Zymomonas mobilis: an emerging microbial cell factory to produce prebiotics

Adelaide Braga[1,2*], Daniela Gomes[1,2], João Rainha[1,2], Cláudia Amorim[1,2], Sara C. Silvério[1,2], Joana Alves[1,2], Beatriz B. Cardoso[1,2], María Fernández-Lobato[3], Joana L. Rodrigues[1,2], Lígia R. Rodrigues[1,2]

[1]CEB-Centre of Biological Engineering, Universidade do Minho, Campus de Gualtar, 4710-057 Braga, Portugal

[2]LABBELS –Associate Laboratory, Braga/Guimarães, Portugal

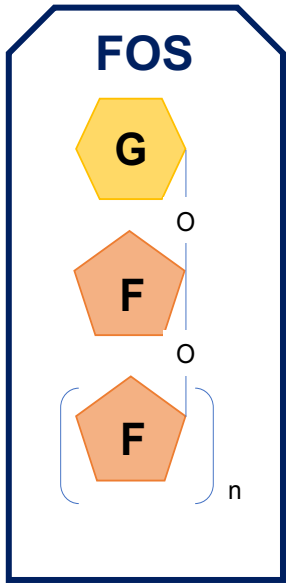
[3]Department of Crystallography and Structural Biology, Institute of Physical Chemistry-Rocasolano (CSIC), 28006 Madrid, Spain

*abraga@deb.uminho.pt

5th October 2022

CONTEXT

Fructooligosaccharides (FOS) are promising prebiotics in the increasing market of functional food



Largely used in the food industry:
Low-calorie sugar substitutes
Prebiotic properties

Market:
USD 3173.3 million by 2025

Industrial production:
Expensive
Not eco-friendly
Complex

Microbial production

Zymomonas mobilis

Holds the biochemical pathways responsible to produce several interesting compounds:

Ethanol, Levan, Sorbitol, Gluconic acid,
Fructooligosaccharides (FOS)

In vivo prebiotic production using *Z. mobilis*

Box-Behnken (RSM)

15 experiments

Sucrose concentration (A)

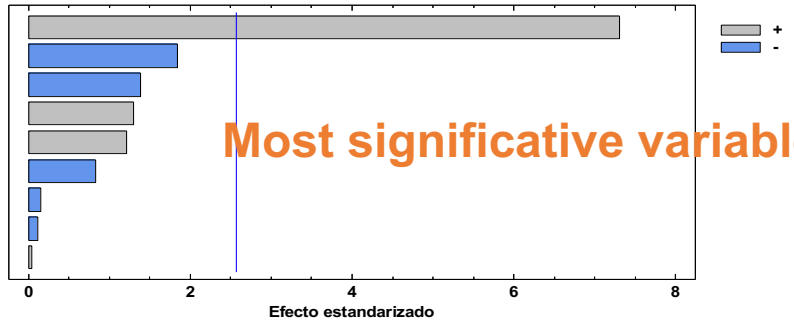
Yeast extract concentration (B)

Sodium chloride concentration (C)

Total FOS production

Static 30ºC

ANOVA



Most significative variable- Sucrose

Model for predicting Total FOS production

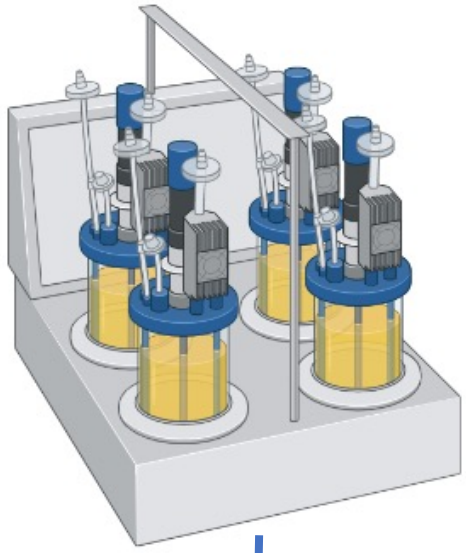
Max. Total FOS

Total FOS
51.6 ± 0.2 g/L

Sucrose 350 g/L
YE 20 g/L
NaCl 2.5 g/L

In vivo prebiotic production using *Z. mobilis*

Process scale up

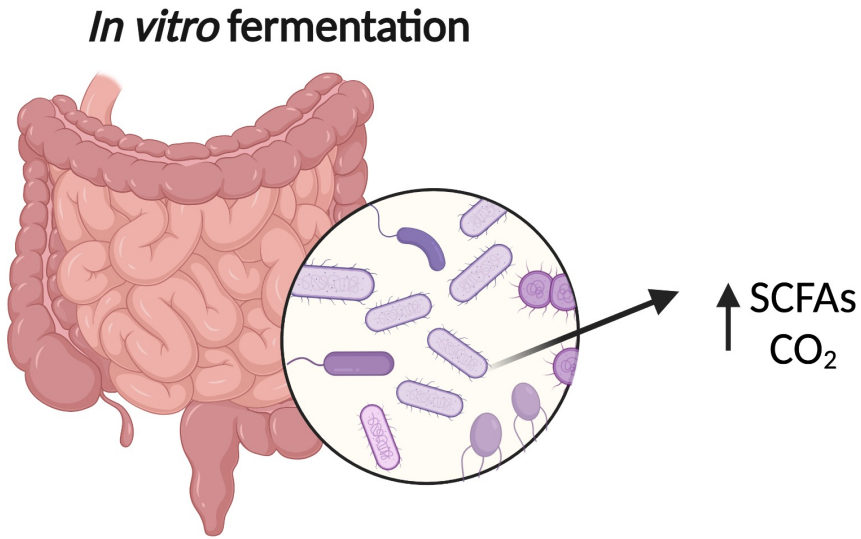


FOS: 156.50 g/L
Yield: 0.52 g/g
Productivity: 4.89 g/Lh

Purification

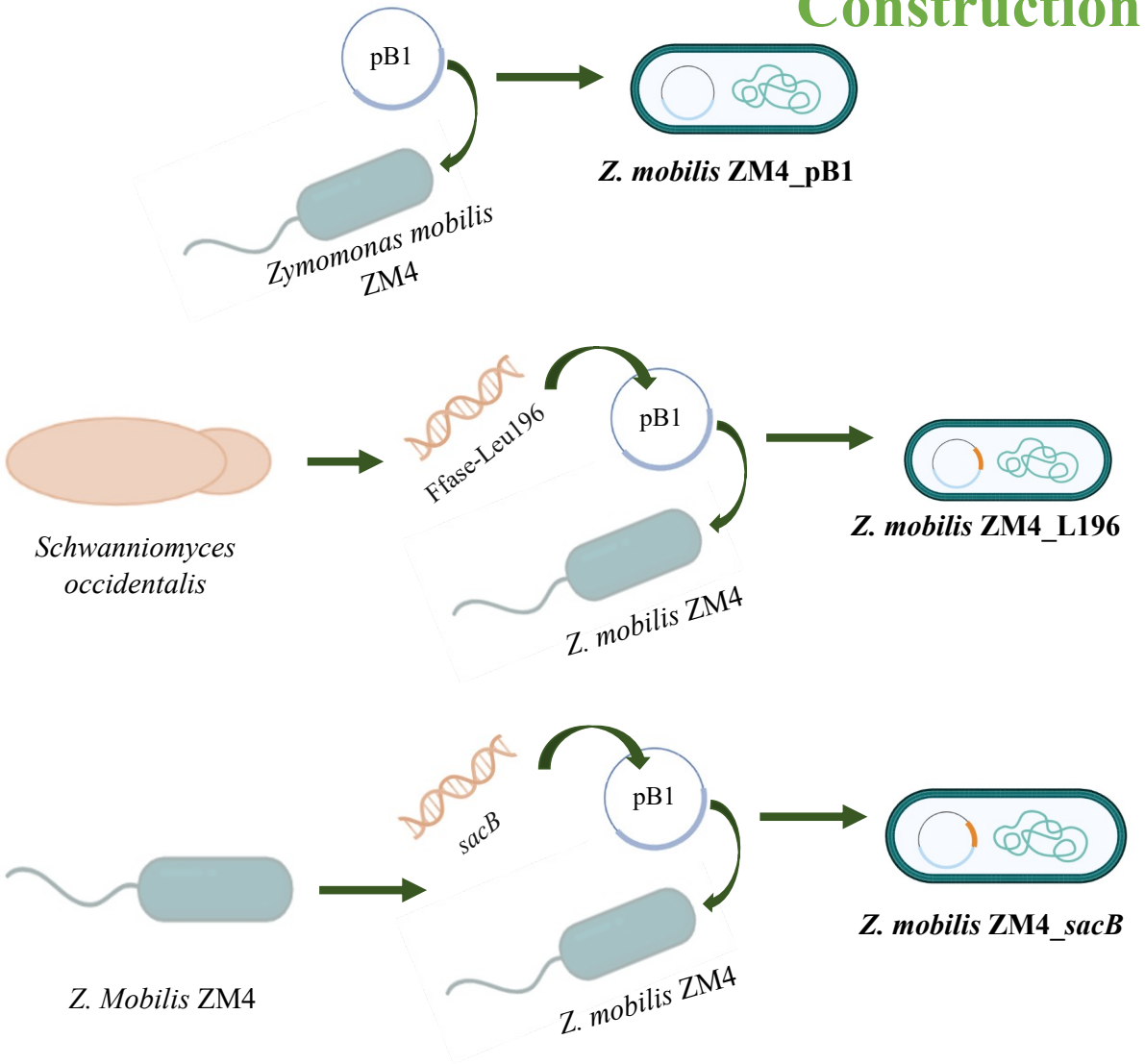
FOS-enriched mixture
(purity 80.2%)

Prebiotic activity



Engineering *Z. mobilis* to produce FOS

Construction of mutant strains



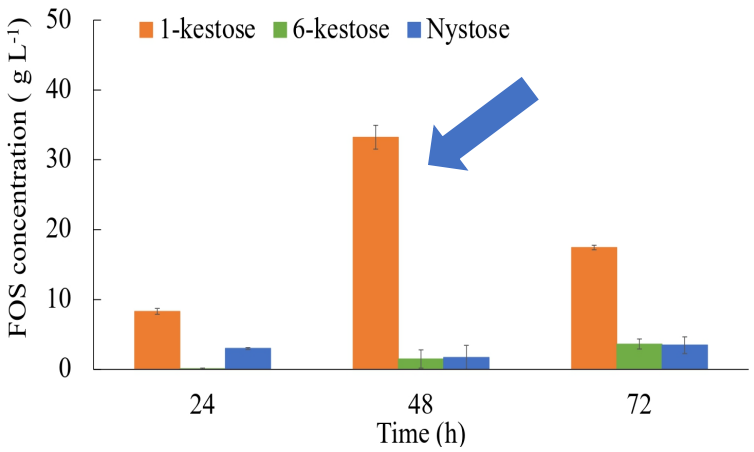
***S. occidentalis* is one of the most selective producers of 6-kestose**

Native extracellular levansucrase enzyme (*SacB*) that converts sucrose into levan and FOS

Engineering *Z. mobilis* to produce FOS

One-step FOS production experiments

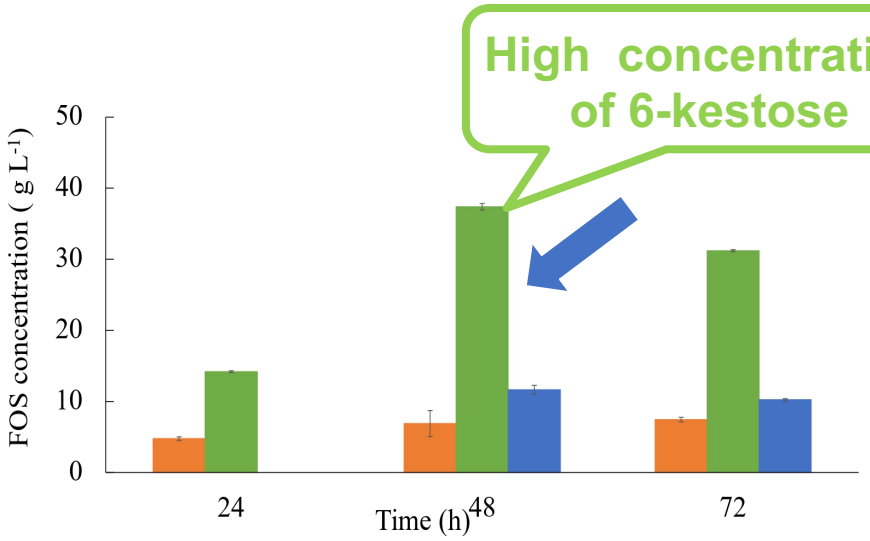
Z. mobilis ZM4_pB1



FOS: 33.5 g/L

Productivity: 0.7 g/Lh

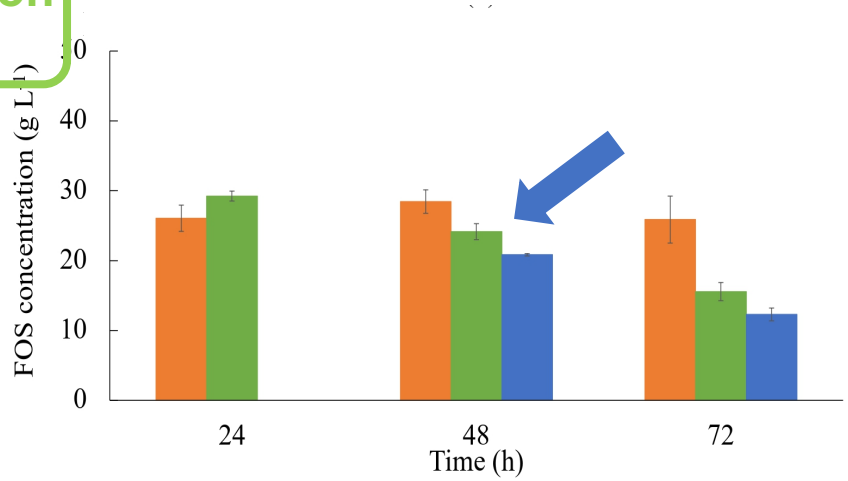
Z. mobilis ZM4_L196



FOS: 56.0 g/L

Productivity: 1.2 g/Lh

Z. mobilis ZM4_*sacB*



FOS: 73.4 g/L

Productivity: 1.5 g/Lh

Perspectives and Final Remarks

- First report on the production of a prebiotic mixture with *Z. mobilis* in an *in vivo* single-step approach

- New prebiotic “mix” → Prebiotic potential

- A new route to produce tailor-made FOS mixtures was presented

- Conversion of industrial by-products (waste) and renewable raw materials into added value food ingredients (prebiotics)→ EU Green Deal

efb 2022

FoSynBio

Synthetic biology approaches to design and construct microbial cell factories for the production of fructooligosaccharides

FCT Fundação para a Ciência e a Tecnologia

COMPETE 2020

PORTUGAL 2020

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