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ORIGINAL PAPER

Biohydrogen Production by Antarctic Psychrotolerant *Klebsiella* sp. ABZ11

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Abstract

Lower temperature biohydrogen production has always been attractive, due to the lower energy requirements. However, the slow metabolic rate of psychrotolerant biohydrogen-producing bacteria is a common problem that affects their biohydrogen yield. This study reports on the improved substrate synthesis and biohydrogen productivity by the psychrotolerant *Klebsiella* sp. strain ABZ11, isolated from Antarctic seawater sample. The isolate was screened for biohydrogen production at 30°C, under facultative anaerobic condition. The isolate is able to ferment glucose, fructose and sucrose with biohydrogen production rate and yield of 0.8 mol/l/h and 3.8 mol/g, respectively at 10 g/l glucose concentration. It also showed 74% carbohydrate uptake and 95% oxygen uptake ability, and a wide growth temperature range with optimum at 37°C. *Klebsiella* sp. ABZ11 has a short biohydrogen production lag phase, fast substrate uptake and is able to tolerate the presence of oxygen in the culture medium. Thus, the isolate has a potential to be used for lower temperature biohydrogen production process.

Key words: *Klebsiella* sp., biohydrogen, facultative psychrotolerant, oxygen uptake, carbohydrate consumption

Introduction

Hydrogen is an attractive alternative energy carrier due to the high energy density, and the cleaner by-products generated when used in automobiles (Khan et al. 2017). Biological hydrogen production is a technique of producing hydrogen through biological processes, using microorganisms as the biocatalysts. Among all the biological processes, bacterial dark fermentation is the most promising one, due to the high biohydrogen yield, and the ability to ferment different substrates to produce biohydrogen (Khan et al. 2017; Miandad et al. 2017).

Psychrophiles and psychrotolerant bacteria are abundant in the colder environment, e.g. Antarctica. Psychrophiles grow optimally at 20°C, and their fermentative processes have been considered beneficial due to the unique enzymes they possess (Corr and Murphy 2011). However, the reduced metabolic rate in psychrophiles is one key factor that affects substrate uptake and synthesis, which invariably affect the rate of substrate degradation and fermentative yield (Lettinga et al. 2001; Thauer et al. 2010; Lu et al. 2011). Psychrotolerant bacteria on the other hand, can grow above 20°C (Morita 1975; Pesciaroli et al. 2012). Thus, they are expected to be more useful for biohydrogen production at ambient temperature. Some psychrotolerant strains can thrive between 0–40°C (Pikuta et al. 2016), giving them an advantage over psychrophiles. Temperature

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