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Carbohydrates extraction technique from different microalgae species

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INTRODUCTION

In the current global context, characterized by rising energy demand and accelerating environmental degradation, the concept of sustainability has gained significant importance. This has led to a strong interest in biofuels as a potential complementary and alternative source of bioenergy. Microalgae play a significant role in the global carbon cycle through the photosynthesis process. They are a valuable and practical source of carbohydrates due to their ability to efficiently convert solar energy and atmospheric carbon dioxide into chemical compounds, such as carbohydrates, while producing oxygen in the process. The utilization of microalgae-based biofuels represents a novel and environmentally friendly area of potential for the utilization of bioenergy, and is technically feasible. A variety of biofuels can be produced from microalgal polysaccharides, including bioethanol, butanol, methane and hydrogen.

MATERIAL AND METHOD

- A new technology (carbohydrates, as reducing sugars, extraction from microalgae species) was developed by INCDO-INOE2000, Subsidiary Research Institute for Analytical Instrumentation, ICIA, Cluj-Napoca, before 2021), in the frame of the PN 19-18.01.01 research project (Contract no. 18N/08.02.2019). The developed technology was optimized by ICIA, in 2024, in a new project (PN 05 23), and named TEZARED. TEZARED technology implies a carbohydrates (reducing sugars) extraction technique from different microalgae species. The TEZARED technology was initiated with an optimized method for growing *Desmodesmus armatus*, *Desmodesmus* spp., *Navicula atomus*, *Chlorella* spp., *Nannoochloropsis* spp., and *Porphyridium* spp. microalgae species, using BBM (Bold Basal Medium) and controlled temperature, lighting and oxygenation conditions. The optimized production method, implying all six microalgae species, is characterized by low-costs (Figure 1).
- In order to extract the carbohydrates content, as reducing sugars, the experiments were carried out in a batch regime (in Erlenmeyer flasks) to which 20 mg of microalgal biomass and a volume of 50 mL of 1% H_2SO_4 were added. The mixture was stirred at 900 rpm for 120 min at 100°C using a heated magnetic stirrer. The resulting mixture was filtered and the hydrolysate (liquid phase) was collected. The content of reducing sugars was determined by a colorimetric method using dinitro salicylic acid (Figure 2).

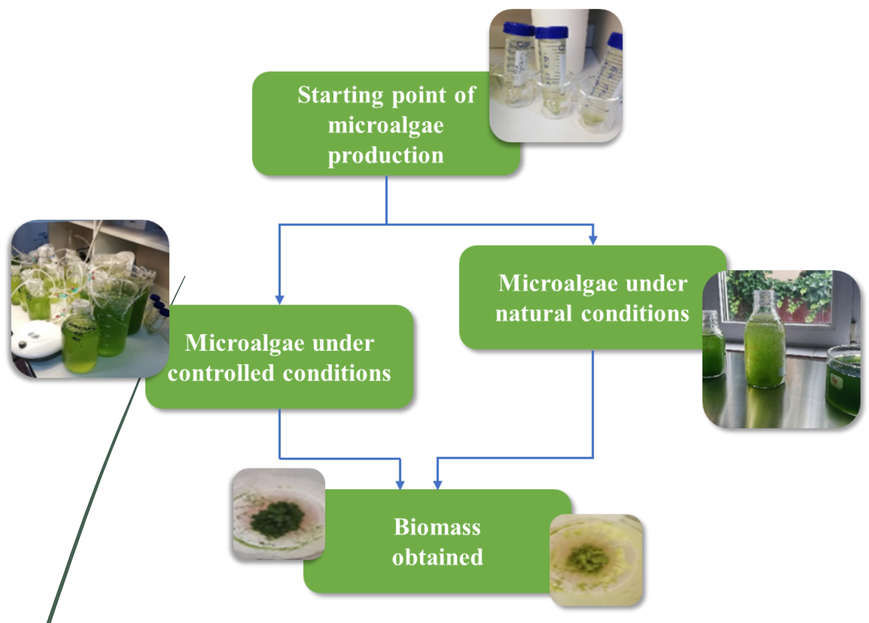

Figure 1. Microalgae production

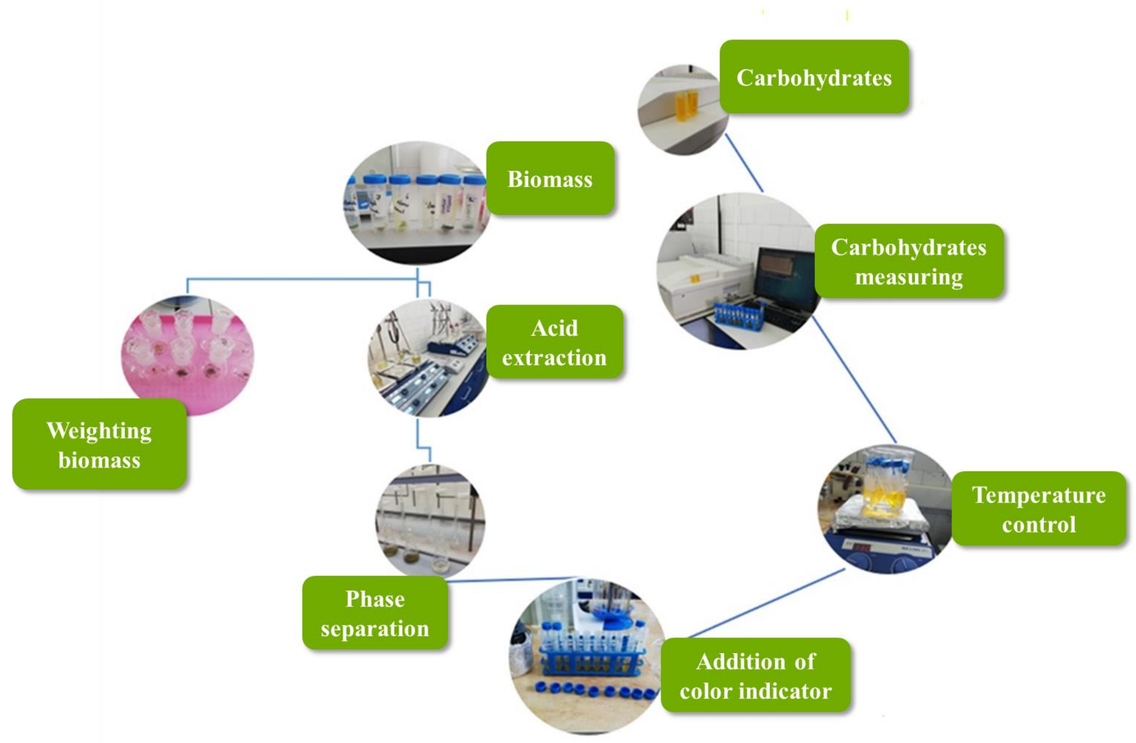

Figure 2. Carbohydrates extraction from microalgae

RESULTS AND DISCUSSION

The results obtained after applying the TEZARED technology showed that 1.0 kg carbohydrates (reducing sugars) was obtained from an amount of approximatively 2.5 kg microalgae biomass. The carbohydrates, as reducing sugars, content was determined in different species of microalgae by applying the optimized TEZARED technology (carbohydrates extraction technique from microalgae species). The obtained results after applying the TEZARED technology are presented in Table 1.

Table 1. Carbohydrates (reducing sugars) content in diverse microalgae species

Species	Carbohydrates (reducing sugars) (%)
Desmodesmus armatus	14.1
***Desmodesmus* spp.**	11.1
***Chlorella* spp.**	12.6
Navicula atomus	9.0
***Nannochloropsis* spp.**	12.7
***Porphyridium* spp.**	11.6

CONCLUSIONS

- TEZARED technology brings the following novelties:
  - using *Desmodesmus armatus* microalgae species to obtain carbohydrates, as reducing sugar
  - employing a discontinuous system for the extraction of the reducing sugars content
  - addition of the extraction phase to the technological flux → adding the specific consumption, required to obtain a quantity of 1.0 kg of carbohydrates (reducing sugars) from 2.5 kg of microalgae biomass, into the technological flux of the TEZARED technology
  - reducing the consumption of energy for obtaining carbohydrates, as reducing sugar → it was calculated that 107.1 kWh of energy is required to produce 1.0 kg of carbohydrates (reducing sugars) from microalgal biomass as dry matter

ACKNOWLEDGEMENTS

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