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Short Communication

Selecting low-cost carbon sources for carotenoid and lipid production by the pink yeast *Rhodosporidium toruloides* NCYC 921 using flow cytometry

Cláudia Freitas, Teresa Margarida Parreira, José Roseiro, Alberto Reis, Teresa Lopes da Silva *

Laboratório Nacional de Energia e Geologia, I.P., Unidade de Bioenergia, Estrada do Paço do Lumiar 22, 1649-038 Lisboa, Portugal

HIGHLIGHTS

- Carop pulp syrup (CPS) and sugarcane molasses (SCM) were used as carbon sources.
- CPS at 75 g L^{-1} induced the highest fatty acid and carotenoid productivities.
- Flow cytometry detected differences between the cell membrane grown on CPS and SCM.
- *R. toruloides* growth on CPS induced lower ratio of permeabilised cells than on SCM.

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ABSTRACT

The present work studied low-cost carbon sources for carotenoid and lipid production using the yeast *Rhodosporidium toruloides* NCYC 921. Carob pulp syrup and sugarcane molasses at different concentrations were used as low-cost carbon sources in *R. toruloides* batch cultivations. Carob pulp syrup containing a total sugar concentration of 75 g L^{-1} induced the highest total fatty acid productivity (1.90 g L^{-1} h^{-1}) and the highest carotenoid productivity (9.79 μg L^{-1} h^{-1}). Flow cytometric analysis revealed that most of the yeast cells (>60%) grown on carob pulp syrup displayed intact polarised membranes, conversely to the cells grown on sugarcane molasses, wherein a large proportion (>45%) displayed permeabilised cytoplasmic membranes.

1. Introduction

Oleaginous microbes such as microalgae and yeasts can be used as biodiesel feedstocks. Compared to other vegetable oils and animal fats, the production of microbial oil has many advantages: short life cycle, less labor required, not affected by season and climate, and easier to scale-up. Among oleaginous microorganisms, yeasts have a few advantages over algae, as they attain higher biomass and lipid productivities (Li et al., 2008). Moreover, biodiesel production from yeasts is of particular interest for countries located at higher latitudes, where the insolation is not as high as in countries near the tropics, wherein autotrophic microalgae may be more suitable.

However, at the moment, biodiesel derived from microbes is economically unsustainable, as its production costs are still higher than biodiesel obtained from agriculture crops (Schneider et al., 2013). Therefore, new strategies must be put forward in order to reduce the overall costs. Considering all the microbial biomass fractions that can be converted into biofuels and/or high value added products, it is possible to produce biofuels in a sustainable way. For instance, if the yeast biomass, beyond its high lipid content (that can be converted into biodiesel), is rich in high value added products such carotenoids (which have many applications in pharmaceutical, nutraceutical and food industries, with a high value market), their commercialization may contribute to reduce the overall process cost (Lopes da Silva et al., 2013).

The oleaginous yeast *Rhodosporidium toruloides* NCYC 921 (which species is an anamorph of *Rhodotorula glutinis* species) has been widely reported as a potential oil producer yeast (Yoon and Rhee, 1983). In addition, this species, often called “pink yeast”, has also been reported as a source of carotenoids of high commercial interest which are used as a natural food colorants and feed additive in aquaculture (Frengova and Beshkova, 2009).

* Corresponding author. Tel.: +351 0924600; fax: +351 7163636.
E-mail address: teresa.lopessilva@lneg.pt (T.L. da Silva).

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