

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

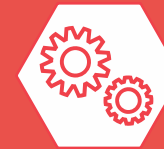
Anne-Syvie Tixier, Université d'Avignon



Qualité sensorielle



Structure de l'aliment

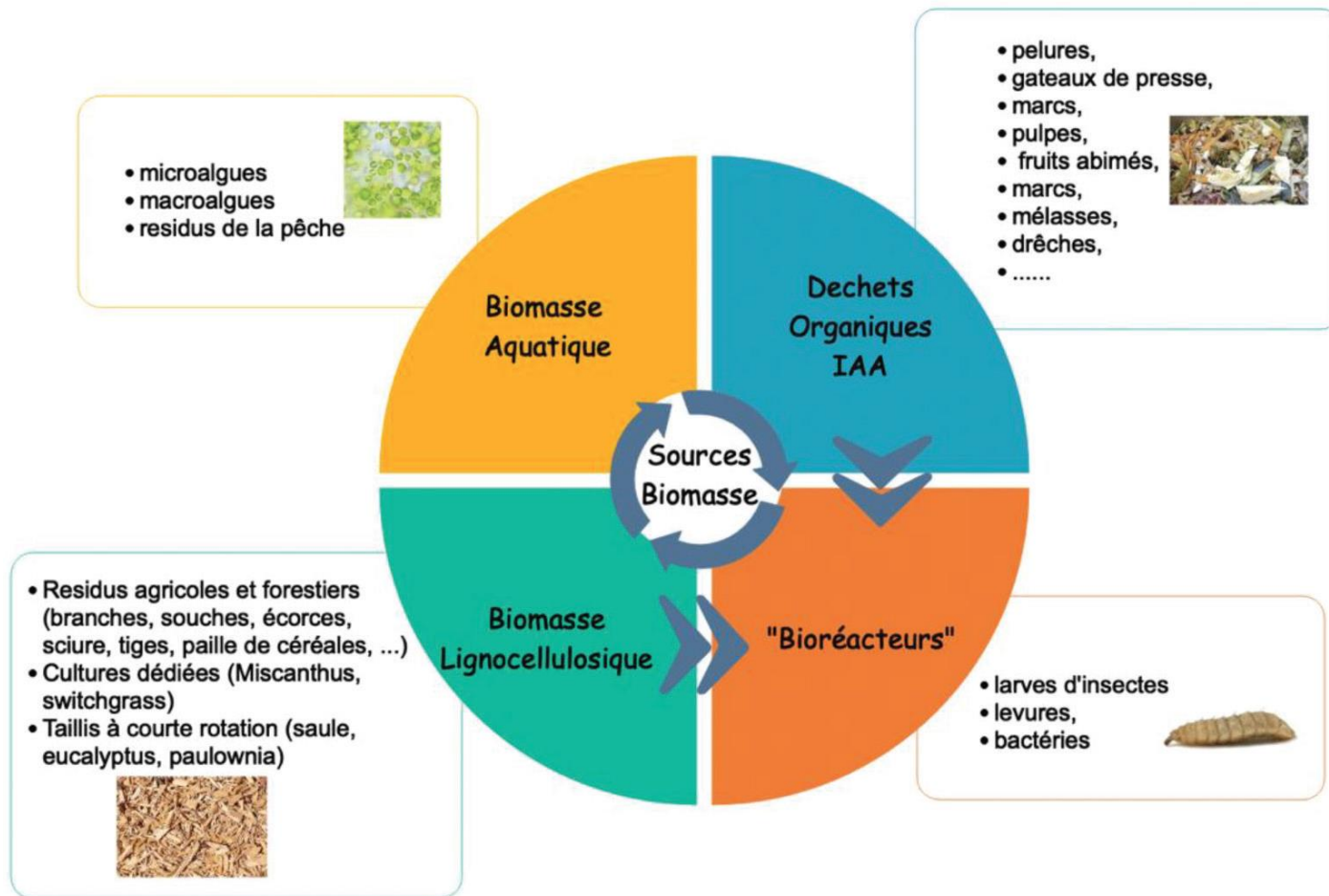


Technologies et procédés agroalimentaires

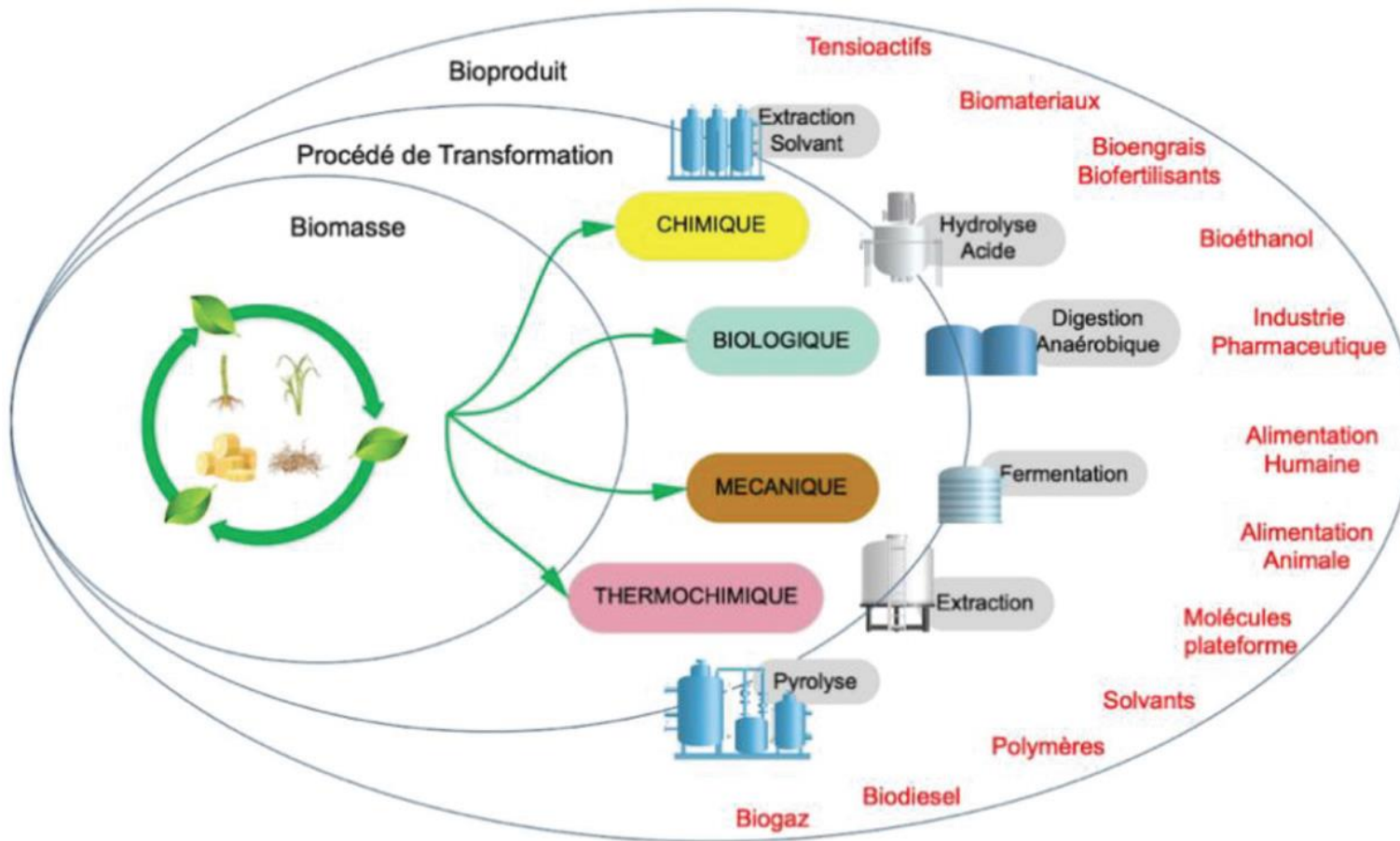


Qualité nutritionnelle et effets sur la santé

Gisement renouvelable de biomasse

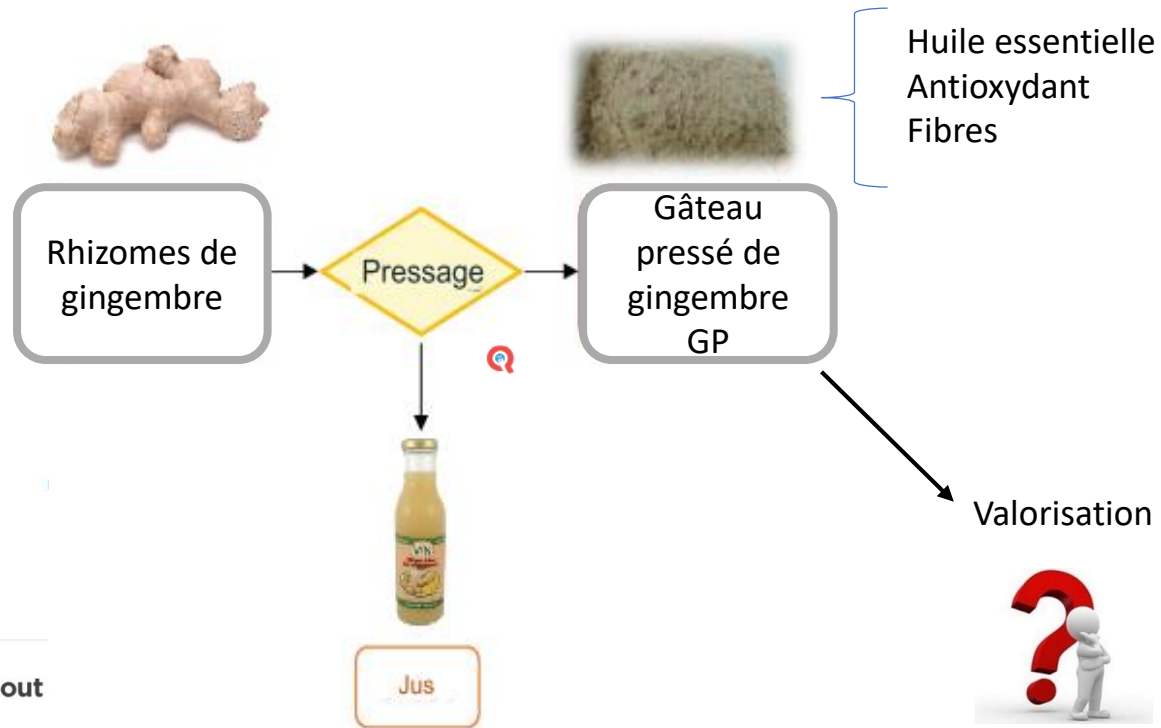


Concept de bioraffinerie



Concept de bioraffinerie

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



Issue 10, 2016



From the journal:
Green Chemistry

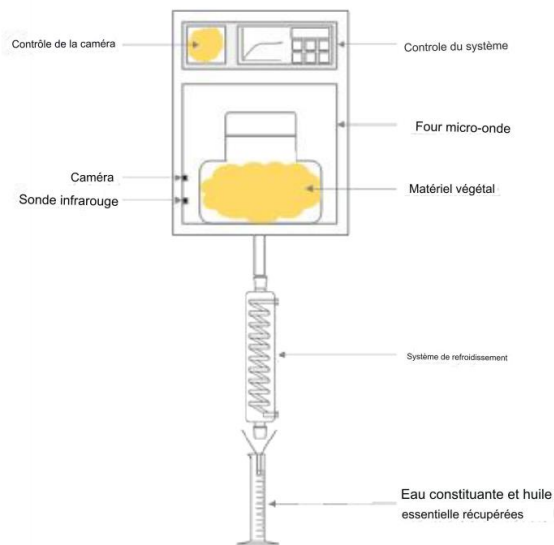
Towards a “dry” bio-refinery without solvents or added water using microwaves and ultrasound for total valorization of fruit and vegetable by-products

M. Jacotet-Navarro,^{abc} N. Rombaut,^{ab} S. Deslis,^{ab} A.-S. Fabiano-Tixier,^{ab} F.-X. Pierre,^c A. Bily,^{bc}



Concept de bioraffinerie

Le chauffage micro-ondes:



(un)

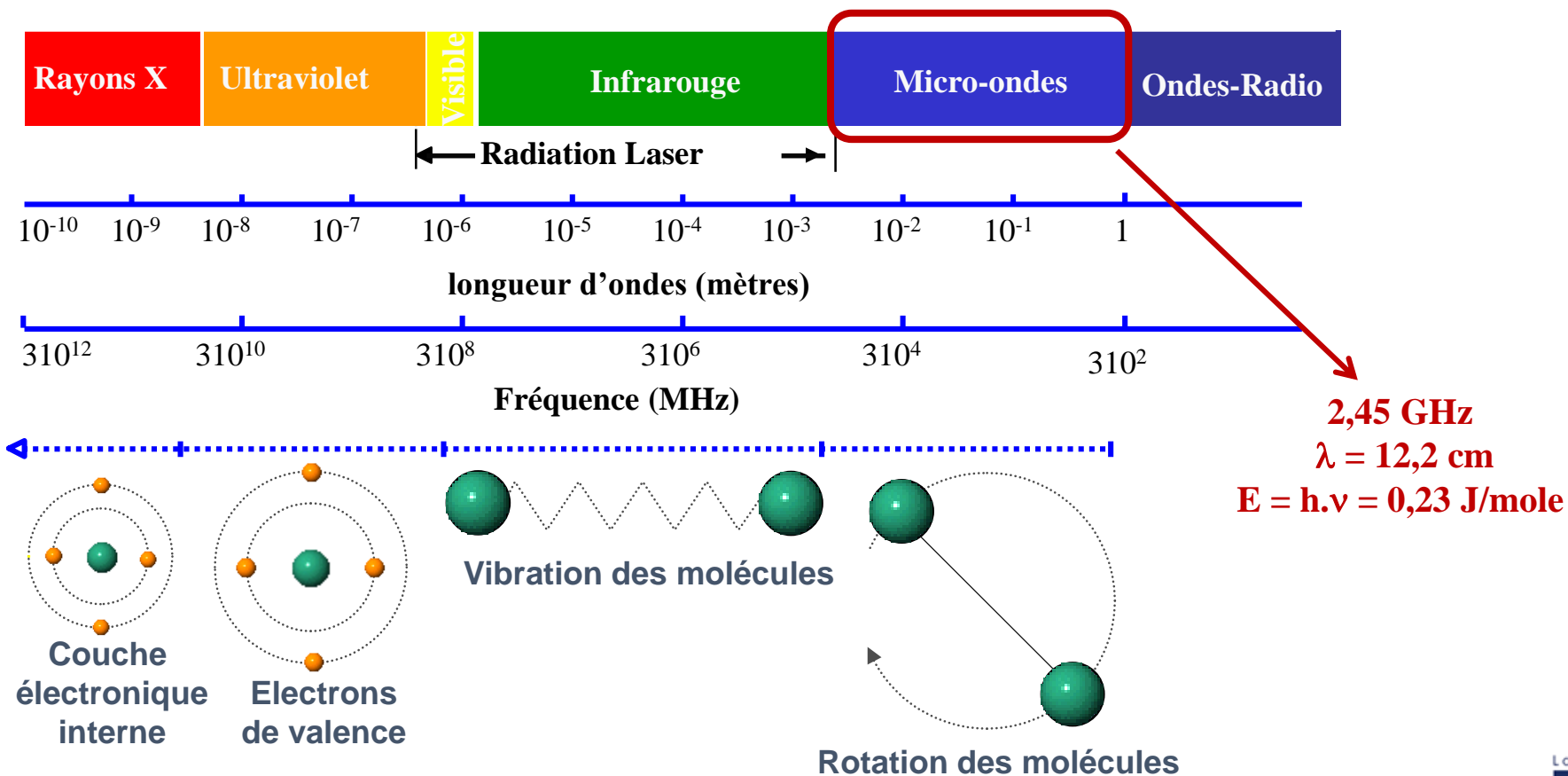


(b)

Concept de bioraffinerie

Les micro-ondes

Spectre électromagnétique*

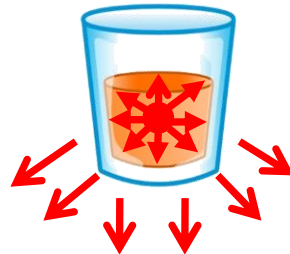
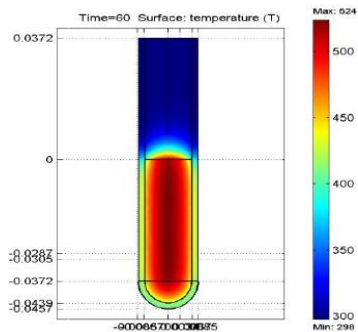


* Neas, E. & Collins, M. Introduction to Microwave Sample Preparation: Theory and Practice (1988) 8.

Concept de bioraffinerie

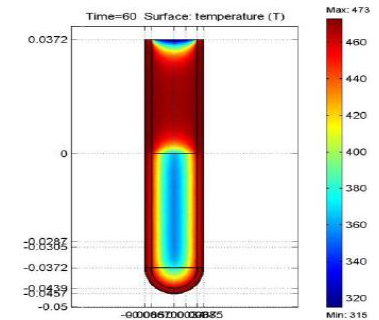
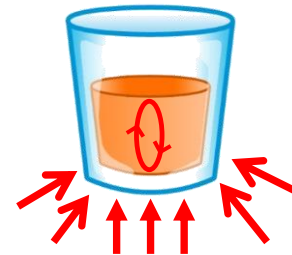
🔍 chauffage micro-ondes versus chauffage conventionnel

Chauffage par micro-ondes



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

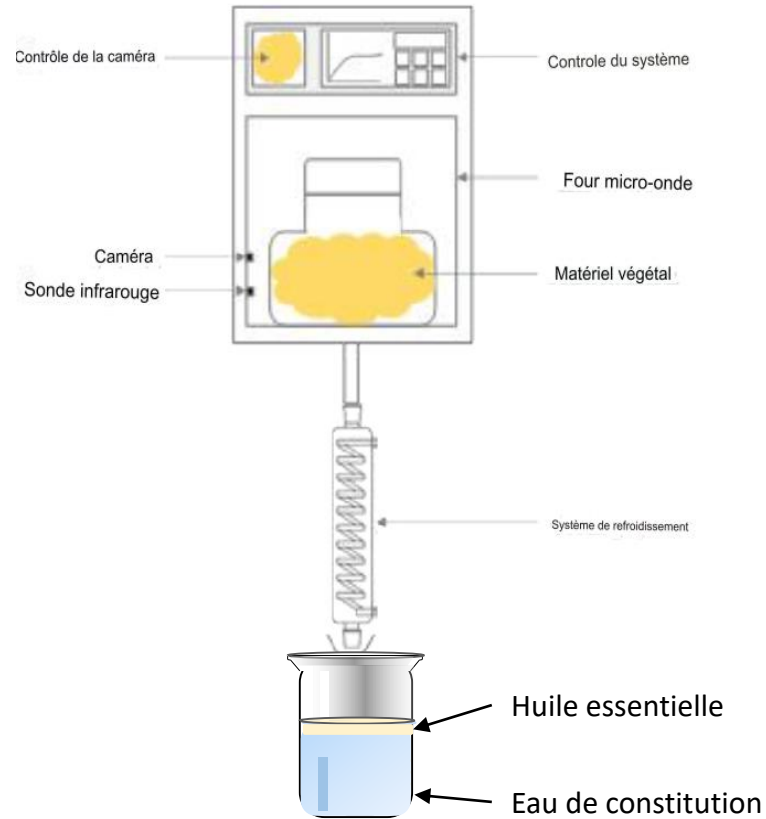
Chauffage conventionnel



- 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

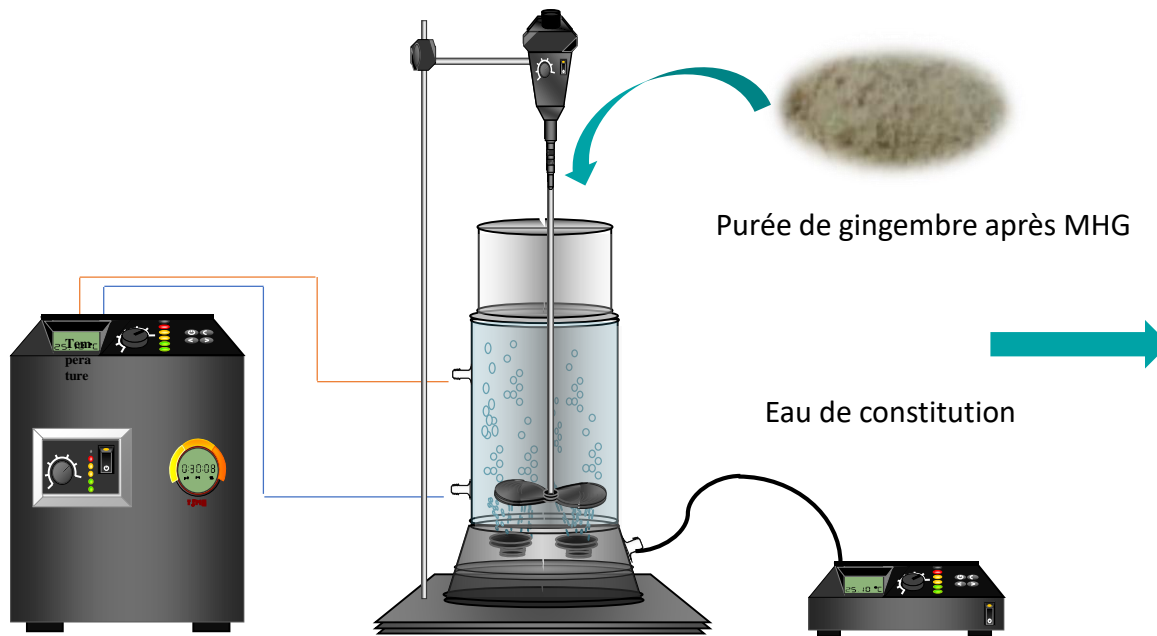
Concept de bioraffinerie

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



Valorisation de coproduit

traction de métabolites secondaires



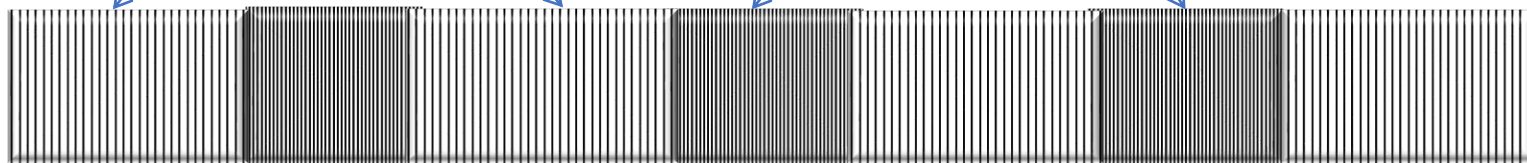
(b)

Valorisation de coproduit

Extraction de métabolites secondaires en utilisant des ultrasons

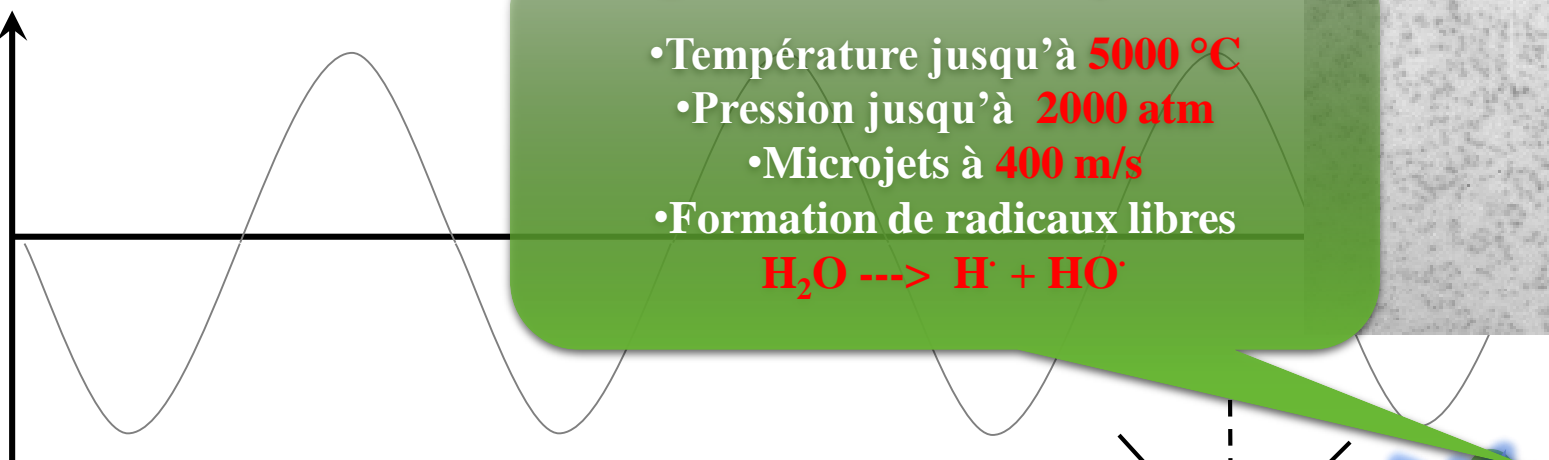
Décompression

Compression



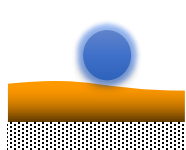
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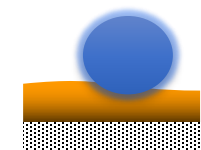


Energie localisée très importante

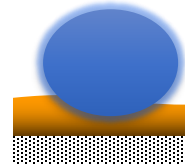
- Température jusqu'à **5000 °C**
- Pression jusqu'à **2000 atm**
- Microjets à **400 m/s**
- Formation de radicaux libres
 $H_2O \rightarrow H^\bullet + HO^\bullet$



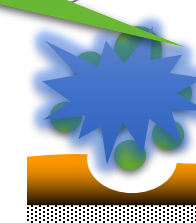
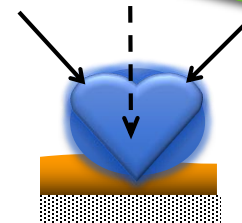
Création



Croissance



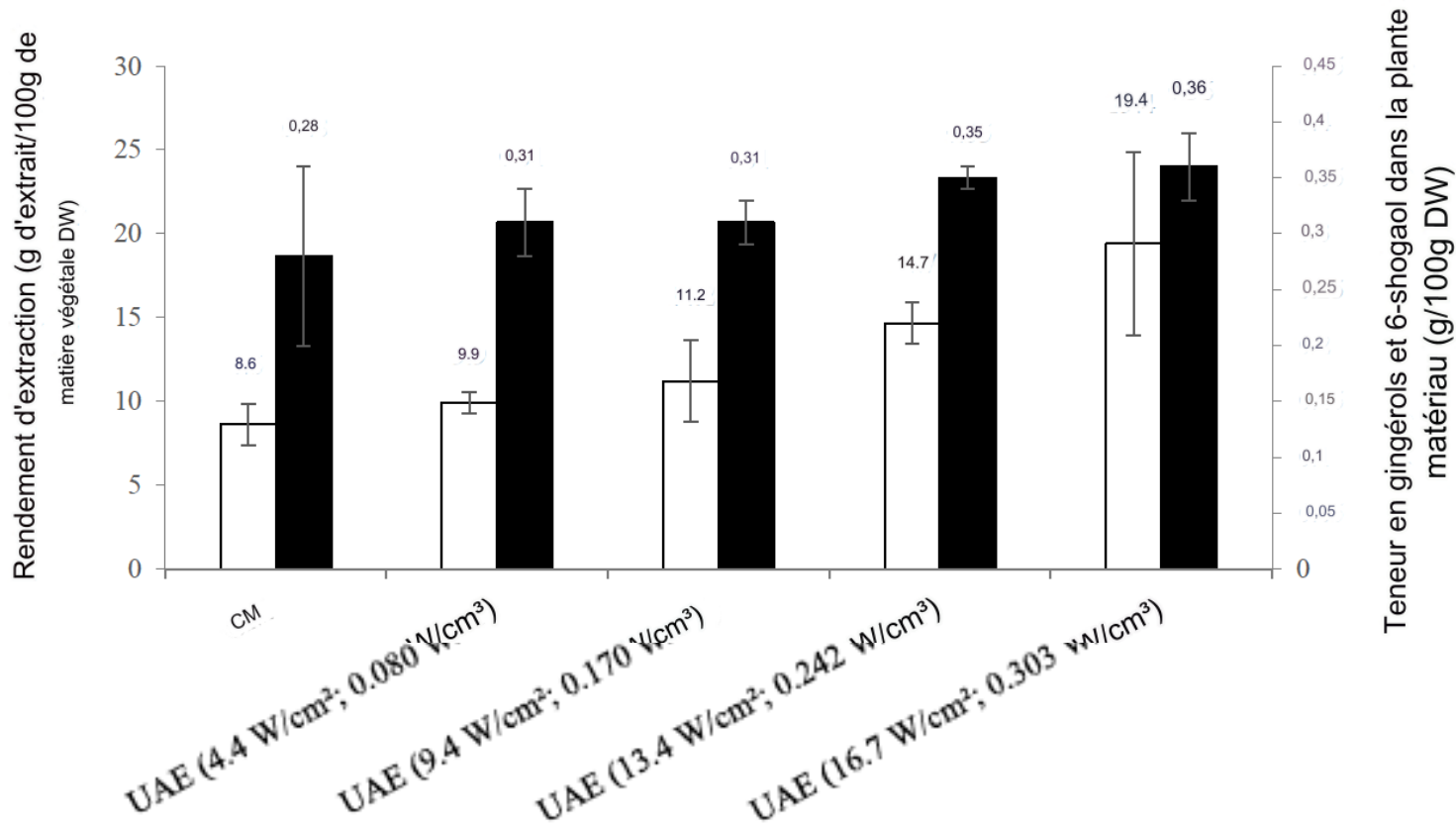
Implosion



Décapage

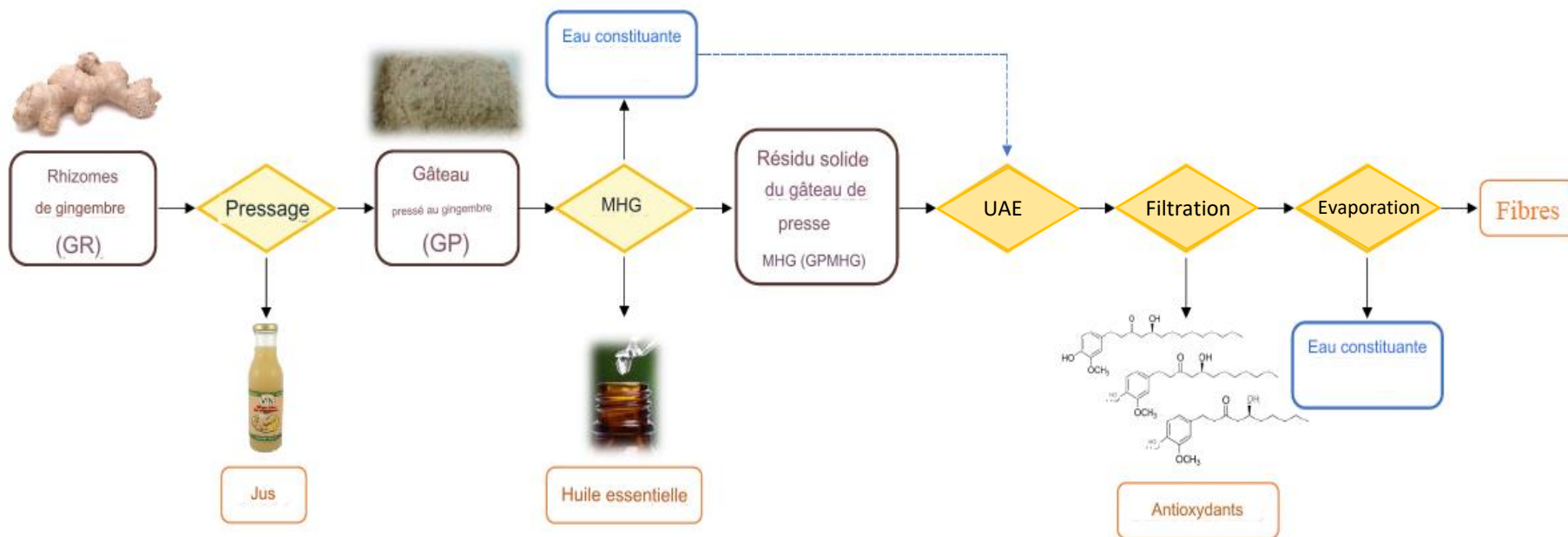
Concept de bioraffinerie

- 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



Issue 10, 2016



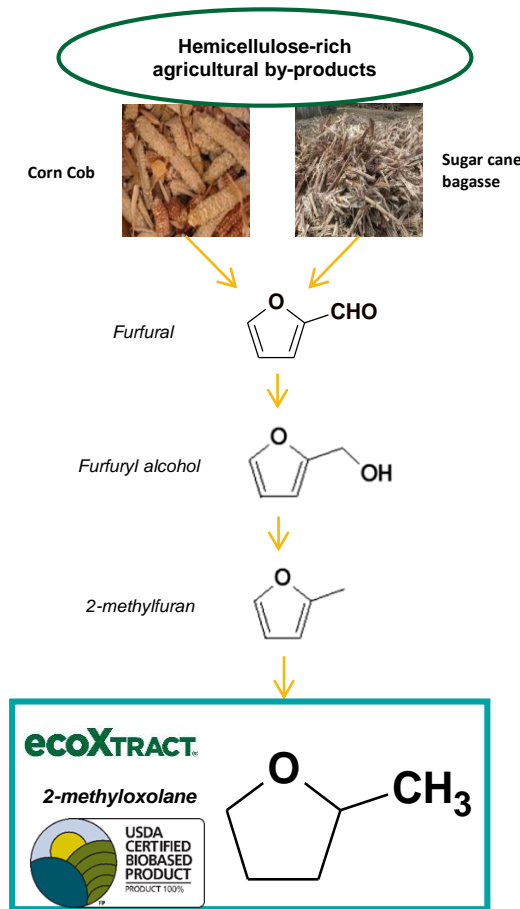
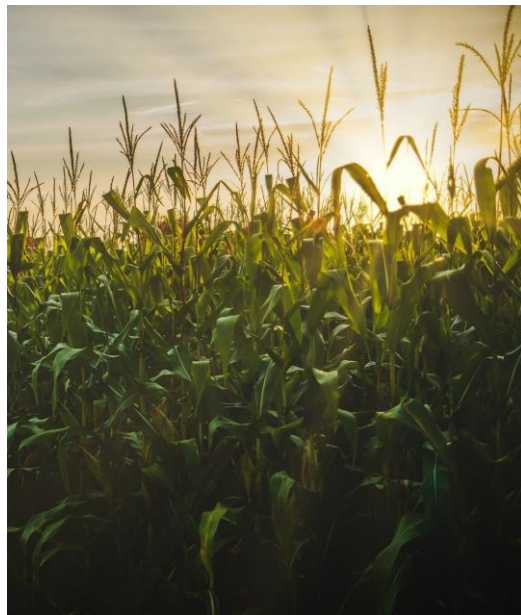
From the journal:
Green Chemistry

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

Extraction à l'aide de solvant biosourcé

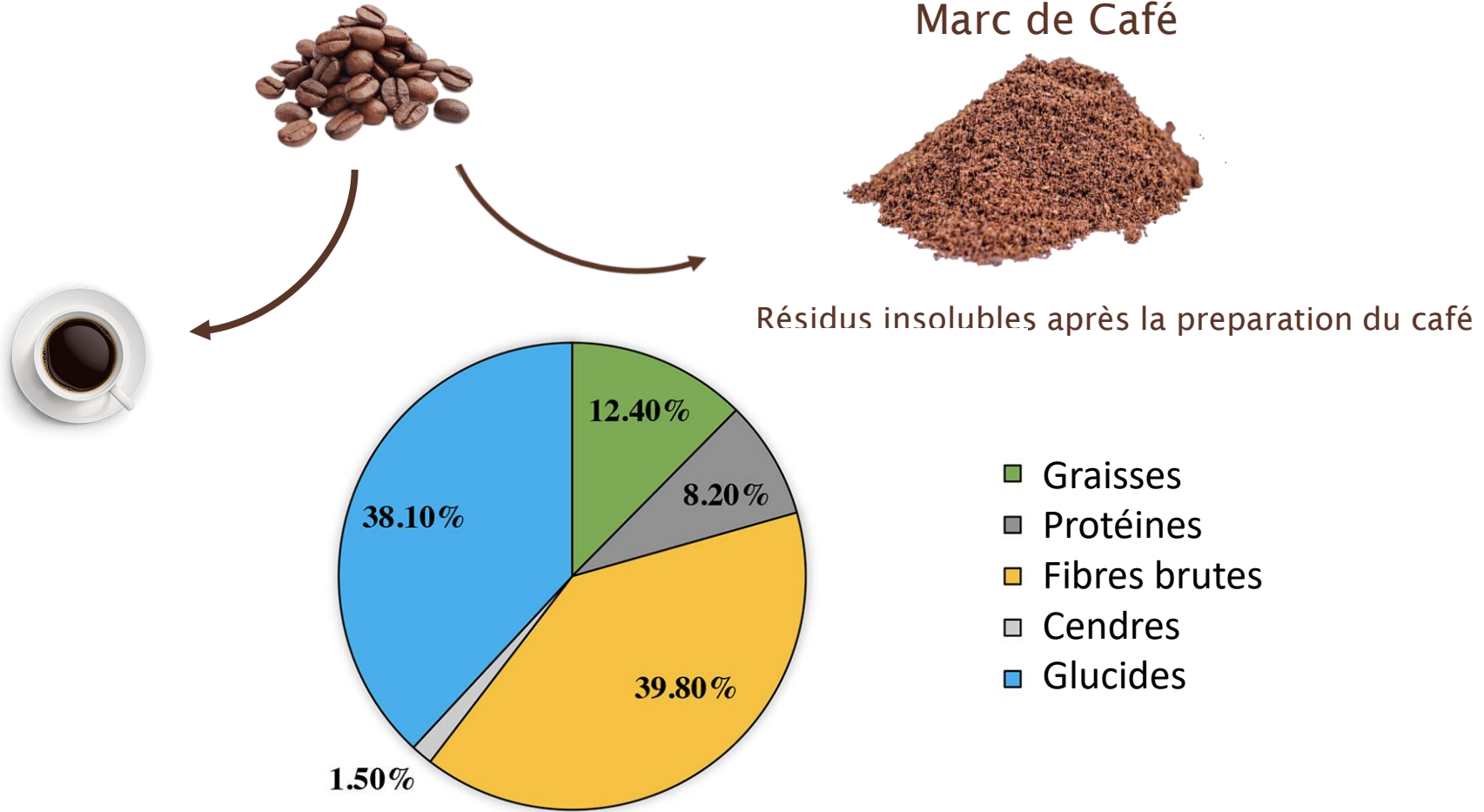
- EcoXtract® est dérivé de l'hémicellulose, que l'on trouve en grande quantité dans de nombreux sous-produits agricoles, et n'entre pas en concurrence avec l'offre alimentaire.

MeOx



Extraction à l'aide de solvant biosourcé

olorisation du marc de café

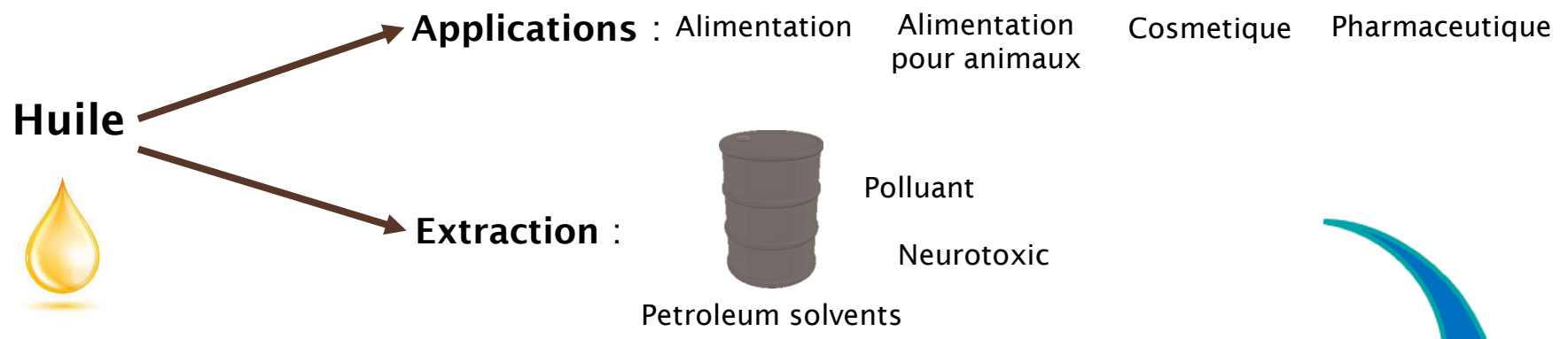




Extraction à l'aide de solvant biosourcé



Valorisation du marc de café

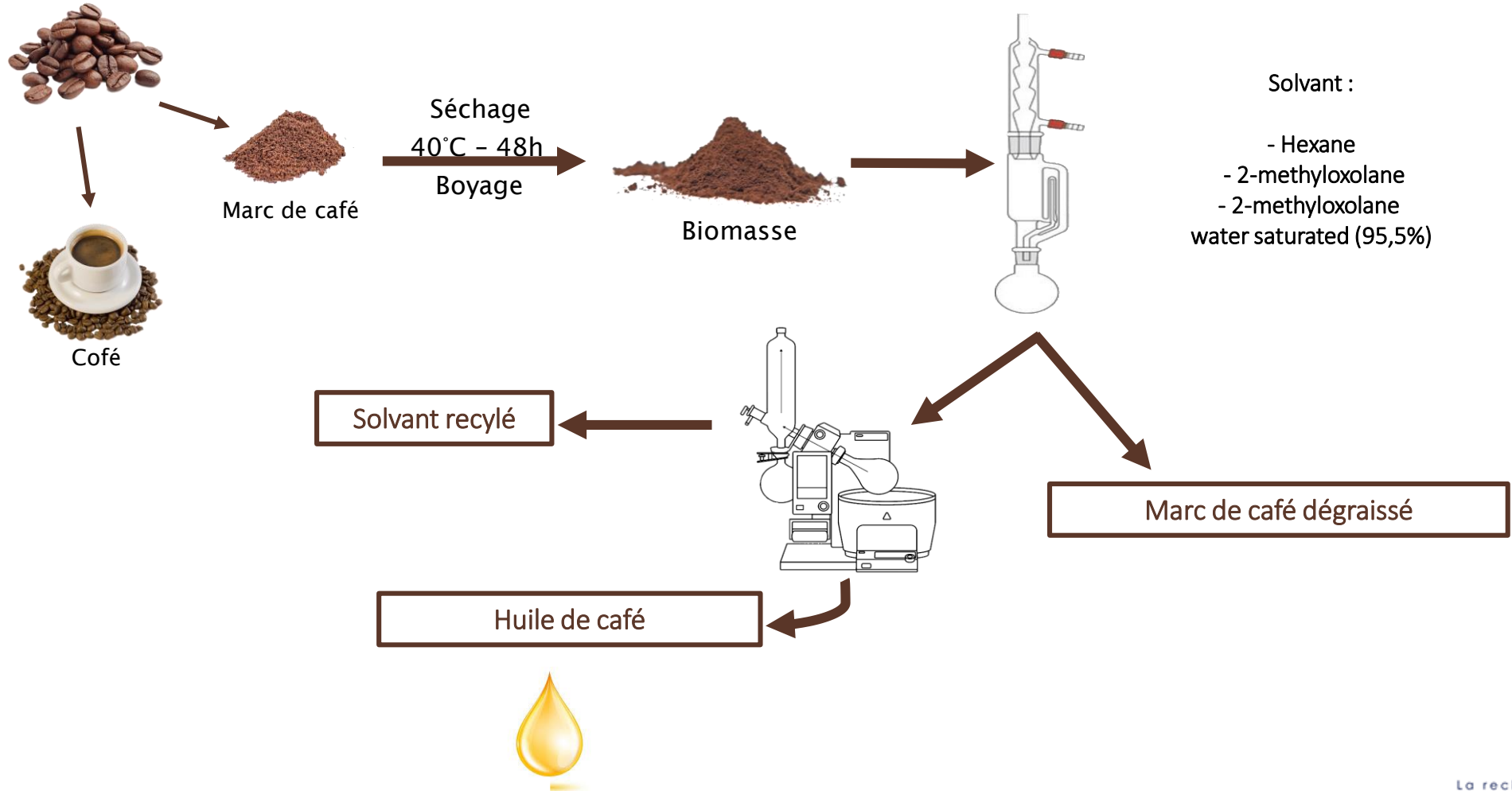


Green extraction principles



Extraction à l'aide de solvant biosourcé

olorisation du marc de café



Extraction à l'aide de solvant biosourcé

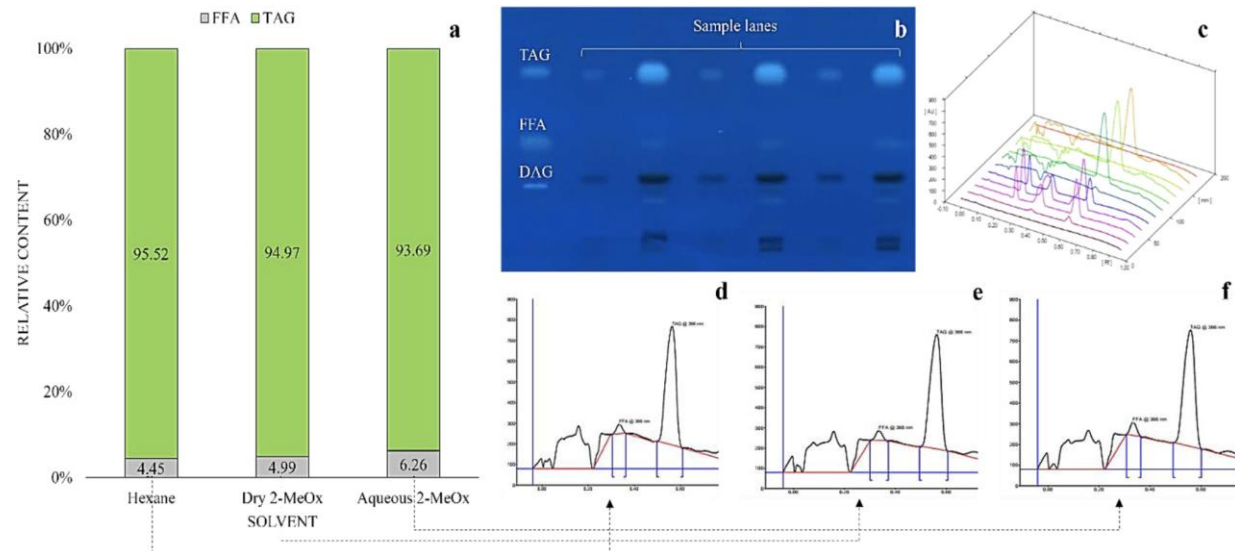
Valorisation du marc de café

Rendement
en huile



Solvent/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

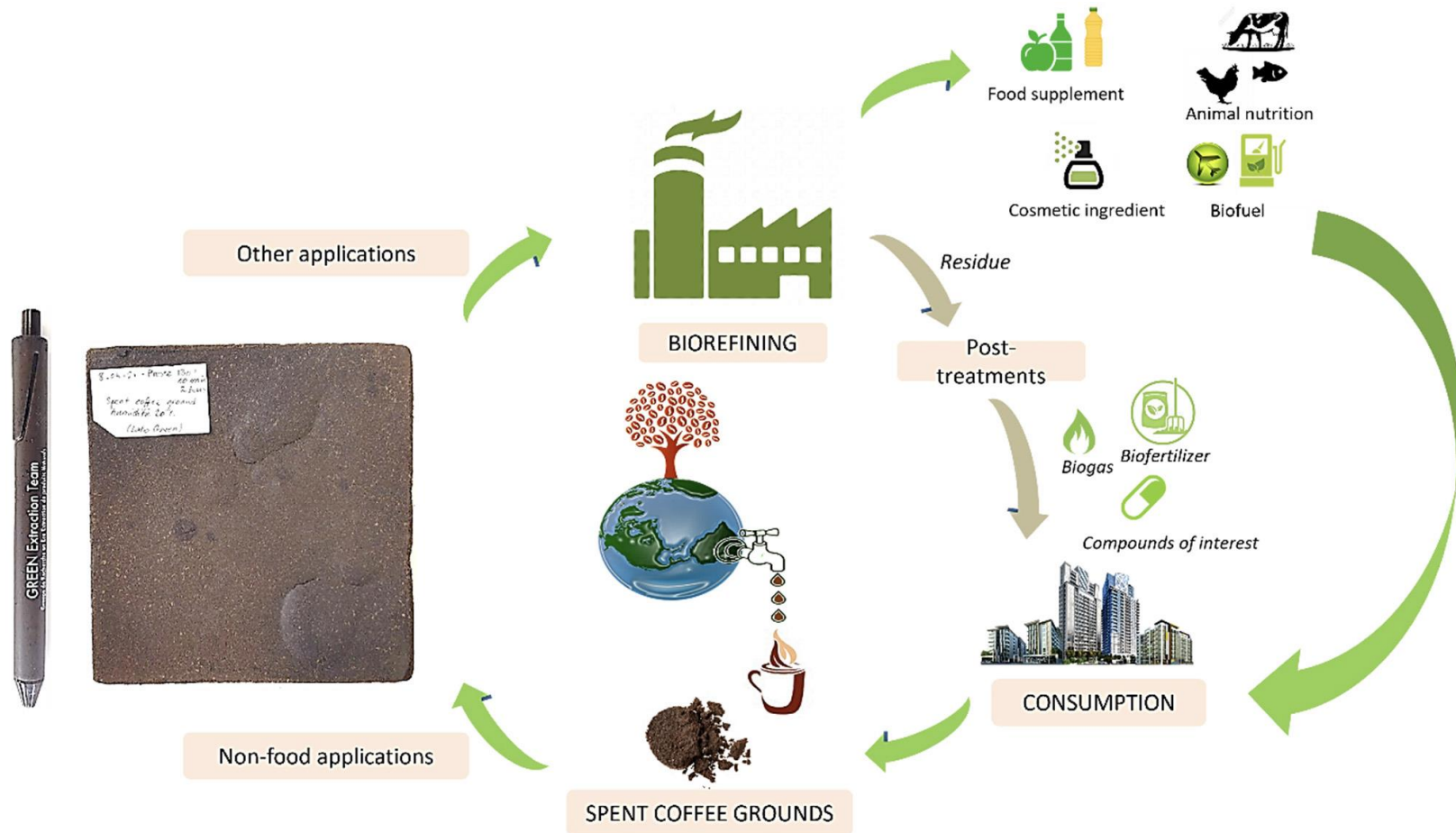


Fatty acid	Hexane	Dry 2-MeOx	Aqueous 2-MeOx (95.5%)
Tridecanoic acid (C13)	1.41 ± 0.09	1.44 ± 0.01	1.45 ± 0.02
Palmitic acid (C16)	34.94 ± 0.11	34.99 ± 0.02	35.01 ± 0.01
Stearic acid (C18)	6.89 ± 0.14	6.83 ± 0.24	6.74 ± 0.18
Oleic acid (C18:1)	7.52 ± 0.02	7.61 ± 0.05	7.53 ± 0.03
Linoleic acid (C18:2)	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

