ALGADISK- INTRODUCTION OF A STARTING FP7 PROJECT (286887)

Petra Sebestyén, Ágnes Dergez, Ákos Koós, Attila Wootsch, PhD, Péter Kesserű, PhD, István Kiss, PhD

Bay Zoltán Foundation for Applied Research Institute for Biotechnology, Derkovits fasor 2. H-6726 Szeged, Hungary
e-mail: sebespetra@bay.u-szeged.hu

ABSTRACT

Microalgae could substitute crops in biofuel production due to their high biomass productivity and lipid content, although none of the existing systems has been enough cost-effective to compete fossil fuels or biodiesel produced from plants so far. Nowadays, microalgae production is usually carried out in open pond and closed photobioreactors; however, these technologies have some limiting factors including high water demand, contamination, large surface area requirements, self-shading and low productivity. ALGADISK project could provide a technology that gives solutions for these limiting factors of open pond and closed photobioreactors. The project includes the selection of microalgae species with high lipid content and examining and determining their ideal growth and operational conditions, construction an energetically efficient reactor system with automatic harvesting system, and a computer based tool in order to optimize operational conditions and estimate profitability, furthermore reducing water demand, reaching at least 20g/l algal biomass.

INTRODUCTION

During the last few decades the consumption of fossil fuels has increased greatly which resulted for instant in high fuel prices and in an increased level of CO_2 emission. Due to the different global environmental programmes (e.g. Kyoto Protocol) the production of biofuels was approximately 8000 kton in EU member countries in 2007 which was 2,6% of the total fuel consumption [1].

Major part of biofuels is produced from crops which can provide a competitive price and a reduced CO_2 emissions, however, it competes with food crops for arable lands and their biomass yields are not high enough. To avoid the rise of the prices of food crops, algae could substitute plants in biofuel production due to their higher productivity than crops and their high level lipid content, moreover, algae can be grown on agriculturally unsuitable lands [2]. Besides biodiesel production, algae are well known producers of rare polyunsaturated fatty acids and carotinoides [3], which are valuable nutrients for humans and the produced biomass can be then converted to several end-products (e.g. ethanol, hydrogen etc.) as it is shown on the Fig. 1.

Algae can be either autotrophic or heterotrophic organisms. Autotrophic algae are able to transform light to biomass via photosynthesis and they only require inorganic compounds, thus they are regarded as a potential solution for reducing CO_2 emission. However, heterotrophic algae only grow in the presence of organic nutrients. [4]

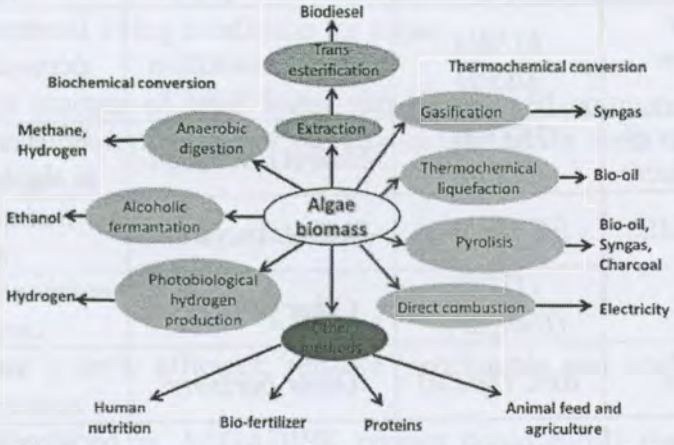

Fig. 1. Processes for algal biomass conversion [5]

For algae biomass production, two systems are used worldwide: open pond and closed photobioreactors. Open pond systems are artificial ponds where air is CO_2 source, the environment is highly selective to prevent contamination and the broth is mixed with paddlewheels. Besides its benefits like low energy input, easy maintenance and cleaning, relatively high production, many limiting factors are known as changes in temperature and light intensity, CO_2 deficiencies, evaporation and only a few alga species are suitable for this production technology [3].

Some of these problems can be overcome using closed photobioreactors. One of its most important benefits that contamination is prevented. Cost of harvesting can be reduced because of the high cell density, however, the overall cost of closed systems are higher than of open ponds.

Although these production methods are commonly used, they are still facing many difficulties such as expensive installation, low productivity, large surface area and high water demand.

The aim of ALGADISK project is to develop a microalgae production technology for efficient biodiesel production, which is able to provide solutions for the limitation factors of the currently applied technologies and can be profitable in small-scale, occupies a little space and can be installed without highly trained end-users.

ABOUT ALGADISK PROJECT

To realize this plan, an FP7 project would be generated, which include three SME (Small and Medium Enterprises) Associations, four RTD (Research and Technological Development) and five other SME partners (Table 1.). The SME and SME Associations are the beneficiaries of the project and the RTD partners will develop the ALGADISK system.

Table 1. Members of ALGADISK project

Project members	*Acronyms*	*Partnership type*	*Responsibilities*
European Biomass Industry Association	*EUBIA (Italy)*	*SME-Association*	*system specification according to the needs of members*
Spanish Confederation of Compound Feed Producer	*CESFAC (Spain)*	*SME-Association*	*focus on the need of SMEs in the food and feed sector*
FUNDACIÓN CESFAC	*FC (Spain)*	*SME-Association*	*training activities, IPR management*
OLAJGÉP-Tec Kft.	*OTEC (Hungary)*	*Other partners*	*mechanical engineering and construction tasks*
Biogas Fuel Cell SA	*BFC (Spain)*	*Other partners*	*reactor design, construction, validation*
ONVIDA GmbH	*ONVIDA (Germany)*	*Other partners*	*alga selection, develop sensors and monitoring system*
Umwelt-Technik Ltd	*UTECH (Hungary)*	*Other partners*	*mechanical, electrical design of reactor, installation*
CAGLAR DOGAL ÜRÜNLER Ltd	*CAG (Turkey)*	*Other partners*	*waste management, pollution monitoring*
MFKK Invention and Research Center Services	*MFKK (Hungary)*	*RTD performers*	*prediction software development, prototype construction*
Cranfield University	*CRAN (United Kingdom)*	*RTD performers*	*surface development*
Wageningen University	*WU (Netherlands)*	*RTD performers*	*selection of alga growth conditions, validating the system*
Bay Zoltán Foundation for Applied Research	*BAYBIO (Hungary)*	*RTD performers*	*alga selection, growth condition optimalization*

The main objectives and steps of ALGADISK project are the following ones:

- selection of algae which grows preferably on surface and have high lipid content
- developing lightweight, inexpensive and biocompatible surfaces for algae growth
- development of automatic harvesting system
- reducing water requirements meanwhile reaching at least 20g/l algae concentration by using bio-film technology
- designing a reactor capable to install within a week
- design and construction of a reactor system integrated with renewable energy sources
- developing a computer based tool for users to optimize operational conditions and to estimate profitability
- optimizing and validating the reactor prototypes under realistic conditions

The objectives of ALGADISK project from scientific view are:

- examining the CO_2 uptake from liquid and gas phases

- calculating the energy input and output for different alga species
- determining the engineering parameters of the reactor such as mixing parameters, mean liquid residence time etc.
- determining optimal living conditions for algae

With this system the amount of used water can be reduced compared to open ponds or photobioreactors, it can be applied either open or closed and it turns the drawback of wall growth into an advantage.

CONCLUSIONS

- During this project a new, efficient, reliable, predictable and scalable system will be created.
- The technology described in ALGADISK project could fulfill the needs of European market where arable land space and capital are limited.

LIST OF REFERENCES

[1] http://ec.europa.eu/energy/publications/statistics/statistics_en.htm
[2] Scott, S. A., Davey, M. P., Dennis, J. S., Horst, I., Howe, C. J., Lea-Smith, D. J., Smith, A. G. (2010) Biodiesel from algae: challenges and prospects. Current Opinion in Biotechnology. 21:277-286
[3] Borowitzka, M. A. (1999) Commercial production of microalgae: ponds, tanks, tubes and fermenters. Journal of Biotechnology. 70. p. 313-321
[4] Lee R. E.(1980) Phycology. New York: Cambridge University Press
[5] Tsukahara K., Sawayama S. (2005) Liquid fuel production using microalgae. Journal of the Japan Petroleum Institute. 48. p. 251-259