Mutation of *Spirulina* sp. by nuclear irradiation to improve growth rate under 15% carbon dioxide in flue gas

Jun Cheng, Hongxiang Lu, Xin He, Weijuan Yang, Junhu Zhou, Kefa Cen

PII: S0960-8524(17)30615-6
DOI: http://dx.doi.org/10.1016/j.biortech.2017.04.107
Reference: BITE 18002

To appear in: *Bioresource Technology*

Received Date: 5 March 2017
Revised Date: 25 April 2017
Accepted Date: 26 April 2017

Please cite this article as: Cheng, J., Lu, H., He, X., Yang, W., Zhou, J., Cen, K., Mutation of *Spirulina* sp. by nuclear irradiation to improve growth rate under 15% carbon dioxide in flue gas, *Bioresource Technology* (2017), doi: http://dx.doi.org/10.1016/j.biortech.2017.04.107

Mutation of *Spirulina* sp. by nuclear irradiation to improve growth rate under 15% carbon dioxide in flue gas

Jun Cheng*, Hongxiang Lu, Xin He, Weijuan Yang, Junhu Zhou, Kefa Cen

State Key Laboratory of Clean Energy Utilization, Zhejiang University, Hangzhou 310027, China

Abstract

Spirulina sp. was mutated by γ-rays from ^{60}Co nuclear irradiation to improve growth and CO_2 fixation rate under 15 vol.% CO_2 (in flue gas from a power plant). Mutants with enhanced growth phenotype were obtained, with the best strain exhibiting 310% increment in biomass yield on day 4. The mutant was then domesticated with elevated CO_2 concentration, and the biomass yield increased by 500% after domestication under 15 vol.% CO_2, with stable inheritance. Ultrastructure of *Spirulina* sp. shows that the fractal dimension of *Spirulina* cells decreased by 23% after mutation. Pore size in the cell wall of *Spirulina* mutant increased by 33% after 15 vol.% CO_2 domestication. This characteristic facilitated the direct penetration of CO_2 into cells, thus improving CO_2 biofixation rate.

Keywords: microalgae; CO_2 fixation; nuclear irradiation; domestication; ultrastucture

1 Introduction

Global warming has become a hotspot in environmental studies because of the increased atmospheric CO_2 levels. Among the numerous studies that attempted to reduce the quantity of CO_2 in the atmosphere, biotechnology using microalgae has extensively been applied for decades (Sivakumar et al., 2014). Microalgae are sustainable feedstocks for the production of biofuels because of their highly efficient carbon sequestration and high lipid