An integrated process of biodiesel production from indigenous microalgae in Northern Greece: first results

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INTRODUCTION

For environmental, economic and competence reasons, the fuel industry has pushed for alternative fuels in the past few years. One option that is considered are biofuels, which are renewable fuels and have the characteristic of lower or zero emissions of CO_2 in the lifecycle, depending on their origin, their production and use. That is done, because the carbon they contain has been committed in the development of organic matter from the atmosphere, which returns after combustion so the balance of emissions throughout the life cycle of biofuel is "theoretically zero" [1].

Alternative biomass for biofuel production is algae, mainly microalgae. These photosynthetic organisms live in salty (sea), brackish (lagoons) and fresh (lakes) water using solar energy, water and carbon dioxide to produce biomass. For optimum growth, they also need nutrients, especially salts of nitrogen and phosphorus in the case of diatoms, silicon compounds. The cell of the microalgae, particularly diatoms and green algae contain lipids (oils) as components of membranes, and 40% of dry weight [3]. The algal oil can be extracted from the organisms and converted into biodiesel by transesterification with short-chain alcohols or by hydrogenation of fatty acids into linear hydrocarbons. Other fuel products can be also synthesized by algae [4].

The advantage and perspective of algae cultivation in relation to farming land plants e.g. corn, soybeans, wheat, is that doesn't affects the cycle of food, since there is no use of agricultural resources such as arable land, fresh water, especially if it is a marine microalga, and a higher photosynthetic efficiency of plants on land [2]. Moreover, the production of algae can be combined with the use of sea water enriched with inorganic nutrients from municipal wastewater treatment plant runoff [3, 4].

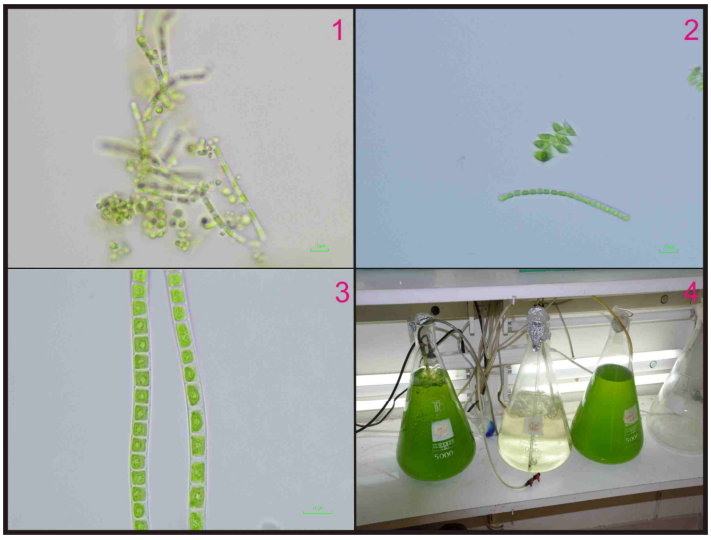

Figure 1. An indigenous Chlorophyte cultivated under laboratory conditions.

The aim of this paper is to present the first results of a Greek project funded within the framework of "ARCHIMEDES III: SUPPORTING RESEARCH IN TEI" aiming for the creation and the development of new knowledge and technology in the process of producing biofuels (biodiesel) from indigenous algal species. The objectives of the project were: a) To select indigenous strains having high oil content and low costs for land-based cultivation and biomass harvest, b) To extract the oils from algae biomass and to transesterificate of oils to biodiesel, c) To study the performance of the produced biodiesel in real combustion conditions, d) To analysed

energy and carbon balance of the process. It will be attempted to cultivate algal biomass as a by-product of local municipal wastewater treatment effluents as a tool to ensure environmental and economic sustainability within an ecosystem based management framework.

METHODOLOGY

The work has been implemented in two well equipped laboratories: a) The "Fisheries Research Institute" Laboratories (www.inale.gr) with experience in chemical analysis, eco-physiology and land-based algae cultivation, b) The Biofuels lab of the Department of Petroleum and Natural Gas Technology with experience in biofuels, catalysis and applications.

Figure 2. Cultivation (1-4) and harvesting (5-9) facilities of fresh water Chlorophyte strain in Fisheries Research Institute, Greece.

RESULTS AND DISCUSSION

The project is in the initial implementation phase. Indigenous fresh water Chlorophyte (Fig. 1) has been selected and cultivated successfully under differently sized land-based facilities (Fig. 2). As a nutrient source has been used commercial fertiliser (Nutrileaf 30-10-10, 70 μmol/l) or secondary treated and UV sterilized domestic effluents (100%) of Nea Peramos municipal wastewater treatment plant. To further optimise the harvestable algal yield a better understanding of the influence of parameters such as, species eco-physiology, control of grazers and parasites and natural bioflocculation is needed [5]. However, the results of this study suggest that cultivating microalgae in municipal wastewaters combines nutrients removal and algal production for potential use as a biodiesel feedstock that may contribute to minimize eutrophication symptoms of Eastern Macedonian coasts.

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