

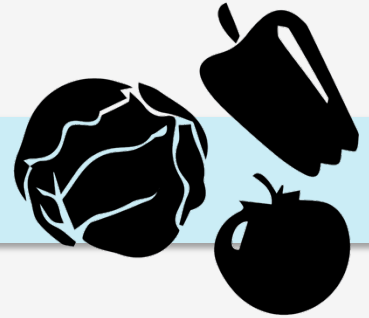
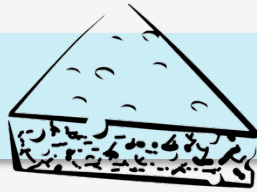
# Industrial Biotechnology

*Technology for biobased products*

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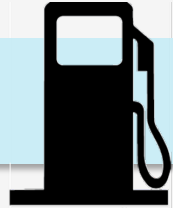
# Biotechnology

*“The use of biological systems to develop or make a valuable product”*



# Industrial biotechnology

*“The use of biological systems (microorganisms or derivatives thereof) to develop or make industrially useful products”*



# “Microorganisms or derivatives thereof...”

## Two kinds of microorganisms

### Bacteria

- Yoghurt
- Wastewater treatment
- Insulin

### Fungi

- Blue cheese
- Quorn
- Penicillin

## Inside microorganisms

### Enzymes

- Bread improvers
- Cheese (chymosine)
- Washing powder
- Organic synthesis

# Bacteria



## Characteristics

- Unicellular
- Size: 1  $\mu\text{m}$
- Shape: varies
- Classification: Prokaryotic

A scanning electron micrograph (SEM) showing a dense network of fungal hyphae and spores. The hyphae are long, thin, and branching, while the spores are smaller, rounded, and often clustered. The background is dark, highlighting the intricate structure of the fungus.

# Fungi

## Characteristics

- Unicellular or multicellular

- Size:

hyphae 1000  $\mu\text{m}$ , spores 1-100  $\mu\text{m}$

yeast 10  $\mu\text{m}$

- Classification: Eukaryotic

# Feed for microorganisms

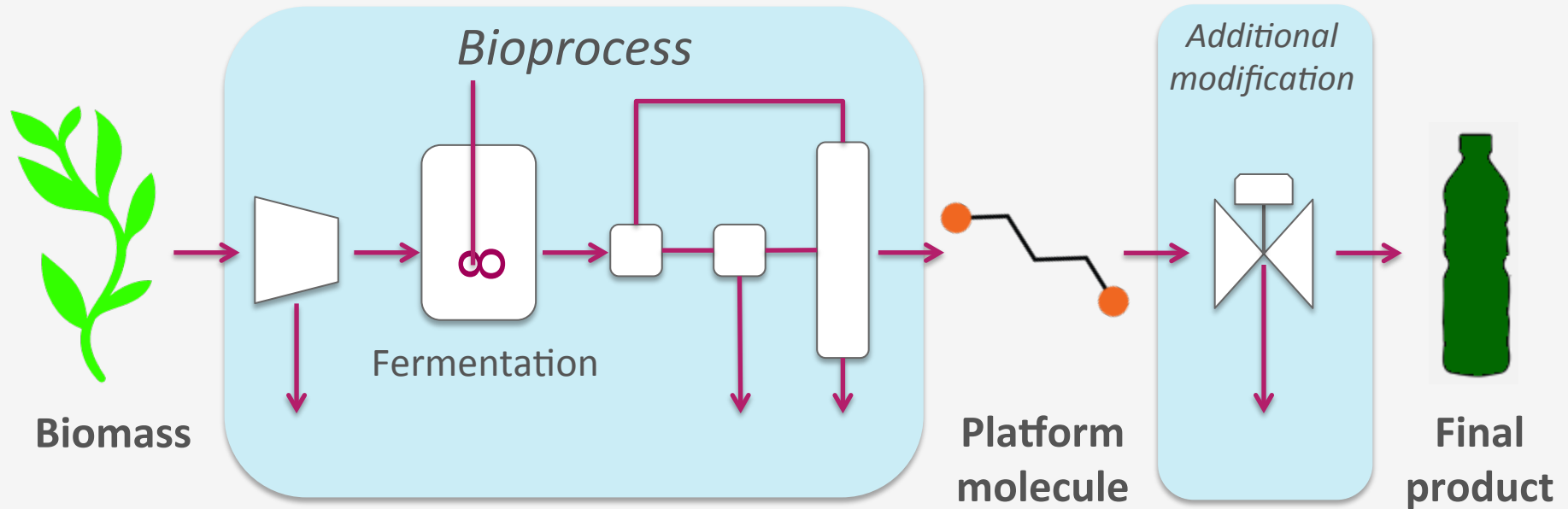
- Microorganisms grow on all kinds of feed
- Converted into a wide range of products
- Sugars are commonly used in Industrial Biotechnology

# Microbial fermentation





# Technology for biobased products



# History of microbiology in Delft

- Antonie van Leeuwenhoek (1632-1723)
- Constructed first microscopes
- Buried in the Old Church in Delft



# History of microbiology in Delft

## **Prof. M. Beijerinck (1851-1931)**

- 1<sup>st</sup> professor in microbiology
- Discovered the Tobacco Mosaic Virus

## **Prof. G. Van Iterson (1878-1972)**

- Founder of Delft Botanical Garden
- Mathematics of biological systems

## **Prof. A. Kluyver (1888-1956)**

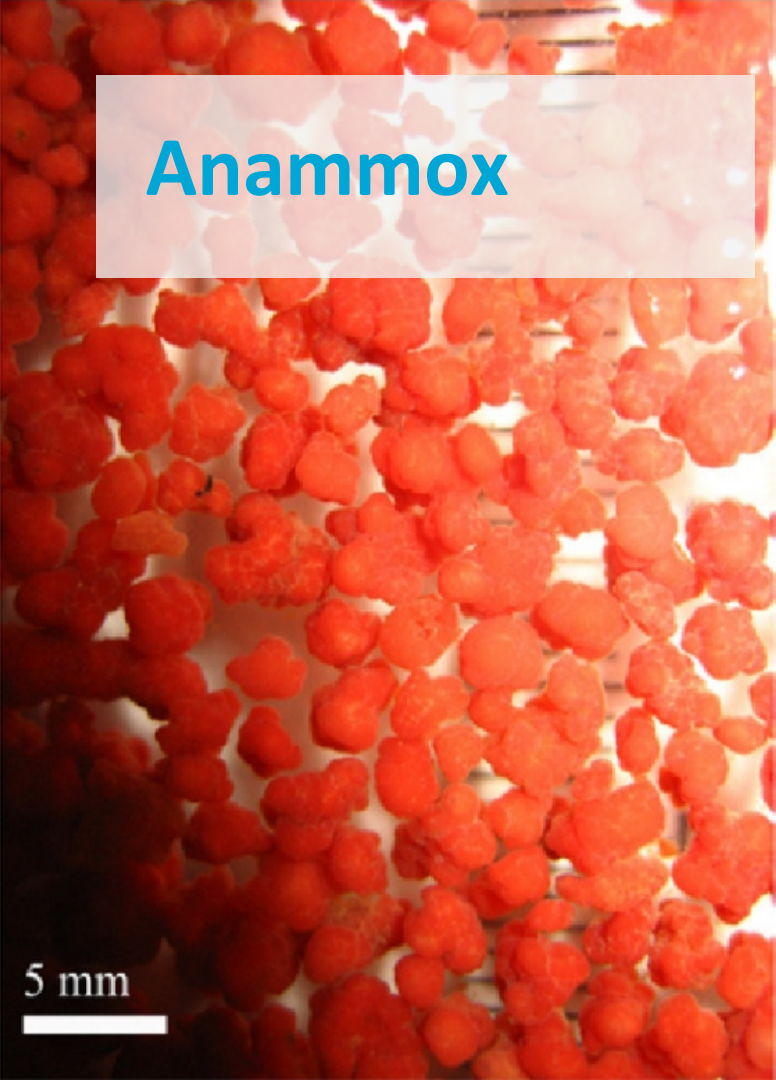
- 2<sup>nd</sup> professor in microbiology
- Unity in biochemistry

## **Prof. G. Kuenen (1940)**

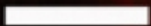
- Discovery of Anammox bacteria



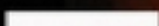
Anammox



5 mm



1 cm



**See you in the next unit!**