Bioproduction and modulation of the composition of Single Cell Protein (SCP)

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Context

- Global population growth
- Climate change
- Nutrition transition

Global protein demand

Alternative source of protein :
Single Cell Protein (SCP)

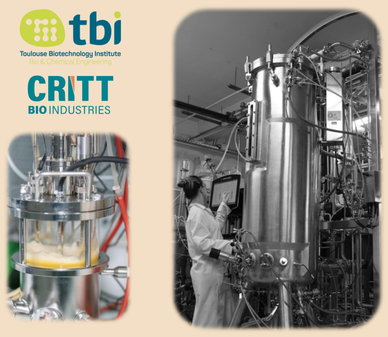
Fast growth	Amount of nucleic acids
High protein content	Low digestibility
Weather-independent	Organoleptic quality
Minimal land requirement	Societal acceptability

The µO-Prot project (ANR-23-DIVP-0001)

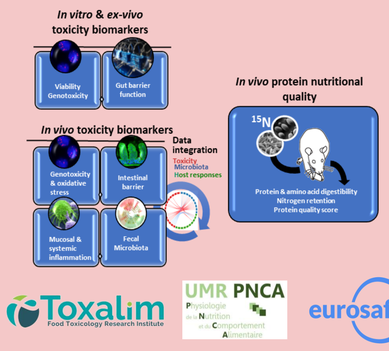
✓ A **multidisciplinary project** aimed at assessing the **potential of SCPs** from their **production** through to their integration into **food systems**.

✓ **Focus** on WP **Bioproduction and Composition modulation**.

Bioproduction and Composition modulation

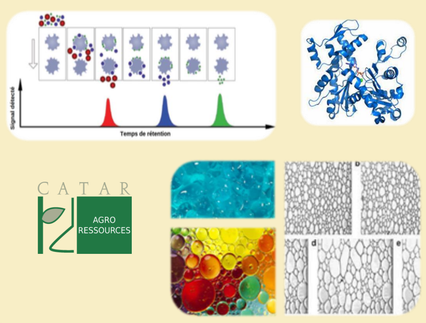


Nutrition, Toxicology and Gut Health



Downstream Processing

Biochemical and Functional characterization



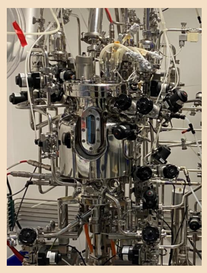
Consumer acceptability, Environmental impact and Regulation

Modulation of the composition of SCPs through the use of **different microorganisms** and **fermentation strategies**.

Yarrowia lipolytica
GRAS oleaginous yeast
Ovoid or filamentous shape

Rhodotorula glutinis
Yeast producing carotenoïds
(β-Carotene ,Torulene, ...)

Phaffia rhodozyma
Large yeast producing astaxanthin, a powerfull antioxydant



Cupriavidus necator
Bacteria able to use CO_2 and H_2 for growth

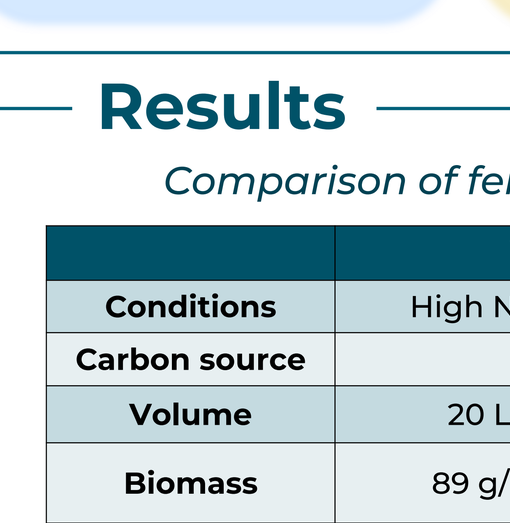
[1]

Results

Comparison of fermentation performance using the different microorganisms in Fed-Batch processes

	Y. lipolytica		*R. glutinis*		*P. rhodozyma*		*C. necator*
Conditions	High N/C	Low N/C	High N/C	Low N/C	High N/C	Low N/C	Gas fermentation
Carbon source	Glucose						CO_2
Volume	20 L	20 L	20 L	22 L	100 L	3 L	5 L
Biomass	89 g/L	40 g/L	73 g/L	63 g/L	67 g/L (O_2 limitation from 51 g/L)	49 g/L	31 g/L
Growth rate	0,07 h^{-1}	0,05 h^{-1}	0,06 h^{-1}	0,06 h^{-1}	0,05 h^{-1}	0,03 h^{-1}	0,07 h^{-1}
Protein content	47 %	36 %	51 %	21 %	38 %	11 %	77 %
Nucleic acids content	0,7 %	1,3 %	3,4 %	1,4 %	4,0 %	1,5 %	12,3 %

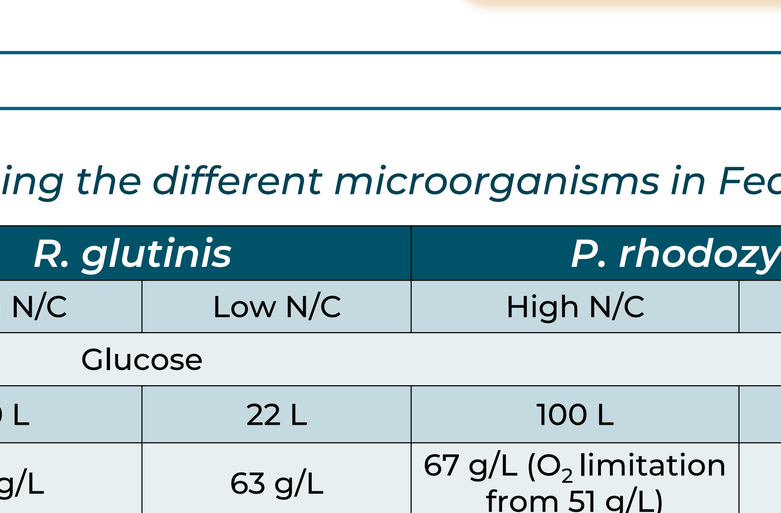
Effect of growth rate (Y. lipolytica)

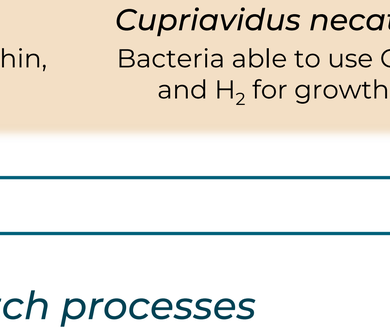


In a continuous process, slowing down the **growth rate** reduces the **nucleic acids content**

Fewer health problems associated with the consumption of nucleic acids (gout)

Effect of N/C ratio (P. rhodozyma)





In a Fed-Batch process, controlling the **N/C ratio** enables the **protein**, **nucleic acids** and **lipid contents** to be adjsuted

Production of SCPs with **different compositions**

[1] Panich J, Fong B, Singer SW. Metabolic Engineering of Cupriavidus necator H16 for Sustainable Biofuels from CO2. Trends in Biotechnology. 2021;39:412–24

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