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CULTIVATION OF *ROTIFERS BRACHIONUS PLICATILIS*

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Fish farming is one of the sectors of the national economy that provides the population with high-protein food. The cultivation of valuable fish species allows us to expand the range of products, increase production volumes, and increase the profitability of fish farming organizations. In artificial fish farming, one of the main challenges is to produce viable juveniles. Growing juveniles during the transition to exogenous nutrition is one of the most problematic stages of the technological cycle of commercial fish farming. In order to obtain full-fledged juveniles for the purpose of accelerated rearing of commercial fish.

In the conditions of specialized fish farms, fish farming is closely related to its feeding, the purpose of which is to obtain the maximum number of high-quality products in the shortest possible time with minimal feed costs. At the same time, the commercial aspect becomes dominant, where profit is the decisive factor. Therefore, in fish feeding, there is a constant search for ways to reduce the cost of feed and increase its productivity, which is gradually but rather difficult to achieve due to the obvious contradiction between these tasks.

The effectiveness of the chosen fish feeding methods directly affects the performance of the fishing industry as a whole.

The purpose of the study was to analyze the ecological and physiological aspects of the cultivation of live feed and starter feed for fish larvae.

The main problem for fish farming is the production of live feed. Mass cultivation of live food as starter food for fish larvae is a rather complicated technological process based on detailed knowledge of the biological characteristics of the objects being bred and their relationship to environmental factors. With a short digestive tract, the ability of larvae to grow rapidly is due to their adaptation to high-protein, easily digestible animal food, i.e. small zooplankton.

The problem of obtaining live feed for rearing juvenile fish in artificial conditions is one of the central issues in industrial fish farming.

Keywords: aquaculture, rotifers, live food, rotifer cultivation, feeding, starter feeds.

Statement of the problem. The problem of fodder is one of the most important problems of marine aquaculture. When growing aquatic animals in artificial conditions, the feed used must fully satisfy the needs of the body of fish or invertebrates in nutrients (proteins, fats and carbohydrates), mineral salts, trace elements and vitamins. At different stages of development of aquatic organisms, food must be of the appropriate size and shape [1].

The issue of feeding fish fry and small invertebrates is particularly acute in aquaristics. For example, corals that do not have symbiotic zooxanthellae algae must be fed from outside, and since aquariums usually have a small number of zooplankton, then, in the absence of additional food, they are in a depressed state to maintain a normal, healthy state of the coral, it must be fed artificially at least once a week [2, 3].

Another problem is the rearing of fry, in particular their feeding. An important stage in the life of many aquatic animals is the transition to independent feeding. It turns out that fish and crustaceans are especially demanding of food at the early stages of ontogenesis. It has been established that live feeds are preferable for normal development and optimal growth of larvae and juveniles of cultivated aquatic organisms. In marine aquaculture, those feed organisms are used that can be grown in the required quantity in artificial conditions [1].

Analysis of remaining research and publications. Rotifera *(Rotatoria)*. Rotifers belong to the phylum *Nemathelminthes* of the class Rotifera.

Brachionus plicatilis is a small rotifer with a size of 0.08-0.3 mm. This is a euryhaline species, found in nature in water bodies with salinity ranging from 1 to 90 %. The rotifer reproduces at temperatures of 15-35 °C (optimally 28+2 °C). The average quantity of 1 million rotifers contains 1.5 g. They live on phytoplankton and bacteria. Males live 2-3 years. Samitsi – up to 2 years. They become mature in 1-1.5 increments. Eggs are important for water. The high value of grub, the lack of vibrancy to the minds of the middle class, the high productivity of reproduction has made this rotator one of the main feeding objects [4].

In water bodies, they lead a mainly planktonic lifestyle and in appearance resemble the larva of worms or mollusks – a trochophore. The body of rotifers is transparent, some are covered with a shell, divided into a head, body, and legs. The front part of the head has the form of a disk, the edges of which are surrounded by a corolla of cilia. The disk covers the upper part of the head and performs the function of movement and food capture. There is also a proboscis, a dorsal projection, and the eyes (ribocerebral) spots are visible through the transparent covers. Rotifers have a developed digestive system, which consists of an oral cavity, a chewing stomach (mastax – has two pairs of jaws – anvil and malleus), an esophagus, a sac-like digestive stomach, intestines and a cloaca, which open laterally in the leg. On the ventral side of the head is the mouth and behind it is a second corolla of somewhat shorter cilia The preoral and postoral corollas form the characteristic rotiferous apparatus, or the so-called “circle” (that is why they are called rotifers). The excretory organs are of the protonephridial type. The posterior ends of both glandular ducts flow into the urinary bladder. The nervous system consists of suprapharyngeal ganglia. The sensory organs are tentacles and setae. There is no respiratory or circulatory system.

The artificial cultivation of aquatic organisms has been around for a long time, since people began not only to catch, but also to breed fish. Humanity growth, resources hang out. Until the beginning of the 1970s, the world's abundance had reached its peak, so that the catch that comes from all corners of the open ocean, in coastal waters, in fresh waters could not be harvested in order to satisfy the protein needs of mankind [5].

The world's practice of aquaculture has accumulated significant evidence growth of various feed organisms – live food can be removed from required quantities and required terms. Lie down to live food organisms that establish a natural food base in water or not, but cultivated in individual fish tanks for the using in fish. Live food - the totality of plants and hydrobionts. Organisms that are treated as objects of cultivation are to blame power with a set of powers that will ensure the ability of the high stage of intensification of production, characterized by full value biochemical warehouse, high calorie content and availability for a specific species of fish at the song stage of its development [6].

Materials and research methods. Brackish-water rotifers are a traditional initial live food for larvae of marine fish and invertebrates in artificial cultivation conditions. According to their size and morphological characteristics, they are suitable for most larvae of marine organisms as a starting live food organism when switching to external feeding (Fig. 1).

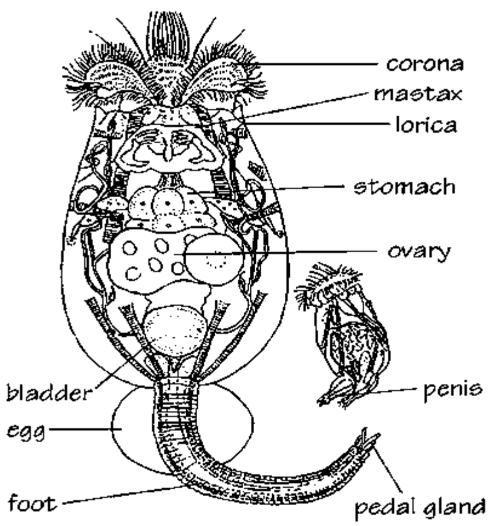

Fig. 1. ***Brachionus Plicatilis***

From a cost perspective, efficient rotifer culture relies on cheap nutrient sources, so baker's yeast has been and remains the main component of nutrient emulsions for their feeding. However, it is well known that yeast-based diets deplete rotifers of essential fatty acids, which are necessary for high growth rates in fish and invertebrates [7]. But many researchers believe that the cultivation of rotifers as food for marine aquatic organisms should be carried out on unicellular microalgae. Unicellular algae meet the requirements for mass cultivation of rotifers in many ways. Unlike yeast, they:

1) are more nutritious, and the rotifers that feed on them correspond in biochemical composition to the needs of marine fish larvae for normal growth and development (Table 1).

2) are in the water column in a mobile state, and do not settle to the bottom like yeast;

3) in this regard, unlike the latter, they do not create favorable conditions for the development of protozoa, which are highly undesirable in the mass cultivation of rotifers, since their toxins negatively affect the growth of the culture, and they themselves are food competitors of rotifers and create an oxygen deficiency;

4) improve the hydrochemical background of the environment, including in their metabolism the waste products of organisms in the form of both inorganic and organic compounds.

Table 1. **Maximum content (% of dry weight) of protein, carbohydrates, lipids in feed microalgae and their total caloric value (kcal/g DM)**

Type of algae	Protein	Carbohydrates	Lipids	Total caloric content
Phaeodactylum tricornutum [15]	40,7	20,8	20,0	4,77
Tetraselmis suecica [15]	40,35	21,33	27,0	4,17
Isochrysis galbana [15]	49,8	28,4	25,6	6,24
Chlorella sp. [7]	40-55	35	5-10	4,15

The following microalgae were used as food objects in experimental studies of rotifers.

The source of monospecific enrichment cultures of these microalgae were microalgae lines grown by the fish cultivation group of the Department of Aquaculture and Marine Pharmacology.

Isochrysis galbana is a golden microalga. The cells are spherical, motile, with two equal flagella [8].

Tetraselmis suecica is a green microalga. The cells are green, oval. The cells are motile with 4 flagella 7.5 μm long. They have a soft shell. They have a high reproduction rate, up to 4 divisions per day [8].

Phaeodactylum tricornutum is a unicellular diatom [8].

Chlorella sp. is a microscopic green alga [9].

The microalgae used in the experiments were grown in a cumulative mode based on sterilized Black Sea water enriched with Waln medium, at a temperature of 23 ± 1.5 ºC. Round-the-clock illumination with an intensity of 900 lux was carried out using FLUORA L18W/77 fluorescent lamps for plants.

Brachionus plicatilis Muller is a brackish-water (salinity range 9-32‰) planktonic rotifer with weak food selectivity, preferring cells 1-15 µm in diameter, feeding on bacteria, yeast, and unicellular algae [10].

Small size, low mobility and tolerance to autoinhibition at high densities determine their technological effectiveness when grown in mass cultures. In artificial cultivation, parthenogenetic clones of the rotifers Brachionus plicatilis are usually used, which consist of diploid females reproducing their own kind, completely identical daughter individuals with a diploid set of chromosomes.

The rotifer culture *Brachionus plicatilis* was added to the exponentially growing microalgae cultures, which are considered to be a higher quality feed.

Determination of the density (number) of algae cells by direct counting in a Goryaev chamber. The contents of the flask with algae were mixed manually, then the algae suspension (aliquot) was taken with a pipette and one drop was applied to the upper and lower parts of the grid of the Goryaev counting chamber. The chamber was then covered with a cover glass, which was ground on the sides until interference rings appeared. Drops of the algae suspension were not applied one after another from one pipette, but by taking the suspension twice into a pipette from the same flask.

After 1-2 minutes of algae cell settling, Goryaev's chamber was placed under the lens of a BIOLAM LOMO binocular microscope with phase contrast KF-4 and the number of algae cells was counted in all 25 large squares of the grid.

The results are being followed. 1. For the cultivation of microalgae, we used an accumulative mode, which allowed us to obtain high numbers of microalgae within 8 days: the initial concentration of algae was 74 • 104, 61.75 • 104, 225.8 × 104, 560 • 104 cells/ml for the microalgae *Tetraselmis suecica, Isochrysis galbana, Phaeodactylum tricornutum* and *Chlorella sp.,* respectively. During the growth of microalgae, there was an increase in cell concentration to the following density, respectively 395.83 • 104, 3818.33 • 104, 3466.67 • 104, 3985 • 104 cells/ml for *Tetraselmis suecica, Isochrysis galbana, Phaeodactylum tricornutum* and *Chlorella sp.* The biomass of *Tetraselmis suecica* increased from 0.036 mg/ml to 0.2 mg/ml, *Isochrysis galbana* – from 0.002 to 0.148 mg/ml, *Phaeodactylum tricornutum* – from 0.026 to 0.391 mg/ml, *Chlorella sp.* – from 0.008 to 0.055 mg/l. That is, all 4 cultures of microalgae *Isochrysis galbana, Chlorella sp., Phaeodactylum tricornutum* and *Tetraselmis suecica* can be used to obtain high-density enrichment cultures.

2. The maximum specific growth rate was demonstrated by the microalgae culture *Isochrysis galbana* – 0.61 days-1.

3. On the 8th day of the experiment, rotifers *Brachionus plicatilis* were added to the container with microalgae cultures in the following quantities:

6 col/ml to the algae *Tetraselmis suecica* and *Sochrysis galbana*, 8,5 col/ml to the algae *Phaeodactylum tricornutum* and *Chlorella*. At the end of the experiment, on the 13th day, the number of rotifers increased to the following values: 345 col/ml in containers with *Tetraselmis suecica, Isochrysis galbana* and *Chlorella sp algae*, 380 col/ml – with *Phaeodactylum tricornutum*. Thus, all microalgae cultures can be used with almost equal success for growing *Brachionus plicatilis* rotifers and obtaining live food for feeding aquatic organisms.

4. The maximum value of the specific growth rate of rotifers was obtained for the microalga *Isochrysis galbana* and amounted to 1.035 day-1. Thus, this microalga is the most preferable for obtaining complete live feed with the least time costs.

Conclusion. Analysis of methods and methods of cultivation of live food showed that the production of live food is based on a direct choice of objects cultivation, comprehensive cultivation of their biological characteristics, infusion of abiotic factors into the growth and development of feed organisms. Cultivation of feed organisms in a specific skin area transfers stagnation various methodical techniques for achieving high productivity. Various workshops will be set up for the production of various types of feed and the installation of cultivators. Let's go ahead and feed the fish with live food – that's the right choice. However, it is necessary to pay attention to various nuances, for example, not to overdo the fish, give up your respect on the size of the stern.

Live food may be more important in the diet of fish, as provide everything necessary for the growth and development of living speech. Parts of the living feed in the diet of fish in a significant world to maintain the growth rate and immunity of fish, development of piece feeds. The main way to ensure the extraction of live food for yearling fish at various stages of their development and individual breeding Hydrobionts.

КУЛЬТИВУВАННЯ КОЛОВЕРТОК *BRACHIONUS PLICATILIS*

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Рибництво є одним із секторів національної економіки, що забезпечує населення високобілковими продуктами харчування. Вирощування цінних видів риб дозволяє розширити асортимент продукції, збільшити обсяги виробництва та підвищити прибутковість рибогосподарських організацій. У штучному рибництві одним із головних завдань є виробництво життєстійкої молоді. Вирощування молоді під час переходу на екзогенне живлення є одним із найпроблемніших етапів технологічного циклу промислового вирощування риб.

В умовах спеціалізованих рибогосподарств рибництво тісно пов'язане з його годівлею, метою якої є отримання максимальної кількості високоякісної продукції в найкоротші терміни з мінімальними витратами кормів. При цьому домінуючим стає комерційний аспект, де вирішальним фактором є прибуток. Тому в годівлі риби постійно ведеться пошук шляхів зниження вартості кормів та підвищення їх продуктивності, чого поступово, але досить важко досягти через очевидну суперечність між цими завданнями.

Ефективність обраних методів годівлі риби безпосередньо впливає на показники рибної галузі в цілому.

Метою дослідження був аналіз екологічних та фізіологічних аспектів вирощування живих кормів та стартових кормів для личинок риб.

Головною проблемою рибництва є отримання живого корму. Масове культивування живого корму, як стартових кормів для личинок риб, – це досить складний технологічний процес, що ґрунтується на детальному знанні біологічних особливостей об'єктів, які розводяться, та їх зв'язку з факторами навколишнього середовища. Завдяки короткому травному тракту здатність личинок до швидкого росту зумовлена їхньою адаптацією до висобілкової, легкозасвоюваної тваринної їжі, тобто дрібного зоопланктону.

Проблема отримання живих кормів для вирощування молоді риб у штучних умовах є однією з центральних у індустріальному рибництві.

Ключові слова: аквакультура, коловертки, живі корма, культивування коловерток, годівля, стартові комбікорма.

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