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EXPERIMENTAL CULTIVATION OF *DAPHNIA MAGNA* IN A SMALL-VOLUME STATIONARY WATER ENVIRONMENT USING A *CHLORELLA*-BASED FEED.

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Abstract. Industrial aquaculture is a rapidly developing sector, and high-quality live feed plays a crucial role in fish cultivation under artificial conditions. In this regard, the zooplankton species *Daphnia magna* is of particular importance due to its high nutritional value, rapid reproduction, and ecological adaptability.

In the conducted study, optimal conditions for the cultivation of daphnia in small-volume (5 L) stagnant water containers were determined: water temperature was maintained at +17 to +21 °C, lighting was provided for 12 hours per day, 30% of the water was renewed every 4 days, and the stocking density was kept at 1000 ind./L. The results demonstrated that feeding with *Chlorella* was the most effective variant, as it reduced water turbidity while increasing daphnia biomass by 18–28% and overall productivity by 26–38%.

Keywords: *Daphnia magna* (*Daphnia magna*), feed organisms, *Chlorella*, live feed cultivation.

Introduction. Zooplankton, which serves as a preferred feed for fish—especially their larvae—is an important component of the natural food base of aquatic ecosystems. *Daphnia magna* has high nutritional value for fish larvae; its dry mass typically contains 50–70% protein and 6–20% lipids [1], resulting in a protein-to-lipid ratio of approximately 3:1 to 5:1. The protein fraction is rich in essential amino acids such as lysine, methionine, and arginine, while the lipid fraction mainly includes omega-3 fatty acids (EPA, and partially DHA) and omega-6 fatty acids (linoleic acid). In particular, EPA is crucial for the development of the nervous system and growth of larvae; however, due to the relatively low DHA content, *Daphnia* is often enriched with other live feeds or microalgae before use [2].

Studies indicate that at the larval stage, natural feeds are more effective than artificial feeds, even expensive starter diets. In particular, replacing fish meal with *Daphnia* in the diet of grass carp (*Ctenopharyngodon idella*) larvae improves feed utilization efficiency and accelerates growth. Research has also shown that under such feeding conditions, the number of digestive cells in fish increases, and these cells perform antibacterial and antiseptic functions within the digestive system [3].

Natural feeds contain high levels of carotenoids, which are essential for fish. A deficiency of these natural antioxidants increases fish susceptibility to infections, water pollution, and oxygen

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deficiency, leading to body discoloration, reduced muscle and roe quality, and decreased survival of juvenile fish [6].

Laboratory experiments have shown that the use of plant straw and cattle manure in the cultivation of two zooplankton species (*Daphnia magna*, *Brachionus calyciflorus*) makes it possible to obtain inexpensive and effective live feed. Under natural conditions, cladocerans feed on phytoplankton, detritus, bacteria, and biofilms; in cases of feed deficiency, enriched feed is introduced into the environment. For this purpose, *Chlorella vulgaris* and *Microcystis aeruginosa* are widely used.

In modern aquaculture, the полноценное feeding of juvenile fish remains a pressing issue, and interest in the use of live feeds alongside artificial diets is increasing. Live feeds are distinguished by their high content of proteins, lipids, essential amino acids, vitamins, and enzymes [8]. In this regard, one of the most widely used zooplankton species is *Daphnia magna*, characterized by high fecundity, rapid growth, and adaptability to environmental factors. However, for efficient cultivation of daphnia, it is necessary to establish an optimal set of conditions tailored to each specific case, taking into account various ecological and technological factors.

At various stages of the cultivation process, several problems may arise. In particular, stagnant water conditions (regardless of the type of feeding) slow down the development of daphnia and reduce overall productivity. This phenomenon is associated with changes in the physicochemical conditions within the system, which can lead to a shift from parthenogenetic to sexual reproduction, resulting in increased egg production and a decrease in the yield of live feed.

Zooplankton density varies depending on environmental factors, including eutrophication caused by excess nutrients, oxidation processes, pollution, salinity, and other internal conditions. Therefore, water quality and feed availability significantly influence the population dynamics of zooplankton, especially in artificial environments.

Under these conditions, there is a need to ensure the stable cultivation of *Daphnia magna* in small-volume stagnant water systems for the purpose of feeding juvenile fish [12]. The main objective of this study is to determine the most optimal feeding regime for daphnia under such conditions.

Materials and Methods. The experimental object was the cladoceran *Daphnia magna* (Straus, 1820), obtained from a mother culture maintained under artificial conditions. During the cultivation of zooplankton, different feeding regimes were tested. For each variant, 5-L glass containers were used, with an initial daphnia density of 1000 ind./L.

The water temperature was maintained at +17 to +21 °C, and artificial lighting was provided for 12 hours per day. Water was renewed every 4 days in the amount of 30% of the initial volume. The duration of the experiment was 14 days.

Hydrochemical parameters were monitored daily. The concentration of free ammonia was controlled and, according to most researchers, should not exceed 0.05 mg/L; in our experiments, it did not exceed 0.03 mg/L in any of the variants. The levels of nitrites and nitrates also did not exceed the maximum permissible concentrations (MPC) and ranged from 0.2–0.4 and 3–5 mg/L, respectively [13].

In the first experimental variant, the daphnia diet consisted of baker's yeast (*Saccharomyces cerevisiae*); in the second, of *Chlorella* (*Chlorella vulgaris*); and in the third variant, of a mixture of these two components. The *Chlorella* suspension used in the experiments was prepared using a specialized technology; it is a unicellular microalga with a size of 6–12 μm. The application of *Chlorella* is significant as it improves the hydrochemical and hydrobiological conditions of the aquatic environment and enriches the feed base in aquaculture; its metabolites also serve as a food source for zooplankton.

The density of the *Chlorella* culture was determined by counting cells under a microscope using a Goryaev chamber. The survival rate of daphnia was assessed on the 7th day and at the

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end of the experiment using a Bogorov chamber with the aid of a binocular magnifier, while their mobility was determined visually based on movement speed.

Table 1.

Experimental design for the cultivation of *Daphnia magna* (Straus, 1820)

Indicators	Experiment 1	Experiment 2	Experiment 3
Feeding frequency	-	Once every 3 days	-
Dose	Yeast – 0.4 g/L	Chlorella – 25 million cells/L	Yeast – 0.20 g/L + Chlorella – 15 million cells/L

Results and Discussion**.** The results of the study showed that by the end of the experiment, the highest values of survival rate, density, and biomass of daphnia were observed in the second variant, where a *Chlorella* suspension was applied (without the addition of yeast) (Table 2). During the experiment, daphnia were distributed almost uniformly across the variants, with the exception of the first variant (where pure yeast was used), in which a difference was observed. In this variant, daphnia exhibited the highest mobility and actively consumed feed; however, they were mainly concentrated at the bottom of the container.

Table 2.

Cultivation performance indicators of *Daphnia magna* (by experimental variants)

Indicators	Experiment 1	Experiment 2	Experiment 3
Distribution (7 days)	At the bottom	Uniformly	Uniformly
Distribution (14 days)	At the bottom	Uniformly	Uniformly
Mobility (7 days)	12	10	9
Mobility (14 days)	11	9	7
Density (7 days, ind./L)	1760	1930	1850
Density (14 days, ind./L)	1290	1790	1450
Survival rate (7 days, %)	85	91	90
Survival rate (14 days, %)	72	90	78
Biomass (7 days, g/L)	0,625	0,676	0,652
Biomass (14 days, g/L)	0,484	0,634	0,532

It is likely that the turbidity caused by yeast interfered with the normal respiration of daphnia under conditions of stagnant water cultivation and the accumulation of metabolic by-products. In addition, the yeast dosage was close to the upper limit recommended by most authors [16]. When feeding with yeast, the boundary between underfeeding and overfeeding is extremely narrow. Underfeeding negatively affects growth, whereas overfeeding leads to intoxication of zooplankton, which are highly sensitive to biogenic substances in the water [15].

CONCLUSION

Based on the conducted research, it can be concluded that under controlled cultivation conditions of *Daphnia magna*, the most optimal feeding strategy is the use of a diet consisting solely of yeast. This approach reduces water turbidity and increases the survival rate of daphnia

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by 18–28%, while the yield of feed organisms is 26–38% higher compared to other experimental variants.

LIST OF REFERENCES

1. Abo-Taleb H.A., Ashour M., Elokaby M.A., Mabrouk M.M., El-Feky M.M.M., Abdelzaher O.F., Gaber A., Alsanie W.F., Mansour A.T. Effect of a New Feed *Daphnia magna* (Straus, 1820) as a Fish Meal Substitute on Growth, Feed Utilization, Histological Status, and Economic Revenue of Grey Mullet, *Mugil cephalus* (Linnaeus, 1758) // Sustainability. – 2021. – Vol. 13. – Art. 7093. – DOI: https://doi.org/10.3390/su13137093.
2. Begum M., Noor P., Ahmed K.N., Mohanta L.C., Sultana N., Hasan M.R., Uddin M.N. Assessment of Four Different Media for the Mass Culture of *Ceriodaphnia reticulata* (Jurine) as a Live Fish Feed // Journal of the Asiatic Society of Bangladesh. Science. – 2013. – Vol. 39, № 2. – P. 129–138.
3. Богданов Н.И., Асанов А.Ю. Прудовое рыбоводство: учебное пособие. – 3-е изд., доп. – Пенза, 2011. – 89 с.
4. Din W.M.U.D., Altaff K. Culture of Zooplankton for Rearing Fish Larvae // Pollution Research. – 2010. – Vol. 29, № 2. – P. 91–93.
5. Ивлева И.В. Биологические основы и методы массового культивирования кормовых беспозвоночных: монография. – М.: Наука, 1969. – 171 с.
6. Калайда М.Л. Биологические основы рыбоводства: учебное пособие. – Казань: Казанский государственный энергетический университет, 2017. – 148 с.
7. Камилов Б.Г., Юлдашов М.А. Аквакультура: учебник. – Ташкент: Lesson Press, 2020. – 412 с.
8. Kar S., Das P., Das U., Bimola M., Kar D., Aditya G. Culture of Zooplankton as Fish Food: Observations on Three Freshwater Species from Assam, India // AACL Bioflux. – 2017. – Vol. 10, № 5. – P. 1210–1220.
9. Кожокару Т.Т., Ульянов В.Н., Дерменжи П. К вопросу направленного формирования естественной кормовой базы выростных прудов // Рыбоводство и рыбное хозяйство. – 2012. – № 3. – С. 59–63.
10. Митишев А.В., Преснякова Е.В., Семёнова Е.Ф., Гурина М.А. Сравнительный анализ штаммов продуцента и инновационного продукта как основных элементов биотехнологии резиноида хлореллы // Известия высших учебных заведений. Поволжский регион. Естественные науки. – 2014. – № 4 (8). – С. 19–28.
11. Rahman H., Azani N., Suhaimi H., Yatim S.R., Yuslan A., Rasdi N.W. A Review on Different Zooplankton Culturing Techniques and Common Problems Associated with Declining Density // IOP Conference Series: Earth and Environmental Science. – 2023. – Vol. 1147, № 1. – Art. 012012. – DOI: https://doi.org/10.1088/1755-1315/1147/1/012012.
12. Руткин Н.М., Лагуткина Л.Ю., Лагуткин О.Ю. Урбанизированное агропроизводство (сити-фермерство) как перспективное направление развития мирового агропроизводства и способ повышения продовольственной безопасности городов // Вестник Астраханского государственного технического университета. Серия: Рыбное хозяйство. – 2017. – № 4. – С. 95–103.
13. Rottmann R.W., Graves J.S., Yanong R.P.E. Culture Techniques of *Moina*: The Ideal Daphnia for Feeding to Freshwater Fish Fry // Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida. – 1992. – P. 1–6.
14. Фролова М.В., Московец М.В., Птицына Л.А., Торопов А.Ю. Особенности влияния штамма *Chlorella vulgaris* ИФР № С-111 на качество воды в прудовом рыбоводстве // Орошаемое земледелие. – 2019. – № 3. – С. 46–49.