

# Metabolic engineering for the production of specialty carbohydrates and biosurfactants

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## Adebiotech Conference, March 30th 2022



# Agenda

- 01 A market pull story  
Specialty Carbohydrates
- 02 A market push story  
Microbial biosurfactants
- 03 Future cell factory development  
Keep an eye on us

01.

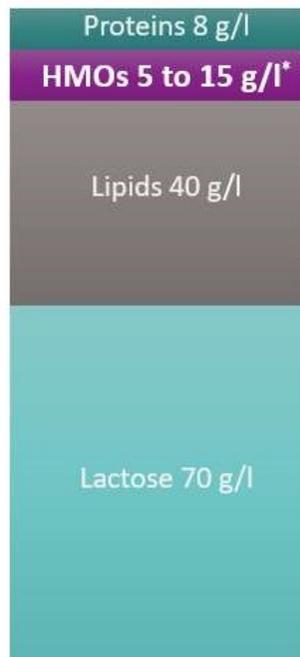
# A Market Pull Story

## Specialty Carbohydrates

# 01. Market Pull Story: specialty carbohydrates



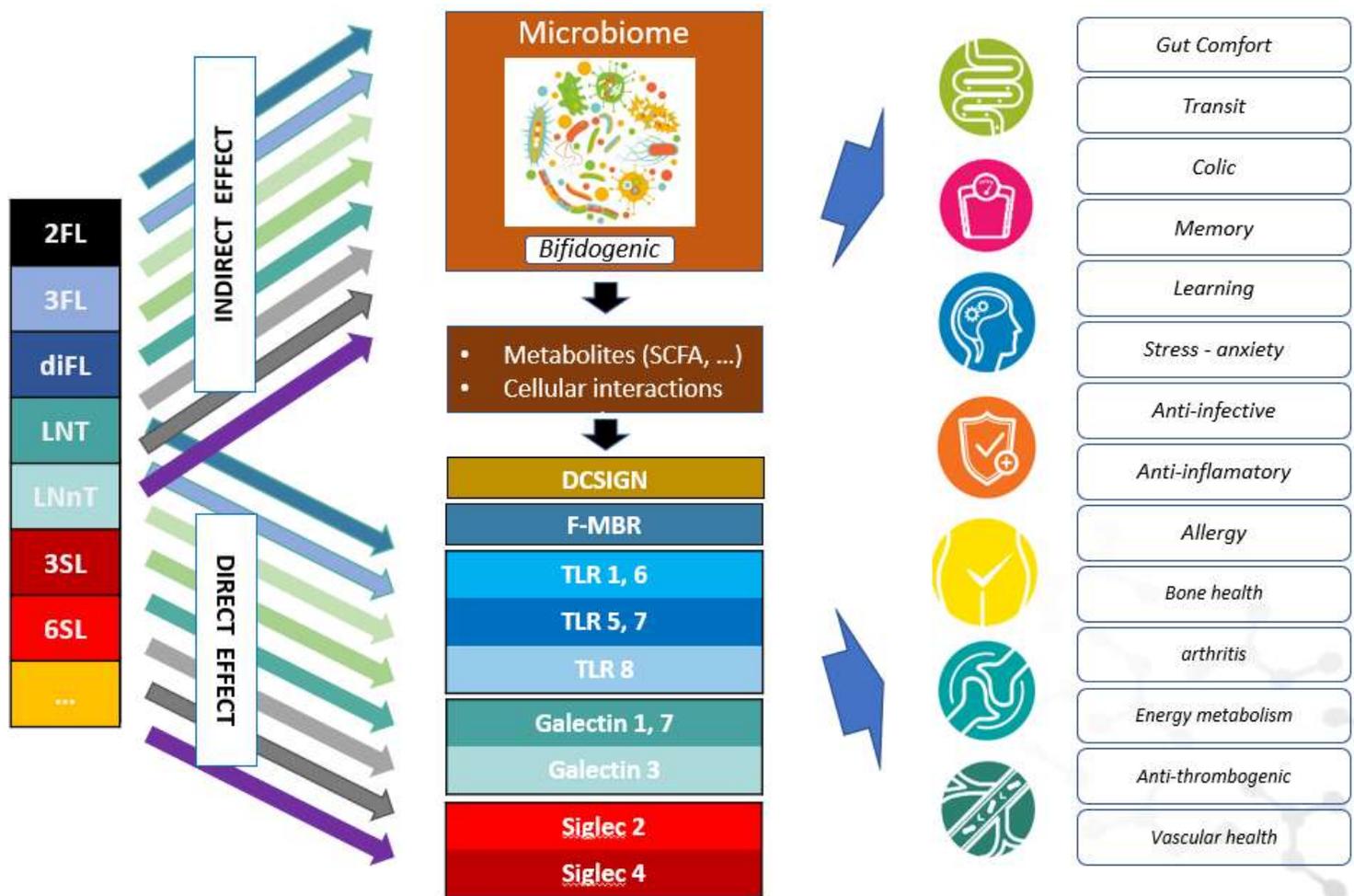
## Introducing HMOs (human milk oligosaccharides)



- 3<sup>rd</sup> most abundant component in human milk
- Family of complex carbohydrates
- Hot topic in new sciences
- > 15000 hits (Google scholar 2018-2020)

# 01. Market Pull Story: specialty carbohydrates

## HMOs exert indirect and direct bio-activities affecting human health



# 01. Market Pull Story: specialty carbohydrates



## HMOs (human milk oligosaccharides):

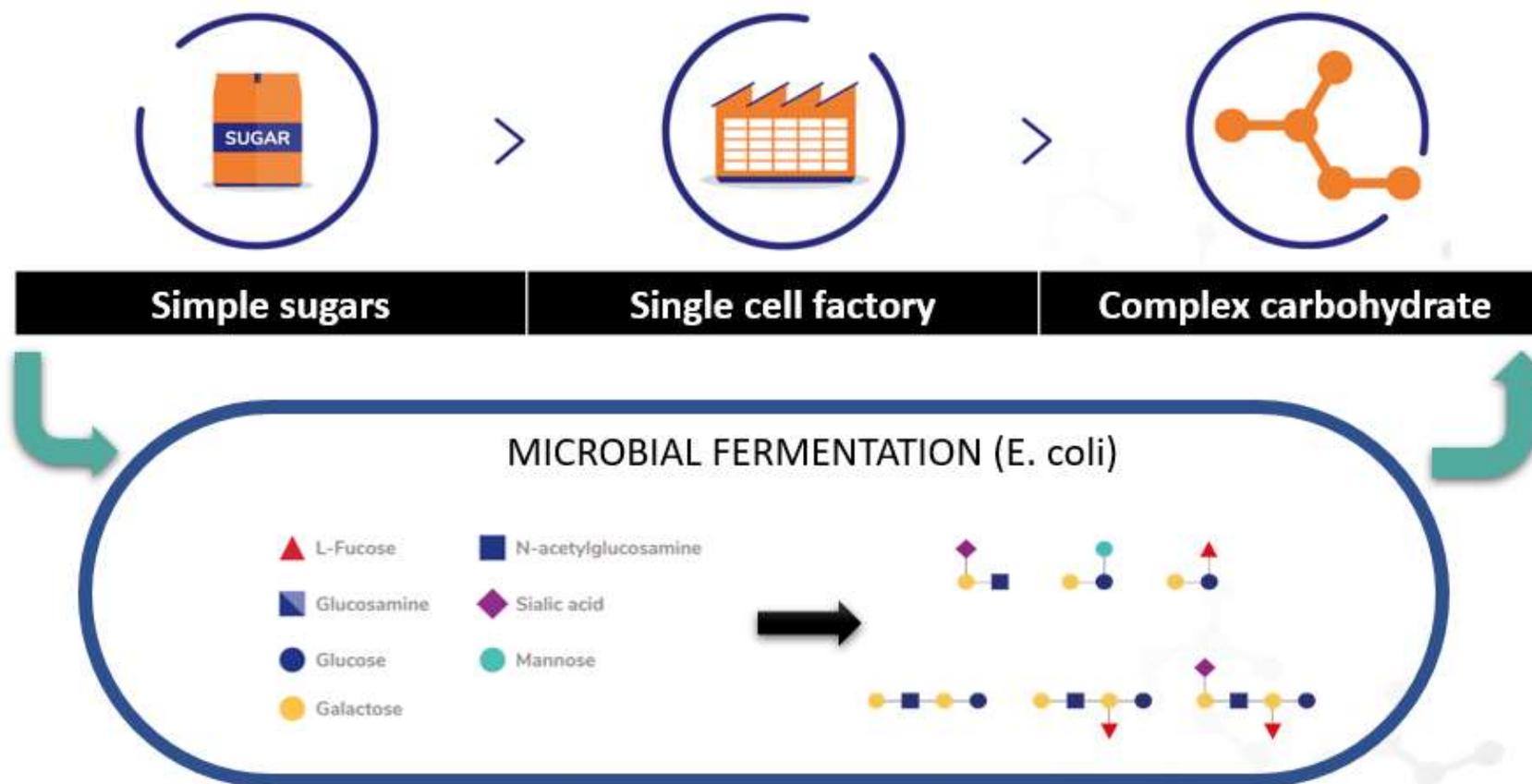
- Clear benefits
- Impossible to economically produce through conventional chemistry

⇒ Market Pull

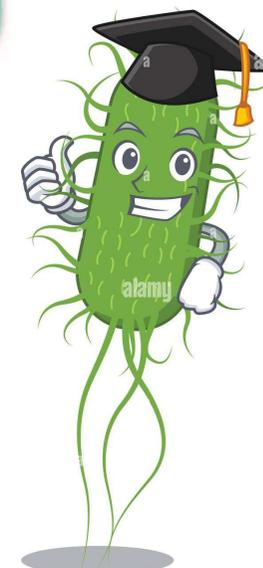
⇒ microbes can do!



# 01. Market Pull Story: specialty carbohydrates



⇒ Spin off company:



# 01. Market Pull Story: specialty carbohydrates

## Infant Formula containing HMOs

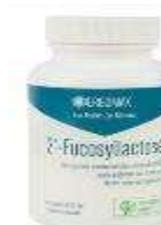
## HMOs are a market reality



US, Hong Kong, Singapore, Mexico, Columbia, Saudi, UAE, Oman, Kuwait, Bahrain, Vietnam, South Africa, Russia, ...

Spain, Portugal, Poland, Greece, Hong Kong, Mexico, France, Saudi, UAE, Oman, Bahrain, Kuwait, South Africa, US, Vietnam, ...

## Dietary Supplements containing HMOs



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Confidential

02.

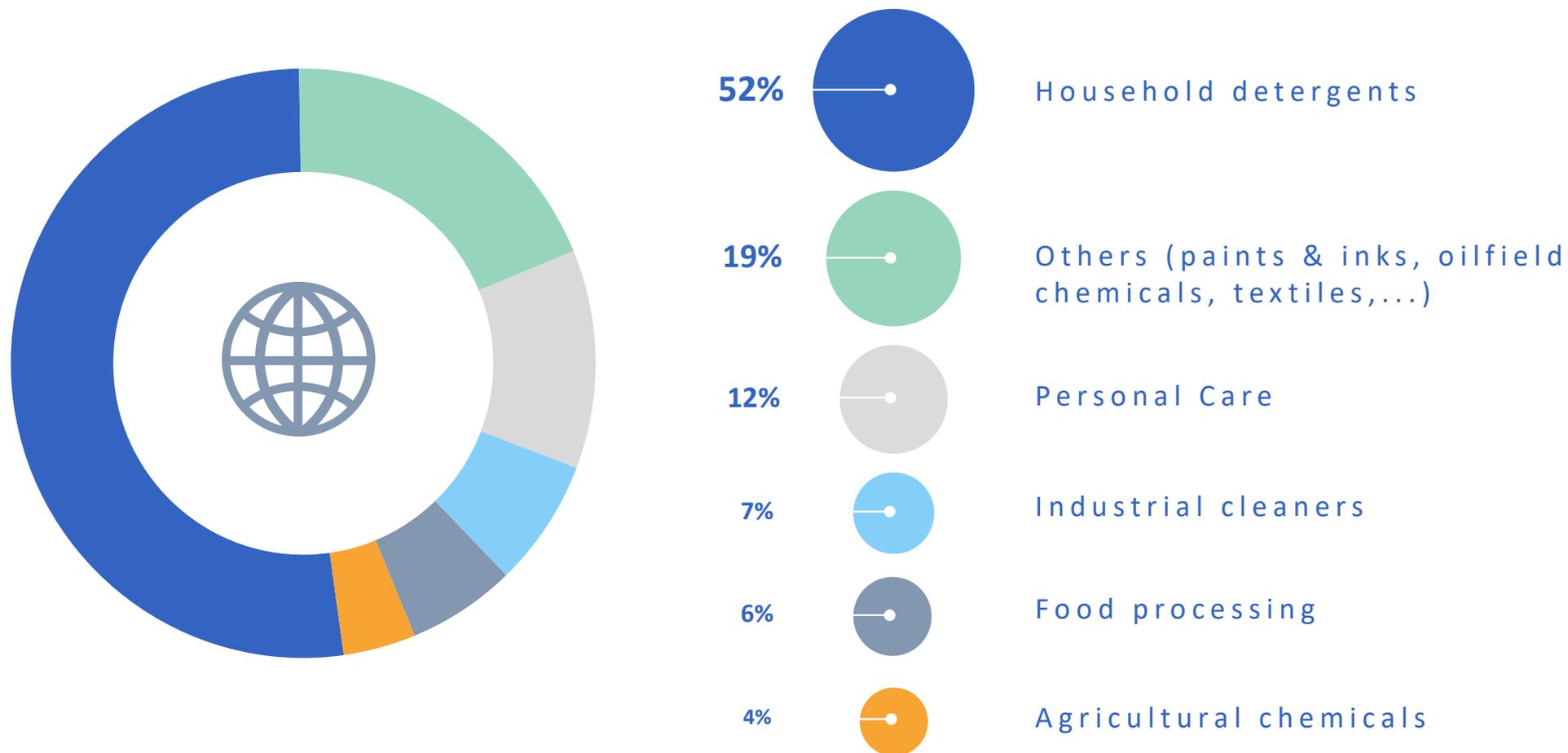
# A Market Push Story

## Microbial biosurfactants

# 02. Surfactants: where?

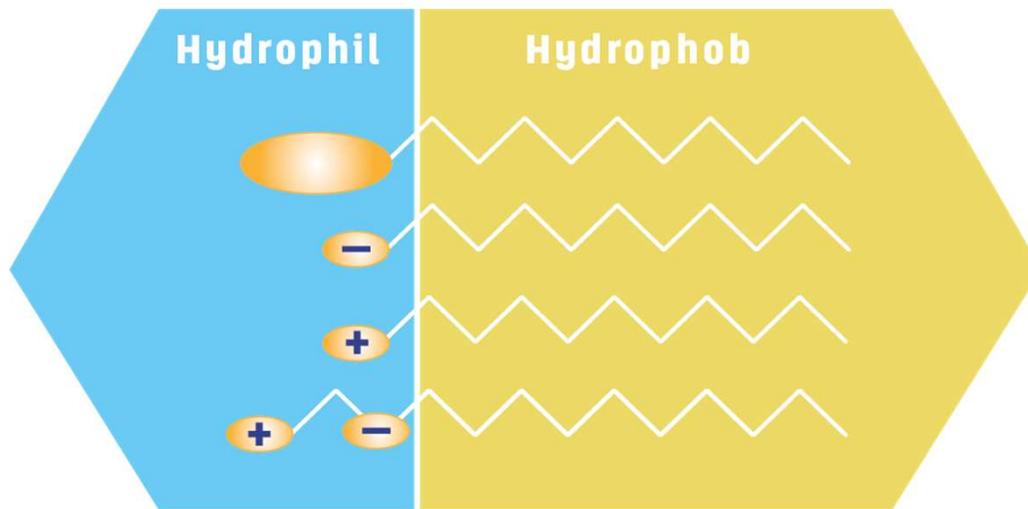


## 02. Surfactants: where?



## 02. Surfactants: what?

### SURFace ACTive AgeNT



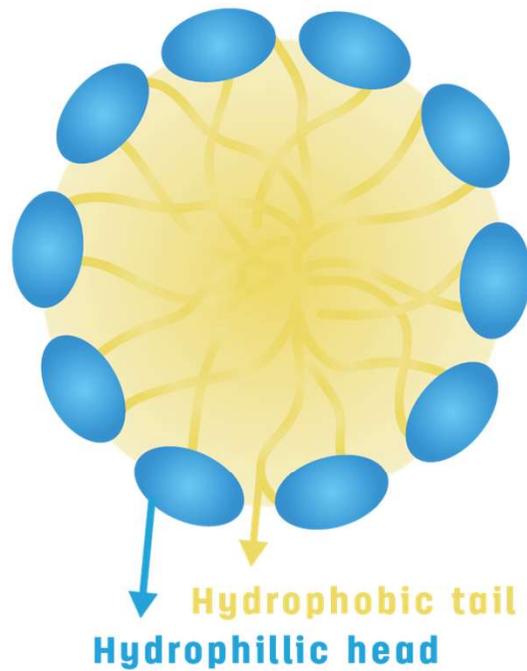
**Amphiphilic**

## 02. Surfactants: how do they work?



# 02. Surfactants: how do they work?

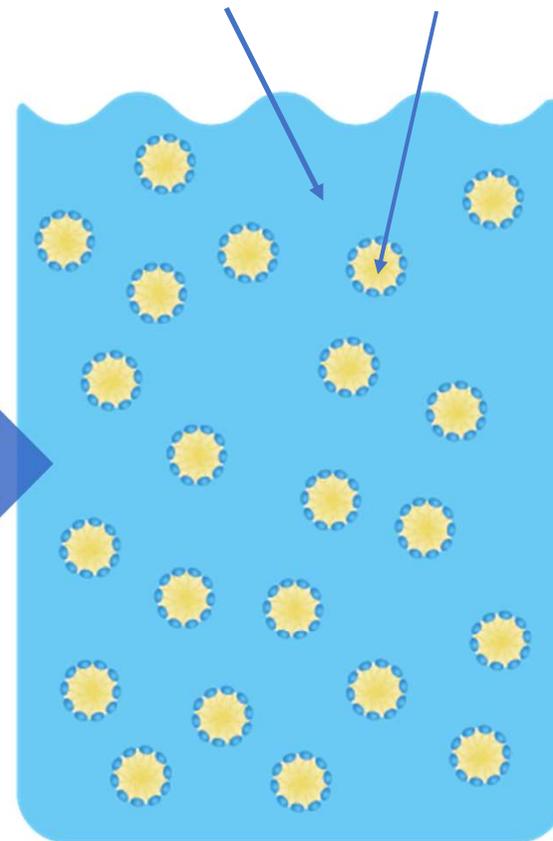
## SURFACTANT



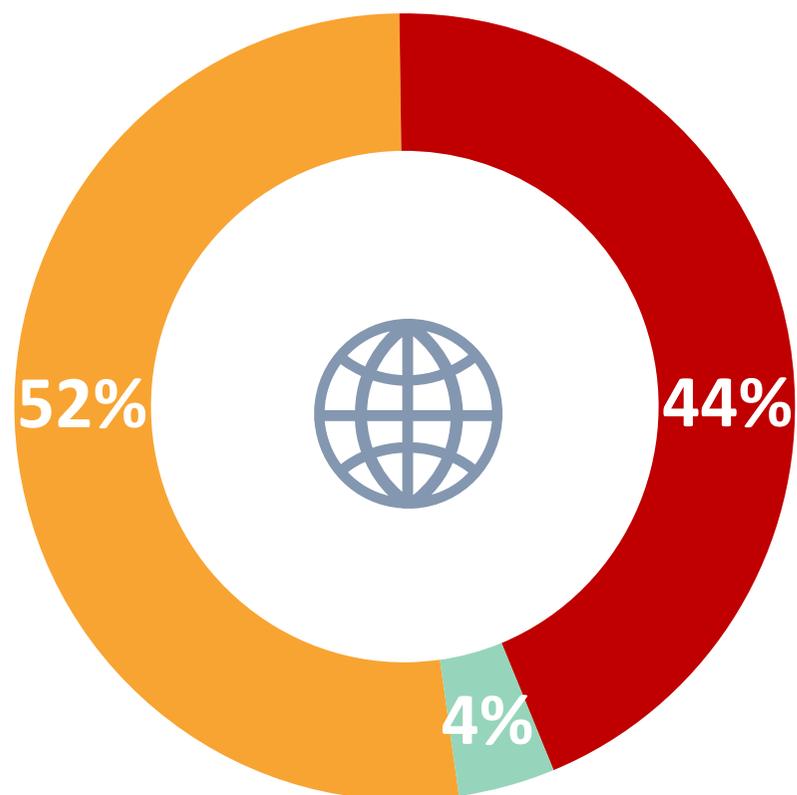
Micelle



Water Oil



## 02. Origin of surfactants



**NON biobased surfactants**  
< 5 % biomass derived

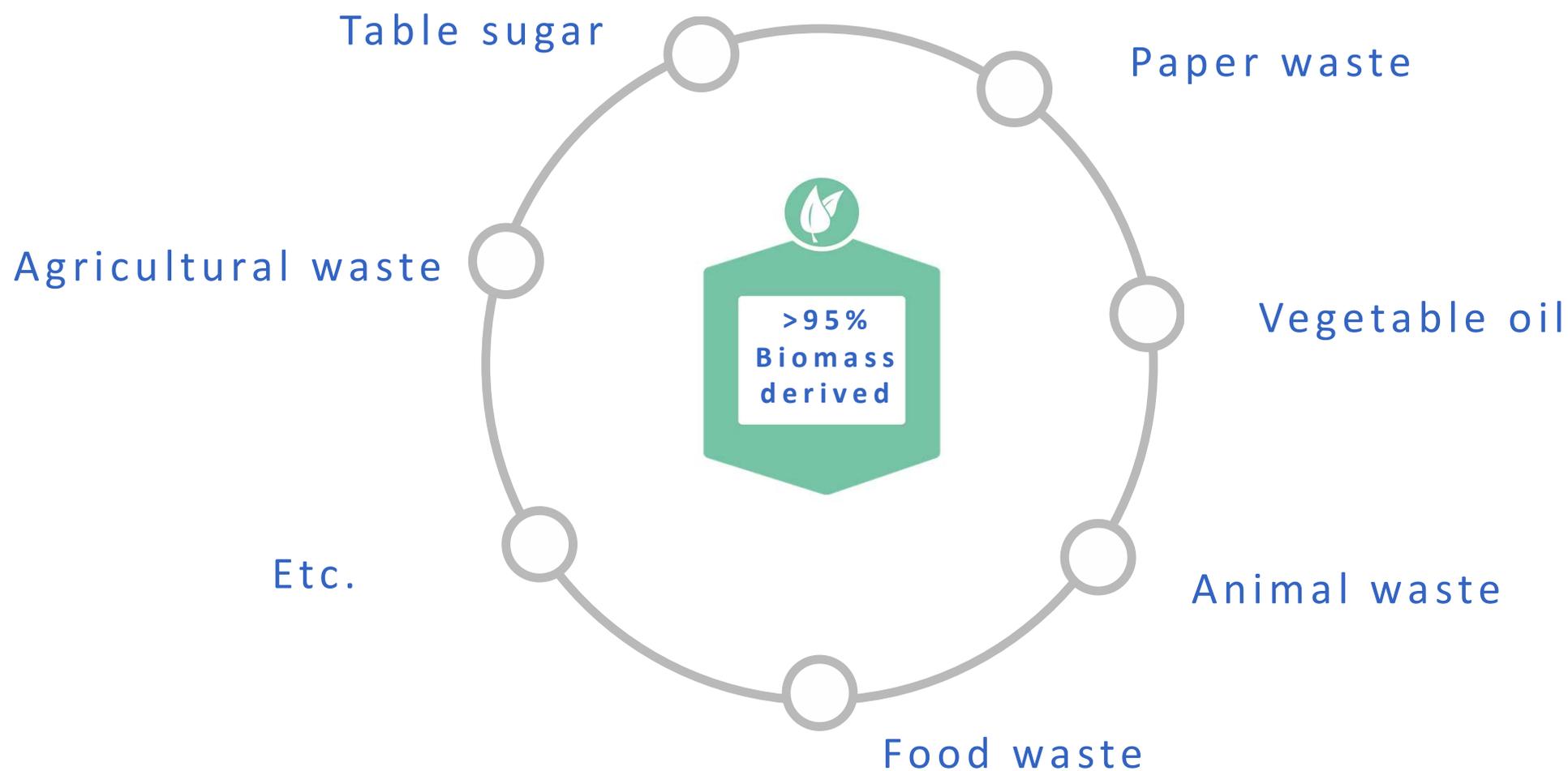


**PARTLY biobased surfactants**  
+/- 40 % biomass derived

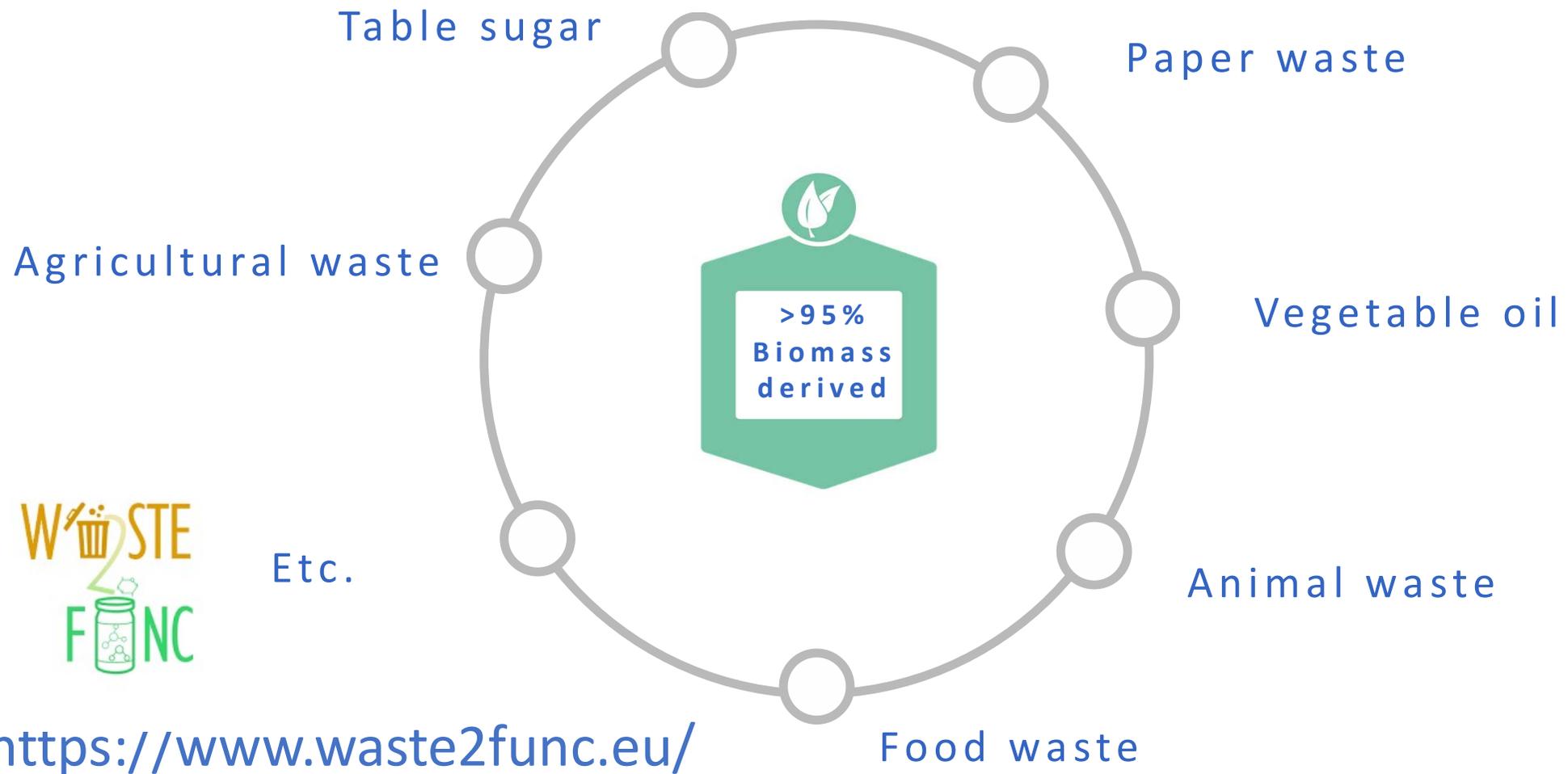


**FULLY biobased surfactants**  
> 95 % biomass derived

## 02. Fully BioBased surfactants: sourcing?



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**FULLY  
Biobased**

> 95% Biomass

### Biomass?

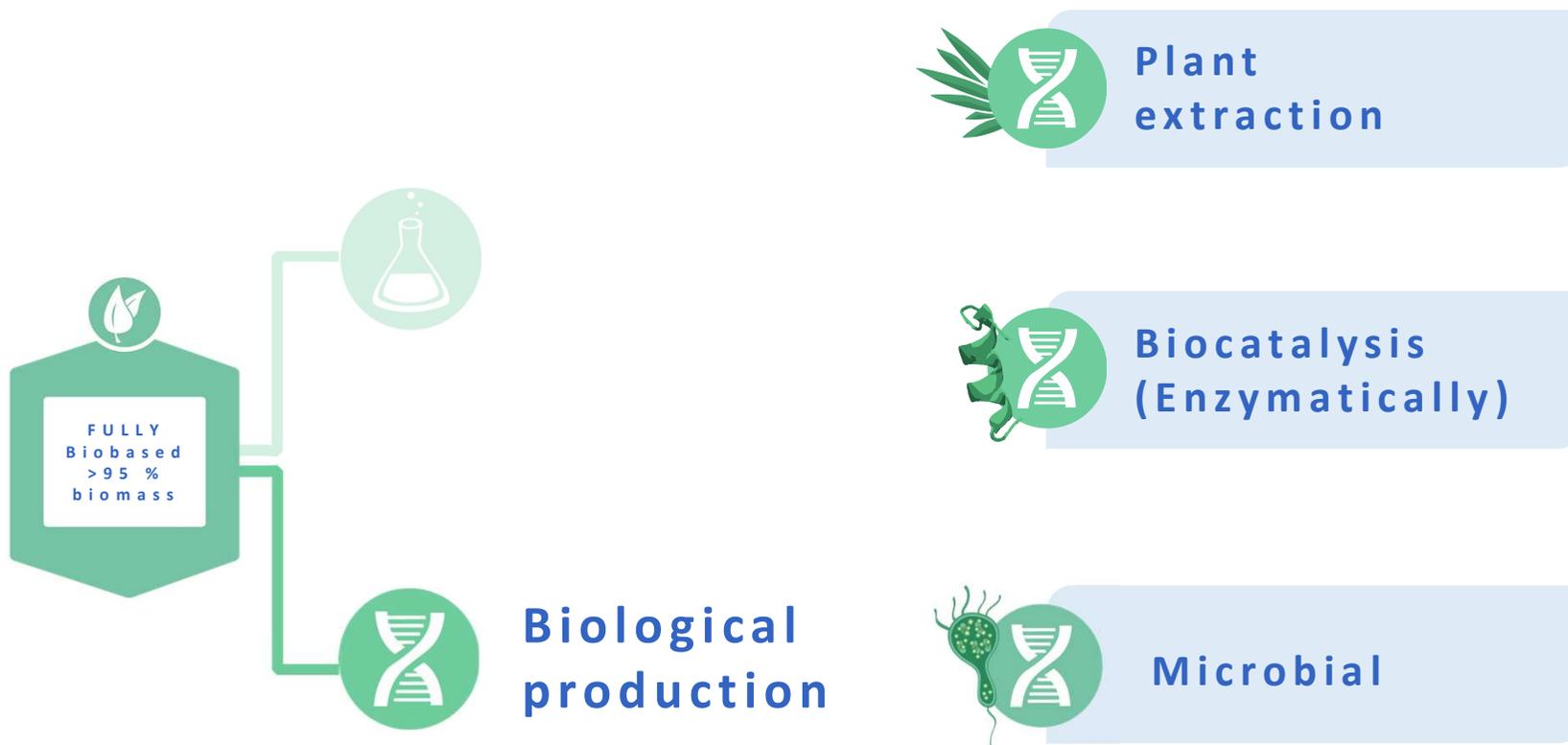
Renewable (new) carbon

Plant and animal derivatives

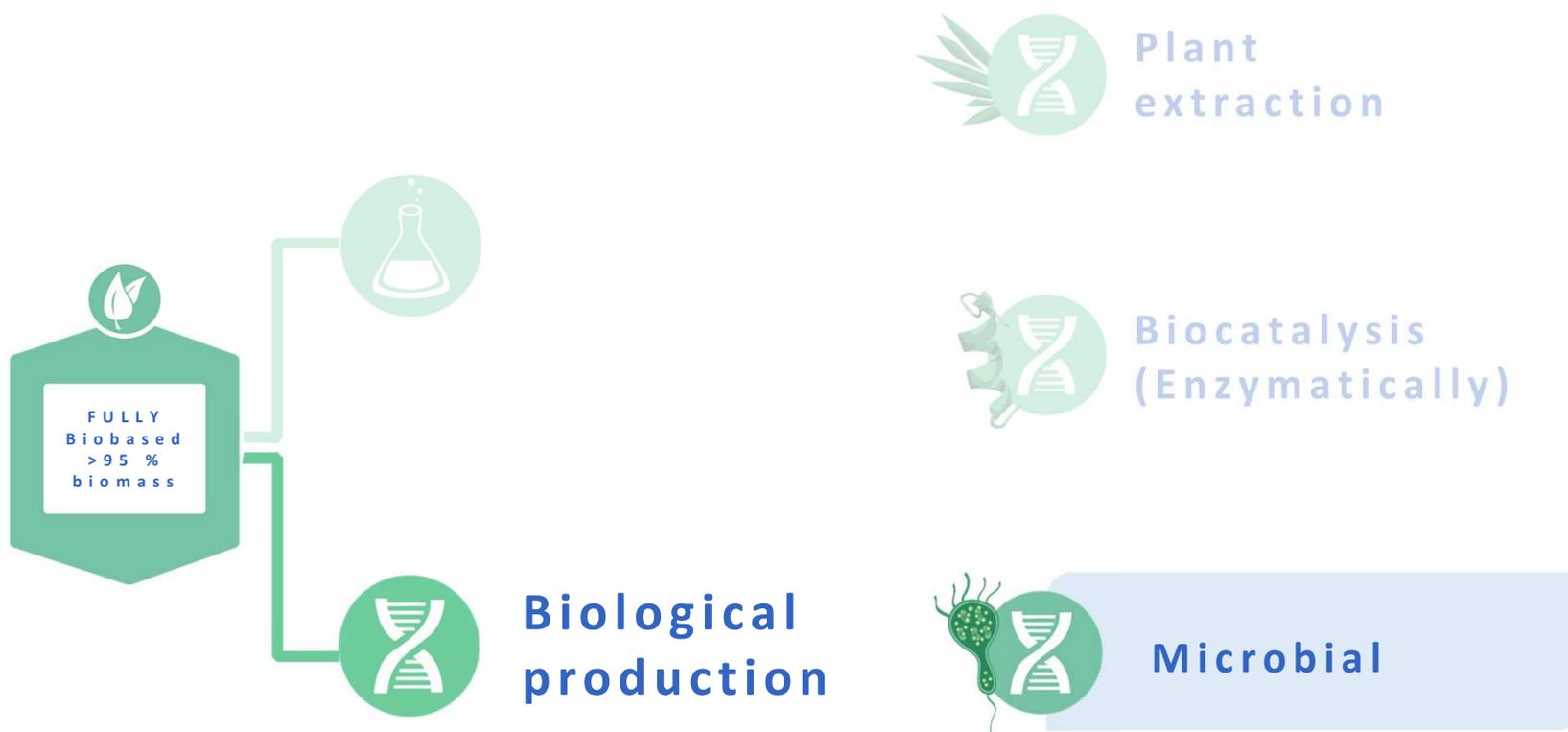
Excludes fossils raw materials

Assessed by  $^{14}\text{C}$  analysis

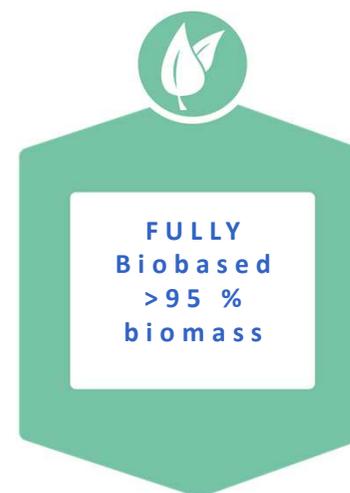
# 02. Biological production of biosurfactants



# 02. Biological production: microbial

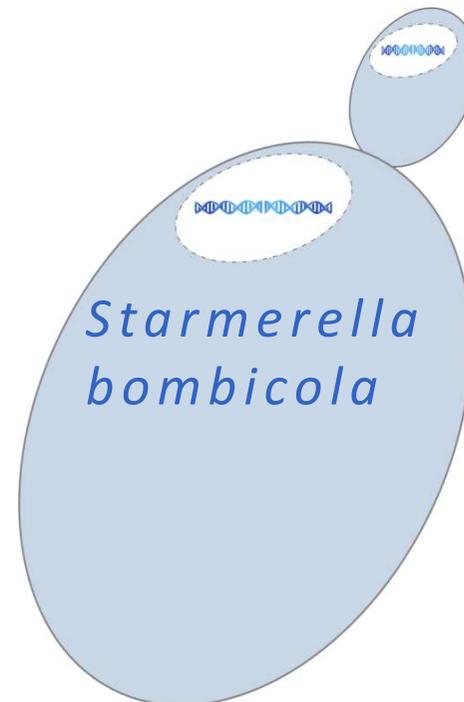


## 02. Advantages of Microbial biosurfactants

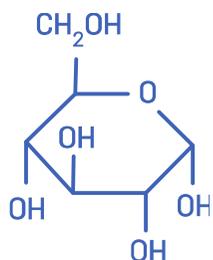


## 02. Microbial biosurfactants

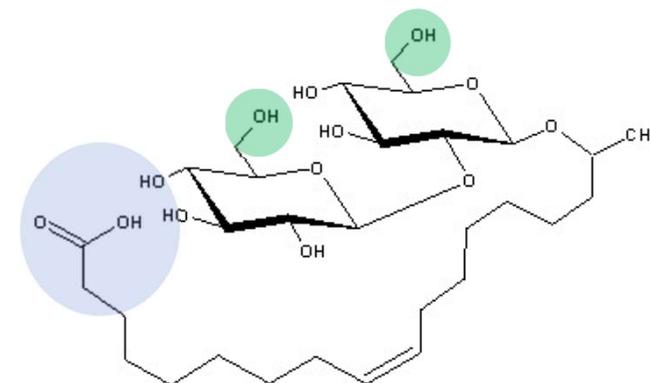
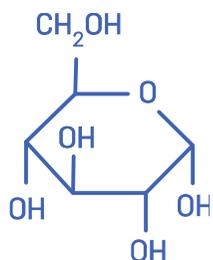
Meet our workhorse:



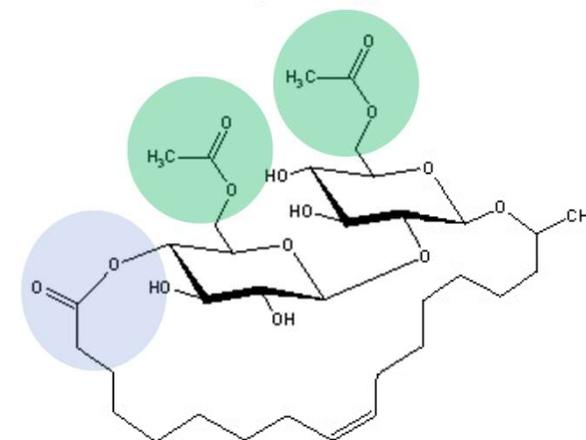
## 02. *Starmmerella bombicola*



# 02. *Starmmerella bombicola*



Acidic form, non acetylated

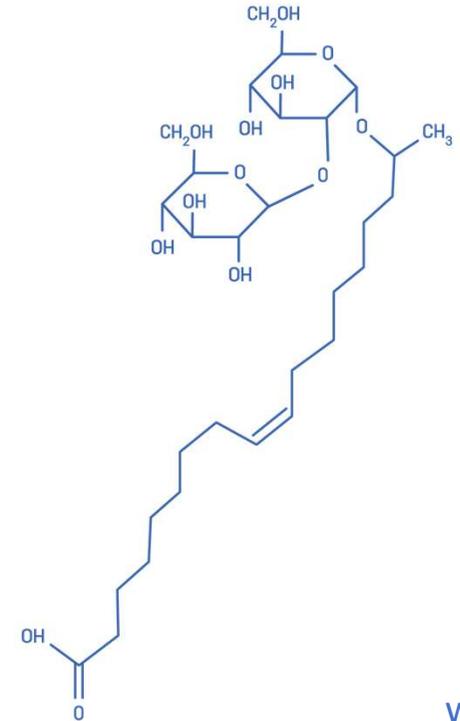
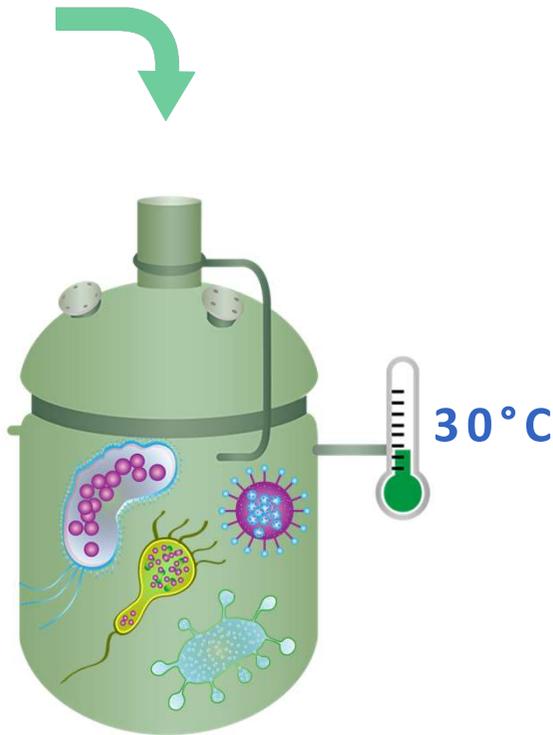
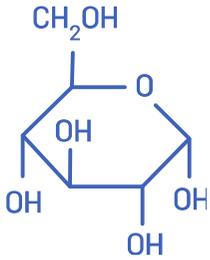


Lactonic form, diacetylated



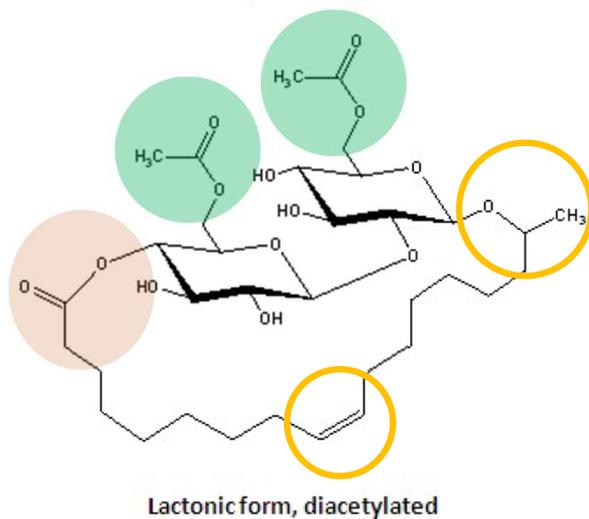
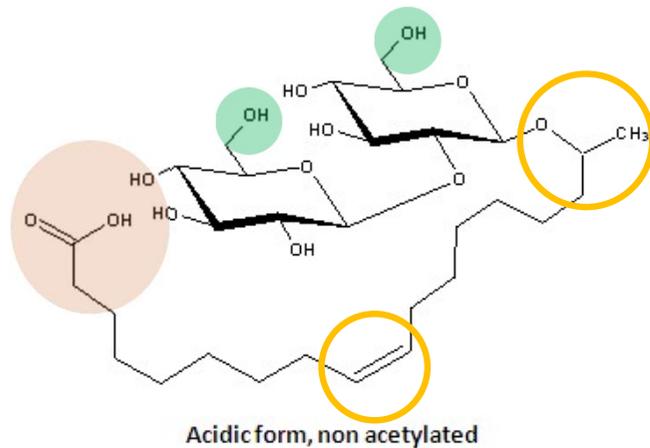


# Microbial BSs example: sophorolipids



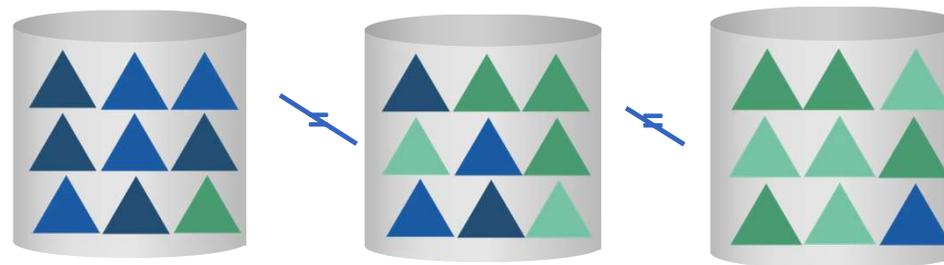
Source:  
[www.ecover.com](http://www.ecover.com)

# 01. Introduction: Sophorolipids a complex mix

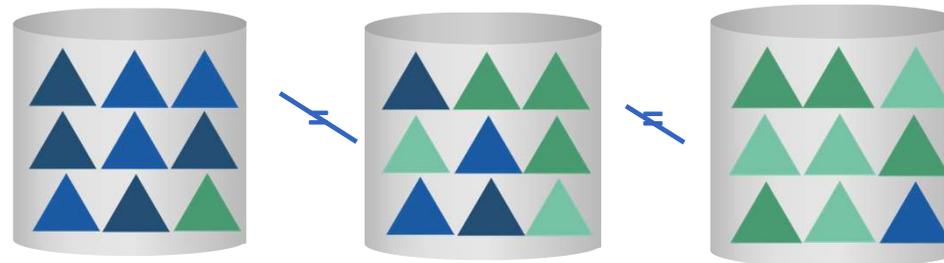


- Acidic or lactonic form
- Acetylation: 0, 1 or 2 groups
- Unsaturated bounds: 0, 1 or 2
- Fatty acid chain length: C16-C18
- Position of hydroxylation:  $\omega$  of  $\omega-1$

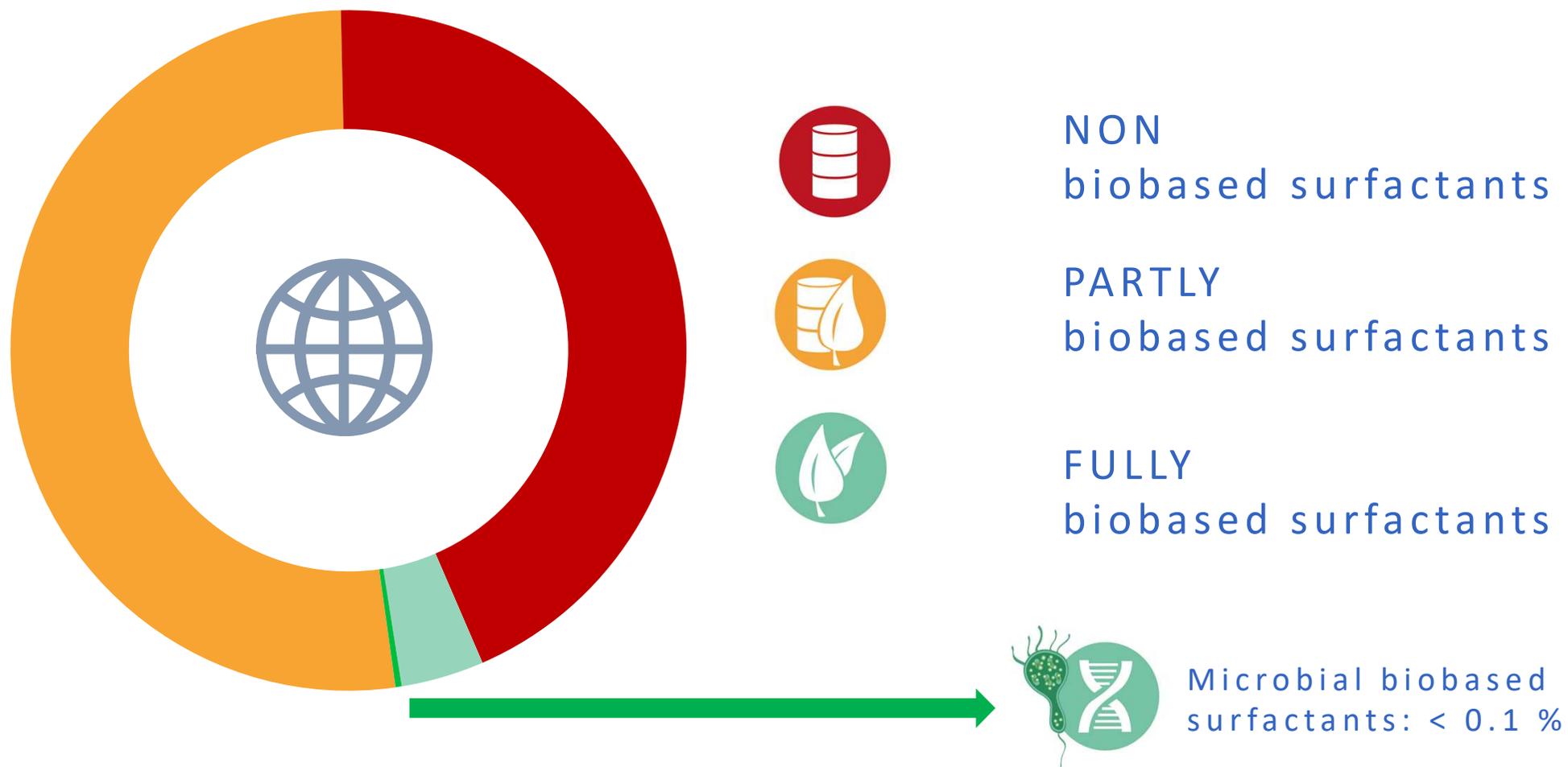
## 02. Disadvantages of Microbial biosurfactants



## 02. Disadvantages of Microbial biosurfactants

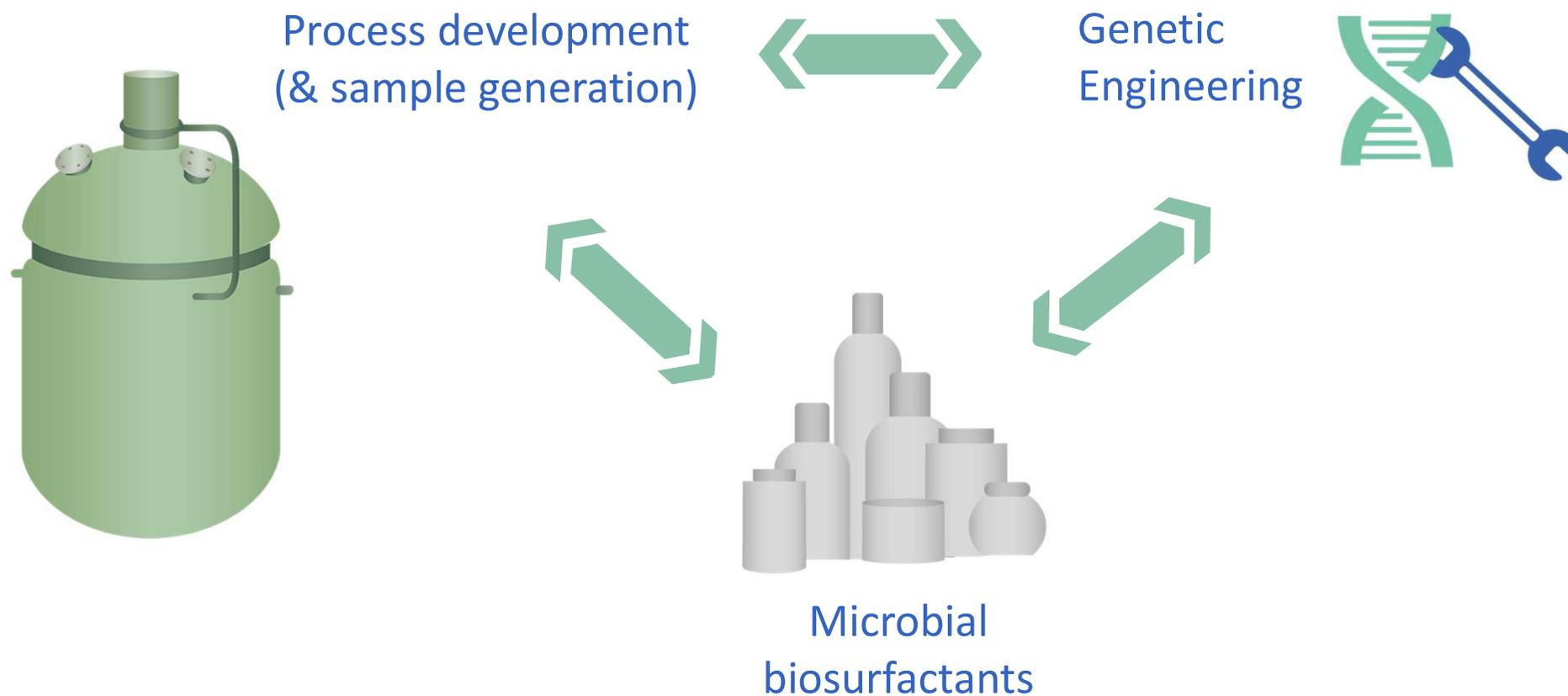


## 02. Microbial biosurfactants: market



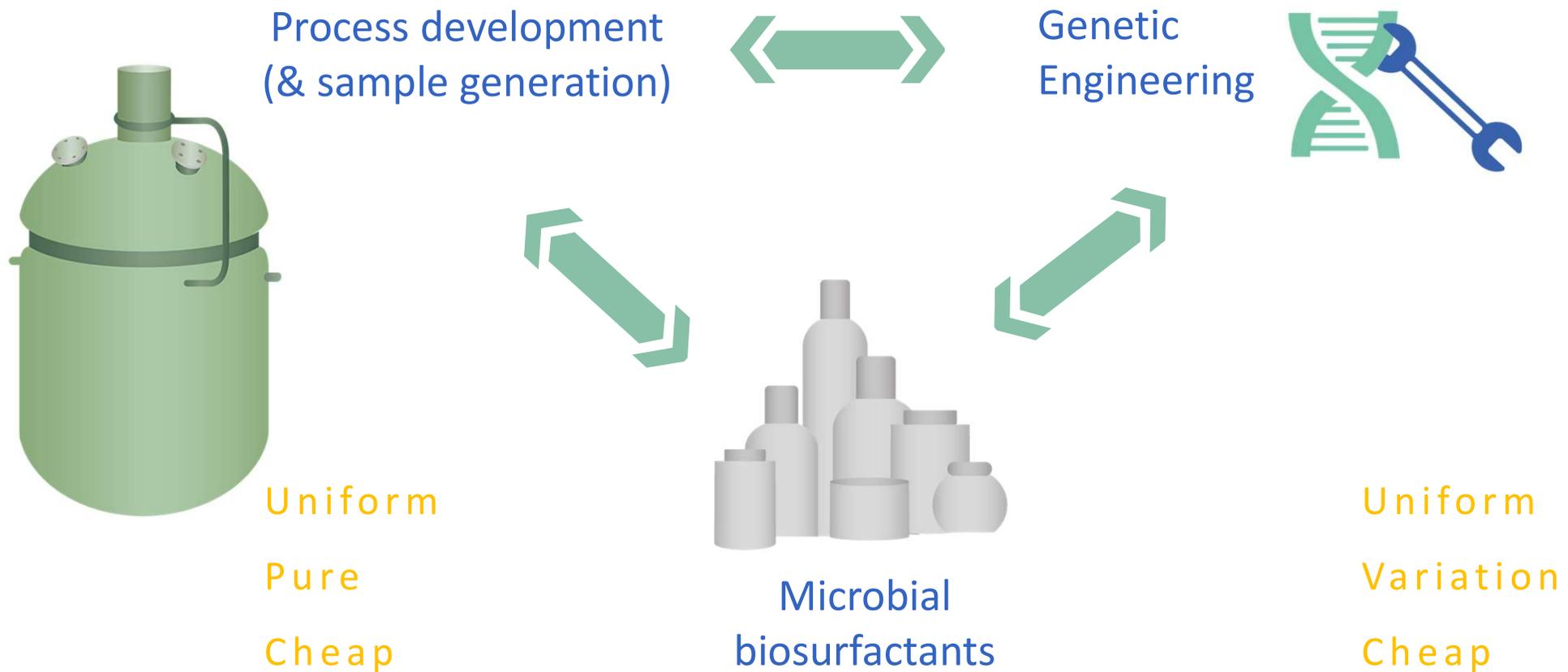
## 02. Disadvantages of Microbial biosurfactants

Solution: Integrated Bio process Design to bring IB to market



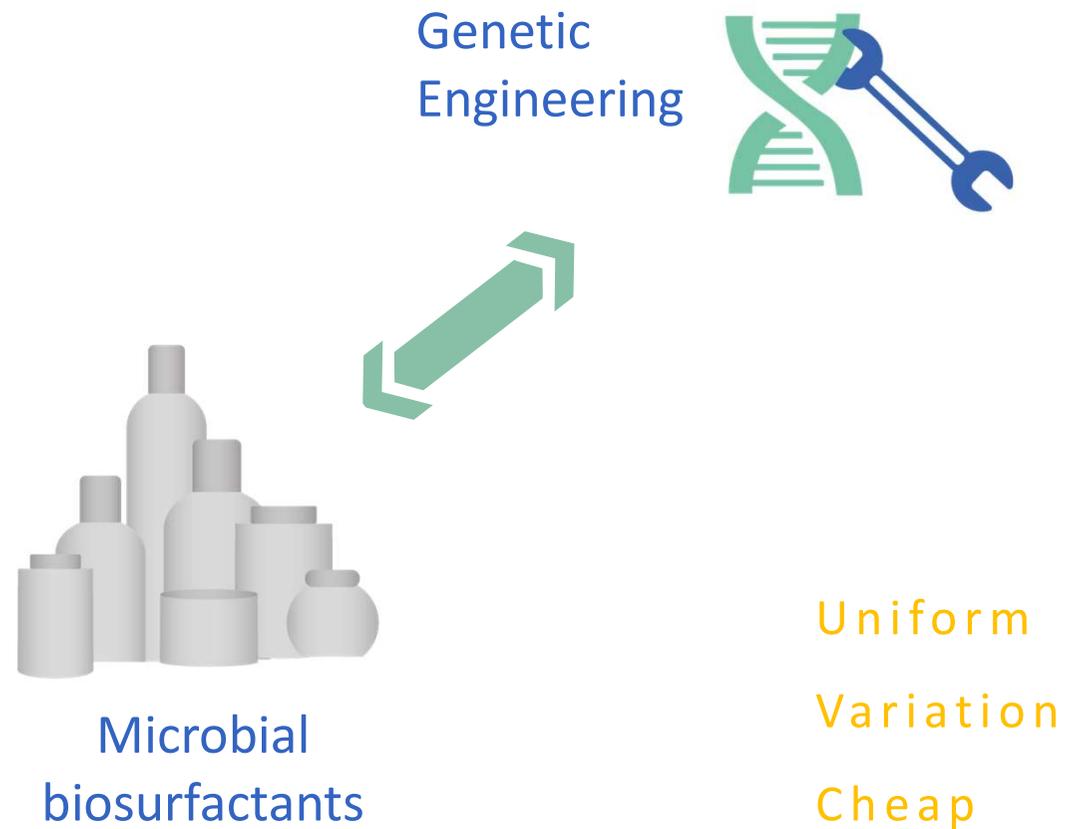
## 02. Disadvantages of Microbial biosurfactants

Solution: Integrated Bio process Design to bring IB to market



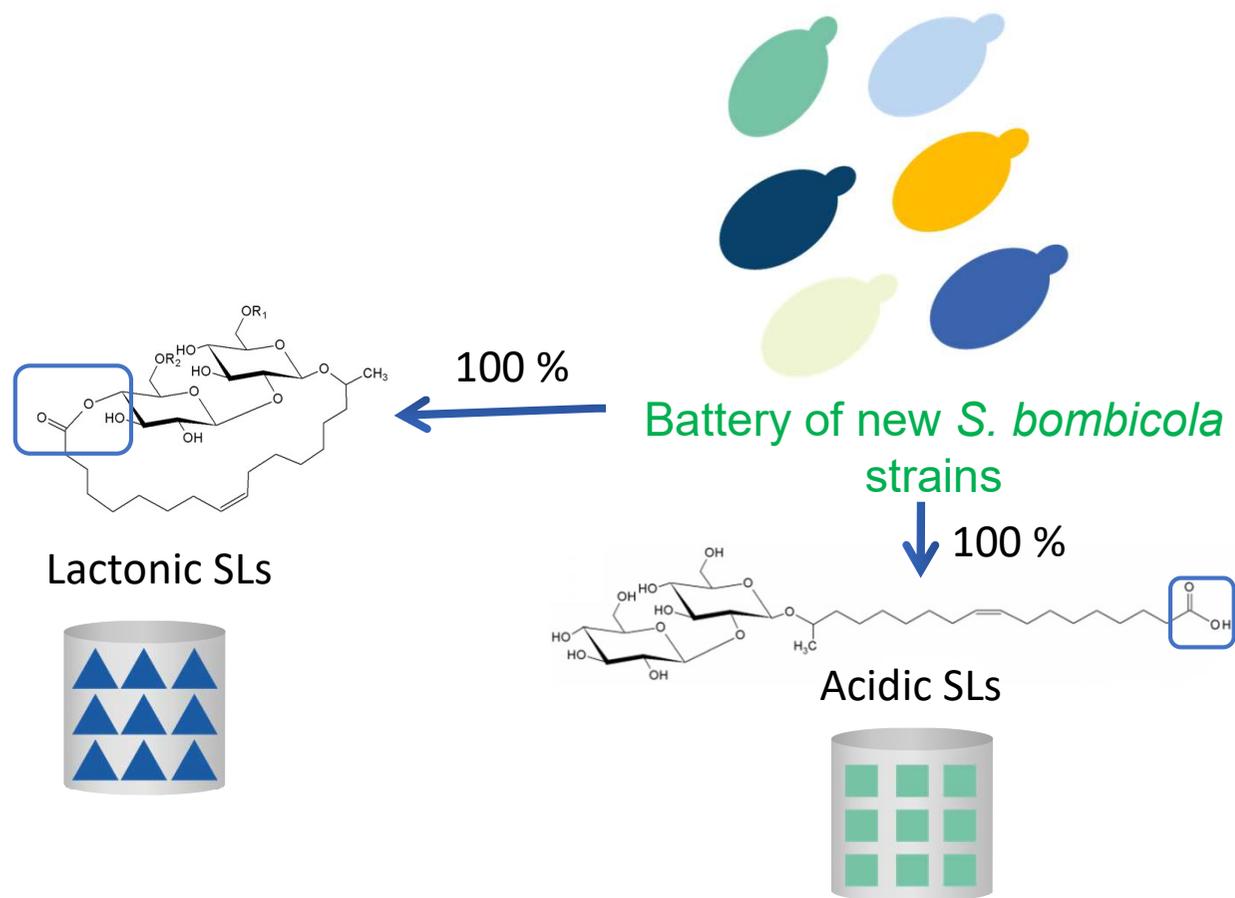
## 02. Disadvantages of Microbial biosurfactants

**Solution:** Integrated Bio process Design to bring IB to market



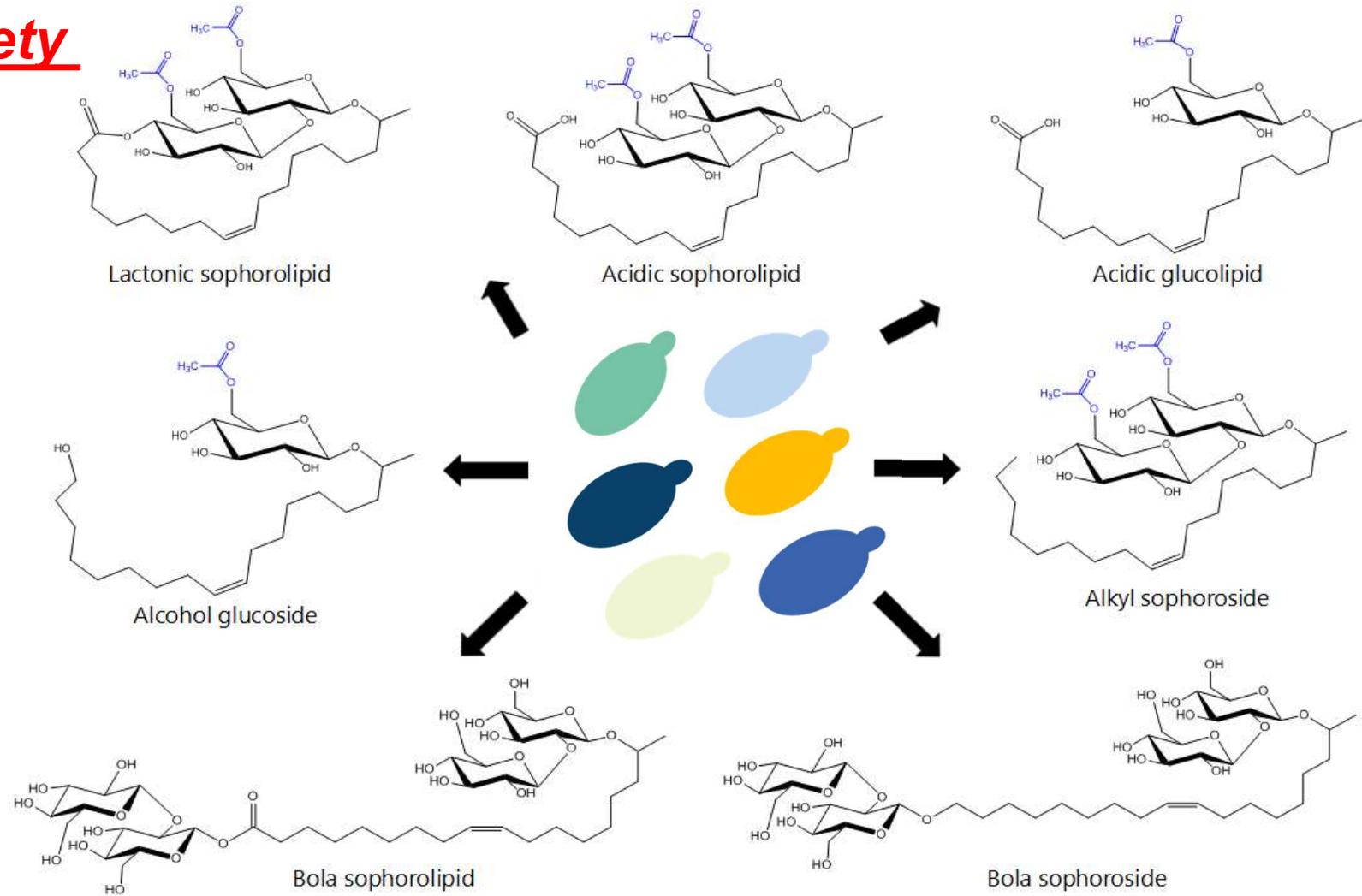
# 02. IBD approach: strain engineering

## Increasing uniformity:



# 02. IBD approach: strain engineering

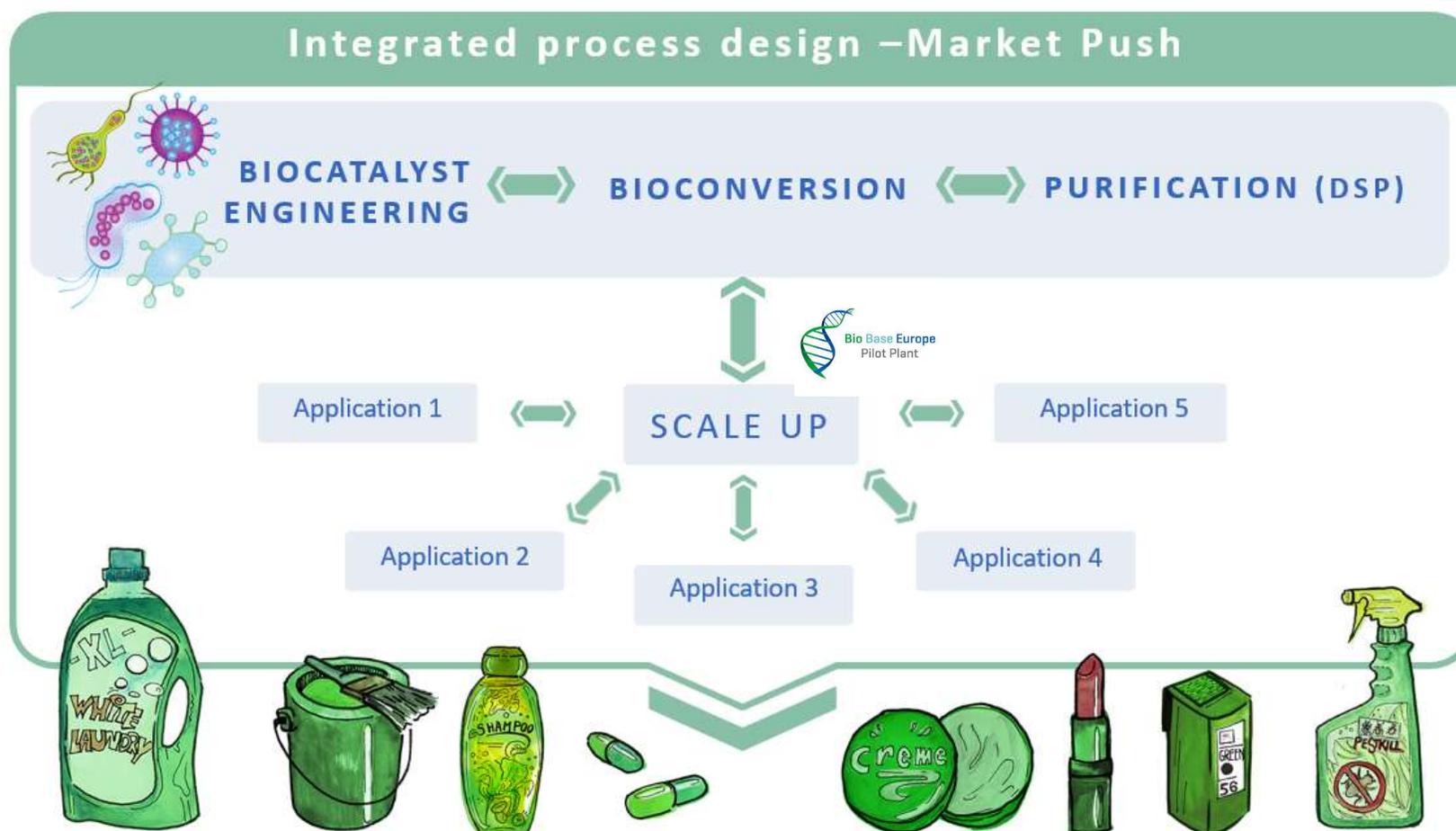
## Increasing variety



# 02. Microbial biosurfactants: a market push story

⇒ 2<sup>nd</sup> Spin off company (July 29<sup>th</sup> 2021):

**Amphi-Star**  
BIOSURFACTANTS



# 02. Microbial biosurfactants: a market push story???



## ⇒ Market push?



### Unilever to eliminate fossil fuels in cleaning products by 2030

Published: 02/09/2020 Average read time: 5 minutes

London/Rotterdam - Unilever, a leading manufacturer of cleaning and laundry products, today announces it will source 100% of the carbon

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BASF strengthens its position in bio-surfactants for Personal Care, Home Care and Industrial Formulators with two distinct partnerships

- BASF establishes a strategic alliance, including an equity stake, with Allied Carbon Solutions Co.,Ltd (ACS) Japan, a commercial provider of surfactants from biomass
- BASF enters a strategic technology cooperation with Holiferm Ltd, UK, to develop a state-of-the-art production process for biosurfactant products

Birgit Wesche  
+49 621 60-42286  
Send email



### Stepan Company Completes Acquisition of NatSurFact® Business from Logos Technologies

March 27, 2020



### Dow Signs Exclusive Agreement with Locus Performance Ingredients to Expand Biosurfactant Offerings in the Global Home Care and Personal Care Markets

Corporate Home > News > Press Releases > Dow Signs Exclusive Agreement with Locus

# Thank you!

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