Optimization of mannans extraction from spent yeast *Saccharomyces cerevisiae*

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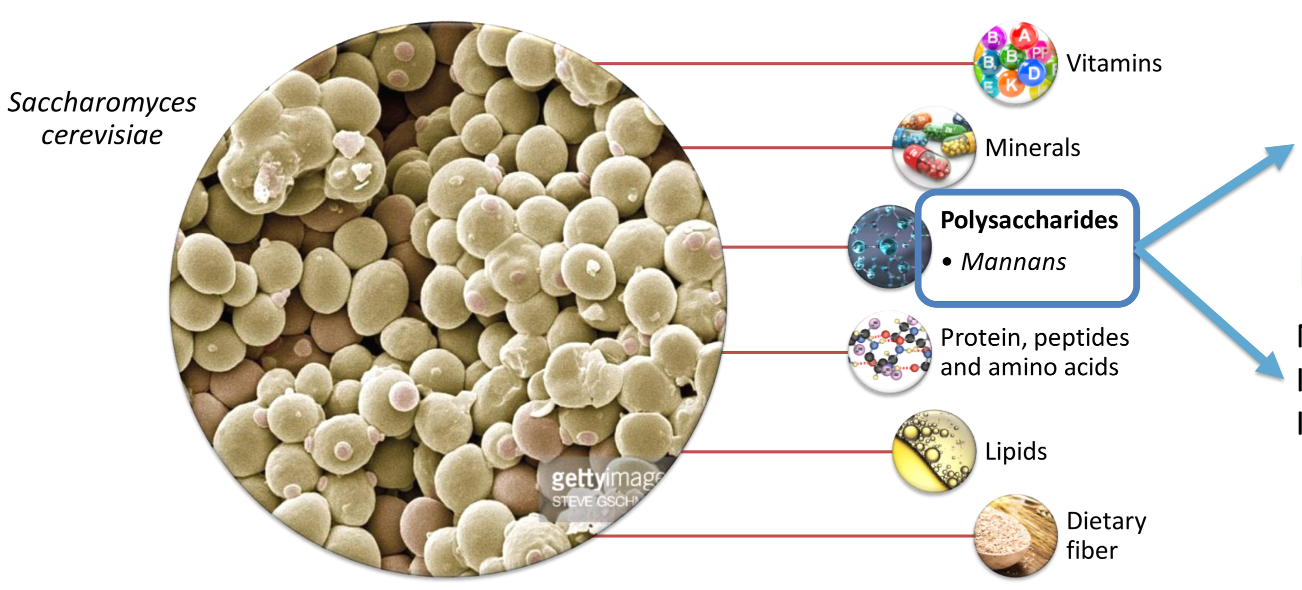
Introduction

Currently, new sustainable industrial practices are being developed, and circular economy concepts encourage the transformation of production waste into by-products. Mannans can be extracted from *Saccharomyces cerevisiae* cell wall, recovered from the brewing or synthetic biology industries.



What is

Mannans derived from the yeast cell wall of *S. cerevisiae* are mainly composed of mannose

Benefits

Nutritional value
Inhibition of pathogen adhesion
Improve immune response

Objectives

In this work, several extraction processes were studied aiming to obtain mannans from spent yeast *S. cerevisiae*; technologies assessed included physical, chemical and enzymatic processes.

The different mannans extracts were characterized for:

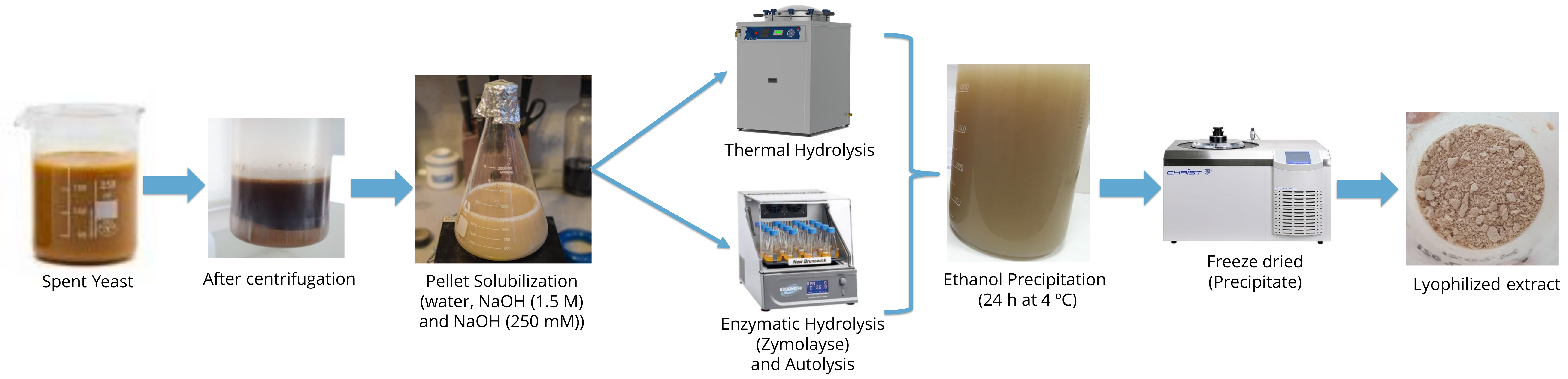
→ ***Structural Properties*** analyzed by Fourier-Transform Infrared Spectroscopy

→ ***Physicochemical Properties*** analyzed by colour, molecular weight distribution, neutral sugars, protein, ash and water content;

→ ***Biological Properties*** analyzed by a screening of prebiotic activity in *Lactobacillus plantarum* and *Bifidobacterium animalis.*

Methods

Mannans were extracted from the spent using different methodologies, individually or in combination: Enzymatic Hydrolysis, Thermal Hydrolysis with different solvents and Autolysis.



Results

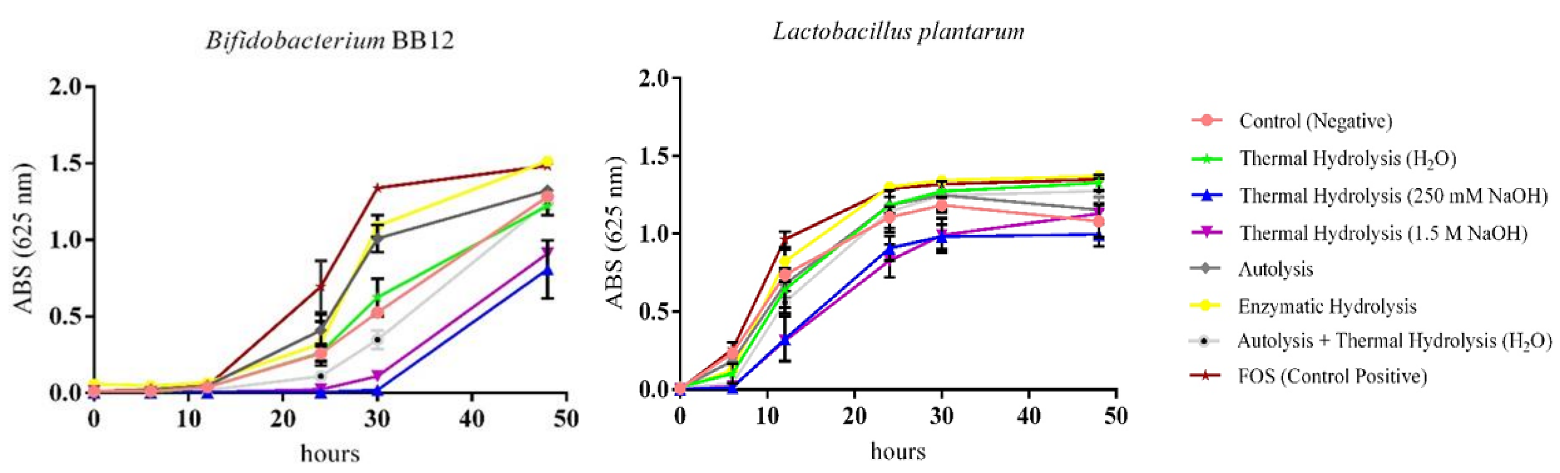


Figure 1 – Screening of prebiotic effect of the different mannans extracts for *Lactobacillus plantarum* and *Bifidobacterium animalis* BB12.

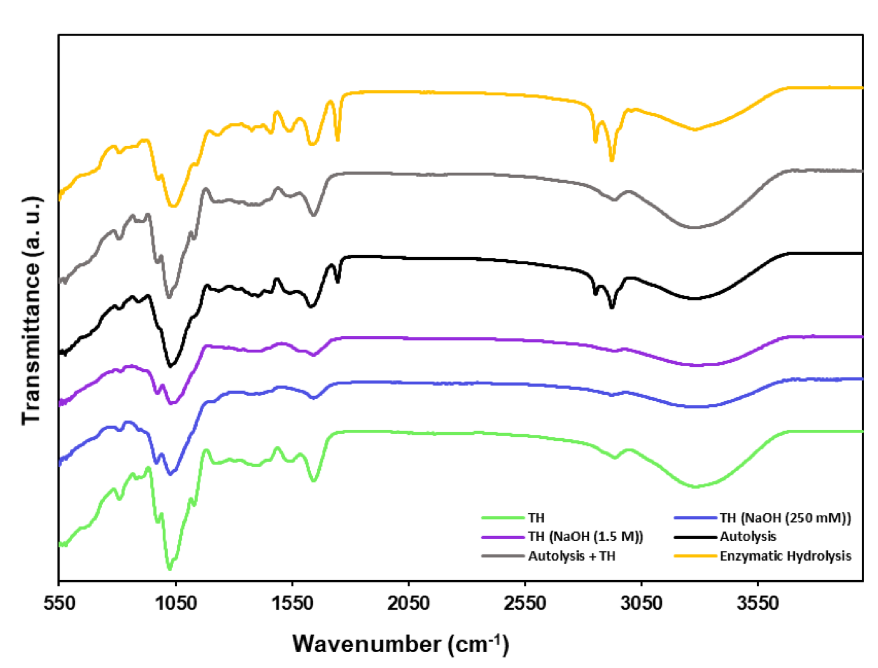
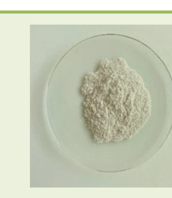
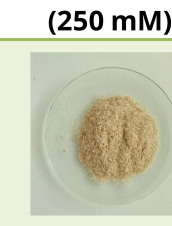
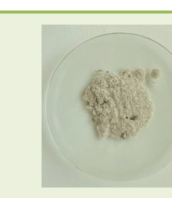


Figure 2 - Structural characterization (FT-IR) of TH (Thermal Hydrolysis with water and NaOH), Autolysis, Autolysis + Thermal Hydrolysis and Enzymatic Hydrolysis.

Table 1 – Yields from the different extraction methods and physicochemical characterization.

	Thermal Hydrolysis (H_2O)		Thermal Hydrolysis NaOH (250 mM)		Thermal Hydrolysis NaOH (1.5 M)		Autolysis		Autolysis + Thermal Hydrolysis (H_2O)		Enzymatic Hydrolysis	
Physical appearance												
Mannose Yield (%)	39 ± 1 ^{c}		**59 ± 2 ^{d}**		29 ± 3 ^{b}		23 ± 3 ^{ab}		19 ± 7 ^{a}		46 ± 2 ^{c}	
Mannose Purity (%)	53 ± 0 ^{d}		33 ± 2 ^{c}		20 ± 2 ^{a}		25 ± 2 ^{b}		**59 ± 1 ^{e}**		22 ± 2 ^{ab}	
Protein Content (% w/w)	13 ± 1 ^{c}		2 ± 1 ^{a}		0 ± 1 ^{a}		19 ± 2 ^{d}		7 ± 1 ^{b}		**22 ± 2 ^{d}**	
Total Sugars (% w/w)	58 ± 1 ^{c}		37 ± 2 ^{b}		24 ± 2 ^{a}		40 ± 2 ^{b}		**66 ± 3 ^{d}**		28 ± 3 ^{a}	
Glucose (% w/w)	5 ± 0 ^{ab}		4 ± 1 ^{a}		5 ± 1 ^{ab}		**15 ± 1 ^{c}**		7 ± 1 ^{b}		6 ± 1 ^{b}	
Molecular Weight (kDa)	MW	Area %	MW	Area %	MW	Area %	MW	Area %	MW	Area %	MW	Area %
	237 ± 1^{b}	82 ± 2	192 ± 0^{a}	29 ± 1	192 ± 0^{a}	10 ± 1	221 ± 1^{c}	65 ± 1	231 ± 5^{d}	84 ± 1	214 ± 3^{e}	67 ± 5
	MW	Area %	MW	Area %	MW	Area %	MW	Area %	MW	Area %	MW	Area %
	129 ± 2^{a}	18 ± 2	135 ± 4 ^{ab}	23 ± 9	144 ± 1^{c}	8 ± 1	132 ± 0 ^{ab}	18 ± 1	133 ± 3 ^{ab}	16 ± 1	136 ± 2^{b}	16 ± 4
Dry Weight (% w/w)	6 ± 1 ^{bc}		5 ± 2 ^{bc}		4 ± 1 ^{ab}		2 ± 1 ^{ab}		**9 ± 2 ^{c}**		1 ± 1 ^{a}	
Ashes (% w/w)	6 ± 0 ^{b}		46 ± 2 ^{d}		**64 ± 0 ^{e}**		5 ± 0 ^{a}		4 ± 0 ^{ab}		11 ± 0 ^{c}	

^{a,b,c,d,e} means within the same line, labelled different subscripts, differ significantly ($p < 0.05$).

Conclusions

The highest production yield (59%) was achieved by using a thermal hydrolysis with alkali, although the correspondent purity was low; concerning the latter, the use of autolysis followed by a hydrothermal step allowed to reach a purity of 59%. Additionally, the extract obtained through the enzymatic process displayed the highest prebiotic activity. As mannans have been increasingly reported as showing very promising bioactivities, this comparative study is expected to lay the scientific foundation for the obtention of well-characterized mannans from yeast, which will pave the way to their application in various fields.

Acknowledgements

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