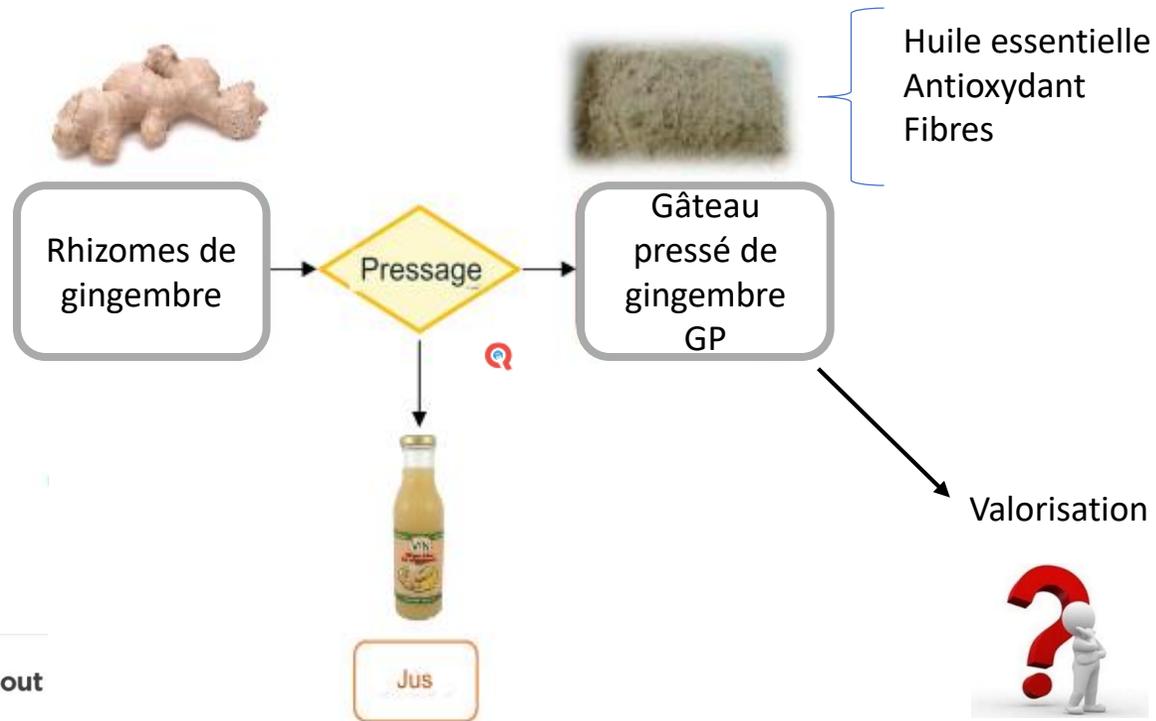


# Concept de bioraffinerie



# Concept de bioraffinerie

Valorisation totale des sous produits du gingembre selon un concept de bioraffinerie



Issue 10, 2016



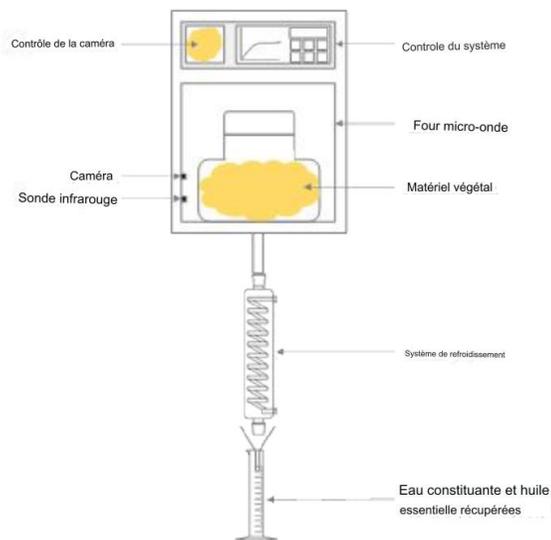
From the journal:  
**Green Chemistry**

**Towards a “dry” bio-refinery without solvents or added water using microwaves and ultrasound for total valorization of fruit and vegetable by-products**

M. Jacotet-Navarro,<sup>abc</sup> N. Rombaut,<sup>ab</sup> S. Deslis,<sup>ab</sup> A.-S. Fabiano-Tixier,<sup>ab</sup> F.-X. Pierre,<sup>c</sup> A. Bily,<sup>bc</sup>

# Concept de bioraffinerie

Le chauffage micro-ondes:



(un)

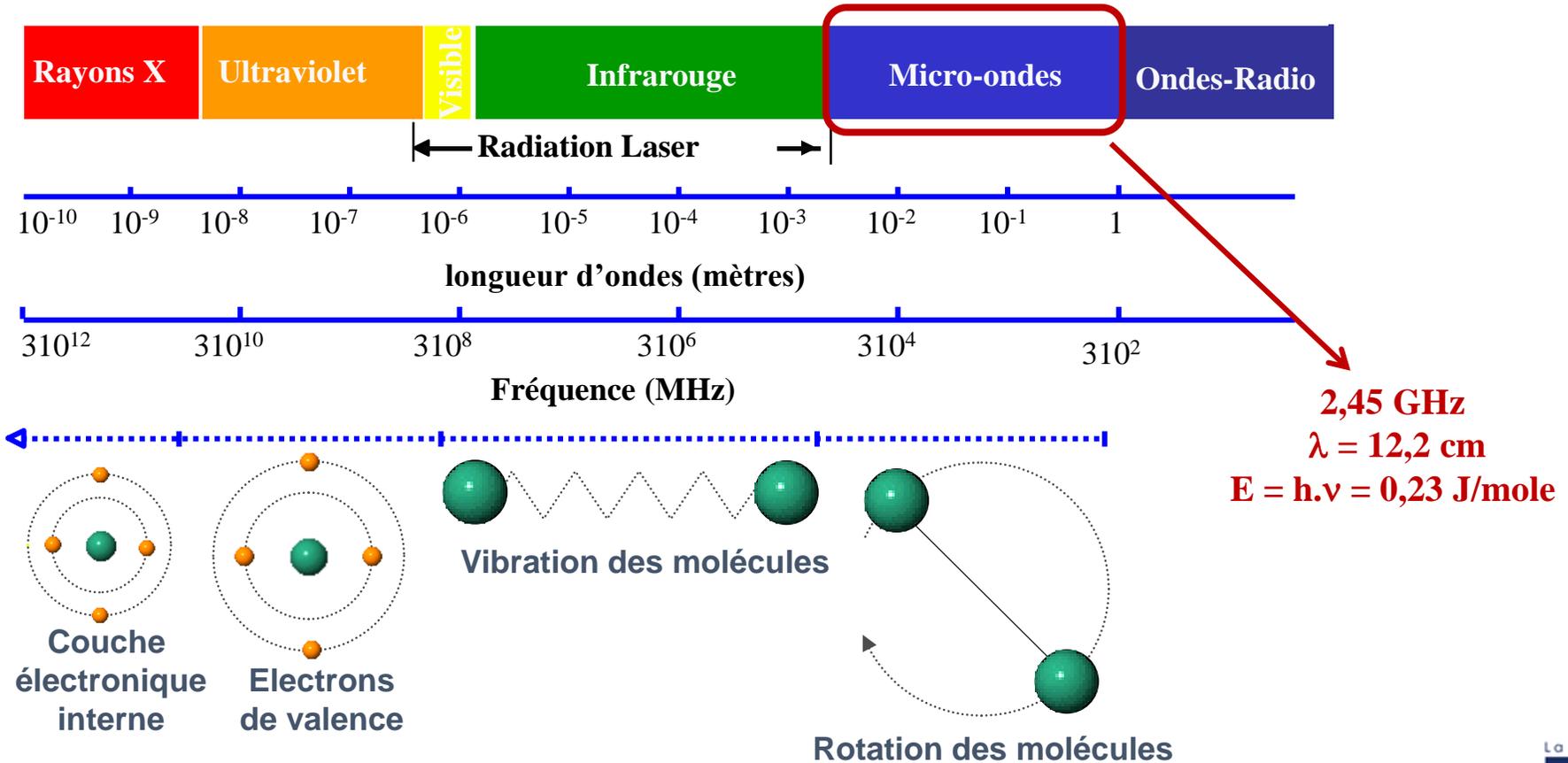


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# Concept de bioraffinerie

Micro-ondes

Spectre électromagnétique\*

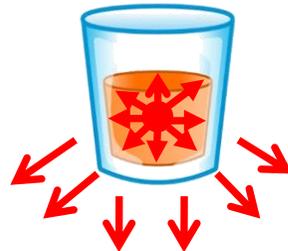
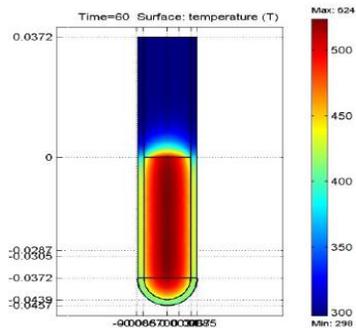


\* Neas, E. & Collins, M. Introduction to Microwave Sample Preparation: Theory and Practice (1988) 8.

# Concept de bioraffinerie

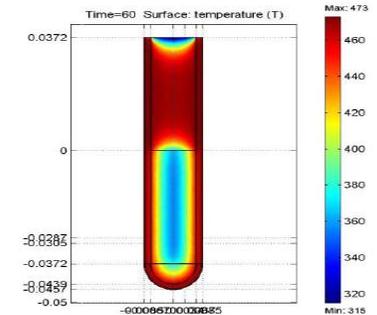
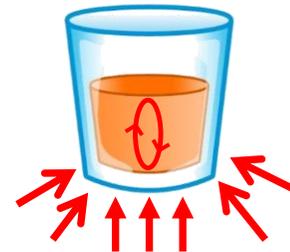
## chauffage micro-ondes versus chauffage conventionnel

### Chauffage par micro-ondes



- Taux de chauffage rapide
- Chauffage volumétrique
- Processus rapide
- Sélectif, directement au cœur de la matrice

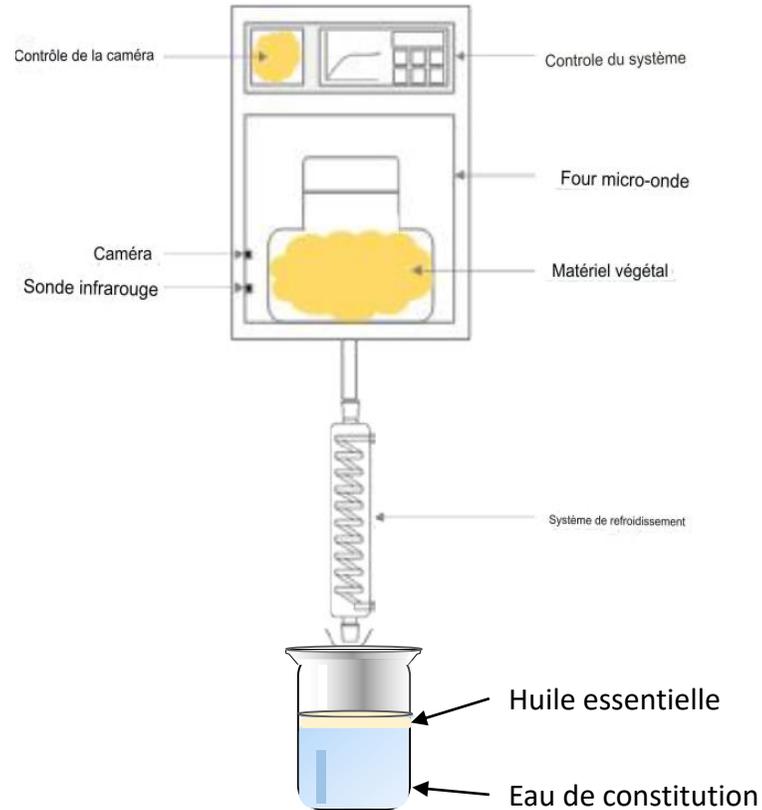
### Chauffage conventionnel



- Taux de chauffage lent
- Chauffage superficiel
- Processus lent
- Non sélectif

# Concept de bioraffinerie

Le chauffage micro-ondes:



# Concept de bioraffinerie

Le chauffage micro-ondes: Composés volatils et antioxydants extraits du matériel végétal du gingembre

		GR	GP	GPMHG							
				0.6 W/g	0.8 W/g	1.0 W/g	1.2 W/g	1.4 W/g	1.6 W/g	1.8 W/g	
Essential oil	Yield (g/100g fresh plant material)	0.2	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
	Major compounds (%)	α-pinene	1.2	1.0	2.3	2.6	2.4	2.6	2.3	2.4	2.2
		camphene	4.3	3.8	9.1	10.3	9.2	10.0	9.1	9.4	9.1
		sabinene	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
		sulcatone	0.0	0.8	1.2	2.8	3.3	3.2	3.0	3.2	2.9
		myrcene	0.6	0.6	0.0	1.4	1.4	1.4	1.3	1.3	1.1
		α-phellandrene	0.2	0.1	0.2	0.3	0.3	0.3	0.3	0.3	0.1
		limonene	0.9	0.9	1.7	1.9	1.9	1.9	1.7	1.8	1.7
		β-phellandrene	4.6	4.2	8.7	10.4	10.3	10.2	9.7	10.0	8.6
		terpinolene	0.1	0.1	0.1	0.1	0.3	0.3	0.3	0.3	0.2
		linalol	0.2	0.2	0.3	0.4	0.4	0.4	0.4	0.4	0.4
		borneol	0.5	0.6	0.8	0.9	1.0	0.9	1.0	1.0	1.1
		α-terpineol	0.2	0.3	0.4	0.5	0.5	0.5	0.5	0.5	0.6
		citronellol	0.1	0.3	0.2	0.5	0.4	0.3	0.4	0.4	0.8
		neral	1.7	0.5	0.4	1.3	1.5	1.7	1.5	1.5	1.3
		geraniol	0.1	0.2	0.1	0.3	0.3	0.2	0.2	0.2	0.6
		geranial	3.3	1.0	0.6	1.9	2.2	2.6	2.3	2.5	2.3
		geranyl acetate	0.3	0.1	0.4	0.2	0.2	0.2	0.2	0.2	0.2
		α-curcumene	3.5	13.9	17.0	7.6	7.2	6.6	7.0	6.8	9.9
		germacrene D	1.6	1.3	0.1	1.3	1.4	1.4	1.4	1.4	0.7
zingiberene	35.7	25.2	18.4	23.2	24.0	24.0	25.1	24.3	18.4		
α-farnesene	6.5	6.5	6.3	5.4	5.5	5.5	5.7	5.5	5.7		
β-bisabolene	5.7	6.8	0.0	4.8	4.7	4.6	4.8	4.7	5.4		
β-sesquiphellandrene	12.1	13.9	12.3	9.9	9.9	9.7	10.2	9.8	10.4		
Antioxydants	Total content (g/100 g plant material DW)	1.17	0.90	0.57	1.24	1.06	1.18	1.22	1.37	1.18	
	Major compounds (g/100 g plant material DW)	6-gingerol	0.77	0.58	0.31	0.81	0.65	0.79	0.81	0.92	0.79
		8-gingerol	0.15	0.11	0.07	0.14	0.11	0.14	0.14	0.17	0.14
		10-gingerol	0.23	0.19	0.11	0.18	0.19	0.19	0.19	0.21	0.19
		6-shogaol	0.02	0.02	0.08	0.11	0.10	0.08	0.09	0.08	0.08

DW: Dry weight

GR =



Rhizomes de gingembre

GP =

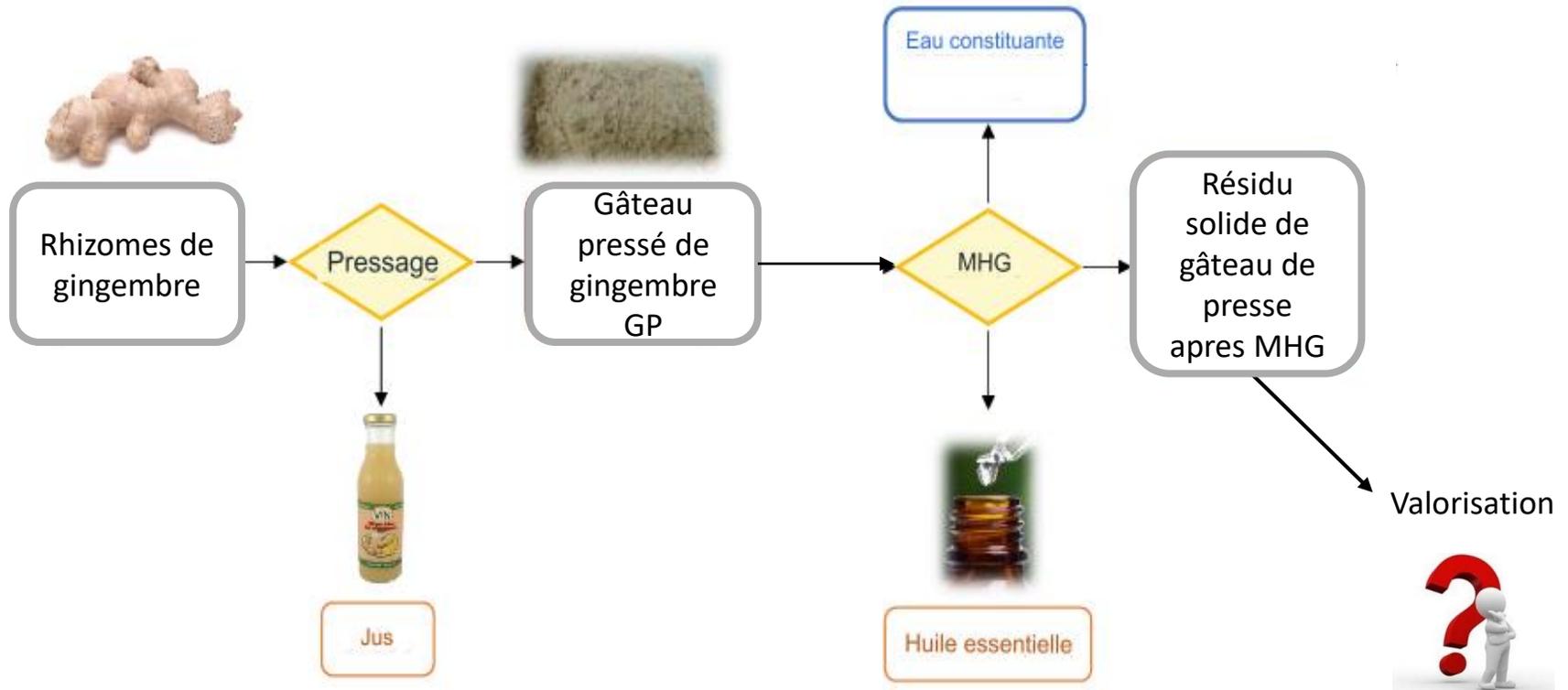


Gingembre pressé

GPMHG = purée de gingembre après MHG

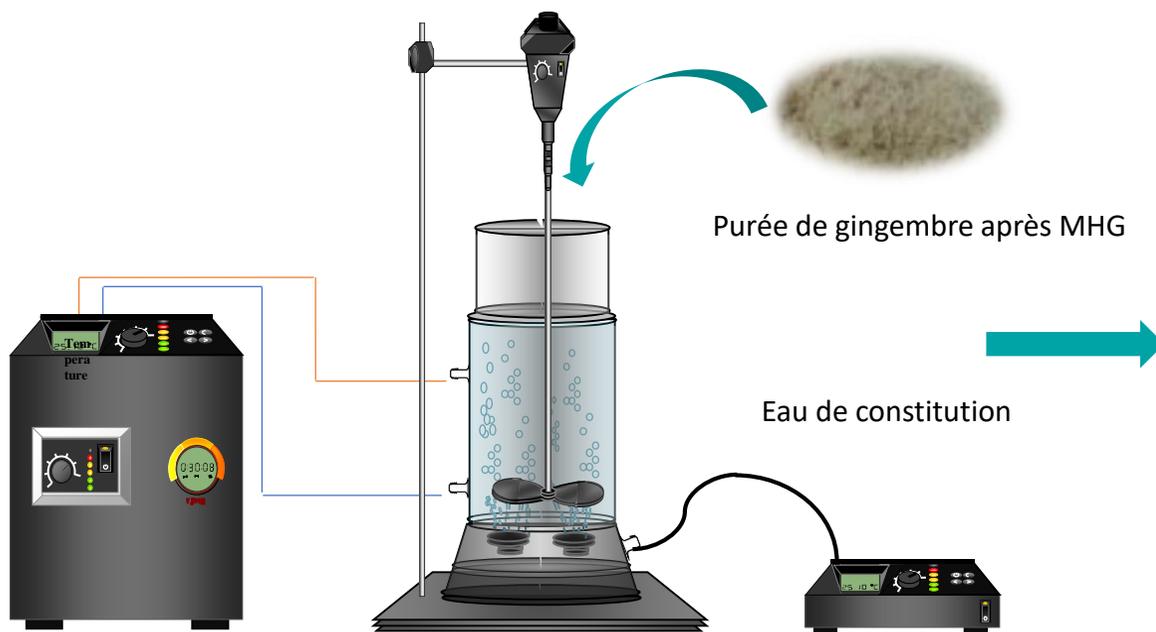
# Concept de bioraffinerie

Valorisation totale des sous produits du gingembre selon un concept de bioraffinerie



# Valorisation de coproduit

traction de métabolites secondaires



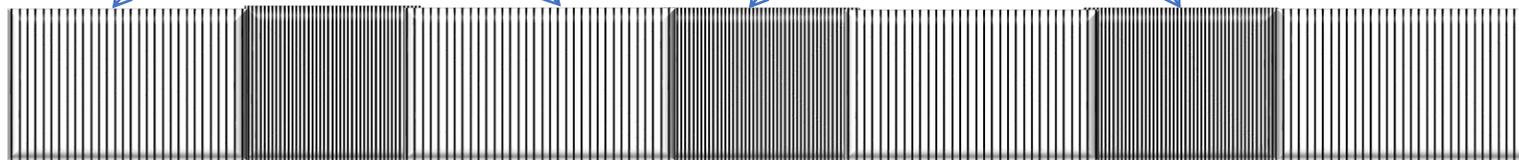
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# Valorisation de coproduit

Extraction de métabolites secondaires en utilisant des ultrasons

Décompression

Compression

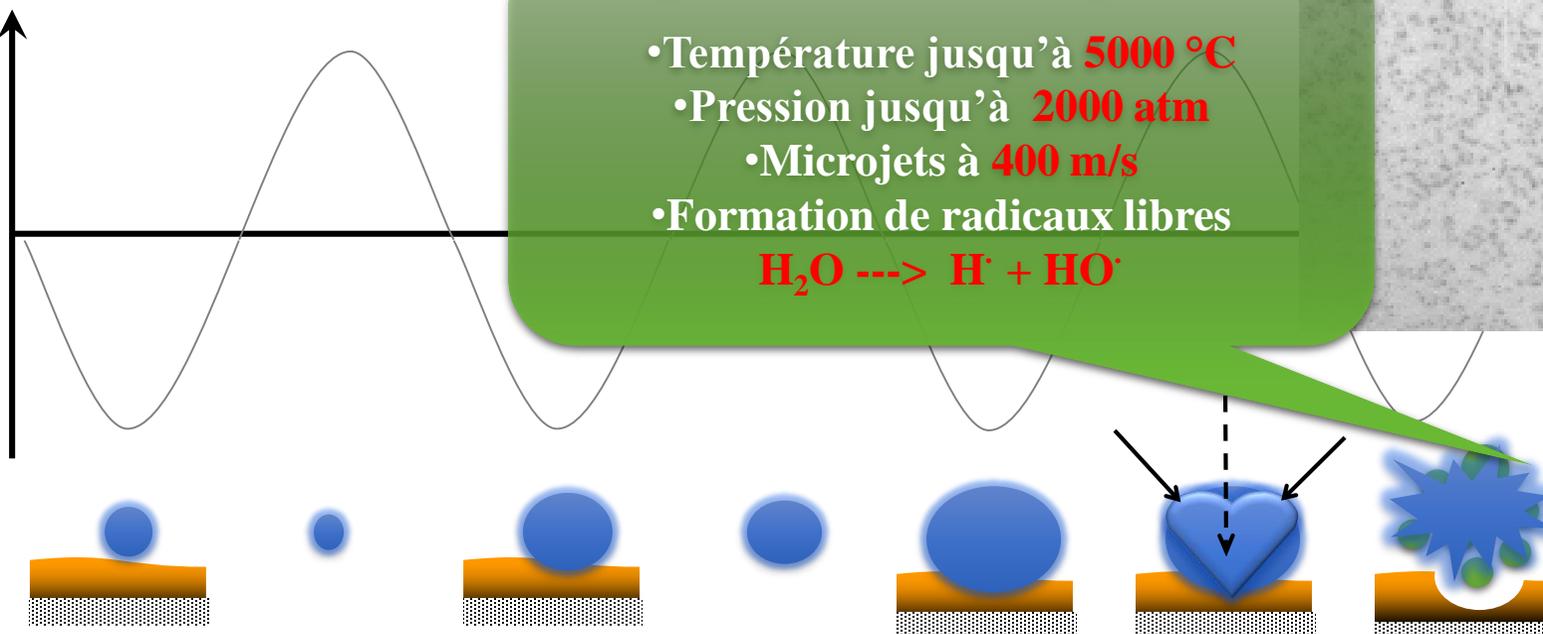


pression

+

0

-



Energie localisée très importante

- Température jusqu'à **5000 °C**
- Pression jusqu'à **2000 atm**
- Microjets à **400 m/s**
- Formation de radicaux libres  
 **$H_2O \rightarrow H^{\bullet} + HO^{\bullet}$**

Création

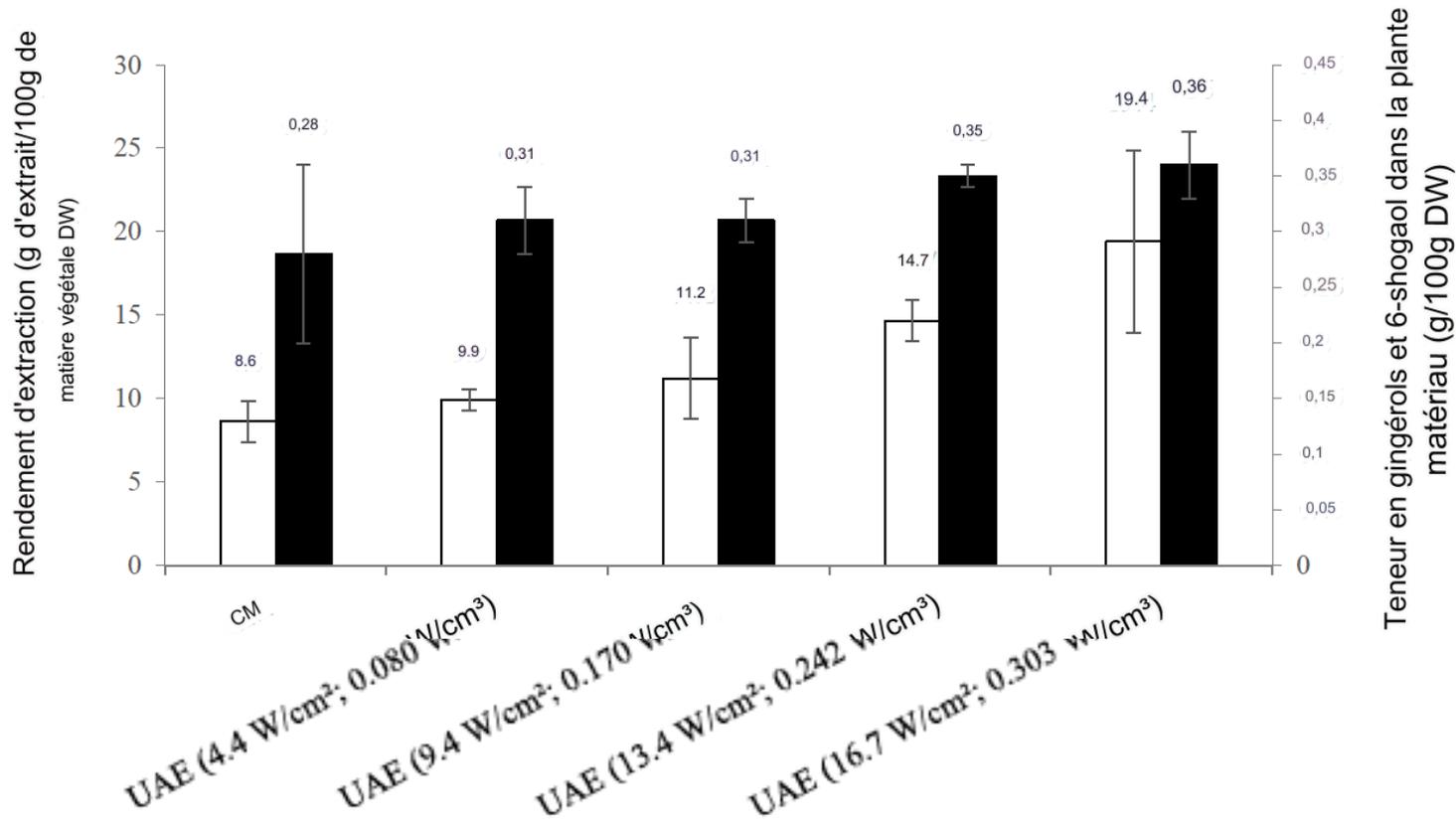
Croissance

Implosion

Décapage

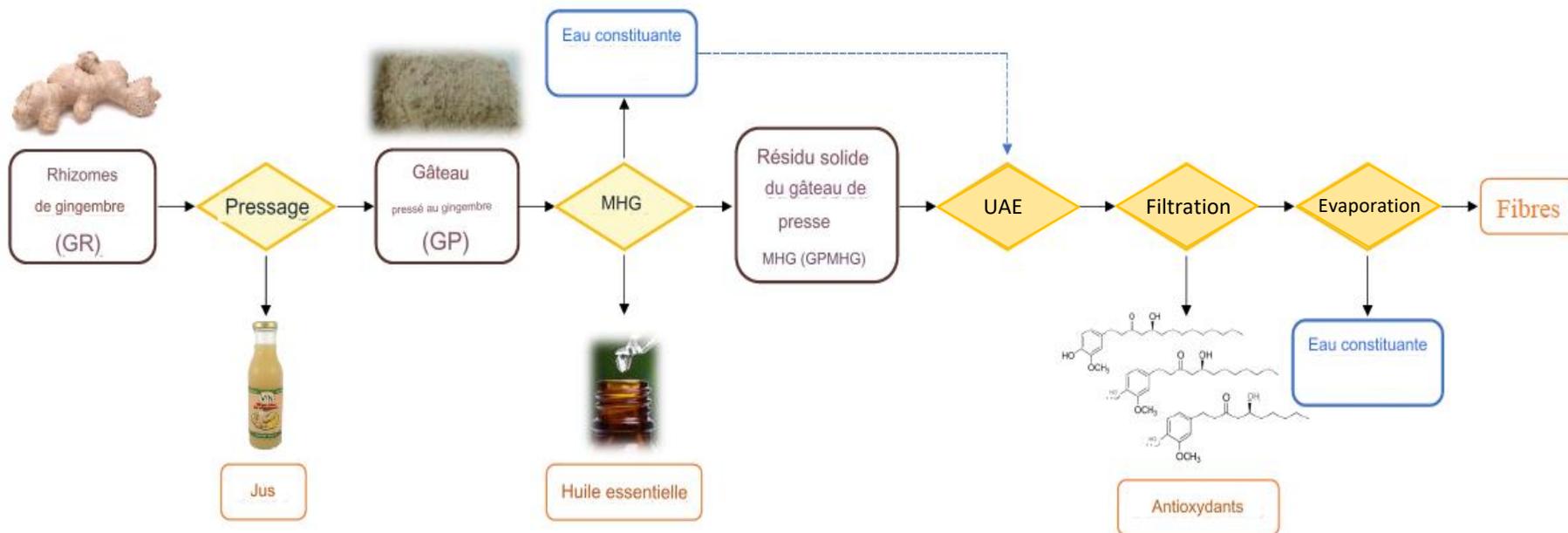
# Concept de bioraffinerie

- Effets des ultrasons sur le rendement d'extraction et sur la teneur en gingerols et en 6-shogaol dans l'extrait



# Concept de bioraffinerie

- Valorisation totale des sous produits du gingembre selon un concept de bioraffinerie



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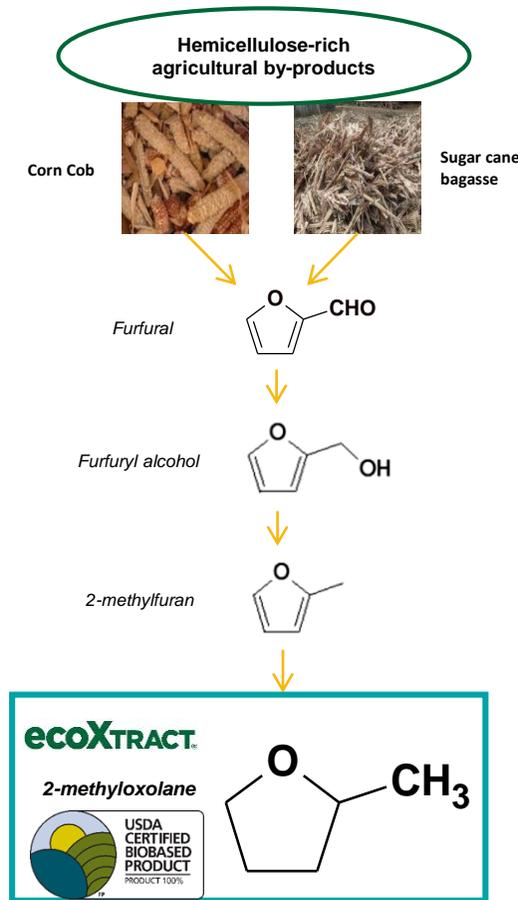
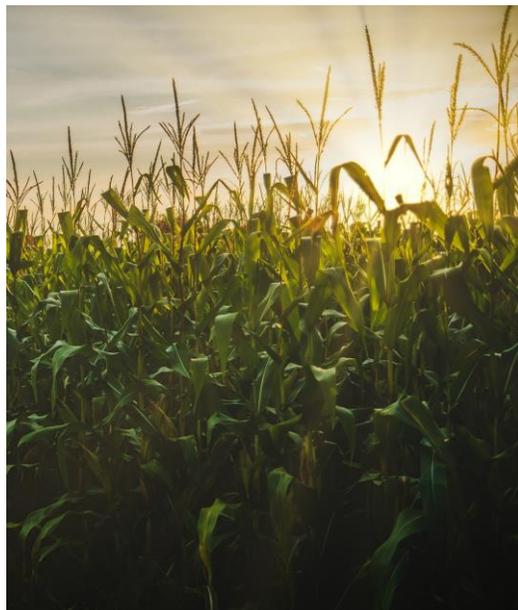
From the journal:  
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# Extraction à l'aide de solvant biosourcé

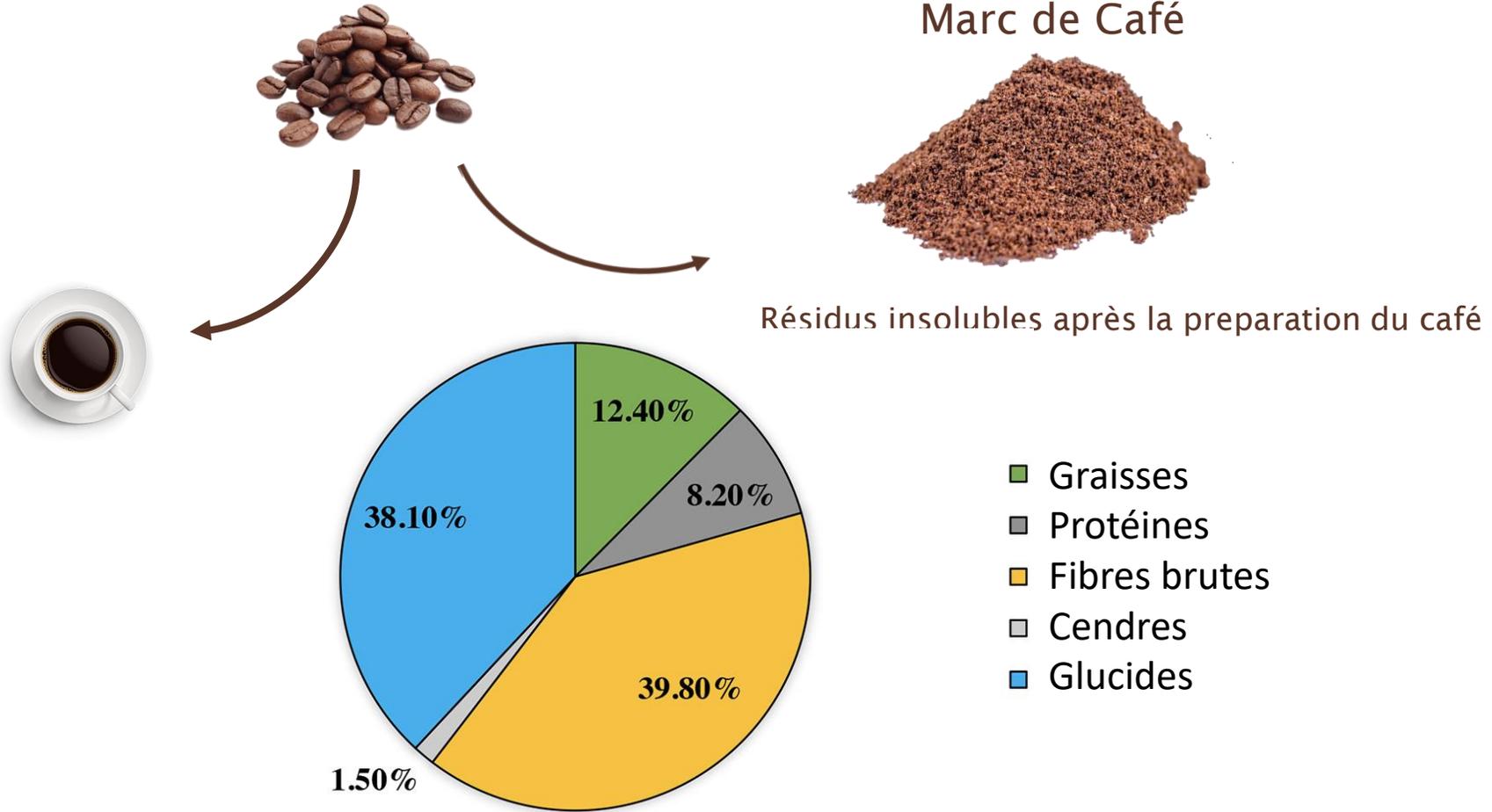
- EcoXtract® est dérivé de l'hémicellulose, que l'on trouve en grande quantité dans de nombreux sous-produits agricoles, et n'entre pas en concurrence avec l'offre alimentaire.

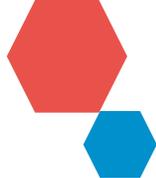
MeOx



# Extraction à l'aide de solvant biosourcé

Valorisation du marc de café

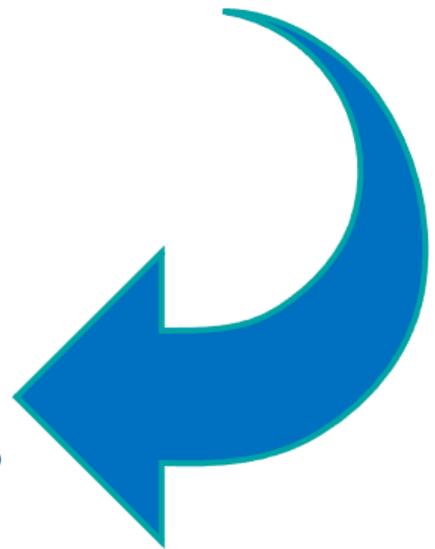
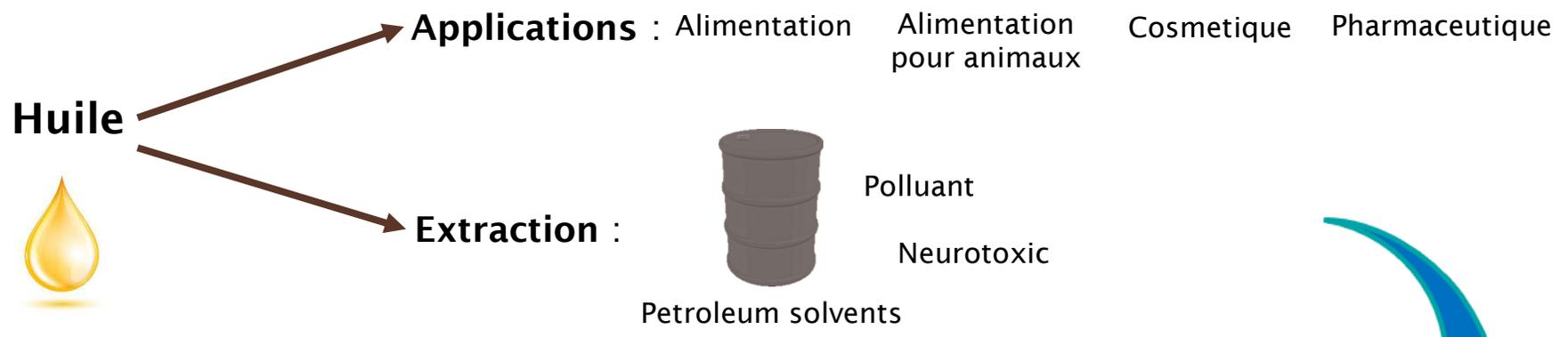




# Extraction à l'aide de solvant biosourcé



Valorisation du marc de café

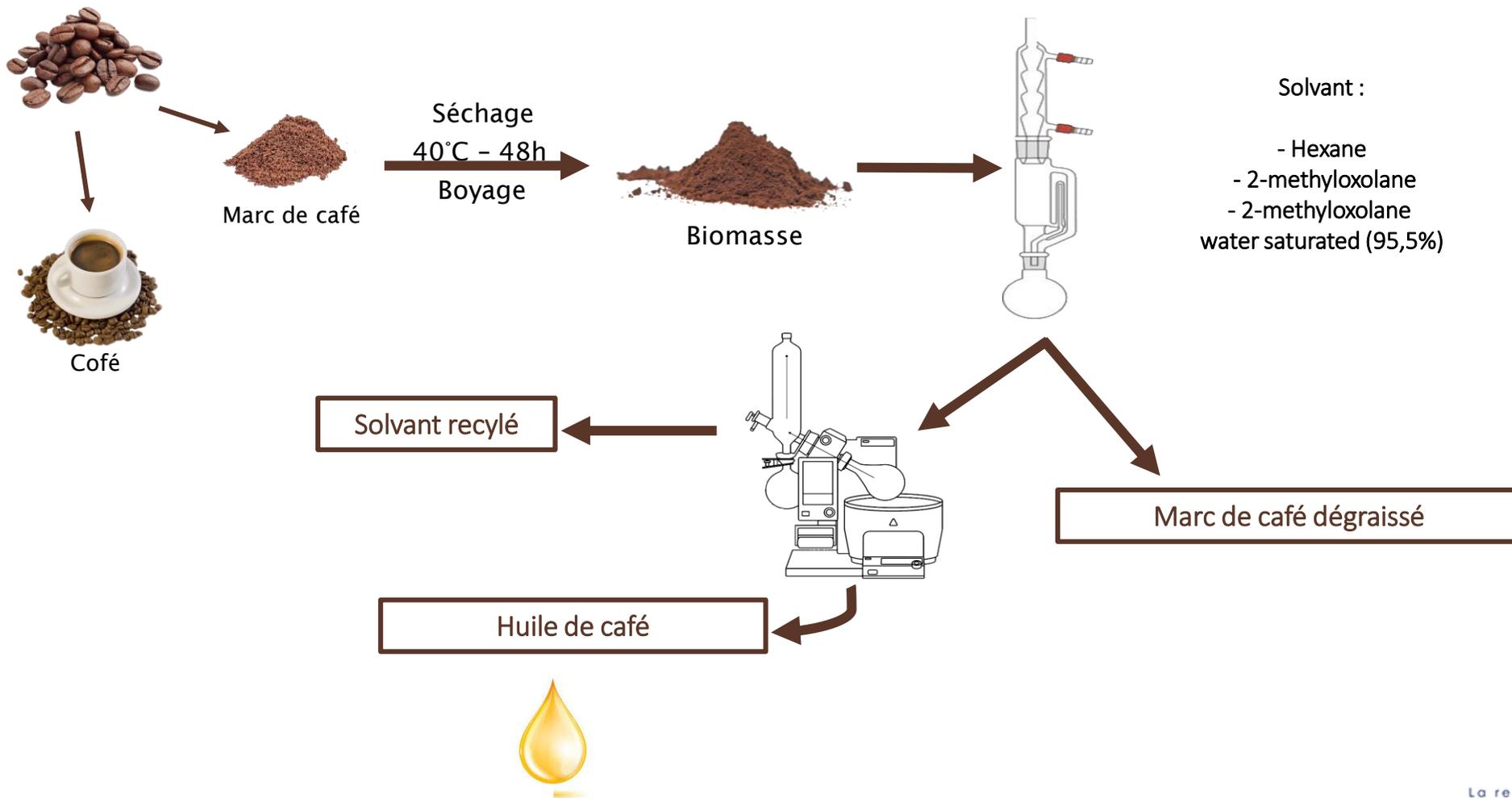


## Green extraction principles



# Extraction à l'aide de solvant biosourcé

olorisation du marc de café



# Extraction à l'aide de solvant biosourcé

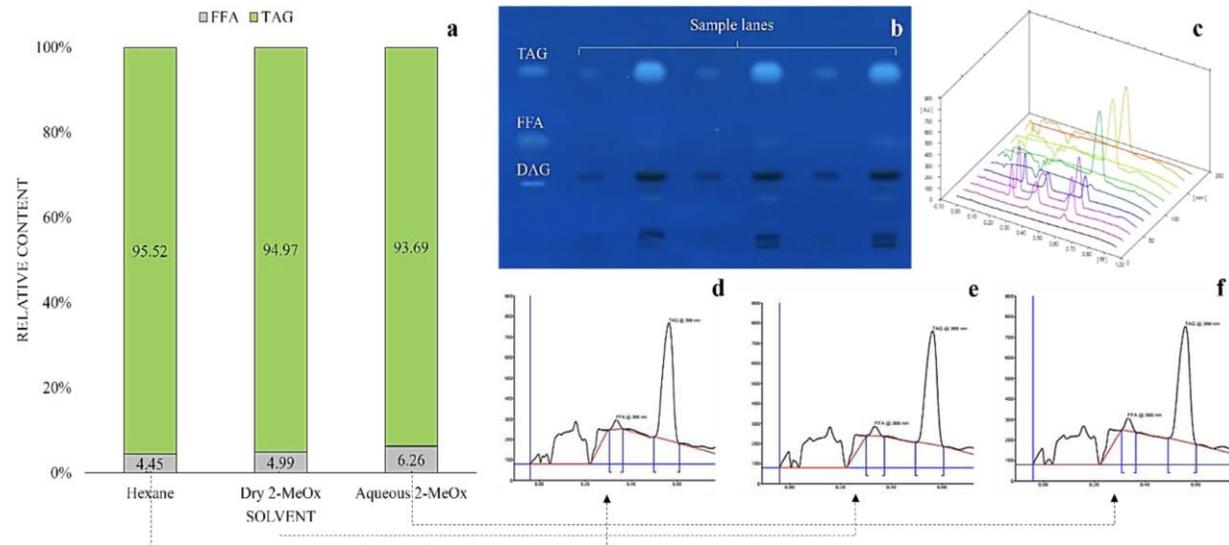
Valorisation du marc de café

Rendement  
en huile



Solvant/Biomass	Marc de café
Reference	This study
Hexane	12.47 ± 0.89
Dry 2-MeOx	13.67 ± 0.14
Aqueous 2-MeOx (95.5%)	15.84 ± 0.96

Composition lipidique



# Extraction à l'aide de solvant biosourcé

## Valorisation du marc de café

Compositions  
en  
acide gras

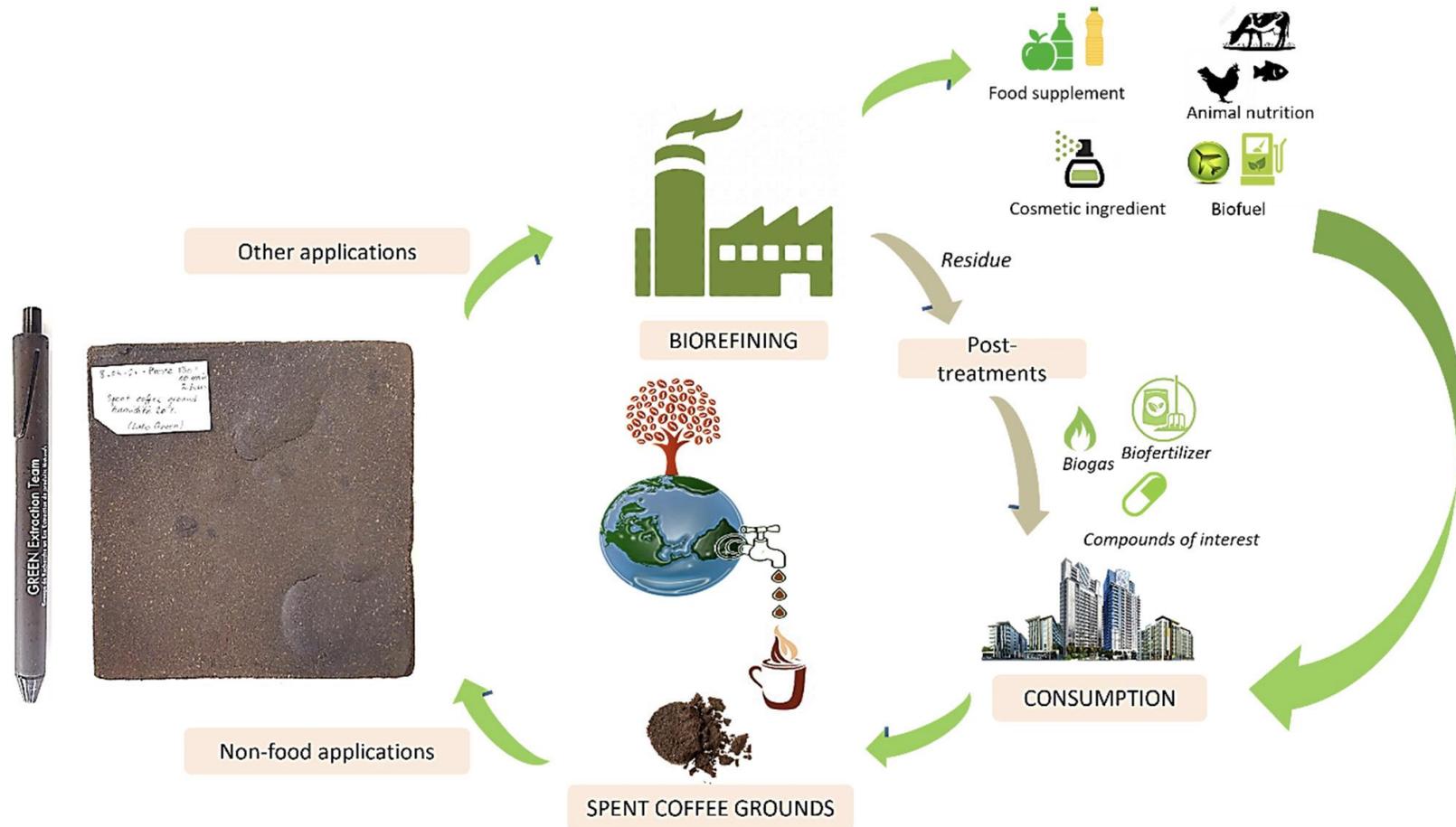


Fatty acid	Hexane	Dry 2-MeOx	Aqueous 2-MeOx (95.5%)
Tridecanoic acid (C13)	1.41 ± 0.09	1.44 ± 0.01	1.45 ± 0.02
Palmitic acid (C16)	34.94 ± 0.11	34.99 ± 0.02	35.01 ± 0.01
Stearic acid (C18)	6.89 ± 0.14	6.83 ± 0.24	6.74 ± 0.18
Oleic acid (C18:1)	7.52 ± 0.02	7.61 ± 0.05	7.53 ± 0.03
Linoleic acid (C18:2)	44.98 ± 0.89	45.04 ± 0.48	45.19 ± 0.41
Linolenic acid (C18:3)	1.36 ± 0.04	1.26 ± 0.07	1.31 ± 0.05
Arachidic acid (C20)	2.67 ± 0.09	2.61 ± 0.13	2.56 ± 0.10
Eicosenoic acid (C20:1)	0.23 ± 0.02	0.22 ± 0.02	0.21 ± 0.03
Σ SFA	45.91	45.87	45.76
Σ MUFA	7.75	7.83	7.74
Σ PUFA	46.34	46.3	46.5

Results are represented as mean ± standard deviation (n = 3). Σ SFA: Cumulative saturated fatty acids; Σ MUFA: Cumulative monounsaturated fatty acids; Σ PUFA: Cumulative polyunsaturated fatty acids.

# Extraction à l'aide de solvant biosourcé

## Valorisation du marc de café



# Conclusions

- ✓ Valorisation des coproduits
- ✓ Réductions des énergies consommées
- ✓ Réduction des quantités de déchets
- ✓ Utilisation de solvants biosourcés
- ✓ Concept de bioraffinerie

