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Study of the interactive effect of temperature and pH on exopolysaccharide production by *Enterobacter* A47 using multivariate statistical analysis

Cristiana A.V. Torres [a], Sílvia Antunes [a], Ana Rita Ricardo [a], Christian Grandfils [c], Vítor D. Alves [b], Filomena Freitas [a,*], Maria A.M. Reis [a]

[a] REQUIMTE/CQFB, Chemistry Department, FCT/Universidade Nova de Lisboa, 2829-516 Caparica, Portugal
[b] CEER - Biosystems Engineering, ISA/Technical University of Lisbon, Tapada da Ajuda, 1349-017 Lisboa, Portugal
[c] Interfacultary Research Centre of Biomaterials (CEIB), University of Liège, B-4000, Liège, Belgium

HIGHLIGHTS

- *Enterobacter* A47 was cultivated at different temperature and pH values.
- RSM was used to evaluate the effect on cell growth and EPS synthesis.
- Cell growth was favored at pH < 7.0.
- EPS production was maximal for 25 < *T* < 35 °C and 6.0 < pH < 8.0.
- Distinct sugar and acyl groups composition were obtained.

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ABSTRACT

Enterobacter A47 synthesizes fucose-containing exopolysaccharides (EPS). Maximum EPS production (>7.00 g L^{-1}) was obtained for temperature and pH within 25–35 °C and 6.0–8.0, respectively. Under these conditions, the polymers contained over 30% fucose. Glucose, galactose, and glucuronic acid contents were about 28%, 25%, and 10%, respectively, and the total acyl groups content was about 20 wt.%. The average molecular weight (Mw) was around 4.0×10^6. Outside the optimal temperature and pH ranges, fucose, galactose and glucuronic acid, and the total acyl group contents were reduced, while the glucose content increased, new monomers (rhamnose and glucosamine) were detected, and the Mw increased to $\geqslant 1.10 \times 10^7$.

This study revealed the ability of *Enterobacter* A47 to synthesize different heteropolysaccharides as a function of pH and temperature, a feature that can be exploited to obtain tailored polymer composition. Moreover, the production of high fucose content EPS was stable for wide pH and temperature ranges, which is important for the envisaged industrial development of the bioprocess.

1. Introduction

Bacterial exopolysaccharides (EPS) are environmental friendly and versatile polymeric materials with unique structural and physical properties that enable their use in a wide range of industrial applications (food, textile, cosmetics and pharmaceuticals), as stabilizing, thickening, gelling, emulsifying and/or flocculating agents. These attributes make such biomaterials a natural fit for sustainable development (Moreno et al., 1998).

Traditional polysaccharides derived from other natural sources (plants, algae and animals) fail to perform in some applications where bacterial EPS may demonstrate new or improved properties. Furthermore, compared to that by higher plants and algae, microbial synthesis of polysaccharides is more productive and less resource-intensive. Moreover, microbial production enables the control of process conditions in order to obtain higher yields and desired properties (Alves et al., 2010). However, due to their high production costs, only a few bacterial EPS are commercially available (e.g. xanthan, gellan gum, hyaluronic acid) (Freitas et al., 2011b). To turn the process more cost effective, improvements in product yields are necessary by optimizing fermentation conditions (e.g. pH, temperature, carbon source concentration), developing higher yield strains (e.g. genetic manipulation) or use of low cost substrates (Freitas et al., 2011b).

* Corresponding author. Address: Departamento de Química, Laboratório de Engenharia Bioquímica e Processos, Faculdade de Ciências e Tecnologia, Universidade Nova de Lisboa, 2825-516 Caparica, Portugal. Tel.: +351 212948300.
E-mail address: ffreitas@netvisao.pt (F. Freitas).

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