NEW AND EMERGING TECHNOLOGY MICROENCAPSULATION USING BIOCAPSULES

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Outline

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- Encapsulation technique
- Yeast based microcapsulation
- Loading cell with active molecules
- Release controled from yeast capsule
- Taste, cost, regulation
- Current applications

State of the art

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Eat healthfully – Live well

Food components recommended

Natural ingredients: antioxidants, essential oils, flavors, pigments, etc.

Challenges

Natural components sensibilities to environmental conditions. Some beneficial compounds possess off-flavors or poorly soluble in water or oil.

Solution

Encapsulation

Encapsulation

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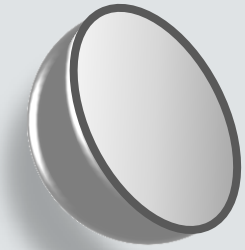
Generality

A technique in which an active molecule is bounded by a wall material

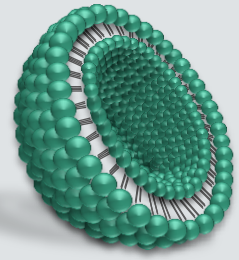
Application domains

- Protection
- Taste mask
- Delivery
- Dispersion
- …

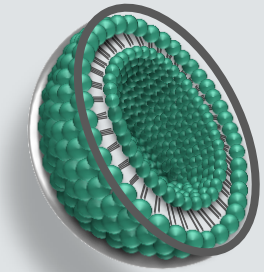
Encapsulation by polysaccharides: chitin, chitosan, maltodextrin, etc.



Encapsulation by lipids: Liposome



Double layers with imitation microbial cells



Technical issues

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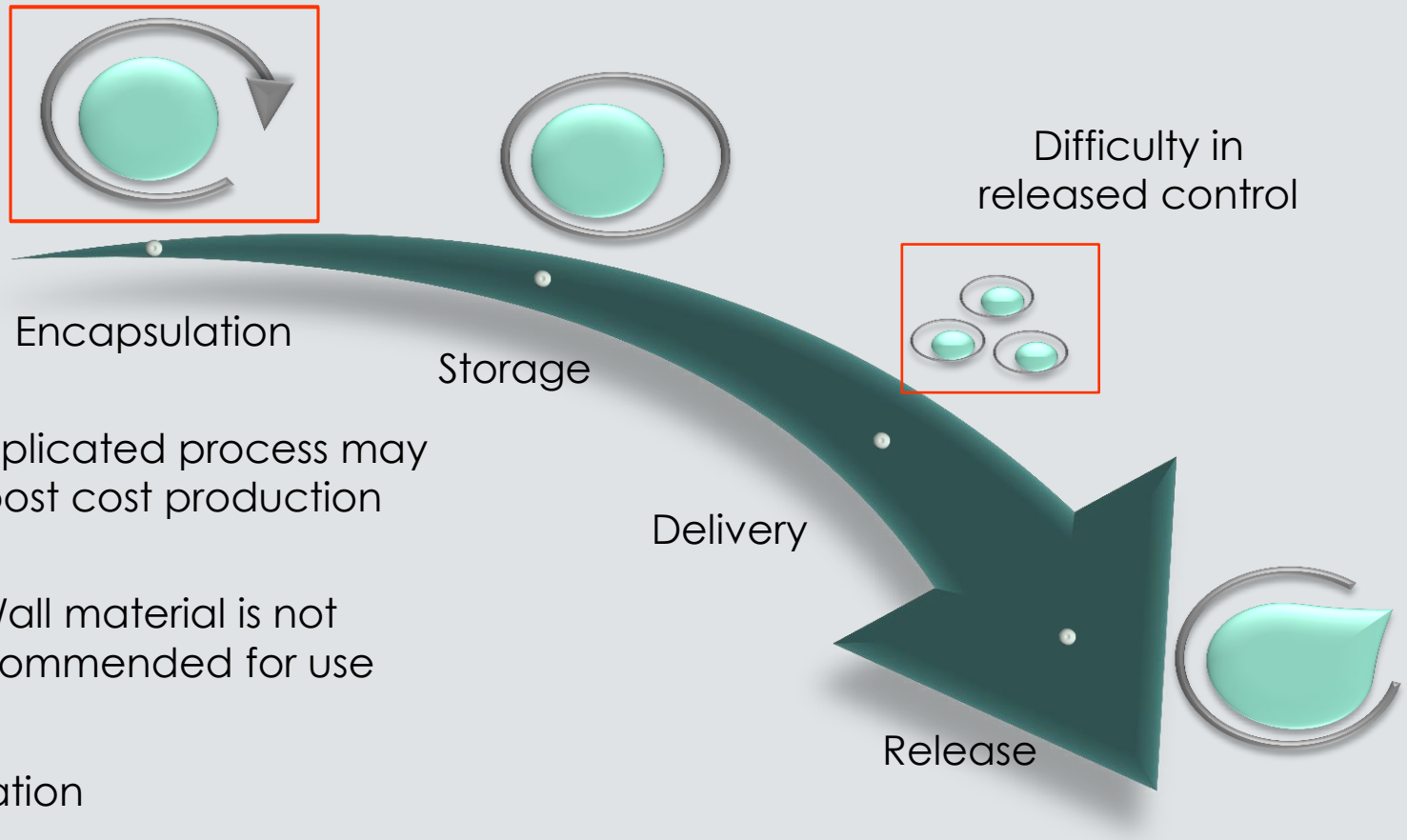
Technology

Bad encapsulation

Economy



Regulation

Yeast based microencapsulation – Yeast cell

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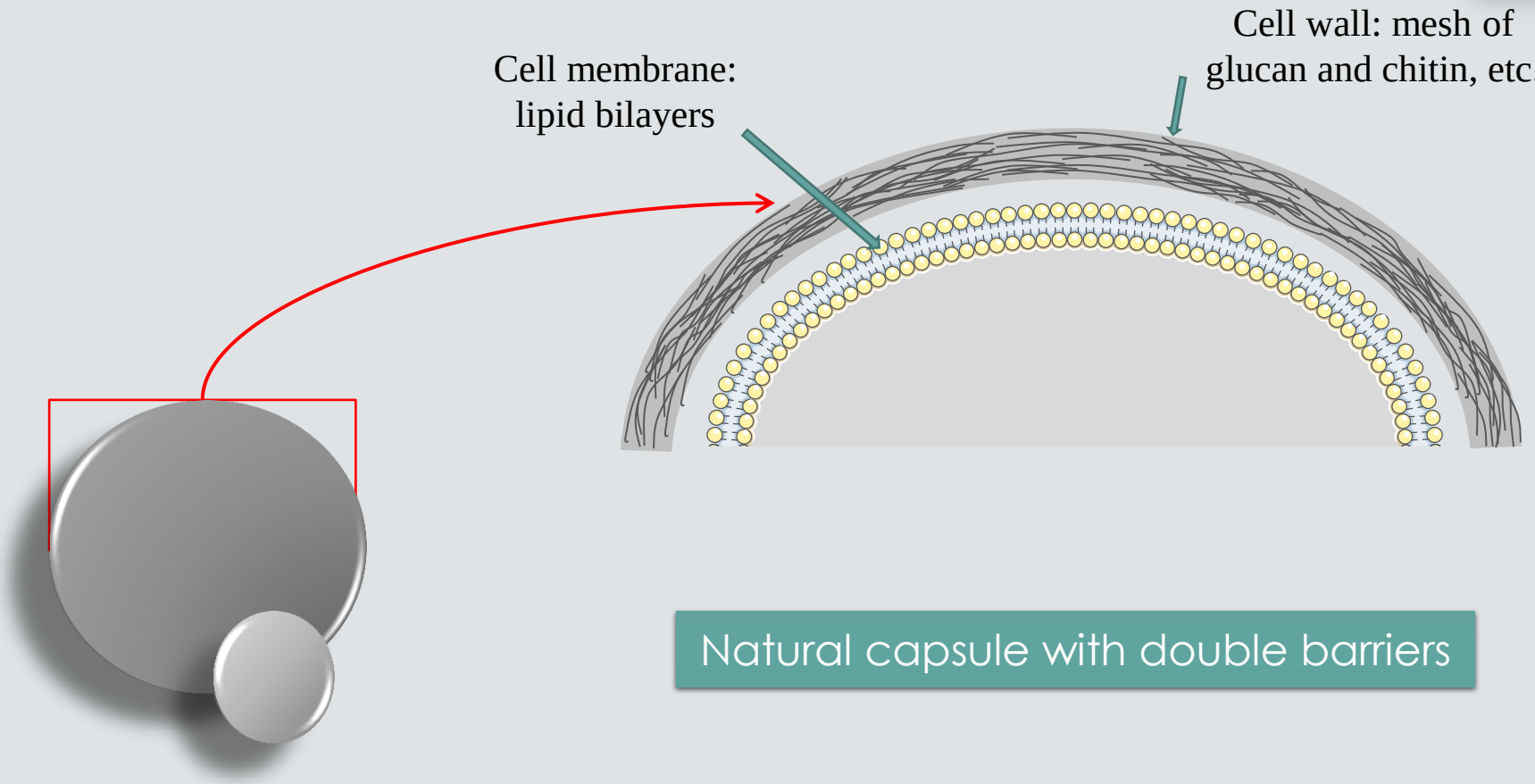
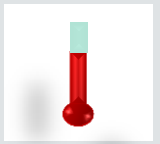


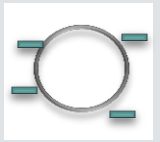
Natural capsule with double barriers

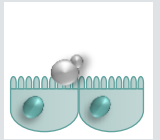
Is yeast cell able to become a **promising** material for encapsulation ???

Yeast based microencapsulation – Advantages

• Widely used in food industries	→	Friendly with consummers
• Resistance to high temperature	→	Protect core material against thermal process
• Resistance to oxygen	→	Application for antioxidant compounds
• Small and homogenous size	→	Smooth texture when incorporating in food
• Possibility to modify surface properties of yeast cell	→	Enhance delivery to the right place (Ex: Caco-2-cells)
• Enhance tight junction of epithelial cells	→	Enhance molecule absorption.







Yeast based microencapsulation – An unconventional method

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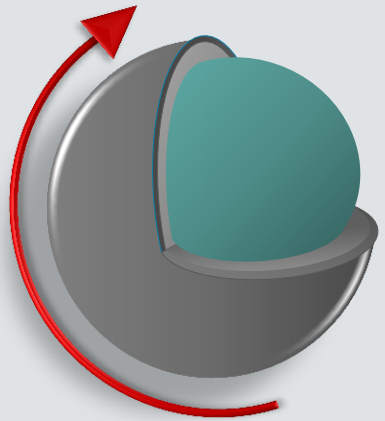
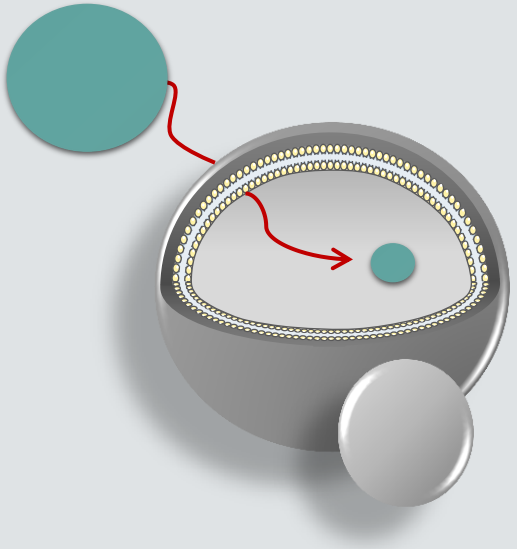
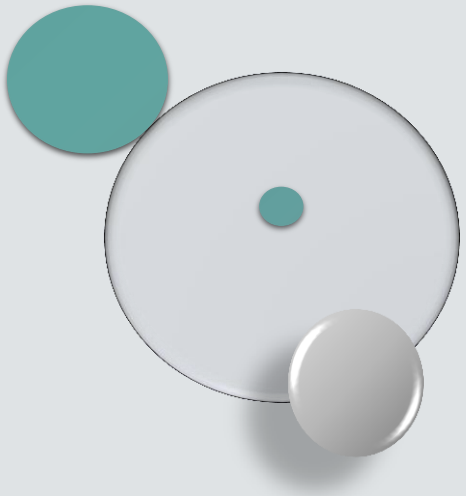
Conventional methods: A layer must be formed around core material



Yeast based microencapslation method: Core material must be placed into yeast cell – Other challenges

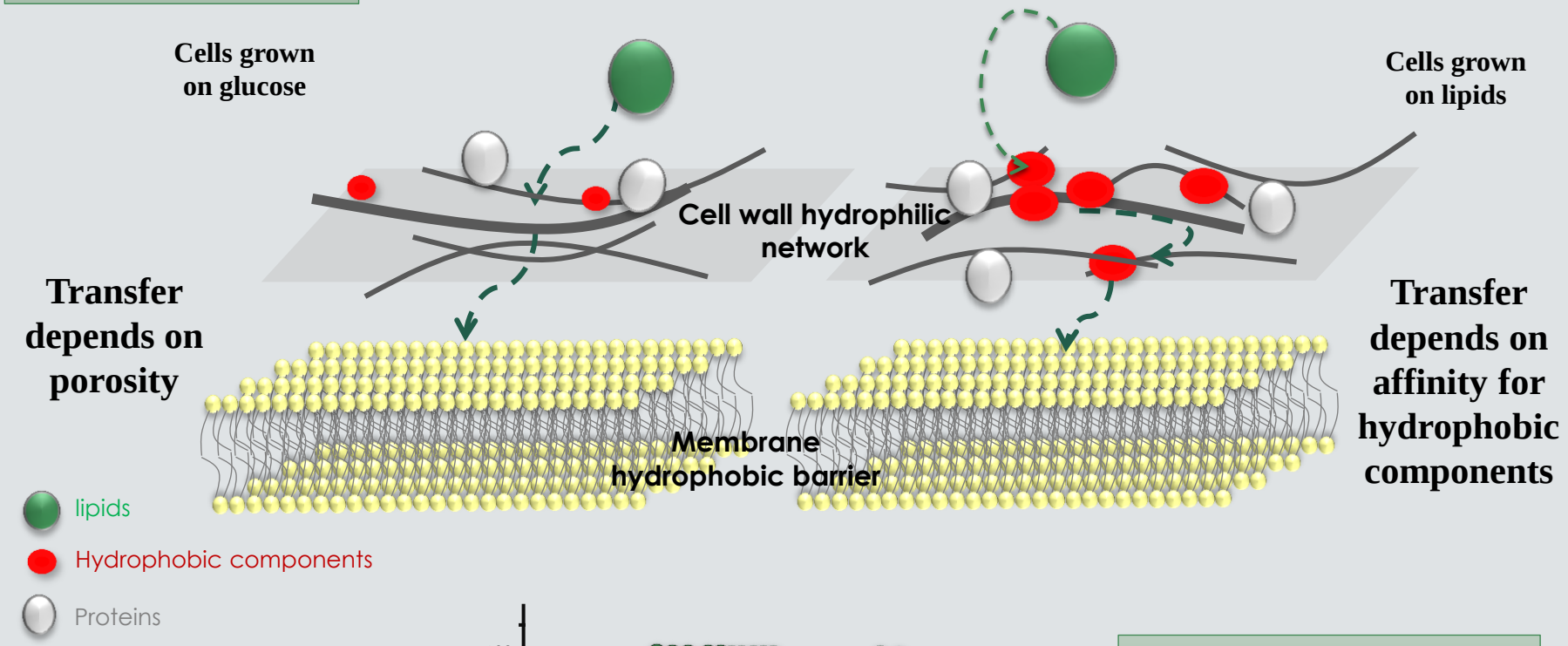


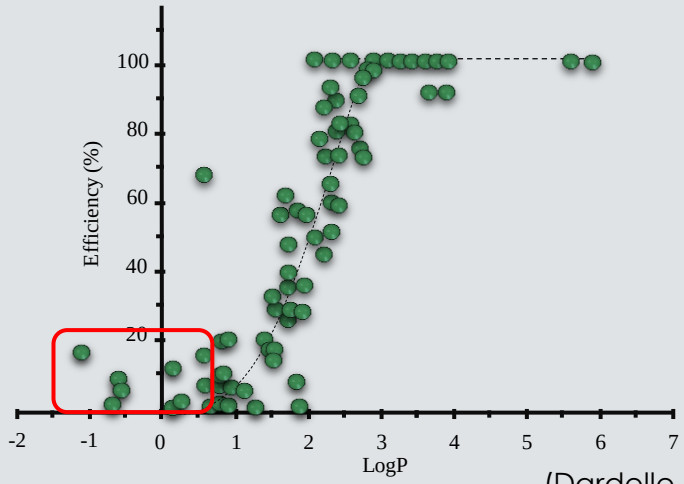
How can a molecule enter into yeast cell ???



How can a molecule enter into yeast cell

Fat soluble molecule

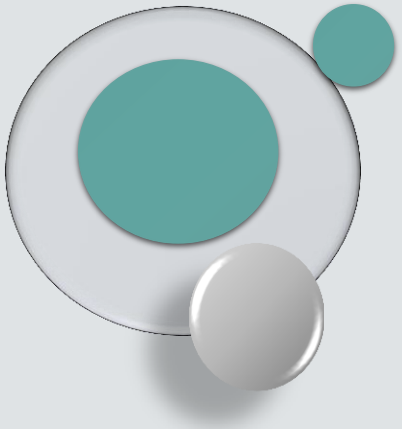




(Dardelle, 2007)

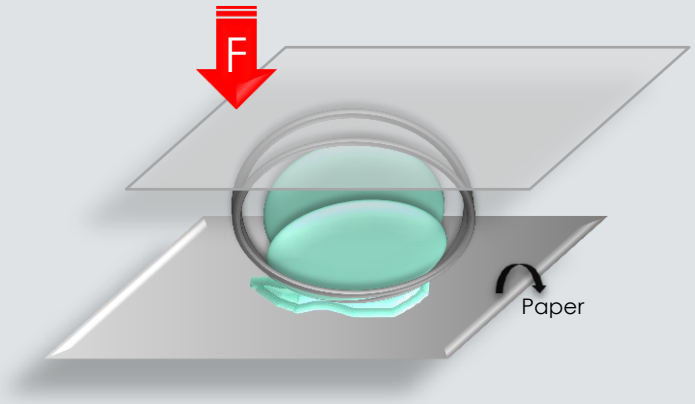
Possibility to enclose water-soluble or low hydrophobic molecules into yeast cell

How a molecule is released from yeast capsule ???



Release mode from yeast capsule

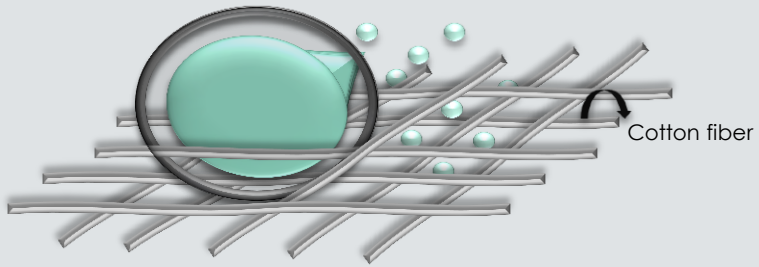
Autocopy paper: dye molecule



Shank, 1976

Molecule release by crushing microcapsules

Perfume: Perfumed fabric softening composition



Behan and Perring, 1992

Molecule release by diffusion from inside to outside microcapsule

Two liberation modes: by crushing capsule or by diffusion through capsule

Released control from yeast capsule

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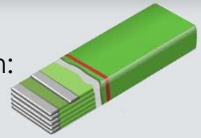
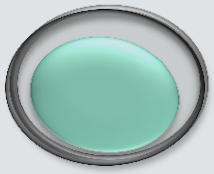
Fabrication process → Storage → Consumption

Chewing gum:
menthol

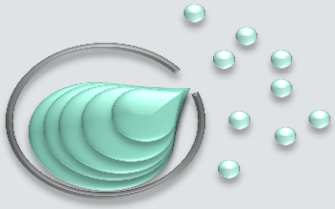




Sasaki, 2003

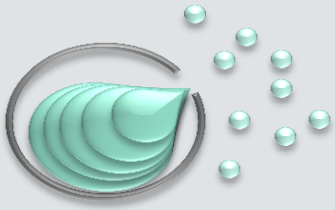
Fish feed:
amino acid

Sagar, 1994



Enhance long lasting
effect in mouth

The liberation of bounded molecule may be controled to requirement conditions

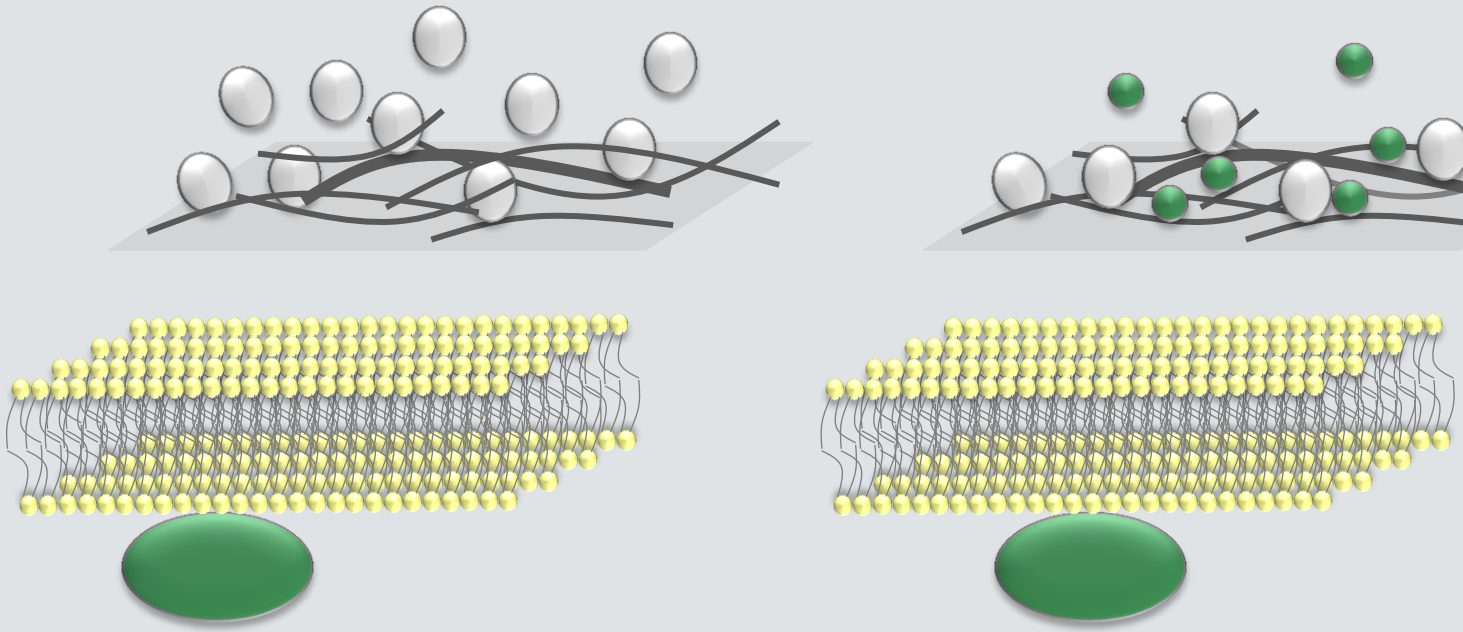


Protect agaist until fish
gastrointestinal tract

Release from yeast capsule - principle

Dried cell

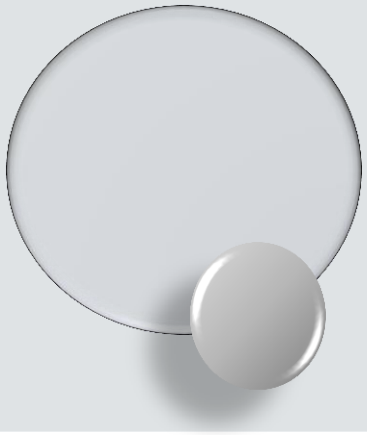
Hydrated cell



Dardelle, 2007

The liberation of bounded molecule depends on a_w of cell wall

Yeast taste, cost and regulation



Yeast taste and cost

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- Yeast off-flavors may be caused by culture media.
- Changing culture media for cultivation may reduce or avoid them

- Simple encapsulation process allows to reduce production cost
- High protection from yeast cell could avoid core material degradation thus allows to reduce the quantity of compound used

Regulation

"Novel food refers to all food which were not consumed in the EU to a significant degree before May 1997, in particular to food produced using new techniques and technologies, such as nanomaterials" *.

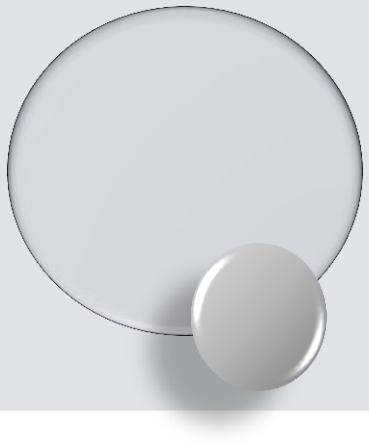
Depending on yeast strains, active core compounds

Ex: Baker yeasts, brewer yeasts,…

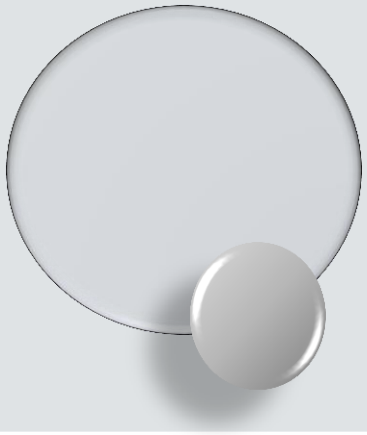
* http://ec.europa.eu/food/food/biotechnology/novelfood/initiatives_en.htm

Summary

- Physiological state of cell and physicochemical properties of active compounds decide the efficiency of encapsulation process using yeast capsule
- Possibility to control the release of the core material from the yeast capsule to the required moment and place.
- Yeast cells can be used as encapsulation materials without any clinic tests.

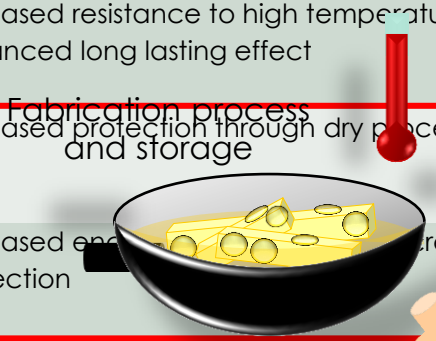


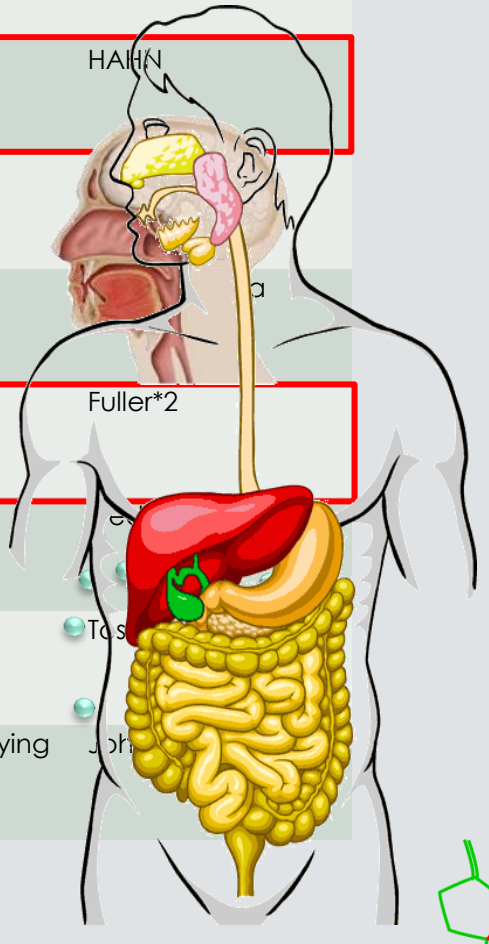
Yeast microcapsule applications



Yeast based microcapsules in food and other domains

Coated material	Application	Specific advantage/problems	References
Flavours		Resistance to high temperature, increased length of perception	Dardelle
Menthol	Chewing-gum	Increased persistence in mouth	SASAKI
Beef flavour	French fries	Increased resistance to high temperature and enhanced long lasting effect	HAHN
Essential oils	Fragrance in paper and tissus	Increased protection through dry process	
Antioxydants		Increased [illegible] protection	
Insulin	Medical	Increased delivery to the epithelial [illegible]	Fuller*2
Bleach activator	Laundry detergent composition	Elimination chemical reac[illegible] compound in cleaning co[illegible]	
Dye	Heat-sensitive recor[illegible] paper	Controlled release	To[illegible]
Perfume	Perfumed fabric softening composition	Increased protection throu[illegible] drying process	Joh[illegible]





Natencaps - Spin off company developing extraction and encapsulation processes of natural molecules

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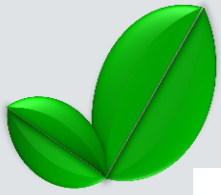

Bio extraction processes

Enhance extracted compounds shelf-life

Process upscale

Extraction

Natural ingredients from plants

Encapsulation

Collaborative R&D Processes

Commercialisation

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