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Biochemical Characteristics of Single Cell Algae and Creation of Environment for Growing Their Culture

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Abstract. In order to isolate algae from its natural environment, it is necessary to pay attention to its physical and chemical habitat. Physicochemical properties of microalgae can be affected by factors such as growth rate, environmental conditions, and life activity. Microalgae growth and chemical composition are largely controlled by light intensity and quality, temperature, carbon dioxide, pH, day length, and nutrients. This is supplemented with defined amounts of major nutrients (eg nitrogen and phosphorus), micronutrients (eg copper, zinc, cobalt, manganese, molybdenum, iron, selenium) and vitamins (ie B12, thiamin and biotin). . In general, cultivated algae are adapted to very low light intensities and a very wide temperature range.

Key words: Algae, chemical composition, vitamins, nitrogen, phosphorus, temperature range.

Introduction

Biochemical properties of unicellular algae are divided into: blue-green, red, golden, diatom, dinophytic, brown, yellow-green, euglena, green, hara-like, according to their pigment, cell shell composition, reserve nutrients and submicroscopic structure of their cells. More than 41,000 species of algae are known. Algae are found in seas (from the coast to 200 m and deeper), fresh and highly saline water bodies, hot springs, soil, including mountains and steppes. Algae are divided into 2 groups: green algae with chlorophyll (euglenoids, green algae) and yellow-brown algae without chlorophyll and often with chlorophyll (golden, diatom, yellow-green). Different divisions of algae are thought to have originated independently from different single-celled organisms.

The chemical composition of seaweed is different. Green algae are distinguished by the highest protein content - 40-45%, which includes bicarboxylic acids, alanine, alginine, leupin. Green algae contains carbohydrates - 30-35%, lipids - 10%, zinc, copper, iron, cobalt and other elements are abundant in its ash.

Brown algae contain 5-15% protein, 70% carbohydrates, 1-3% lipids. Carbohydrates include sugar mannitol, laminite, polyuronides - alginic and furic acids, fuchcidin, laminarin (algal starch), cellulose ("algulase"), the ratio of protein and non-protein nitrogen is 1:1, iodoamino is abundant. acids in proteins.

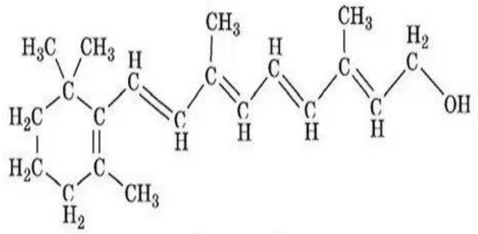
Red algae contain up to 70% carbohydrates: from simple saccharides - phloridzin, from disaccharides - trehalose, sugar alcohols, from polysaccharides, the most valuable mucilaginous sugars - agar. All polysaccharides are part of the cell membrane of algae in the form of sodium, potassium and calcium salts of the corresponding acids. Proteins are about 20%. Ash contains the most sulfides, sodium, potassium, calcium, magnesium, chlorine in smaller amounts.[10]

Analysis results

Algae, especially green ones, have a high nutritional value. Algae contain many vitamins (especially a number of group B), micro and macro elements. Algae have the ability to accumulate unlimited amounts of elements present in the surrounding seawater. Thus, the concentration of magnesium in sea cabbage (Laminaria) is 9-10 times higher than sea water, sulfur - 17 times, bromine - 13 times. One kilogram of kelp contains iodine dissolved in 100,000 liters of sea water. Laboratory studies have shown that it contains the same amount of provitamin A as apples, plums, cherries and oranges. According to the content of vitamin B1, kelp is not inferior to dry yeast. Vitamin C is present in dried kelp from 15 to 240 mg. According to the content of vitamin C, brown algae are not inferior to oranges, pineapples, strawberries, ituzum, green onions.

Seaweed contains a large collection of biologically active substances: various unsaturated fatty acids, chlorophyll derivatives, polysaccharides, fucoidans, glucans, galactins, pectins, alginic acid, plant sterols, carotenoids.

Antihemorrhagic vitamin A was found in algae.



Many algae have antitumor activity (Laminaria, fucus), antimicrobial, antibacterial and antiviral activity.[11] Algae have antimutagenic and radioprotective effects, as well as anti-inflammatory and immunomodulatory effects.

Table 1. Lipid composition and productivity of algae

Sea and fresh water types of herbs	Lipid composition (% dry weight biomass)	Lipid productivity (mg/l/day)	Volumetric productivity biomass (g/l/day)	Productivity of the area biomass (g/m2 /day)
Ankistrodesmus sp.	24.0–31.0	-	-	11.5–17.4
Scenedesmus obliquus	11.0–55.0	-	0.004–0.74	-
Scenedesmus quadricauda	1.9–18.4	35.1	0.19	-
Scenedesmus sp.	19.6–21.1	40.8–53.9	0.03–0.26	2.43–13.52
Chlorococcum sp.	19.3	53.7	53.7	-
Botrycococcus braunii	25.0–75.0	-	0.02	3.0

As shown in Table 1, in microalgae, the oil content of dry biomass can reach 75%, but is associated with low productivity (for example, for Botryococcus braunii). The most common algae (Chlorella, Crypthecodinium, Cylindrotheca, Dunaliella, Isochrysis, Nannochloris, Nannochloropsis, Neochloris, Nitzschia, Phaeodactylum, Porphyridium, Schizochytrium, Tetraselmis) have an oil content of 20 to 50%. but higher productivity can be achieved.

Discussions

The composition of different fatty acids can also have a significant effect on water horses. Of these, saturated and unsaturated fatty acids have 12-22 carbon atoms. [66] analyzed the fatty acid composition of seven freshwater microalgae species, all of them C14:0, C16:0, C18:1, C18:2, and C18:3 fatty acids. A relative of this author reported that the intensities of other individual fatty acid chains are species-specific, such as C16:4 and C18:4 species in Ankistrodesmus sp.

Algae contain forms of saturated and unsaturated fatty acids with 12-22 carbon atoms.

Microalgae are adapted to clean their habitat from various resources. For biomass growth (consisting of 40-50%), microalgae must be provided with carbon and light energy necessary for photosynthesis [14]. Nevertheless, they change their internal structure to changes in the external environment (for example, biochemical and physiological adaptation) and also release various compounds from the outside, thereby limiting the growth of competitors [15].

Conclusion

Microalgae can adopt many types of metabolism (eg, autotroph, heterotroph, mixotroph, photoheterotroph) and have the ability to shift metabolically in response to changes in environmental conditions. For example, some organisms can grow [13] :

- Photoautotroph that is, using light as the only source of energy, converting it into chemical energy as a result of photosynthetic reactions.
- Heterotroph ie. using only organic compounds as a source of carbon and energy.
- Mixotrophs use photosynthesis as their main source of energy, although they also need SO2. Amphitrophy, a subtype of mixotrophy, refers to the ability of organisms to live either autotrophically or heterotrophically, depending on the concentration of organic compounds and the intensity of available light.
- Photoheterotrophy, also known as photoganitrophy, photoassimilation, photometabolism, describes metabolism that requires light to use organic compounds as carbon.

Photoheterotrophic and mixotrophic metabolism are not clearly distinguished, in particular, they can be determined by the difference in the energy source required for growth and the formation of specific metabolites.

The metabolism involved can also be distinguished by changes in pH depending on the growth stoichiometry of the microalgae.

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Chlorella vulgaris, Haematococcus pluvialis, Arthrospira (Spirulina) platensis are examples of strains that grow under photoautotrophic, heterotrophic, and mixotrophic conditions. Other strains, such as Selenastrum capricornutum and Scenedesmus.acutus, can grow photoautotrophically, heterotrophically, or photoheterotrophically [13].

Under suitable climatic conditions and with sufficient nutrients, microalgae can grow actively. They typically double their biomass within 24 hours under favorable conditions or 3.5 hours during the exponential growth phase [16].

There are several factors that affect the growth of algae:

Abiotic - the concentration of factors such as light (quality, quantity), temperature, nutrients, O2, CO2, pH, salinity, and toxic chemicals;

Factors such as biotic pathogens (bacteria, fungi, viruses) and competition with other algae.

Operational factors - operational factors such as cutting, mixing, dilution rate, depth, collection frequency and addition, factors created by bicarbonates.

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