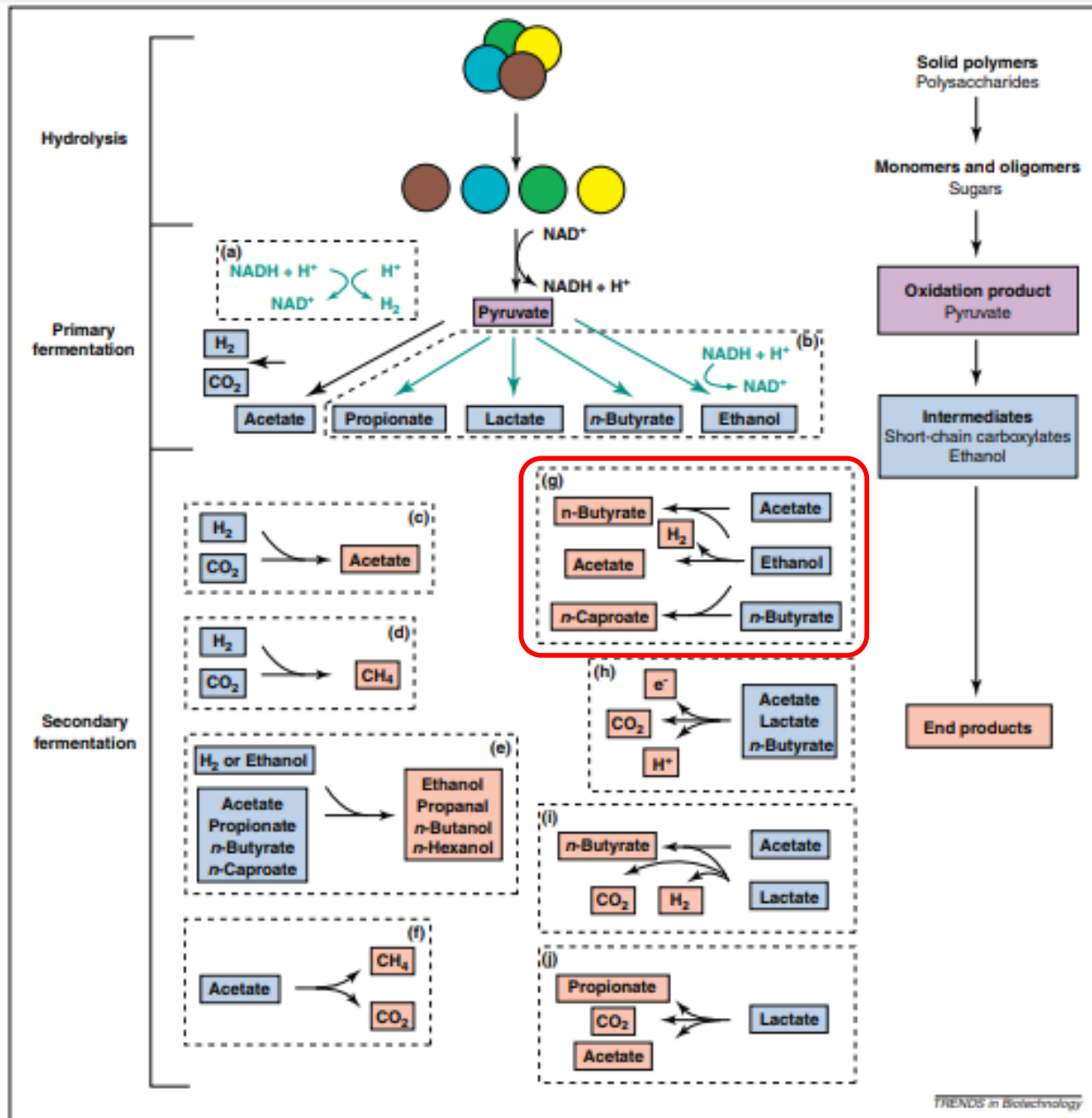


# Chain Elongation:

Production of hexanoate from short chain caboxylates

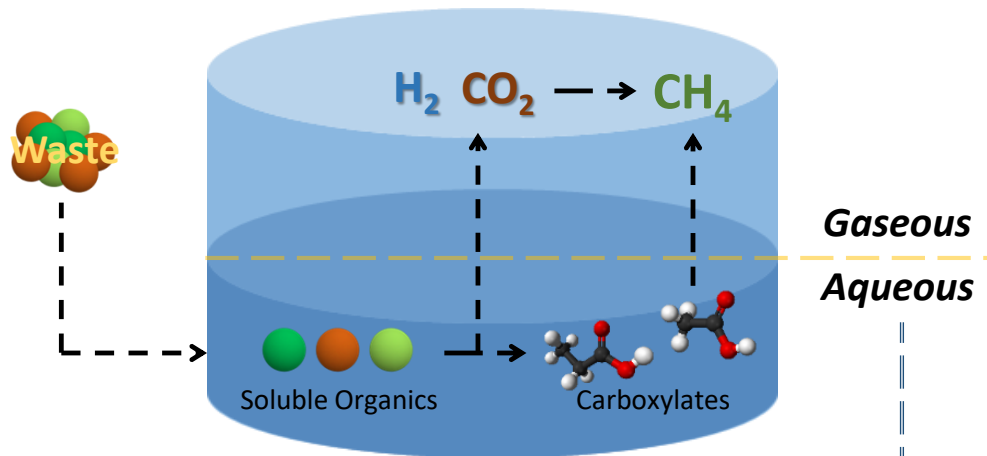
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# Anaerobic Fermentation\_Carboxylate platform



# Background

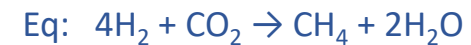
## ❖ Value of the fermentation product



✓ Biphasic separation

–  $H_2$ : can not recover carbon

–  $CH_4$ : relatively low value



–  $H_2$ : 1.188 J/L (x 4)

–  $CH_4$ : 3.78 J/L

–  $CO_2, H_2$  will also be used for cell growth

Table 1. Approximate price (Euro) per kg and kmol-e (June 2013)

		EUR/kg	EUR/kmol-e
Methane (US)	$CH_4$	0.2	0.4
Hydrogen	$H_2$	2.0	2.0
Sugar	$C_6H_{12}O_6$	0.28	2.1
Ethanol	$C_2H_6O$	0.52	2.0
Caproate	$C_6H_{12}O_2$	1.00	3.6

Kleerebezem et al. 2015

Short Chain Carboxylates

: acetate, butyrate, etc

Alcohols

: ethanol, propanol, etc

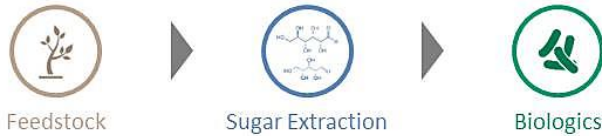
Medium Chain Carboxylates

→ Easy to extract

# Carboxylate platform

❖ Waste biorefinery : **Carbon** and **energy** recovery from waste

## ✓ Sugar Platform



- High yield, High cost

## ✓ Syngas Platform



- Diverse raw material, Low yield

## ✓ Carboxylate / Biogas Platform



- Diverse raw material, High yield
- Mixed product

If we can *control the product composition* and *improve the purity*,



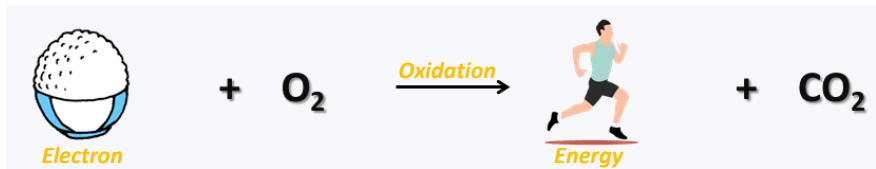
we can efficiently recover carbon from various waste stream!

➤ In the previous lecture (Lecture 3.)

- ✓ Controlling the environmental condition to control the anaerobic fermentation

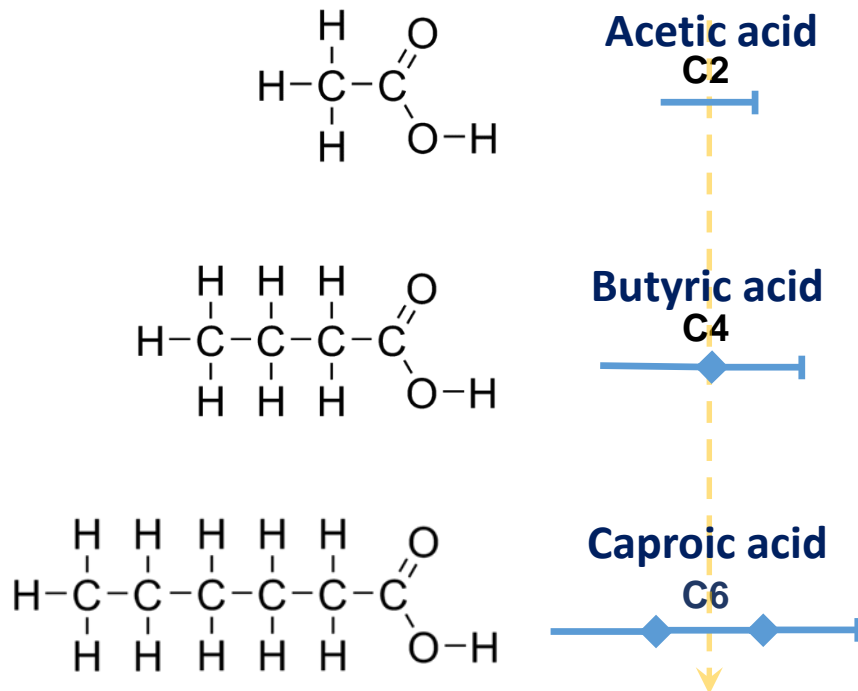
# Chain Elongation

## ❖ How can we produce caproate?

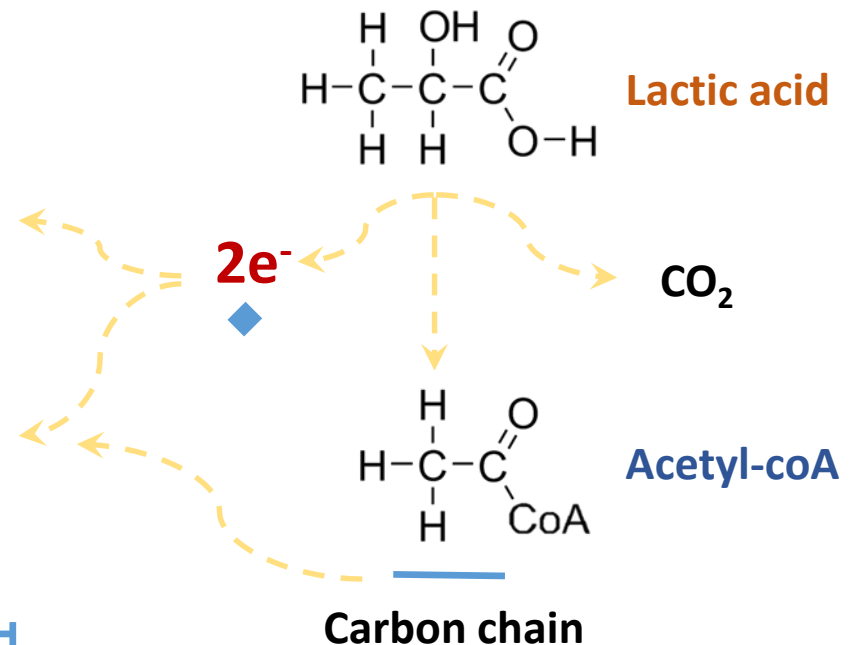


✓ Energy can be obtained through oxidation of the reduced carbon!

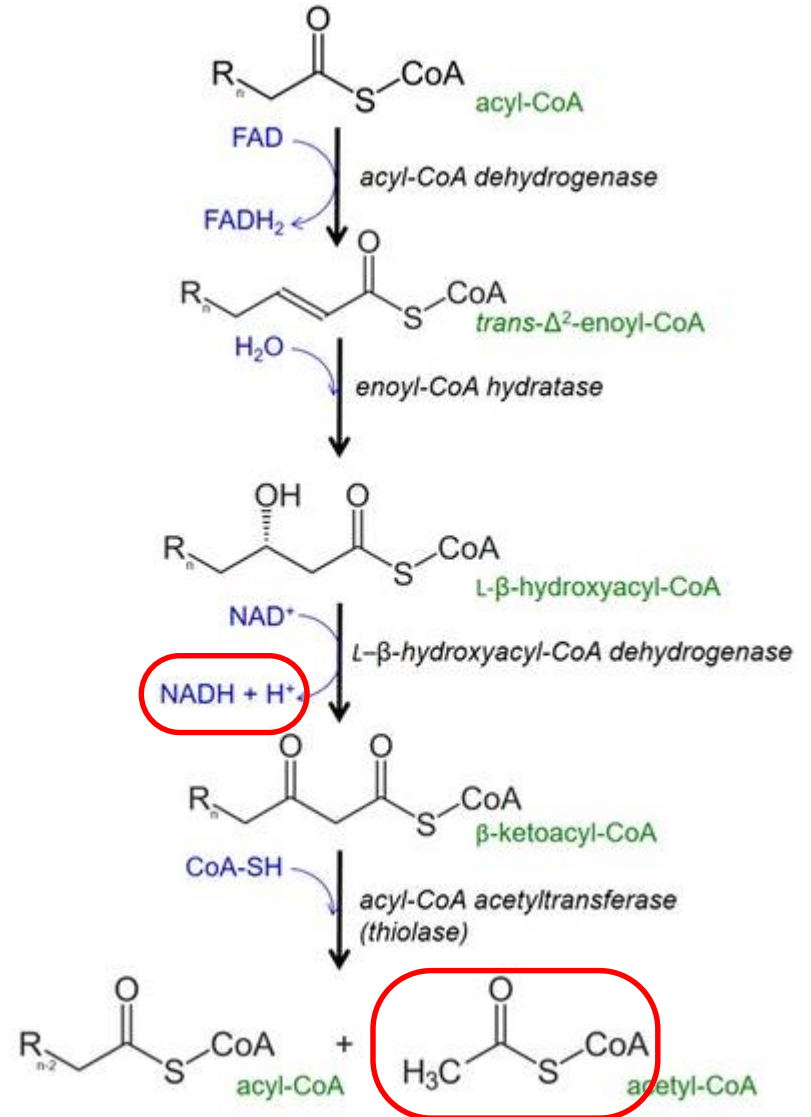
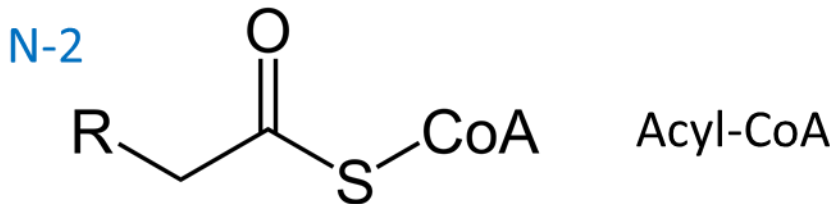
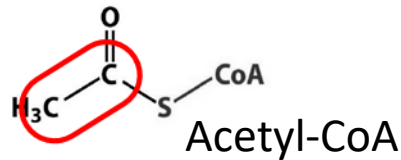
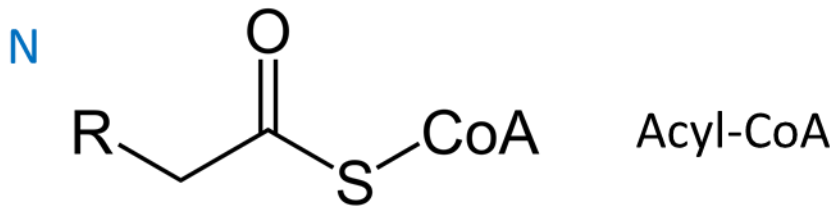
### ➤ Electron acceptor



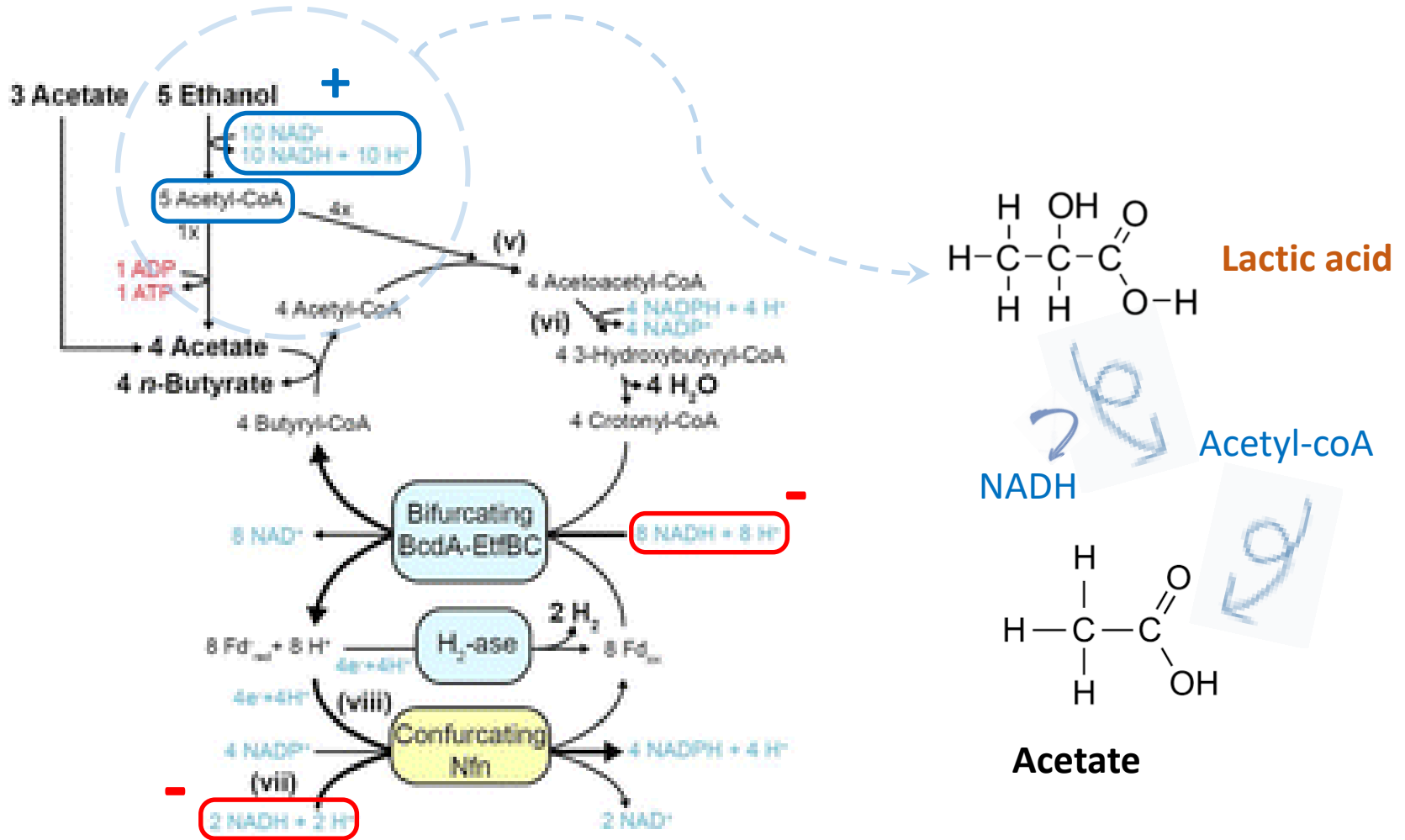
### ➤ Electron donor



# Beta Oxidation



# Reverse Beta Oxidation

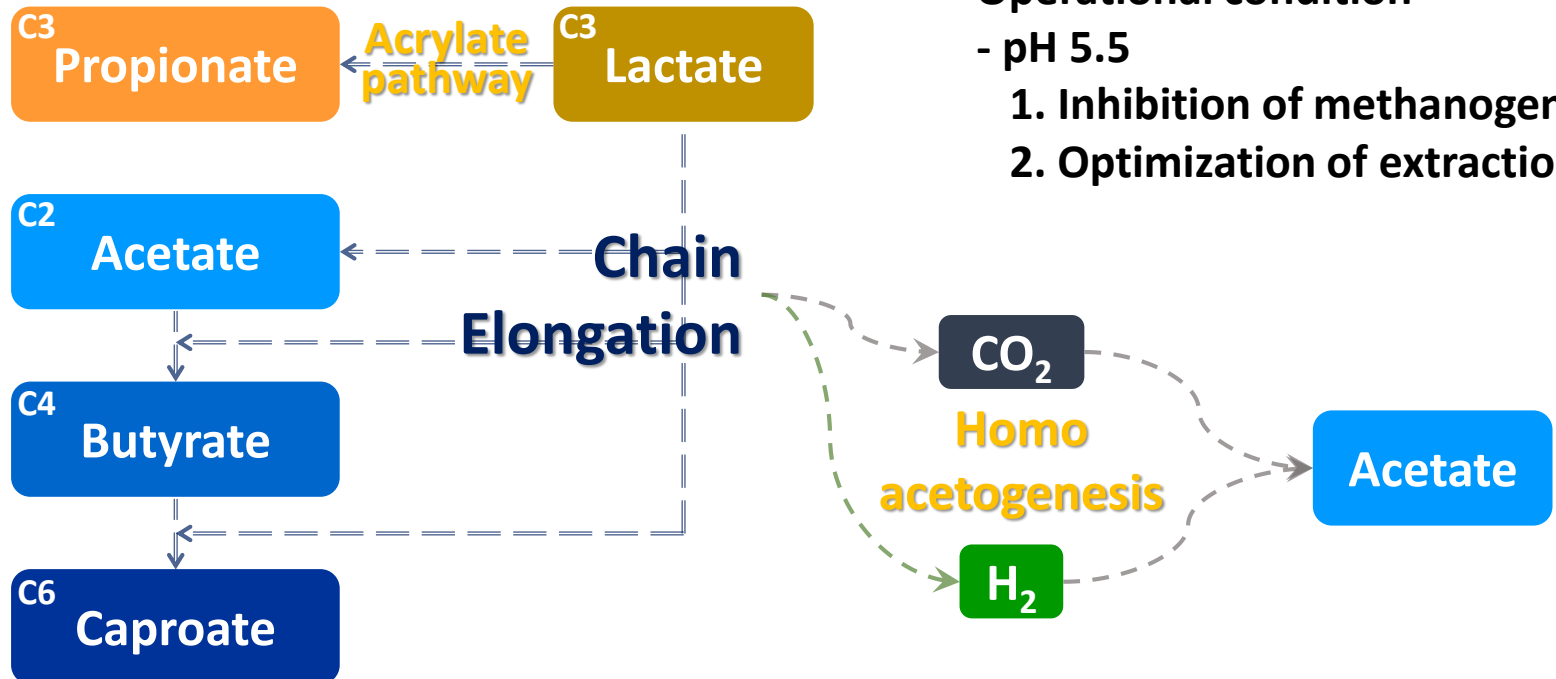


# Shaping chain elongating culture

## ❖ Objectives of shaping microbial culture

- ✓ **Microbiome:** To select target microbiome quickly and efficiently
- ✓ **Metabolite:** To efficiently convert substrate into target metabolite

## ➤ Possible pathways



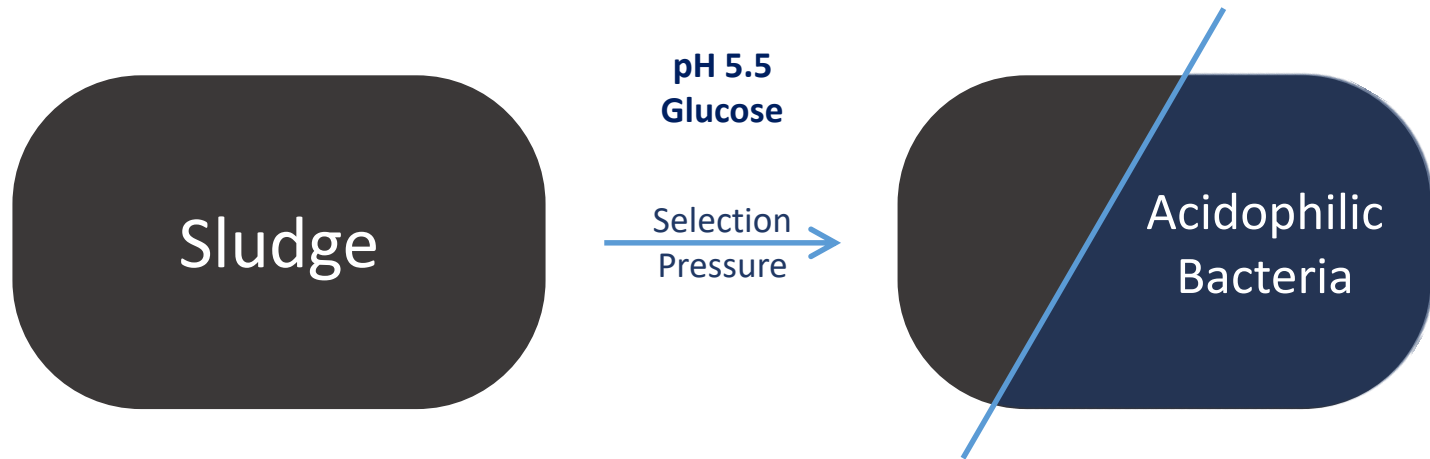
- ✓ **Operational condition**
  - pH 5.5
  - 1. Inhibition of methanogen
  - 2. Optimization of extraction



# Shaping Sludge Microbes

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[Step 1] Selection and enrichment of acidophilic microbes



[Step 2] Enrichment of caproate producing microbes

