**Culture of green algae *Ulva rigida* C. Ag.: producing germ plants**

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Biological features of growth and high specific production, rich in carbohydrate component, availability of essential macro- and microelements, average calorie content make *Ulva rigida* C. Ag. an attractive target species of marine aquaculture in the Azov-Black Sea area. It allows in the future to consider this species as an accessible resource [1, 2].

In the course of experiments on obtaining and growing ulva germ plants, cultivation modes were worked out: in the first version, the ulva thallus were grown under conditions of increasing salinity from 22 to 29 ‰, in the second, the salinity was maintained in the range of 18–22 ‰. Ulva was cultured in aquariums with constant aeration and water circulation.

The water temperature in all aquariums was the same and, depending on weather conditions, varied from 18 to 22.6 ºС, the average temperature was (20.9 ± 0.2) ºС. Thelight intensity was slightly different − in the first version it varied within 640–4500 lux, in the second − 570–3800 lux. More intense fruiting was observed in the first variant of the experiment, which is probably associated with an increase in light intensity up to 3.5–4.7 thousand lux and salinity up to 26–29 ‰ on certain days.

Under the experimental conditions, the frequency of production of ulva spores was observed, as evidenced by the presence of peaks on the variation curves of the distribution of the length of the longest ray of germ plants and an increase in heterogeneity. According to A.A. Kalugina-Gutnik [3], in the Black Sea, the maturation of zoospores and ulva gametes and their release are associated with the phases of the moon and occur every 12 days in the full moon and new moon, with the destruction and dying off of the fertile part of the thallus lamina.

The abundant number of germ plants was obtained at the end of January, the length of the most developed ray of the germ plants reached 420 μm, the width was 21 μm, the number of rays was recorded from 3 to 8. With further germination of embryos, a single-row filament is well differentiated, consisting of primary adherent cells and rhizoidal cell extensions in the lower region of the filament. The division of cells along the longitudinal axis leads to the development of a tubular monostromatous sprout.

Under the experimental conditions, the formation of creeping filaments was observed, arranged in the form of a disk, from the cells of which one or more vertical single-row filaments grew later.

The filamentous form of ulva ("slender") is also found in nature and is also used in cooking. Some authors believe that the appearance of this form is due to a change in some environmental factors, in particular, the microbiological component [4]. It is believed that macroalgae can create a favorable environment around themselves, forming and controlling the species composition of organisms [5, 6]. For green algae r. Ulva, bacterial effects on morphogenesis were noted [7−9]. Over time, the tubular monostromatous sprout, like slender, can transform into a dystromaticlamina.

Thus, the processes of sporogenesis and gametogenesis in green algae depend on many factors, to a large extent on light intensity, length of daylight hours, salinity and temperature. An increase in salinity above 26 ‰ and illumination exceeding 3–4 thousand lux, intensifies the fruiting of ulva, significantly reducing the growth of the biomass of the sporophyte alga. During the period of active release of spores, the growth of the ulva biomass decreases, the average daily increment is only 0.03−0.04%. The maximum vegetative growth of algae 4.0−4.5% per day is observed during periods of absence of intensive fruiting. Ulva sprouts develop rather quickly and grow well under laboratory conditions, withstanding significant fluctuations in environmental parameters (salinity and light intensity), reaching a marketable size (weight) in 6−8 months of cultivation. By adjusting the environmental conditions, it is quite possible to adjust the intensity of biomass growth and fruiting, obtaining not only a significant increase in algae thalli, but also young lamellar or filamentous forms of ulva from germ plants.

**References**

1. Titlyanov E.A., Titlyanova T.V. Marine plants of Asian-Pacific Region, their use and cultivation. Vladivostok: Dalnauka, 2012. 377 p.
2. Bitutskaya O.E., Bulli L.I., Donchenko L.V. // Rybnoe hozyajstvo. 2020. № 4. P. 94−100.
3. Kalugina-Gutnik A.A. Phytobenthos of the Black Sea. Kiev: Nauk. Dumka. 1975. 247 p.
4. Antica М., Marcenko Е.  // Acta Bot. Croat. 1984**.** №43. P. 43–48.
5. Voskoboinikov G.M. PhD-thesis. Murmansk: MMBI. 2006. 46 p.
6. Pugovkin D.V. PhD-thesis. Murmansk: MMBI. 2016. 146 p.
7. Provasoli L., Pintner I.J. // J. Phycol. 1980. V. 16. P. 196–200.
8. Tujula N.A. PhD-thesis. New South Wales: University of New South Wales. 2006. P. 178.
9. Singh R. P., Reddy C.R.K. // FEMS Microbiol. Ecol. 2014. V. 88. P. 213– 230.