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Production of glycolipid biosurfactants, mannosylerythritol lipids, from pentoses and D-glucose/D-xylose mixtures by *Pseudozyma* yeast strains

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ABSTRACT

The pentose-assimilating capacity of yeasts from the genus *Pseudozyma*, *P. antarctica* PYCC 5048^T, *P. aphidis* PYCC 5535^T and *P. rugulosa* PYCC 5537^T, was exploited towards the production of mannosylerythritol lipids (MEL), a glycolipid with biosurfactant properties. The three strains tested were able to grow on D-xylose and L-arabinose with similar maximum specific growth rates to those estimated on D-glucose (around 0.2 h^{-1}). The highest MEL titres (4.8–5.4 g/l) and yields (0.11–0.14 g/g) from D-xylose were found in *P. antarctica* PYCC 5048^T, which presented similar values to those estimated on D-glucose and on D-xylose/D-glucose mixtures. *P. rugulosa* PYCC 5537^T showed a pattern of sugar conversion into MEL similar to *P. antarctica*, but at 40% lower titres. *P. aphidis* PYCC 5535^T presented lower MEL titres from D-xylose (1.2 g/l) than from D-glucose (3.4 g/l). Nitrate supply increased sugar consumption rate and, when accompanied by D-glucose or D-xylose feeding, additional biomass production. In this case, sugar was completely consumed before sugar feeding at day 7, but not when feeding is performed at day 4. Higher MEL titres where obtained for the later condition reaching 7.3 g/l and 5.8 g/l, in fed-batch cultures with glucose and xylose, respectively.

1. Introduction

Microbial surfactants are recognized as fine chemicals with high-value applications and interesting characteristics such as low toxicity, high biodegradability, effectiveness at extreme temperatures or pH, and mild production conditions when compared to chemical surfactants [1–3]. Biosurfactants, in particular lipopeptides and glycolipids, have industrial applications in the production of food, cosmetics, and pharmaceutics, as well as for soil decontamination of heavy metals, oils and other toxic organics [4]. In microbial environments, the roles of biosurfactants include the increase of surface area and bioavailability of hydrophobic water-insoluble substrates, heavy metal binding, bacterial pathogenesis, quorum sensing and biofilm formation [2].

Mannosylerythritol lipids (MELs) are glycolipids containing a 4-O-β-D-mannopyranosyl-meso-erythritol as the glycosidic/hydrophilic moiety and two short-chain fatty acids (usually C8–C12) as the hydrophobic groups (Fig. 1) [4]. These amphiphilic properties classify these molecules as biosurfactants [1]. MELs are designated as MEL-A, -B, -C, according with their elution position in thin layer chromatography (TLC), and corresponding to the degree of acetylation at C-4 and/or at C-6 position of the mannosyl moiety [5]. MEL-A corresponds to the diacetylated compound while MEL-B and MEL-C are monoacetylated at C-6 and C-4 of

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