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The prospects of biodiesel from microalgae

Abstract:
Highly productive Chlorella sp. C-2m strain was received, which in future can be used as a source of lipids for biodiesel production.
Key words: highly productive, microalgae, biodiesel production.

Introduction

Currently, the depletion of world reserves of oil and waste pollution of the planet led to the use environmentally friendly fuel from renewable biological resources. Most developed countries are considering the possibility of growing more oilseed crops as a solution to the oil crisis. Biofuel is a fuel derived from plant materials, is considered as environmentally friendly alternative to fossil hydrocarbons. But it is not so simple: the more agricultural lands used to industrial crops to produce biofuels, the higher food prices. This problem, some experts solve by using the biomass of algae, since they also synthesize oil, which could become a feedstock for biodiesel production. These microalgae have several advantages: they have a short life cycle and grow throughout the year [1, 2].

Algae – the fastest growing phototrophic organisms on the Earth – they are growing 30 times faster than the plants.

For the cultivation of microalgae requires available sources: sunlight, water, carbon dioxide and nutrients (P and N microdoses of phosphorous and nitrogen fertilizers).

Microalgae are the producers of valuable natural products: pigments, proteins, enzymes, sugar, fats, amino acids and vitamins.

According to research carried out in different countries, some species of algae under optimum conditions of cultivation accumulate more lipids. For example, the lipid content in *Scenedesmus dimorphus* is 16-40%, in *Prymnesium parvum* – 22-38%, *Euglena gracilis* – 14-20%, *Chlorella vulgaris* – 14-22%, *Dunaliella salina* – 16-44%, *Haematococcus pluvialis* – 25 -45%, *Isochrisis galbana* – 22-38%, *Stichococcus sp.* – 40-59% [3, 4].

Nowadays, in Kazakhstan there is no any technology for production of oil from algae, but presents a large collection of algae – producing important substances (proteins, lipids and biologically active substances), and has studied their physiological and biochemical properties, and developed techniques of mass cultivation of microalgae some active strains in the laboratory semi-industrial conditions to use it as bio-fertilizers and fodder additives, water treatment and biodiesel production.

The aim of our study is to obtain highly productive microalgae strains with high lipid accumulation capability and study of its productivity and lipid content in the cells.

Materials and methods

We used wild strains of microalgae *Chlorella sp. C-2, Scenedesmus obliquus-Z-2* and mutant strain *Chlorella sp. C-2m*. The cultivation of microalgae in autotrophic conditions was performed at 25-28^{0}C.

The growth rate was determined by counting in Goryaev cell an increasing cell number. To obtain mutants of microalgae we used UV light with a wavelength of 254 nm. The radiation dose varied depending on ekspodentional time [5,6].

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Determination of lipid accumulation rate in algae cells was measured by fluorescence staining reagent Nile Red. The total protein content was determined by Lowry, carbohydrate by phenol-sulfuric method.

Results and discussion

We have carried out selection of wild and collection strains of algae and studied their morphological properties for obtaining active strains of microalgae – producers of oil.

For industrial application we used autoselection methods in intensive culture, which promotes resistible, competitive and promising forms.

We conducted autoselection for the most productive strains of microalgae *Chlorella sp. C-2* and *Scenedesmus obliquus-Z-2*. To do this, we use the modified growth mediumthe 04, cultivation was carried out in a special laboratory. As a result of long-term cultivation of strains of *Chlorella sp. C-2* and *Scenedesmus obliquus-Z-2* on the basis of the results of autoselection we recognized *Chlorella sp. C-2* as the most active strain of microalgae (Figure 1).

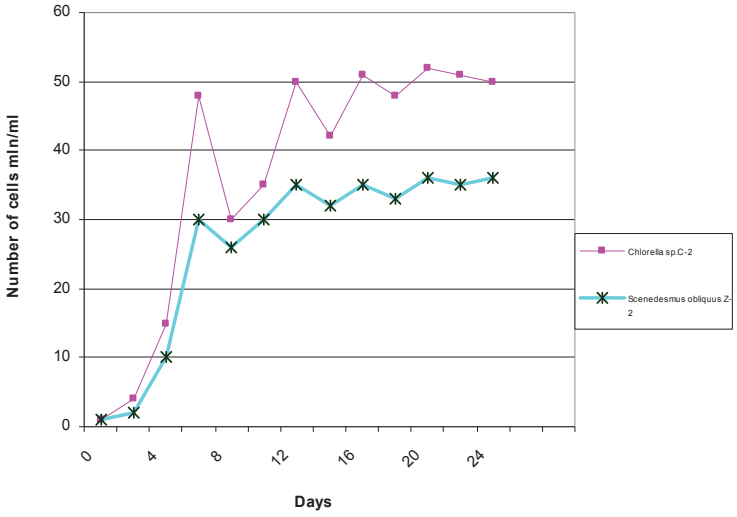

Figure 1 – Autoselection of *Chlorella sp. C-2* and *Scenedesmus obliquus-Z-2* strains in conditions of long-term cultivation.

We have obtained highly productive *Chlorella sp. C-2m* strain by methods of mutagenesis and selection. Highly productive *Chlorella sp. C-2m strain more productive and has more amount of lipids than control Chlorella sp. C-2 strain. Dry biomass of Chlorella sp. C-2m strain is 4.5 g/l, while the content of total lipids – 32%, compared to control Chlorella sp. C-2 strain of – 3.5 g/l and 18%, respectively. Comparative dynamics of biomass and lipids is shown in Figure 2.*

As a result of selection of the most productive strains of microalgae *Chlorella sp. C-2* and *Scenedesmus obliquus-Z-2* on lipid accumulation capacity the *Chlorella sp. C-2m strain was considered as the most productive strain.*

Wild strains isolated from natural ecosystems and collection strains of microalgae have been analyzed to identify the most productive and stable strain.

Analysis of the chemical composition of the major cellular compounds of microalgae is an essential part of the study of biochemical characteristics of the culture for the subsequent selection of the productive strain with the most useful characteristics of productivity [5,6].

In this study we carried out a biochemical analysis of cells of highly productive *Chlorella sp. C-2m strain.*

As a result of biochemical analysis of highly productive *Chlorella sp.*

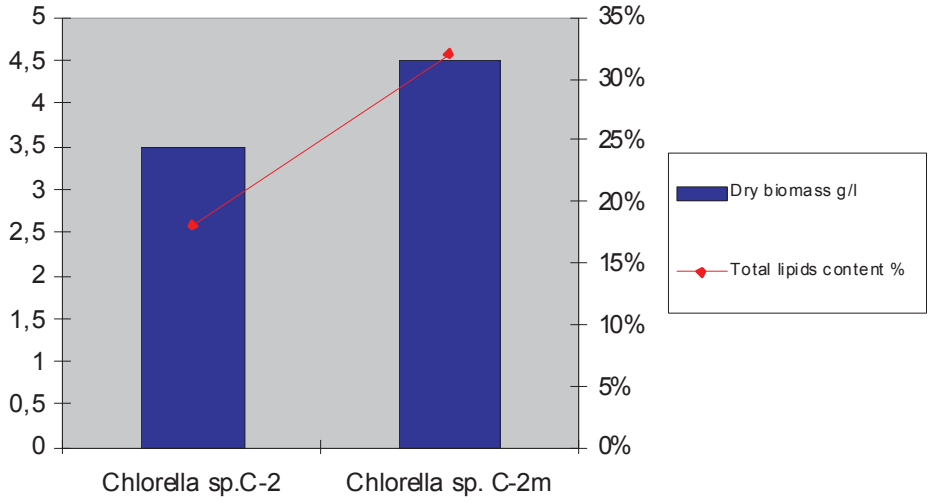

Figure 2 – Dynamics of biomass and lipids accumulation capacity of active strains of microalgae (*Chlorella sp. C-2, Chlorella sp. C-2m*)

C-2m strain contains 40% of proteins to its dry weight, 21% of carbohydrates to its dry weight, 32% of lipids to its dry weight and 7% of ash (Fig. 3).

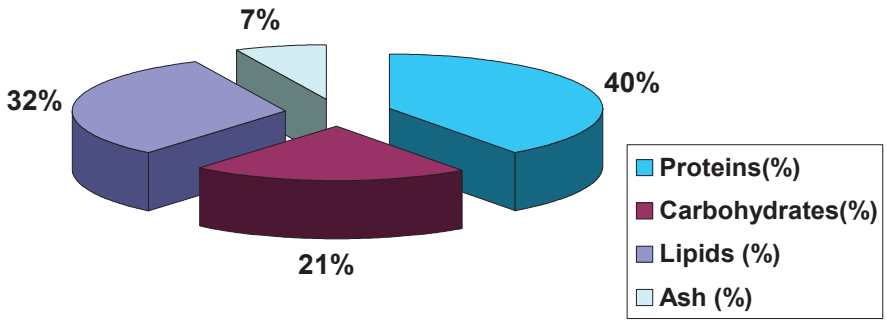

Figure 3 – The ratio of the major cellular compounds of *Chlorella sp. C-2m* strain

Thus, we studied main compounds of highly active *Chlorella sp. C-2 m* strains of microalgae.

Our future investigations will be focused on the analysis of fatty acids and triglycerides of *Chlorella sp. C-2m strain.* Recent years microalgae attract growing interest as an alternative source to diesel production. It was shown that microalgae are the most potential source for energy output amount various kinds of oilseeds plants.

It is established that the obtained *Chlorella sp. C-2m* strain is the most productive and stable, which can be used as a source of biodiesel.

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