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Microalgae – the “green gold” – a renewable source of energy

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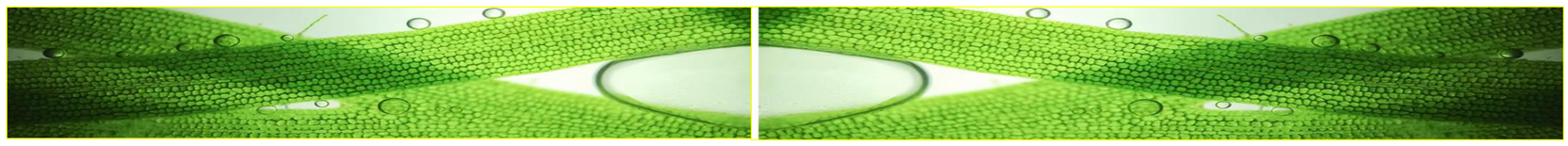


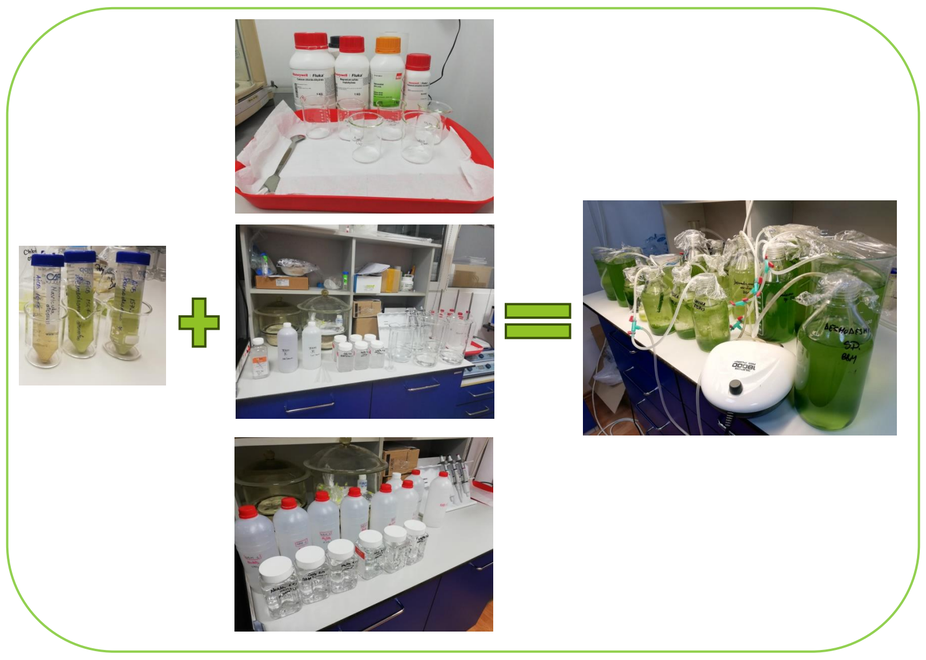
Introduction

The world's demand for energy is rising quickly, and since supplies of fossil fuels are limited and unsustainable, dependency on them is in jeopardy. In order to produce food and fuel, sustainable resources are necessary. Microalgae represent a potential answer to address the demands for fuel and energy. One of the planet's oldest living species, these microscopic, unicellular, and photoautotrophic organisms are primarily found in watery habitats at the base of the food chain. Microalgae are alternative sources for diverse compounds, such as proteins, carbohydrates, pigments and lipids. Depending on the species, different levels of these products can be generated. The metabolism of microalgae is influenced by environmental conditions (light, temperature) and chemical composition. Microalgae are natural resources that can be used for the synthesis of bioproducts, chemicals, materials, cosmetics, food supplements, animal feed, and fuels.

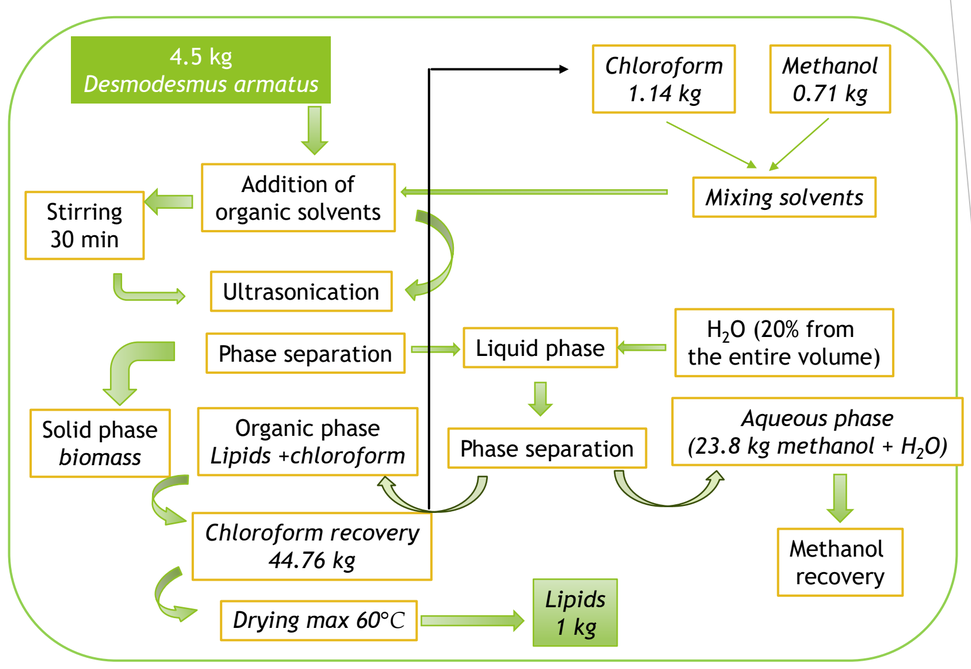
A renewable source of energy = microalgae → products (biodiesel, carbohydrates, pigments, vitamins, proteins, lipids)

Materials and methods

For the lipid extraction from microalgae, a two steps technology was optimized. In the first stage, the raw material, namely the microalgae mass from six different species (*Navicula atomus*, *Desmodesmus* spp., *Desmodesmus armatus*, *Chlorella* spp., *Porphyridium* spp., *Nannoochloropsis* spp. and *Dunadellia salina*) was produced under optimal and low-cost conditions. In the second stage, lipids were extracted with the help of organic solvents and water under ultrasonication and a succession of separation phases. Both stages are represented in the following figures:



Stage 1. Microalgae production



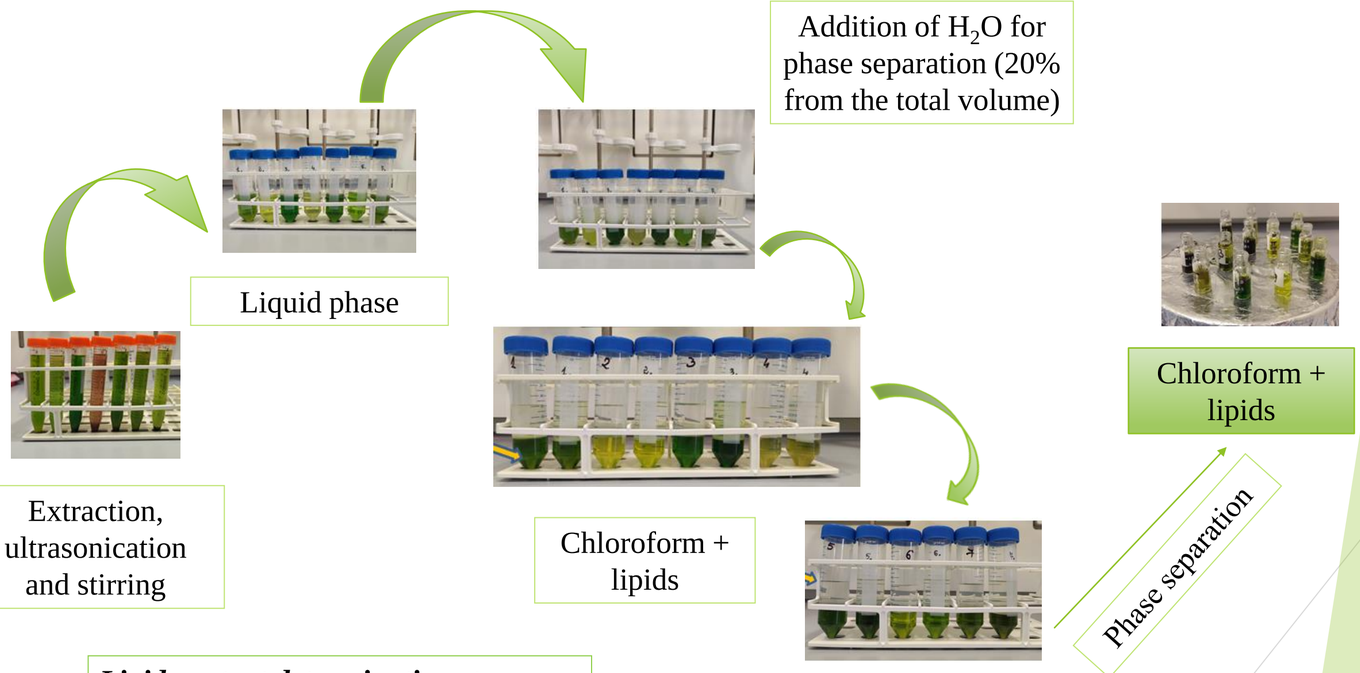
Stage 2. Lipid extraction from microalgae

Results and discussion

The results indicated that from an amount of approximatively 4.5 kg microalgae, 1.0 kg lipids were obtained. Lipids were measured in several microalgae species. The lipid content determined in different species of microalgae by applying the optimized extraction technique assisted by ultrasonication is represented in Table 1. The chronologic phases are represented in the following figure:

Table 1. Lipid content in different microalgae species

Species	Lipids (%)
Navicula atomus	44.3
Desmodesmus spp.	28.9
Desmodesmus armatus	22.6
Porphyridium spp.	14.8
Chlorella spp.	17.4
Nannochloropsis spp.	20.1
Dunadellia salina	21.5



Lipid content determination stages

Conclusions

Giving the limitation of fossil fuel resources, the renewable energy demand considerably increased. This way, a special attention is given to the utilization of microalgae as raw material for the third-generation biofuel production (bioethanol, biogas, biohydrogen and biodiesel). The production of biodiesel is the most investigated option, although there is still a necessity for research and progress in order to obtain biodiesel with the help of microalgae at large scale. Microalgae assure equilibrium in the aquatic ecosystems, due to their position in the food pyramid and their role in the trophic transfer.

Lipids are considered to be a significant source of energy for humans. It is important to know that burning lipids provides twice the energy that burning proteins does. Lipids play a significant role in the normal functioning of the human body, as they represent a source of energy (1 g lipids = 9.3 kcal).

By applying the optimized lipid extraction technique developed, a total amount of 1.0 kg of lipids is obtained from approximatively 4.5 kg of microalgae.

Acknowledgments

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