



Short Communication

Alteration of the biomass composition of *Arthrospira (Spirulina) platensis* under various amounts of limited phosphorus

Giorgos Markou

Department of Natural Resources Management and Agricultural Engineering, Agricultural University of Athens, Iera Odos 75, 11855 Athens, Greece

HIGHLIGHTS

- ▶ *A. platensis* biomass composition is affected by the degree of intracellular P limitation.
- ▶ Carbohydrates, lipids and C/N ratio increase gradually as intracellular P becomes limited.
- ▶ Proteins decrease as intracellular P becomes limited.

ARTICLE INFO

Article history:

Received 26 February 2012
 Received in revised form 4 April 2012
 Accepted 7 April 2012
 Available online 17 April 2012

Keywords:

Arthrospira (Spirulina)
 Biofuels
 Biomass composition
 Phosphorus

ABSTRACT

In this study the biomass composition alteration of the cyanobacterium *Arthrospira (Spirulina) platensis* under various amounts of limited phosphorus is studied. It was observed that the alteration of the compounds of the biomass occurred gradually as the phosphorus became limited. Carbohydrates and lipids increased from about 9% up to 65% and from about 4.9% up to 7.5%, respectively, while proteins decreased from about 46.5% to 25% as the phosphorus became limited. The increasing of carbohydrates and lipids in addition to the decrease of proteins resulted to an increase of the carbon to nitrogen (C/N) ratio from about 4.6 to 12.2.

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1. Introduction

Microalgae are photosynthetic micro-organisms, which convert and store solar energy and inorganic compounds into chemical energy. They are considered to have high photosynthetic efficiencies, grow fast with low nutritional needs and therefore are superior for biomass production over terrestrial plants (Costa and de Moraes, 2011). The stored chemical energy is mainly carbohydrates, proteins and lipids. The microalgal biomass composition is strongly affected by the environmental and cultivation factors and thus it is possible to be manipulated. The most frequently used microalgal biomass composition manipulation strategy is related to the nitrogen nutrient limitation. Specifically, nitrogen starvation causes an alteration in the metabolic pathways of the microalgae resulting to an increase in the lipids accumulation, which are the feedstock for biodiesel production after their esterification (Li et al., 2008). However, besides the production of biodiesel, microalgal biomass can be used as substrate for bioethanol or biomethane production. Especially in the technology for bioethanol production through the anaerobic fermentation the main feedstock are carbohydrates, while in the technology for biomethane production through the

anaerobic digestion, a controlled biomass composition, having a carbon to nitrogen ratio between 20:1 and 35:1 is more desirable (Demirbas, 2010; Sialve et al., 2009).

In a previous work of Markou et al. (2012) phosphorus limitation in cultures of *Arthrospira platensis* caused a strong increase in the biomass carbohydrate content. The alteration of the biomass composition was affected by the degree of the phosphorus deficiency. Therefore, aim of this work was to present and to discuss the relationship between intracellular phosphorus and biomass content of carbohydrates, proteins and lipids.

2. Methods

2.1. Microorganism and growth conditions

The cyanobacterium *A. platensis* SAG 21.99 used in the study was obtained from SAG (Sammlung von Algenkulturen der Universität Göttingen). *A. platensis* was maintained in *Spirulina* medium (SAG: http://epsag.netcity.de/pdf/media_and_recipes/02_Spirulina_Medium.pdf) under white fluorescent lamps with about $20 \mu\text{Em}^{-2}\text{s}^{-1}$ light intensity at $17 (\pm 0.2)^\circ\text{C}$. However, the inoculum for the study was obtained from a previous semi-continuous experiment with the same conditions with the present.

E-mail address: markoug@aua.gr