Sugarcane bagasse cello-oligosaccharides as prebiotic agents

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Introduction

Sugarcane bagasse, the major by-product of the sugarcane industry and a very promising renewable and low-cost raw material, can be used to produce valuable materials such as cellulose or cellulose-based materials as cello-oligomers. Cello-oligosaccharides (COS) are linear chains of β-1→4 linked anhydroglucose units with a low degree of polymerization (DP) usually up to 6, which can be obtained by hydrolysis of cellulose. They are water-soluble molecules that are not digested or absorbed by the human gastrointestinal tract, so they have potential to be used as prebiotic agents (Zweckmair et al., 2016, Ávila et al., 2021). COS are a less explored class of non-digestible oligosaccharides, in comparison to fructo-, xylo- or galacto-oligosaccharides, which is probably related to complex processes, usually multistage approaches, required for its production, thus resulting in low production yields and high costs (Zweckmair et al., 2016). Therefore, more research is needed to explore its technological and biological properties aiming its use at industrial level (Ávila et al., 2021).

Objectives

The aim of this work was to explore the potential of using COS, produced through an acid hydrolysis from cellulose pulp, previously extracted from sugarcane bagasse, as prebiotic agent. For this purpose, the COS at two different concentrations (1 and 2% w/v) was used as carbohydrate source of probiotic bacteria, i.e., *Bifidobacterium* BB-12, *Lactobacillus plantarum* 299v and *Lactobacillus casei* and its effect on the bacteria growth was compared to standard glucose (at 1 and 2% w/v), standard fructo-oligosaccharides - FOS (at 1 and 2% w/v), and to a commercial cellobiose (at 1 and 2% w/v) (Sun Cellobio®) from Nippon Paper Industries.

Methods

In this work, COS were produced from sugarcane bagasse and evaluated as carbohydrate source of probiotic bacteria. To do so, COS obtained by an acid hydrolysis of cellulose pulp, previously extracted from sugarcane bagasse, was tested at 1 and 2% (w/v) on the growth of 3 different strains of probiotic bacteria i.e., *Bifidobacterium* BB-12, *Lactobacillus plantarum* 299v and *Lactobacillus casei.* These bacteria were tested and cultivated with basal nutrient media (BNM) in the absence of glucose or any other carbohydrate at the optimal growth temperature of 37 ºC in anaerobiosis. A standard glucose at 1 and 2% (w/v) and fructo-oligosaccharide (FOS) at 1 and 2% (w/v), and a commercial cellobiose at 1 and 2% (w/v) (Sun Cellobio®) from Nippon Paper Industries were used as control. The effect on the growth of such probiotic bacteria was evaluated and compared with COS. Growth rate of bacteria was monitored by identifying the optical density at 625 nm during 24 h.

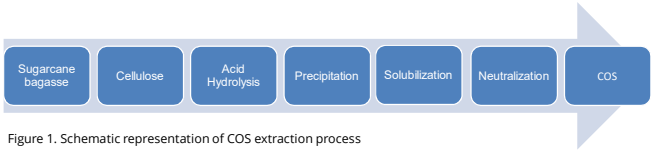

Figure 1. Schematic representation of COS extraction process

Results

Results showed that different carbohydrate sources impact differently the bacterial growth, which was particularly observed for *Bifidobacterium* BB-12 (Figure 2a). The growth rate of *Bifidobacterium* BB-12 was the lowest for the commercial cellobiose regardless the concentration used. On other hand, *Bifidobacterium* BB-12 showed higher growth with COS, compared to the commercial cellobiose, reaching the same optical density than FOS. The glucose showed to be the preferred source of carbohydrates for *Bifidobacterium* BB-12. For *L. plantarum* (Figure 2b), the COS showed an identical performance to the exhibited by glucose and better than FOS, thus suggesting that COS can be an important alternative to FOS in gastrointestinal microbiota modulation. From Figure 2c, it was possible to see that for *Lactobacillus casei* the FOS was the preferred carbohydrate source, while COS at 2% exhibited an identical performance than glucose.

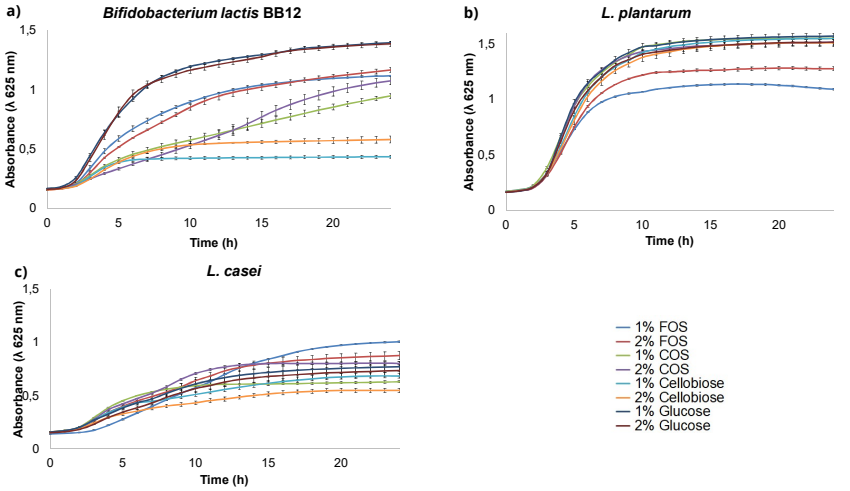

Figure 2. Growth of *Lactobacillus casei* (a), *L. plantarum* (b) and *L. casei* (c) in BNM containing, 1% and 2% of commercial FOS, cello-oligosaccharides (COS), cellobiose or glucose.

Conclusions

COS showed to be a promising carbohydrate source of *L. plantarum* 299v, since promoted it growth more than FOS (used as control) and identical to the obtained when this bacteria was supplemented with glucose. This can be an interesting finding through the development of a new prebiotic agent from the major sugar industry by-product, in alternative to FOS, important in gastrointestinal microbiota modulation.

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