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Production of pigments by *Rhodotorula mucilaginosa*

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ABSTRACT

Aims: Pigments have a large and growing market in the world. Drawbacks in their production such as raw materials availability and low productivity prompt the search for fermentation routes for industrial production. A carotenoid-producing yeast identified as *Rhodotorula mucilaginosa* was isolated in our laboratory. The aim of this study was to investigate the growth and carotenoid production capacity of the yeast.
Methodology and results: A cost-effective substrate of sago starch hydrolysate (SSH) derived from sago fiber waste was used for the fermentation. The fermentation was carried out for 96 h at 27 °C in batch mode. The biomass produced during 5 days of fermentation was 9.6 g/L, which contained a carotenoid concentration of 8.1 mg/L and a specific yield of 845.9 μg/g.
Conclusion, significance and impact of study: The results demonstrated the capacity of *R. mucilaginosa* yeast to produce carotenoids and its potential for larger-scale production.

Keywords: Rhodotorula, carotene, torularhodin, torulene, sago starch hydrolysate

INTRODUCTION

The colourful splendour of nature is mainly due to the presence of compounds like carotenoids, anthocyanins, porphyrins, and chlorophylls. Carotenoids have high impact in nature since they are responsible for many of the brilliant red, orange, and yellow colours in plants and animals. The paramount interest in using microbial pigments is because of their natural character, safety, and medicinal properties, and their ability to provide controllable and predictable yields (Joshi *et al*., 2003). Carotenoids produced by the microbial route are very significant due to seasonal and geographic variability in the marketing and production of some pigments of plant origin (Frenova and Beshkova, 2009). Microbial processes are low-cost, with the use of natural carbohydrate sources as substrate bringing economic advantages. Carotenoids are synthesized by many microorganisms and plants in nature with acetyl-CoA being the key precursor during carotenoid biosynthesis (Olson, 1964; Moise *et al*., 2014). The production of carotenes such as Torularhodin and Torulene by the yeast *Rhodotorula mucilaginosa* (*R. mucilaginosa*) has been demonstrated previously (Aksu and Eren, 2005; Irazusta *et al.*, 2013; Cheng and Yang, 2016; Yen *et al*., 2016; Yoo *et al.*, 2016). While use of this yeast is currently limited due to the prohibitive cost of production, it remains of interest since carotenoids have high demand and price in the market. The market value of β-carotene, estimated at around $250 million in 2007, increased to nearly $261 million in 2010. This market is expected to grow to $334 million by 2018 at a compound annual growth rate of 3.1%. Lutein was around $233 million in 2010 and is expected to reach $309 million by 2018 with a compound annual growth rate of 3.6% (McWilliams, 2011). In the fermentation industry, the market is affected by the availability of the raw materials to produce the desired products. In the case of carotenoids, diverse raw materials have been tested to decrease the production cost and at the same time to maintain or even increase the productivity (Cheng and Yang, 2016). The consensus is that the production cost could be reduced when the yield of the product is increased, and a less expensive substrate is utilized. Fermentation parameters have a strong influence on productivity, and control of production facilitates the extraction of intracellular carotenoids from yeast (Yoo *et al.*, 2016). To reduce the production cost, efforts to use cost-effective substrates such as food waste

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