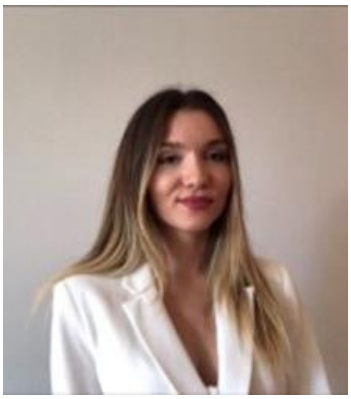
Seminars in Biotechnology BTEC 591 & BTEC 691

"Biodiesel Production from *Chlorella vulgaris* ESP-6"



Thursday, December 23, 2021
13:30
GTU Congress Center, Red Hall

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Selen Şenal is an entrepreneurial bioengineer well-experienced in process design, synthetic biology, reactor engineering, renewable energy, and climate change. She is a competent engineer, and a professional in project management and design. Selen Şenal graduated from Marmara University's Department of Bioengineering in 2018 with plant biotechnology studies. Therewithal she studied biotechnology at Wroclaw University in Poland with the Erasmus Exchange program. She started her Master's degree in Bioengineering at Yıldız Technical University in 2018 and completed her education with the thesis of 'Biodiesel Production from *Chlorella vulgaris* ESP-6 Microalgae' in June 2020 with a GPA of 3.9. During this period, she attended the 2nd Environmental Engineering Resource Recovery International Congress, 'Greenhouse Effect in the Atmosphere' and she published a paper under the title obtaining "Biodiesel from Microalgae by Fixation of CO_2 that Creates a Greenhouse Effect in the Atmosphere". In September 2020, she started Biotechnology PhD program at Yeditepe University and is currently working on the production of food and cosmetic raw materials from *Chlorella vulgaris*, *Chlorella vulgaris* ESP-6, *Chlorella variabilis* and *Chlorella protothecoides* species. In 2021, she established a company with the support of TUBITAK BIGG 1512. Şenal is an entrepreneur who has made a name for herself in many national and international news both in Turkey and globally and she is on the "40 Under 40" list of Fortune Turkey magazine.

Some of these achievements are;

- In 2019, the 2nd prize 'Obtaining Biodiesel from Microalgae through Wastewater and Flue Gas Disposal' in the competition called "İlk İşim Girişim" organized in cooperation with Yıldız Teknopark and Çalık Holding.
- In January 2020, TUSIAD Bu Gençte İş Var competition, the 2nd prize "ALGAE BIODIESEL".
- 2020 Big Bang Start-Up Challenge Top 20 Finalist

- In May 2020, the 2nd prize in the "Hayal Et Gerçekleştirelim" organized by Kredi Kayıt Bürosu.
- In November 2020, 3rd prize in Otomotivin Geleceği Tasarım Yarışması organized by Otomotiv İhracatçıları ve Uludağ İhracatçılar Birliği.
- MIT Clean-Tech Prizes 2021. Algae Biodiesel became the only startup selected from the global to the USA.
- GSEA-Entrepreneurship Organization 2021. Global Social Impact Award among 56 countries.
- "Enerjim Sensin 2021" competition the 2nd prize in the which was held in cooperation with EPDK-ELDER-ODTÜ TEKNOKENT.
- By Hello Tomorrow Deep-Tech Pioneer Award.
- European finalist for the Global Innovation through Science and Technology program organized by the U.S. Department of State.
- Accelerate2030 Turkey 2021 Edition Semifinalist
- Turkcell Geleceği Yazan Kadınlar Competition 2021 Semifinalist
- Başakşehir Living Lab Inovation Competition 2021 Semifinalist

Abstract

Microalgal biomass production is of great importance to different industries around the world. It can be used as a food supplement, biomass, feed, pigment, fertilizer and fuel while reducing CO_2 emissions during its production [1,2]. The CO_2 level in the atmosphere has exceeded 413 ppm and this poses a serious threat to the world as it exacerbates the effects of global warming. Therefore, emission-neutralizing biodiesel production from microalgal biomass has been accepted as a promising solution to combat this threat by all the countries in the world [3,4]. Microalgae are living things that have the ability to absorb air pollutants (CO_2, NO_2, SO_2). Since microalgae contain fatty acids, it carries an important potential for biodiesel production. In this study, the growth conditions of *Chlorella vulgaris* ESP-6 in different environments were examined and biodiesel was produced from microalgae for the first time by in-situ esterification method [5]. This study has two objectives; the first one is the examination of the growth kinetics of *Chlorella vulgaris* ESP-6 with CO_2 supply, air supply, and ambient conditions (without CO_2 and air supply), the other one is a combination of oil extraction and esterification in one step by optimizing various process parameters (catalyst quantity and type, alcohol amount) to produce biodiesel by in-situ esterification method. While the microalgae grown in CO_2 environment had the highest biomass yield (0.26 g/L), it has been found that μ_{max} value was 1.06 d^{-1}. Microalgal lipid content and lipid efficiency obtained from the culture grown under ambient conditions were determined as 24% and 3 mg/L.day, respectively, and the volume biomass productivity value was 13 mg/L.day. In in-situ esterification reaction used 100-150% by weight (oil-based) sulfuric acid as acid catalyst and 6.25-25% by weight NaOH as base catalyst. The reactions in both catalysts were carried out at 60˚C for 150 minutes. Methyl ester contents were determined by gas chromatography (GC) and qualitative results were determined by thin layer chromatography (TLC). Increasing the volume of reacted alcohol from 6:1 to 10:1 (v/w biomass) and increasing the catalyst rates, raised the oil extraction in the base catalyst, and enhanced the fatty acid methyl ester (FAME) by 29.1% and the methyl ester content by 7.16%.

When using H_2SO_4, an acidic catalyst, the FAME efficiency (98%) was found to be much higher than the base catalyst's FAME efficiency (29.1%). When the amount of acidic catalyst was increased from 100% to 150% in the esterification reaction, it was observed that the FAME efficiency (98%) and the ester content (29.5%) were higher than 93.2% and 21.4%, respectively. Overall, it was deduced that the *Chlorella vulgaris* ESP-6 microalgae species can be used as an efficient potential source for the reduction of CO_2 emissions and biodiesel production.

References

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[3] Khan, S., Siddique, R., Sajjad, W., Nabi, G., Hayat, K. M., Duan, P., & Yao, L. (2017). Biodiesel production from algae to overcome the energy crisis. HAYATI Journal of Biosciences, 24(4), 163-167

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