

Futures Perspectives for Microencapsulation of Flavors

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Flavors & co.

Flavor or flavour is the sensory impression of a [food](#) or other [substance](#), and is determined mainly by the chemical senses of [taste](#) and [smell](#).

Fragrance is a mixture of fragrant [essential oils](#) and [aroma compounds](#), [fixatives](#), and [solvents](#) used to give the human body, objects, and living spaces a pleasant smell.

Aroma is a volatilized [chemical compound](#), generally at a very low concentration, which humans and other animals perceive by the [sense](#) of [olfaction](#).

**Off-flavors,
Preservatives / pest control**

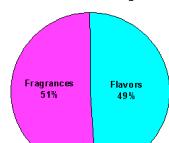
Category	% sales
Flagrances	35
Flavors	41
Aroma	12
Essential oils Natural products	12

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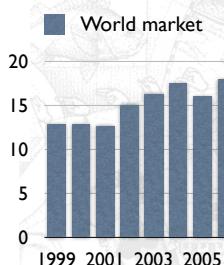
Market !

1999 Worldwide Flavor & Fragrance Market



Source: Allured Publishing News Release from IRI Consultants (June 23, 2000)
<http://www.perfumefor.com/news/news.htm#938>

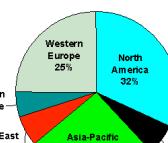
1999 Worldwide Fragrance Market



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1999 Worldwide Flavor Market



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Flavor Market (2006)

Leffingwell & associates

Company	Market (US \$)	Percentages
Givaudan	2,400	13.3
IFF	2,100	11.7
Firmenich	2,050	11.4
Symrise	1,600	9.0
Quest International	1,150	6.4
Takasago	950	5.3
Sensient Flavors	550	3.0
T. Hasegawa	400	2.2
Mane S.A.	400	2.1
Robertet S.A.	300	1.6
Frutarom	300	1.6
Danisco	250	1.5
Cargill Flavors	250	1.5
Others	6,000	34.0
Total	18,000	100.0

Large companies but also many small ones

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Food flavoring



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Cosmetics



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Hair & Skin



Cleansers

Shampoos

Deodorants

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Feed flavoring and supplementat



Antibiotic substitute



Taste exhauster



Taste masking



Aquaculture

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Cosmeto-textiles

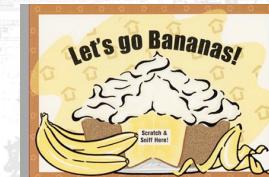


Slimness, vitality, well-being



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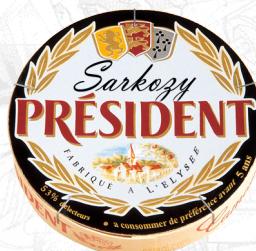
Marketing



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Packaging



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Air control



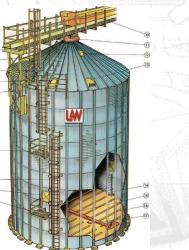
Image fournie par AnneSofie
& www.cao.fr



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Pest and microbial controle



Essential Oil Formulations Useful as a New Tool for Insect Pest Control

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Health



Dermo-cosmetics



Anti-nocosomial

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Microencapsulation ?

- Entrapment of actives inside microparticles for:
 - Immobilisation
 - protection
 - controlled release
 - structuration
 - functionalisation



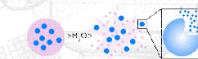
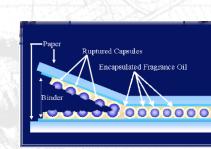
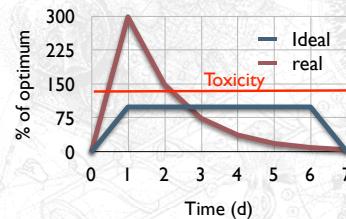
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Capsulae
Encapsulation Library

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Microencapsulation ?

- Entrapment of actives inside microparticles for:
 - Immobilisation
 - protection
 - controlled release
 - **structuration**
 - functionalisation

Liquid > solid
Dispersibility
Flowability
Tabletisation
Dust free



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Microencapsulation ?

- Entrapment of actives inside microparticles for:
 - Immobilisation
 - protection
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Marketing !
Nice capsules
Easier to use
Innovations
Dreaming



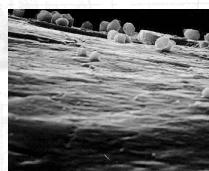
Size of capsules ...



nanocapsules
 $< 1 \mu\text{m}$



microcapsules
 $50 \mu\text{m} - 1 \text{ mm}$



microparticles
 $1 \mu\text{m} > 50 \mu\text{m}$



millicapsules
 $> 1 \text{ mm}$



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Methods : 3 steps

Incorporation	of the active ingredient within the microcapsule core/matrix
Dispersion	of the core as droplet or mixing of core particles
Stabilisation (solidification)	of the droplets or of coating layer around particles



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Methods ...

Incorporation	liquid core (water, solvent, melt) solution, emulsion, suspension	solid core (particles, powder) absorption, layering, entrapment, agglomeration
Dispersion		
Stabilisation		

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Methods ...

Incorporation	liquid core		solid core	
Dispersion	Spraying	Dripping	Emulsion	Spray coating Suspension coating
Stabilisation				

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Methods ...

Incorporation	liquid core			solid core		
Dispersion	Spraying	Dripping	Emulsion	Fluid bed coating	Suspension coating	
Stabilisation	Solidification	Spray cooling	Prilling		Hotmelt spray coating	
	Evaporation (drying)	Spray drying		Solvent evaporation	Spray (drying) coating	
	Gelation	Spray chilling	Hydrogel beads	Internal gelation		
	Polymerisation			Interfacial in situ pol..		
	Precipitation coacervation			coacervation		polymer coating
	Molecular interaction		Interfacial coacervation	liposomes	Dry powder coating	Ionic coating

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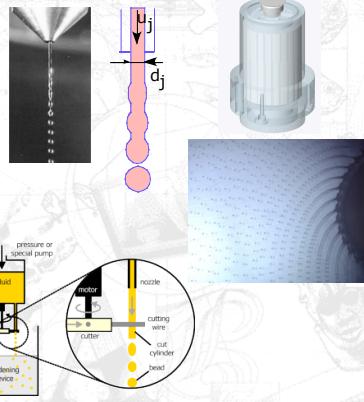
Spray technologies

- Spray drying
- Food technologies
- Very large production
- Emulsification ?
- Matrix ?
- Over-heating
- Spray cooling
- Barrier ?
- High pressure !

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Dripping technologies



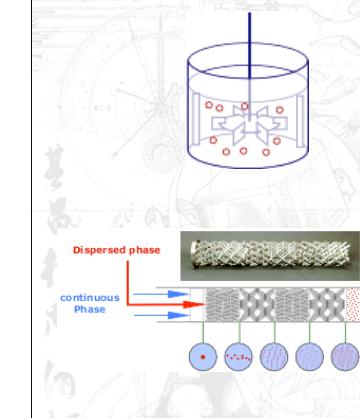
- Good productivity (tons/d)
- “large” size ($> 200 \mu\text{m}$)
- Low dispersion (visual effect)
- Solidification ?
 - Melt (high pressure)
 - Gel (high dry matter)

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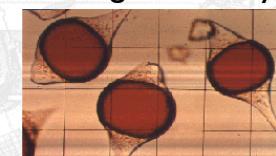
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Emulsification



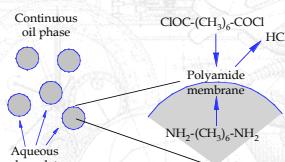
- Large production
- low size
- Coacervation
 - new materials
 - No glutaraldehyde



Capsulae

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Interfacial polymerisation



- new chemistry !
- Biodegradable
- neutral pH
- low toxicity
- membrane permeability

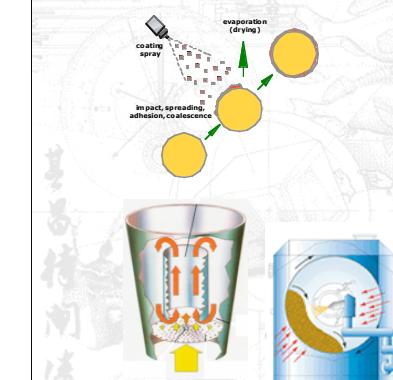
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Capsulae

Fluid bed / pan coater



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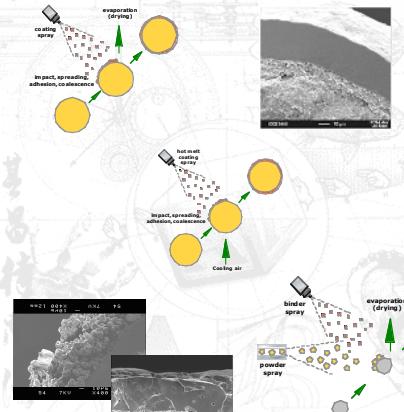
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Capsulae

- Core production
 - New porous material
 - prilling
- Size !
 - $> 200 \mu\text{m}$
- Fluisation air !
- New design

Fluid bed coating



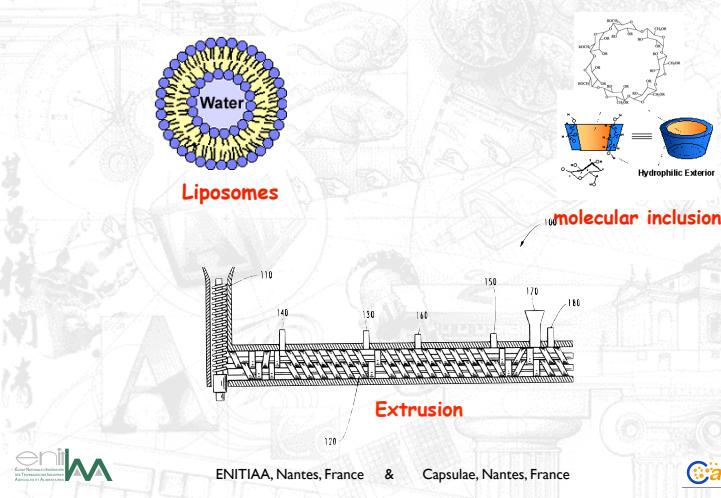
- Drying
 - nice coating
 - hot air
- Cooling
 - barrier ?
- Dry technology
 - low temperature
 - fast / low air
 - large particles

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Methods ...

Liposomes, molecular inclusion ...



Conclusions ...

*The way was long
and we still have long way to go,
challenging but fruitfull*



<http://Bioencapsulation.net>



<http://COST865.Bioencapsulation.net>



Industrial consortium for FP7 collaborative projects
RTD and industrial information provider office



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