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MODERN TECHNOLOGIES APPLICATION IN WATER BIORESOURCES AND AQUACULTURE

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ПРИМЕНЕНИЕ СОВРЕМЕННЫХ ТЕХНОЛОГИЙ В ОБЛАСТИ ВОДНЫХ БИОРЕСУРСОВ И АКВАКУЛЬТУРЫ

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Abstract. The production and use areas of aquatic plants are investigated in the article. In recent times, the development of fishing and the all-round use of aquatic plants (as food, the purchase of environmentally oil, as fertilizer) is one of the main issues of our day. Macroalgae are the basis of the cultivated sea products. Mainly, brown algae — laminaria, fucus, red algae — *Kappaphycus alvarezii* and *Eucheuma* are widely used for both food and alginate production. Spirulina algae, a representative of blue-green algae living in freshwater basins is one of the most cultivated and widely used algae. The fact that its composition is rich in proteins and vitamins creates the basis for the widespread use of algae. Algae thallome contains 60% protein, amino acids, oils, mineral salts, and fatty acids, which help to strengthen the immune system and eliminate anemia. In addition, biological substances obtained from algae active substances are easily absorbed by the body, it is one of the important substances for the regeneration of liver cells.

Аннотация. В статье исследуются области производства и использования водных растений. В последнее время развитие рыболовства и всемерное использование водных растений является одним из главных вопросов современности. Макроводоросли являются основой культивируемых морепродуктов. В основном бурые водоросли: ламинария, фукус, красные водоросли (*Kappaphycus alvarezii* и *Eucheuma*) широко используются как для пищевых продуктов, так и для производства альгинатов. Водоросль спирулина, представитель сине-зеленых водорослей, обитающих в пресноводных водоемах, является одной из наиболее культивируемых и широко используемых водорослей. Тот факт, что его состав богат белками и витаминами, создает основу для широкого использования водорослей. Слоевище водорослей содержат 60% белка, аминокислоты, масла, минеральные соли и жирные кислоты, которые способствуют укреплению иммунитета и устранению анемии. Кроме того, биологически активные вещества, получаемые из водорослей, легко усваиваются организмом, это одно из важных веществ для регенерации клеток печени.

Keywords: tannins, mannitol, alginates, microalgae, aquaculture.

Ключевые слова: таннины, маннит, альгинаты, микроводоросли, аквакультура.

The production of aquaculture products in the world can be compared to the processing of aquatic bio resources from nature sources. At the same time, the share of algae production is more than 25% of the total volume of aquaculture products, which is close to the level of production of 25 million tons of sea and freshwater algae per year. China accounts for 13.5 million tons of aquaculture products [1, 2].

There are large reserves of seaweed in Russia which has 60.000 km coastline, which is estimated by experts at 15-16 million tons [3]. At the same time, according to bio economic estimates 23,5 billion dollar spent on the extraction and the use of bio resources and 0,5% falls into algae`s share [7, 8].

In order to protect the sustainable acquisition of seaweed, it is necessary to carry out effective monitoring of the state of bio resources and study on the environment of the distribution of natural populations on the coastline of the sea. In this regard, the development and the use of new cultivation technologies for the cultivation of algae with certain biochemical properties and quality to obtain the maximum biomass are required. Because of this, it is necessary to know not only the biology, productivity, development periods and biochemical composition of cultivated species, but also the entire technological cycle of aquaculture, the optimal time for algae extraction, deep processing technology of raw materials.

Recently, there has been a growing demand for HACCP (Hazard Analysis and Critical Control Point) certified natural seafood with biological activity, including feeds used to breed fermented algae, invertebrates and valuable fish species. Over the past half century, aquaculture has grown from a small part of seafood production to an industry comparable to the fishing industry. Currently, more than 187 countries are engaged in the production of seafood using aquaculture technology, where 567 types of water bodies are registered as cultivation facilities. Including 354 types of fish, 102 types of mollusks, 59 types of crustaceans, 6 types of amphibians and reptiles, as well as 37 types of marine and freshwater algae are cultivated. In the last few years (1980-2020), the average annual growth rate in the aquaculture sector in the field of food-fish production has increased from 9-10% to 12% [6].

In 2012, about 88% of the world's aquaculture production was achieved in the Asian region. At the same time, the amount of objects cultivated in fresh water in the world gradually increased from 60% in 1990 to 68-72% in 2020 [11].

The main share of aquaculture products in the world is made up of freshwater fish (33.7 million tons) — which is 56% of the total production. A significantly smaller share is molluscs — 14.2 million tons (24%), crustaceans — 5.7 million tons (10%), marine fish 3.6 million tons (6%) and 1.8 million tons of red algae (3%) holds [8].

Thailand, the Philippines, Japan, and Bangladesh are the world's leading countries in the production of aquaculture products. The People's Republic of China accounts for 61% of world aquaculture production. In Europe, as in other regions of the world, 75% of seafood production is fish, and about a quarter of the total production is mollusks. Seaweeds form the main part of the production of aquatic plants [6].

The productivity of cultivated algae in 2020 was equal to 23.8 million tons (wet, weight) (Table). 60% of fresh water, 30% of sea water, and 10% of salt water are used for the production of aquaculture products.

37 types of algae are grown in 33 countries in the world. Since 2012, most of the red algae have been cultivated. Eg: *Kappaphycus alvarezii* and *Eucheuma* etc. (8.3 million tons wet weight). Laminaria japonica is the most widely cultivated red algae (5.7 thousand tons) laminaria japonica is used both as food and in the production of alginates. In recent years, a large amount of *Gracilaria* — (2.8 million tons) and porphyra-nori (*Porphyra*), (1.8 million tons) — red algae (*Undaria pinnatifida*) (2.1 million tons) have been grown [9].

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Table 1

DISTRIBUTION BY COUNTRY

Countries	*Tons*	*%*
China	36,734215	61
India	4,648815	8
Vietnam	2,671800	4
Indonesia	2,304828	4
Thailand	1,286122	2
Croatia	1,008010	2
Philippine	0,744 695	2
Other countries	7,395281	12

In addition, a small amount of sargassum from brown algae, spirulina from blue-green algae species living in fresh water, etc. are cultivated.

Laminaria takes the main place among macrophytes in marine products, and it is grown in large quantities in China, Japan, and South Korea. In Japan, another type of laminaria, *Undaria pinnatifida*), is one of the most cultivated algae in recent years. Laminaria algae are mainly grown for food purposes, mainly used as a thickener [3].

Brown algae are seaweeds. Brown algae surprise people due to their large size, variety of shapes, and complex structure. Most brown algae live on stones, rocks, or on other algae near the shore. They create underwater jungles in the sea. Brown algae are multicellular organisms based on the structure of the thallus, from single-celled — thread-shaped forms to several meters long. The most complex structures are fucus and laminaria. In the cells of brown algae, chlorophyll a and c chloroplasts are disk-shaped, brown-gold in color. Chlorophylls are hidden due to fucoxanthin pigment belonging to brown algae. Chloroplast is covered by two layers of membrane [2, 4].

Chloroplasts themselves have a very simple structure. The main reserve substance in them is Chrysolaminarin (Laminarin), as well as mannitol (hexagonal alcohol) and oils. Mannitol also regulates the osmotic pressure in the cell. The cell wall is 2-layered: the inner layer is composed of fibril networks, the composition of which is cellulose, and it forms the basis of the structure of the algal cell [9].

The outer layer of the cell wall is composed of a mucous amorphous layer, the composition of which consists of alginates and kalloid [5].

The main goal in obtaining brown algae is to obtain mainly fucocolloids and alginates from kalloid. Spores for breeding are taken from plants bearing sporangia. The ropes are soaked in the solution in which the zoospores are dissolved. There are other methods for planting zoospars. Cultivation is carried out under laboratory conditions or under natural conditions. Ropes with developed spores are placed on sea rigs [9].

In spring, when the sea is free of ice, it is necessary to raise the device on the sea. Planting can be done when the sprouts reach a length of 10-15 cm. Transplantation of laminaria is done in bunches, 3-5 specimens of the same size are planted every 10 cm.

In the 2nd year of planting, collection of laminaria is carried out from the second half of July. By this time, the laminaria reaches the required weight and size. For high productivity, it is recommended to harvest in early autumn, but even if the volume of thallus is large, its quality decreases. After harvesting, the substrate and horizontal ropes are cleaned.

In the littoral zone, fucus grows noticeably on stones and rocks. *Fucus distichus, F. serratus* are large algae, with 1.5 m long cylindrical and plate-shaped branched single and double air sacs. The air bladder ensures the resistance of the algae to the flow of water in a vertical position in the water [10].

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When the algae come ashore in the littoral zone of the water, some small samples are taken of the *Fucus vesiculosus* algae. The collected algae samples are grouped according to the age of the plant. The weight unit of the material belonging to each group is drawn up in a table and the weight unit of the material belonging to each group is recorded. First the wet and then the dry weight of the selected plant samples is measured. After drying the macroalgae collected from the littoral zone with filter paper, we number the plants. We wrap the samples in filter paper and place them in the drying cabinet. We store the prepared material in a drying cabinet at a temperature of 70-80 °C for one day. We keep the sample in the drying cabinet depending on the size of the material we are working with and compare the wet and dry weight of the samples (Table 2).

Table 2

DATA ON THE WEIGHT OF ALGAE THALLI

An example	*1 year before drying (wet)*	*1 year after drying*
№1	24	13,4
№2	19	8,7
№3	32	16

In the upper layer of the sublittoral zone, the solid soil is dominated by one-year plates of laminaria. They are *Laminaria saccharina* (L.) J. V. Lamour., *L. digitata* (Huds.) J. V. Lamour., *L. hyperborea* (Gunnerus) Foslie, *Alaria esculenta* (L.) Grev. Cultivation of laminaria is done on ropes in a marine plantation. *Laminaria* is cultivated with spores and stalks.

Conclusion

Laminaria *Fucus* algae cultivation method and procedure, *Fucus* algae age and dichotomous branching can be used to determine the age of the plant.

Using the method of drying algae, we can buy algae biomass and use it in laboratory lessons of aquaculture.

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