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Conversion of biowaste leachate to valuable biomass and lipids in mixed cultures of *Euglena gracilis* and chlorophytes

Tossavainen Marika[a,*], Katyal Chopra Neha[b,1], Kostia Silja[c], Valkonen Kalle[a,2], Sharma Anil K.[d], Sharma Suvigya[d], Ojala Anne[a,e,f], Romantschuk Martin[a,g]

[a] Faculty of Biological and Environmental Sciences, Ecosystems and Environment Research Programme, University of Helsinki, Niemenkatu 73, 15140 Lahti, Finland
[b] Department of Biotechnology, Faculty of Engineering and Technology, Manav Rachna International Institute of Research and Studies, Aravalli Campus Sector - 43, Delhi, Surajkund Road Faridabad, Haryana 121004, India
[c] Faculty of Technology, Lahti University of Applied Sciences, Mukkulankatu 19, 15210 Lahti, Finland
[d] Department of Biological Sciences, Govind Ballabh Pant University of Agriculture and Technology, Pantnagar 263145, Uttarakhand, India
[e] Faculty of Agriculture and Forestry, Institute of Atmospheric and Earth System Research (INAR)/Forest Sciences, P.O. Box 27, 00014, University of Helsinki, Finland
[f] Faculty of Biological and Environmental Sciences, Helsinki Institute of Sustainability Science (HELSUS), Niemenkatu 73, 15140 Lahti, Finland
[g] Institute of Environmental Sciences, Kazan Federal University, 420008 Kazan, Russia

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ABSTRACT

Microalgae are a sustainable alternative for production of valuable omega −3 fatty acids (FAs), but high production costs limit commercialization. Utilization of waste as a nutrient source increases the economics of the cultivation process. Additionally, using mixed algal cultures instead of monocultures makes the cultivation process more flexible and can increase biomass and lipid production. Here, the growth and lipid production of microalgae *Euglena gracilis*, *Selenastrum* sp. and, *Chlorella sorokiniana* were studied in mono- and mixed cultures in small and pilot scale experiments in biowaste leachate. In pilot scale, also nutrient reduction and the number of bacteria were analyzed. Biomass production in the most productive mixed cultures was similar, but not higher than in most productive monocultures. The lipid production was highest in the small-scale monoculture of *Selenastrum* (10.4% DW) and in the pilot scale culture of *Selenastrum* with *E. gracilis* (11.1% DW). The content of alpha-linolenic acid (ALA) increased and eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) remained stable during the cultivation period in all pilot scale cultures. However, increases in biomass and lipid production toward the end of the cultivation resulted in higher EPA and DHA yields in the well growing monoculture of *E. gracilis* and in the mixed culture of *E. gracilis* with *Selenastrum*. Co-cultivation of *E. gracilis* and *Selenastrum* also had a positive influence on nutrient uptake and resistance against bacteria. This type of mixed culture may be a good option for commercialization. However, as shown here, minor changes in cultivation conditions can rapidly result in dominance of a subdominant strain, and thus the stability of strain performance and production of desired FAs needs further investigation.

1. Introduction

Sustainable production practices and alternatives for fish oils as a source of essential long chain polyunsaturated fatty acids (LC-PUFAs) are needed to satisfy nutritional needs of a growing world population and to protect endangered aquatic ecosystems [1]. Concerns have been raised on pollution effects of growing fish farming and over-exploitation of wild fish populations as fish-feed ingredients [1,2]. Microalgae produce several health promoting, essential omega −3 FAs such as ALA (18:3n3), EPA (20:5n3) and DHA (22:6n3). The polyunsaturated fatty acid (PUFA) ALA is a common C_{18} FA (18 carbon atoms in FA chain) in plant oils, while LC-PUFAs EPA and DHA, (C_{20} and C_{22}) have traditionally been obtained from marine and fresh water food [3,4]. ALA is classified as an essential FA, since it is a precursor of LC-PUFAs in the omega −3 family [5]. Most animals cannot synthetize precursor FAs de novo, whereas conversion efficiency to LC-PUFAs varies between

* Corresponding author at: Faculty of Biological and Environmental Sciences, Ecosystems and Environment Research Programme, University of Helsinki, Niemenkatu 73, 15140 Lahti, Finland.
E-mail address: marika.tossavainen@helsinki.fi (M. Tossavainen).
[1] Present address: Department of Research, Sir Gangaram Hospital, Sir Gangaran hospital marg, Old Rajinder nagar, New Delhi 110060, India.
[2] Present address: Kyrö Distillery Company, Rye Rye Oy, Oltermannintie 6, 61500 Isokyrö, Finland.

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