**SÜRDÜRÜLEBİLİR YAŞAM KAYNAĞI: MİKROALGLER**

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***Özet***

*Mikroalgler denizlerde ve tatlı sularda yaşayan ve fotosentez yapabilen tek hücreli canlılardır. Atmosferdeki oksijenin yaklaşık yarısını mikroalgler üretir. Yüz binlerce farklı mikroalg türü var. En yaygın mikroalg türleri diatomlar (Bacillariophyceae), yeşil algler (Chlorophyceae) ve altın rengi alglerdir (Chrysophyceae). Mikroalgler güneş ışığını ve inorganik maddeleri (örneğin karbondioksit, su, azot, fosfor) kullanarak farklı organik maddeler (örneğin karbonhidrat, protein, yağ asitleri) üretebilir.*

*A, B1, B2, B6, B12, C, E, folik asit gibi insan sağlığı için önemli vitaminleri içerir. Biyoteknolojik çalışmalarda küf ve mantarların yanı sıra algler de kullanılır. Alglerin bu konuda tercih edilme nedenleriyse; günde ağırlıklarının yaklaşık iki katına çıkartabilmeleri, biyoteknolojik işlemlerden geçirilme kolaylıkları, maliyetlerinin düşük olması, çok sayıda yararlı madde içermeleri ve çevresel faktörlere direnç göstermeleri olarak özetlenebilir.*

*Algler, fotosentetik (fotosentez yapan) ya da heterotrofik (dış beslek) yöntemlerle geliştirilir. Okyanus çevresindeki denizlerde, besin yoğunluğunun düşük olduğu sularda, gün ışığının girebileceği en derin bölgelerde, 100 m yüzey sularına kadar yayılım gösterdiklerinden, onların en pratik endüstriyel üretimi, çok güneş alan göl ve havuzlarda gerçekleştirilir. Algler üzerinde pek çok proje bulunmaktadır. Bunlardan en önemlisi, büyüme hormonlarıyla (oksin, giberellin, sitokinin) ilgili olanıdır. Alglerden elde edilen bu ürünler, bitki gelişimini %23 arttırır.*

*Mikroalglerin hayatta kalması gezegenimizdeki bildiğimiz anlamdaki yaşamın devamı için son derece önemlidir. İnsan da dahil olmak üzere en gelişmiş organizmaların hayatı, iklim döngülerinden beslenme zincirlerine kadar her şeyin temelinde yer alan bu tek hücreli mikroorganizmaya bağlıdır.*

***Anahtar kelimeler:*** *Mikroalg, yaşam, enerji, sucul ekosistem.*

**SUSTAINABLE SOURCE OF LIFE: MICROALGAE**

***Abstract***

*Microalgae are single-celled creatures that live in seas and fresh waters and can perform photosynthesis. Microalgae produce about half of the oxygen in the atmosphere. There are hundreds of thousands of different types of microalgae. The most common types of microalgae are diatoms (Bacillariophyceae), green algae (Chlorophyceae) and golden algae (Chrysophyceae). Microalgae can produce different organic substances (eg carbohydrate, protein, fatty acids) using sunlight and inorganic substances (eg carbon dioxide, water, nitrogen, phosphorus).*

*It contains important vitamins for human health such as A, B1, B2, B6, B12, C, E, folic acid. In addition to molds and fungi, algae are also used in biotechnological studies. The reasons why algae are preferred in this regard; They can be summarized as their ability to double their weight per day, ease of biotechnological processes, low cost, contain a large number of useful substances and resist environmental factors.*

*Algae are developed by photosynthetic (photosynthetic) or heterotrophic (outer food) methods. Since they spread up to 100 m surface waters in the seas around the ocean, in waters with low nutrient density, in the deepest areas where daylight can enter, their most practical industrial production is carried out in lakes and pools with lots of sun. There are many projects on algae. The most important of these is the one related to growth hormones (auxin, gibberellin, cytokinin). These products obtained from algae increase plant growth by 23%.*

*The survival of microalgae is extremely important for the survival of life as we know it on our planet. The life of the most advanced organisms, including humans, depends on this single-celled microorganism, which is at the heart of everything from climate cycles to food chains.*

***Keywords:*** *Microalgae, life, energy, aquatic ecosystem.*

**INTRODUCTION**

Microalgae are single-celled creatures that live in sea and fresh water and can perform photosynthesis. Microalgae produce about half of the oxygen in the atmosphere. There are different types of microalgae. The most common types of microalgae are diatoms (Bacillariophyceae), green algae (Chlorophyceae) and golden algae (Chrysophyceae). Microalgae can produce different organic substances (eg carbohydrate, protein, fatty acids) using sunlight and inorganic substances (eg carbon dioxide, water, nitrogen, phosphorus).

The survival of microalgae is extremely important to the survival of life as we know it on our planet. The life of the most advanced organisms, including humans, depends on this single-celled microorganism, which is at the heart of everything from climate cycles to food chains. Algae are developed using photosynthetic (photosynthetic) or heterotrophic (outer food) methods. Since they spread up to 100 m surface waters in the seas around the ocean, in waters with low nutrient density, in the deepest areas where daylight can enter, their most practical industrial production is carried out in lakes and pools with lots of sun.

Diatoms and other microscopic algae found in the oceans produce two-thirds of the photosynthetic carbon the entire world needs. Micro algae are photosynthetic organisms with very high production potential as energy raw materials. They can be grown in different agro-climatic conditions and can produce many byproducts of commercial value such as oils, extracts, bioactive compounds. They have an important place in future renewable energy scenarios. Algae with high nutritional value are the most important source of macro nutrients, vitamins and trace elements for aquatic living communities. They also provide essential pigments necessary for the development of coloration in fish and other aquatic creatures. They carry chlorophyll-c and contain other pigment substances not found in plants. It is these pigment substances that give special colors to various groups. In breeding facilities, algae culture units are the inevitable and most important step of the system in feeding larvae. The success in these units is reflected in the other links of the established chain (Kuenz et al., 2020).

**GREEN MIRACLES: MICROALGAE**

Today, in commercial microalgae production, *Chlorella, Spirulina* microalgae, which are generally considered as human food and used in medicine and pharmacy, are cultured. *Dunaliella salina* from micro algae has been produced for beta-carotene, for *Hematoccoccus pluvialis* astaxanthin pigment for over 30 years. For these reasons, commercial micro algae production has spread rapidly in the world and various industries have been formed.

In addition, they contain Omega-3 and Omega-6 substances that cannot be produced in the human body and vitamins important for human health. Because of all these properties, they are frequently used in areas such as health, cosmetics and medicine. Micro algae have recently been seen as a natural resource with a new agricultural production potential that is not dependent on the soil. It is used in many areas such as wastewater treatment, heavy metal removal, bio-monitoring material, ecotoxicological tests. Micro algae; They are the source of rich compounds that can be used in biofuels, health supplements, pharmaceuticals and cosmetics. They are also used in wastewater treatment and atmospheric CO2 reduction applications. Microalgae produce a wide variety of bioproducts, including polysaccharides, lipids, pigments, proteins, vitamins, bioactive compounds, and antioxidants. Interest in microalgae as a renewable and sustainable raw material for biofuel production has gradually increased recently. However, photosynthetic microorganisms, including algae, help to biologically remove soil and water pollution and to keep nitrogen in biofertilizers. While algae are sold directly as food and nutritional supplements for commercial purposes, their processed products or extracts are used in the biopharmaceuticals and cosmetics industry (Sirakov et al., 2015).

Algae are widely used in wastewater treatment of basic pollutants such as nitrogen and phosphorus, nutrients, heavy metals, pesticides, organic and inorganic toxins, radioactive substances, which pose a danger to aquatic ecosystems. Especially their ability to collect heavy metals and radioactive materials in the cell put them at the forefront of the biological treatment process. Systems utilizing algal-bacterial relationships for industrial and urban wastewater treatment perform a treatment equivalent to other treatment systems.

In order to use microalgae in food or biofuel production, it is necessary to obtain a large amount of biomass by growing in a suitable nutritious environment. Wastewater rich in inorganic and organic substances are used for feeding microalgae. It is possible to increase the nutritional value of the products by adding biomass rich in basic nutrients such as protein, carbohydrate and vitamins, obtained from dense algae cultures produced in algal waste water treatment pools, into animal feed or foodstuffs.

The idea of using microalgae for nutritional purposes was first put forward after the Second World War. Today, a large number of single-cell microalgae are used in the food industry in the world and many of them are commercially produced. Microalgae; They contain carbohydrates, proteins, essential amino acids, lipids, vitamins and mineral substances that are essential for nutrition. It is an important advantage that microalgae can be grown on land that is not suitable for agriculture. Also, production times and cycles are very short compared to terrestrial plants. Microalgae promise potential for the future of sustainable edible oil production. Compared to the cultivation of oil crops, the fast growth rate of microorganisms and the climate-independent nature of microbial oil production due to the cultivation of them in closed systems are the most important advantages.

Algae produce important pigments such as chlorophyll a, b and c, β-carotene, astaxanthin, phytocyanin, xanthophyll, phytoerythrosine. Some of these pigments are used as colorants in the food industry. With the increasing demand for natural products instead of synthetics in consumers, microalgae are shown as an important source for natural colorants. Β-carotene as a food color; Used for foodstuffs such as margarine, cheese, fruit juices, dairy products. Phycoerythrin and phycocyanin are used as coloring agents especially in acidic beverages and ice cream due to their pinkish-red color. Agar-agar, carrageenan, alginate, which are also named as "gelatin" in the food sector, are obtained from algae and are used in making cake, jam, marmalade and ice cream (Rioux et al., 2015).

Due to the fact that fossil fuels are non-renewable resources and the demand is increasing day by day, the need for renewable energy resources has emerged. Biofuels have emerged as a growing opportunity worldwide as an alternative to fossil fuels. Biofuels such as biodiesel and bioethanol have proven to be excellent alternative fuels. The most important advantages of biofuels produced from biomass are their contribution to renewability, environmental pollution and global warming. Greenhouse gas emissions are mainly caused by the burning of CO2 from fossil fuels. This is the main cause of global warming. Biofuels have 10-45% oxygen and low levels of sulfur emissions, while petroleum-based fuels have high sulfur emissions and lower oxygen levels.

Microalgae are the most promising raw materials for bioenergy production due to their characteristics such as meeting and balancing the increasing demands for biofuel, food, feed and valuable chemical production. Microalgae-based fuels are environmentally friendly, non-toxic and have the potential to stabilize CO2 globally. Many countries in Asia, Europe and America have begun to industrialize towards the production of bioenergy from microalgae biomass. Microalgae are photosynthetic organisms (77g/biomass/m2/day) that have the potential to transform 9-10% of solar energy into biomass. The absence of lignocellulosic materials in the microalgae cell wall facilitates the pretreatment process and reduces the overall production cost (Hannon et al., 2010).

Most microalgae species are suitable for biodiesel production due to their high lipid content of 50-70%. Like plants, microalgae use sunlight to produce oil. However, they use this energy more efficiently than plants. The oil efficiency of many microalgae species is superior to that of the best oil crops. Microalgae contain high energy thanks to fatty acids such as oleic acid and palmitoleic acid, which are more than 80% in their body. Apart from biodiesel, which consists of oils obtained from algae, methane produced as a result of anaerobic degradation of algae biomass and biohydrogen production are prominent. Gasification, pyrolysis and transesterification methods are used to convert microalgae into biodiesel (Huang et al., 2010; Teresa et al., 2010).

**CONCLUSION**

Scarcity of arable land, drought, climate changes, etc. Considering the lack of food worldwide for reasons, the use of terrestrial plants used as foodstuffs for biofuel production creates a contradiction. In the biomass production of microalgae, higher biomass production can be achieved in smaller areas. Since the technology of biofuel production from algae is a new field, improvements are required to make it attractive for investors and consumers. In today's studies; It does not focus on reducing the costs of microalgae cultivation, making the processes economical, and the engine performance and emissions of the biodiesel obtained.

Microalgae are also known as blue-green algae. Lehninger, the scientist who laid the foundations of biochemistry, talks about microalgae in 1975 as follows: “Blue-green algae are believed to be the first microorganisms to be collected on land during evolution. This happened years ago and has been proven. Blue-green algae were the first microorganisms to self-regenerate after the 1883 eruption of Mount Krakatoa completely destroyed life in a large ocean area. '' Based on this, we also observe that their existence on earth dates back thousands of years. If we come to its full definition; Although they are single-celled, they are very small aquatic plants that can perform photosynthesis and can live on land and in the sea because they can do photosynthesis. We cannot call them exactly plants because their size is too small to be plants and they can only be seen under microscopes. In addition to all this, they are responsible for keeping the ocean waters clean. Do not look at their tiny size, they alone have the power to meet 90% of the world's oxygen needs.

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