номічного прибутку для проведення відповідних природоохоронних заходів на території заповідника.

З метою залучення більшої кількості вітчизняних і зарубіжних туристів необхідно поліпшення якості інфраструктури; підвищення пропагандистської, рекламної діяльності; підвищення професійного рівня екскурсоводів.

СПИСОК ВИКОРИСТАНОЇ ЛІТЕРАТУРИ:
1. Підгайний М.М. Інформаційна довідка: Природно-заповідний фонд міста Херсона. Історія формування та перспективи розвитку. Херсон, 2003. 6 с.
2. Методичні рекомендації щодо визначення максимального рекреаційного навантаження на природні комплекси та об'єкти у межах природно-заповідного фонду України за зонально-регіональним розподілом / С.С. Комарчук, В.П. Шлапак, Л.П. Яременко та інші. Київ, 2003. 51 с.

THE INFLUENCE OF IMMUNOSTIMULATORS ON THE SURVIVAL OF BREEDERS OF HERBIVOROUS FISH

Olifirenko V.V. – Candidate of Veterinary Medicine, Associate Professor at the Department of Ecology and Sustainable Development named after Professor Yu.V. Pilipenko, Kherson State Agrarian and Economic University

Kornienko V.O. – Candidate of Agricultural Sciences, Associate Professor at the Department of Aquatic Bioresources and Aquaculture, Kherson State Agrarian and Economic University

Kozichar M.V. – Candidate of Agricultural Sciences, Head of the Department of Earth Sciences and Chemistry, Kherson State Agrarian and Economic University

The growth of the world's population poses a number of challenges to fish industry professionals to provide people with a sufficient amount of quality, primarily protein products. Ukraine has a sufficient resource of reservoirs and has potential opportunities for the construction and development of a powerful fisheries complex. This makes it necessary to find ways, first and foremost, to restore inland fishing and increase the productivity of fisheries. One of the ways to solve this problem is to organize a large-scale introduction of valuable fish species into natural and transformed reservoirs. The latter should be based on the annual supply of a sufficient amount of quality and viable young fish. This is not possible without the presence on specialized farms of their own replacement and broodstock population, able to ensure effective artificial reproduction of fish. Under this problem, the main result of effective fish farming is the preservation of offspring, their quality and the ability to quickly restore reproductive potential after technological work. One way to overcome this problem may be the use of immunostimulants, which became the basis of our research.

The main purpose of the study was to improve the methods of preserving the offspring of herbivorous fish after factory reproduction, associated with the use of immunostimulants on farms in southern Ukraine. The place of special research was the incubation shop and summer stock ponds of the State Institution of the Novokakhovka fish factory. The research material
was the broodstock of white silver carp grown on the farm. Data are presented as mean values and standard error (x ± SE). Statistical analysis was performed by means of analysis of variance (one-way ANOVA). The research used commonly used methods in fish farming.

The analysis allows us to conclude on the feasibility of treatment of fetuses with the drug as an antimicrobial and stimulant. The use of the experimental immunostimulant Anfluron 2 IU significantly increases the resistance of silver carp breeders after operations on artificial reproduction in the factory. Females of white silver carp injected with immunostimulants showed higher growth and survival throughout the observation period.

Key words: immunostimulant, fish, silver carp, reproduction, resistance, survival, broodstock.

Formulation of the problem. The current state of aquatic bioresources in inland waters in recent years should be described as tense – due to the threat of extinction of certain species and populations, due to irrational fishing and pollution of the aquatic environment, reducing the efficiency of natural reproduction. Against the background of a sharp decline in the effectiveness of fishing within the inland waters, Ukraine is making significant efforts to meet the Sustainable Development Goals of the planet, both in the direction of preventing hunger and conserving aquatic living resources [1]. This situation makes it necessary to find ways, first of all, related to the restoration of fish catches in inland waters and the provision of affordable fish products to the population. There are hopes for the preservation and replenishment of biological resources associated with the artificial breeding of herbivorous fish, which allows to maintain industrial stocks and increase the production of marketable aquaculture products under regulated conditions. The progressiveness and importance of this area is repeatedly emphasized in the publications of a number of authors.
The real large-scale introduction of herbivorous fish into the Dnieper-Bug estuary was started in 1974, and representatives of the Far Eastern ichthyofauna – white and variegated silver carp, grass carp – were chosen as priority introducers. The basis for this was the fact that the lower reaches of the Dnieper and Southern Bug, as well as the Dnieper-Bug estuary have significant forage resources, which representatives of aboriginal ichthyofauna practically do not use and the introduction into the reservoirs of the Dnieper-Bug estuary. increasing fish productivity in these areas [5; 6]. At the same time, given the biology of reproduction of herbivorous fish, the creation of their powerful industrial herd is impossible without their artificial reproduction and cultivation and subsequent introduction of planting material into reservoirs of different origin and purpose. At the same time, the systematic growth of industrial stocks is largely constrained by the lack of sufficient planting material, the production of which is quite difficult even in the presence of the required number of broodstock. Despite all the apparent study of various aspects of assessing the quality of offspring in fishery science has not yet conducted a comprehensive study, which would be analyzed on a single methodological basis, the triad “quality of producers – quality of sexual products – quality of youth” [7].

In this aspect, there are several important problems, one of which is the need to preserve the offspring during the production operations of artificial reproduction against the background of a possible improvement in the quality of sexual products. One of the ways to overcome this problem may be the use of immunostimulants, which became the basis of our research.

**Analysis of recent research and publications.** A series of recent studies allows us to talk about the important role of the quality of broodstock and obtained sexual products to obtain high-quality viable planting material for introduction into natural and artificial reservoirs [8; 9; 10].

Traditional methods of breeding and evaluation of mature fish on the basis of external features do not fully reflect the qualitative characteristics of broodstock in the conditions of artificial reproduction, as they are weakly related to fish hatching and subsequent embryonic development [3; 7; 9]. Selection work in combination with the assessment of the quality of broodstock in the chain of functional relationships “metabolism of mature fish – fertility – quality of sexual products – viability of young people” can be one of the ways to increase the efficiency of artificial breeding [7; 9; 11].

Improving existing biotechnologies of artificial reproduction involves finding ways to improve the efficiency of work with mature fish. These pathways are based on the achievements of fisheries science, including scientifically sound methods of preserving broodstock and their reproductive potential during factory reproduction [7; 12]. From a practical point of view, there is no single approach to assessing the quality of offspring and methods of their preservation during factory reproduction. One way to overcome this situation may be the use of immunostimulants to increase the level of resistance of the offspring.

Immunostimulants are substances that stimulate non-specific resistance of the organism (NRO) and immunity (humoral and cellular immune responses). In the literature, the term “immunomodulatory” is often used as a synonym for the term “immunostimulant”.

The most common use of immunostimulants in fish farming is mainly associated with feeding fish to alleviate infectious diseases or increase growth rates [13; 14; 15; 16].
Problems of increasing productivity and survival in the cultivation of fish of different ages are also called various kinds of feed additives that increase the body's resistance. There are methods of introducing into the main diet of biennials carp saponite, analcym and bentonite [17], inactivated baker's yeast to the diet of young Russian sturgeon [18], bentonite clays in the cultivation of marketable fish [19], studied the effect of selenium on the metabolism of selenotoid and selenoprote of aquaculture [20].

At the same time, there are almost no data on the use of immunostimulants to improve fish performance in artificial reproduction operations, which are characterized by high trauma to the offspring against the background of a significant deterioration of their physiological condition. The use of modern highly effective drugs to preserve broodstock can make a significant contribution to improving the biotechnology of artificial fish farming.

**Setting objectives.** The purpose and objectives of the study were to improve methods for preserving the offspring of herbivorous fish after factory reproduction, associated with the use of immunostimulants in farms in southern Ukraine. The experimental part was aimed at studying the effect of the drug with a typical immunostimulant of recombinant interferon. In our studies, we used the drug recombinant human interferon Anfluron. This drug is the first and only recombinant interferon created in Ukraine from scratch, from the stage of scientific development, after the stage of long-term research.

Interferons (IFNs) are a group of biologically active proteins or glycoproteins synthesized by cells in the process of protective reaction to foreign agents – viral infection, antigenic or mitogenic effects.

IFN of different species of animals, despite minor interspecific differences in amino acid composition, work effectively in the bodies of heterogeneous animals. When IFN comes into contact with various cells of the body, the latter become immune to almost all known viruses and many toxins of protein and other nature. IFNs, in contrast to immunostimulants (inducers of IFNs), are powerful modulators of the immune system. α-IFN is produced by lymphoid cells in response to foreign agents – viruses, bacteria or neoplastic agents. Activates almost all cells of the immune system, promotes the production of antibodies. Modulates B-cell immunity. γ-IFN is produced by activated T lymphocytes. Activates cells of the immune system, especially macrophages (increases activity by 1000 times). Modulates T-cell immunity. Antiviral activity is lower than in α-IFN.

The place of special research was the incubation shop and summer uterine ponds of the State Institution of the Novokakhovka fish factory of partial fish. The research material was the broodstock of white silver carp grown in the farm. The research was guided by the principles of bioethics. The studies were carried out in accordance with the European Convention for the Protection of Vertebrate Animals used for Experimental and other Scientific Purposes ETS No. 123 and approved by the Science Council of the Kherson State Agrarian and Economic University.

Experimental and control groups of 28 individuals were formed to conduct an experiment to study the effect of immunostimulants on the quality of broodstock. The formation of the study groups and the calculation was performed on the principle of groups of analogues [21; 22]. As an experimental immunostimulant we used Anfluron 2 IU, in vials with a capacity of 10 ml. It was a sterile isotonic (0.15 NaCl, 0.1 Na, K-phosphates pH 7.2-7.4) aqueous solution of recombinant a- and γ-interferons – analogs of human a-2a- and γ-interferons, total protein <15 mcg/ml.

The drug was administered according to the current method, intramuscularly, once, immediately after the selection of sexual products. The injection was made into the dor-
sal muscles at an angle of 45° at the anterior edge of the dorsal fin. The injection site was treated with 75% ethyl alcohol.

After injection, the offspring of the experimental group were placed in a summer-uterine pond with an area of 0.9 ha. A control group was landed in a similar pond. The final control of the survival of the experimental material was performed during the unloading of summer uterine ponds by the method of direct accounting [21; 22]. Morphological studies of offspring were performed according to commonly used methods with the definition of the main indices of physique [22].

Data are presented as mean values and standard error (x ± SE). Statistical analysis was performed by means of analysis of variance (one-way ANOVA). A value of P <0.05 was considered statistically significant. Analysis of the variance of the influence of technological and environmental factors on the growth of larvae was carried out using the MANOVA.

**Presentation of the main research material.** Given the pharmacodynamics of the drug, its effect on fish, according to our research and material sources, the effect of recombinant interferon can be divided into 2 phases: the first is a strong bacteriostatic and bactericidal effect on all known groups of bacteria, fungal diseases and even viruses. acts as an antibacterial and anti-inflammatory agent, this action lasts for at least eight days.

It is at this time that the fish's body has the least resistance and is able to be exposed to both pathogenic microflora and secondary microorganisms. Even inflammations that occur naturally after receiving sexual products in the internal organs, muscles, due to the introduction of pituitary drugs and on superficial formations, as a result of trauma during catching and manipulation during the spawning campaign often lead to various pathological processes in the body of broodstock. Due to the physiological state of the above processes have a very negative effect on the survival of the offspring of herbivorous fish, mainly causing their death.

The second phase of the drug is due to the peculiarities of the main active substance. In terms of pharmaceutical properties, it has a stimulating and immunoprotective effect. These properties are extremely necessary at the post-spawning maintenance of broodstock. If during the first phase the preservation of offspring is determined by the prevention of infectious diseases and post-spawning complications of infectious ethology, then in the second phase it is desirable to stimulate the immunostimulant as the main component of the drug. This effect is manifested in the stimulation of immunity, resulting in increased resistance of the body of the offspring, stimulates the processes of digestion, respiration and, importantly, tissue regeneration.

In experimental studies of the quality of the immunostimulant, we used Anfuron 2 IU, which was injected into the muscular part of the body of the offspring before landing them for feeding. As our research has shown, due to the stimulating effect of the immunostimulant, the period of physiological rehabilitation after receiving sexual products is reduced. The stimulating effect of the drug allows fetuses to start feeding at an earlier date, which has a positive effect on the growth of fish and the development of their gonads. All this can be easily traced when comparing the linear-weight indicators of the offspring of the experimental and control groups obtained during the autumn inventory restock.

As a result, the final weight of the offspring of the experimental group exceeded the similar rate of fish in the control group by 5.4–10.0%, which averaged about 7.7%. A slightly smaller difference was observed in the linear indicators – 1.9–5.1% (Table 1).
Table 1

| Indicators          | x ± SE | σ | x ± SE | σ | M_diff  |
|---------------------|--------|---|--------|---|---------|
|                     | experiment | control | experiment | control |         |
| Weight, kg          | 5.92±1.41 | 5.46±1.86 | 1.79 | 1.87 | 0.22    |
| Full length L, см   | 79.91±3.60 | 79.45±2.54 | 7.05 | 7.82 | 0.13    |
| Short length l, см  | 66.17±6.55 | 65.97±11.43 | 7.21 | 7.31 | 0.02    |
| Body height Н, см   | 22.83±0.70 | 19.89±1.68 | 3.39 | 3.02 | 1.65    |
| Body girth О, см    | 41.28±2.40 | 40.19±4.37 | 6.35 | 6.27 | 0.22    |
| Index I/Н           | 34.50±0.99 | 30.15±1.07 | 2.25 | 2.02 | 3.68    |
| Index I/O           | 62.38±0.15 | 60.92±0.23 | 2.09 | 2.01 | 5.32    |

The most strikingly stimulating effect of the drug was manifested when comparing the physique indices of the broodstock involved in the experiment. According to the indicators of high-back and body girth index, the broodstock of the experimental group exceeded the similar indicator of fish of the control group by 12.6 and 2.3%, respectively. There was a significant mathematical difference between these indicators, the coefficient of differentiation of the series ranged from 3.68 to 5.32.

The antimicrobial and stimulating effect of the drug was also reflected in the survival rates of offspring, as shown in table 2.

Table 2

| Groups of females | Mortality in the first three days after spawning | Mortality during the period of summer detention | Mortality in total during the observation period |
|-------------------|-----------------------------------------------|-----------------------------------------------|-----------------------------------------------|
|                   | copy | %       | copy | %       | copy | %       |
| experiment        | 5    | 17,2    | 1    | 3,4     | 6    | 20,6    |
| control           | 8    | 27,5    | 8    | 27,5    | 16   | 55,0    |

Already in the first three days, the mortality of the offspring of the experimental group decreased by 12% compared with the norm. At the same time, the offspring of the control group showed almost regulatory death rate. This trend persisted during the summer season. It is during the summer maintenance and feeding of broodstock that all the negative consequences related to the quality of broodstock and the level of their resistance are manifested. The overall survival of the offspring of the experimental group for the entire observation period reached 79%. At the same time, the mortality of fish in the control group exceeded 55%.

Conclusions. The conducted analysis allows to draw a conclusion about the expediency of treatment of ovaries with the drug as a promicrobial and stimulant. The use of the experimental immunostimulant Anfluron 2 IU significantly increases the resistance of silver carp breeders after operations on artificial reproduction in the factory. Females of white silver carp injected with immunostimulants showed higher growth and survival throughout the observation period. The treatment itself easily fits into the technology of factory reproduction of herbivorous fish and can be offered for introduction into the technological scheme of artificial reproduction.
REFERENCES:

1. Цілі Сталого Розвитку: Україна : національна доповідь / за координацією Н. Горшкової ; Міністерство економічного розвитку і торгівлі України, 2017. 176 с. URL: http://www.un.org.ua/images/SDGs_NationalReportUA_Web_1.pdf (дата звернення: 05.04.2021).

2. Пилипенко Ю.В. Оценка производителей белого толстолобика выращенных в различных условиях. Проблемы воспроизводства растительноядных рыб, их роль в аквакультуре : материалы Международной науч. практ. конф. Аллер. 2003. С. 37–38.

3. Виноградов В.К., Вергин Б.Ф., Ерохина Л.В. Руководство по биотехнике разведения и выращивания дальневосточных растительноядных рыб. Москва : ООО «ИП Комплекс», 2000. 211 с.

4. Грициняк І.Б., Третяк О.М. Приоритетні напрямки наукового забезпечення рибного господарства України. Рибосподарська наука України. Київ : ИРГ НААНУ, 2014. № 1. С. 5–20.

5. Екологічні передумови раціонального ведення рибного господарства Дніпровсько-Бузької естуарної області / Ю.В. Пилипенко, В.В. Оліфіренко, В.О. Корнієнко, В.С. Поліщуцький. Херсон : Гринь Д.С., 2013. 190 с.

6. Рибальство та рибництво трансформованих річкових систем півдня України : наукова монографія / І.М. Шерман, К.М. Гейна, М.С. Козій, П.С. Кутіцев, Ю.М. Воліченко. Херсон : Вид-во Гринь Д.С., 2016. 308 с.

7. Шерман І.М., Світченко М.Ю. Теоретичні основи рибництва: підр. К. Київ :Фітосоціоцент, 2011. 484 с.

8. Еколого-технологічні основи відтворення і вирощування молоді осетроподібних / І.М. Шерман, В.Ю. Щевченко, В.О. Корнієнко, О.В. Ігнатов. Херсон : Олді-Плюс, 2009. 348 с.

9. Екологія та технологія вирощування посадкового матеріалу коропових в умовах Півдня України : наукова монографія / І.М. Шерман, Г.А. Данильчук, С.О. Незнамов та інші. Херсон : Гринь Д.С., 2014. 228 с.

10. Дмітрієв Є.В., Саркісян В.І, Рекрут С.В. Шляхи удосконалення технології формування племінного матеріалу рослиноїдних риб в умовах ставів півдня України. Таврійський науковий вісник. 2007. Вип. 46. С. 105–111.

11. Шерман І.М., Гринєвський М.В, Грициняк І.І. Розведення та селекція риб. Київ : БМТ, 1999. 336 с.

12. Коваленко В.О., Шумова В.М., Поплавська О.С. Удосконалення технології відтворення об'єктів рибництва (на прикладі стерляді і білого толстолоба). Матеріали наук.-практ. семінару на виставці «FishExpo-2015» в рамках Міжнародної виставки-ярмарки «Агро2015» / 5 червня 2015 р., м. Київ. Київ : НТУУ «КПІ», 2015. С. 82–89.

13. Dawood M.A.O., Koshio S., Esteban M.Á. Beneficial roles of feed additives as immunostimulants in aquaculture: a review. Reviews in Aquaculture. 2018. Volume 10, Issue 4. P. 950–974. URL: https://doi.org/10.1111/raq.12209/ (дата звернення: 05.04.2021).

14. Mehana1 E.E., Rahmani M.Á, Esteban M.Á. Beneficial roles of feed additives as immunostimulants in aquaculture: a review. Reviews in Aquaculture. 2018. Volume 10, Issue 4. P. 950–974. URL: https://doi.org/10.1111/raq.12209/ (дата звернення: 05.04.2021).

15. Doan H.V., Hoseinifar S.H., Khanongnuch Ch., Kanpiengjai A., Unban K., Kim V.V., Srichaiyo S. (2018). Host-associated probiotics boosted mucosal and serum immunity, disease resistance and growth performance of Nile tilapia (Oreochromis niloticus). Aquaculture. 2018. Volume 491. P. 94–100. URL: https://doi.org/10.1016/j.aquaculture.2018.03.019 (дата звернення: 05.04.2021).

16. Chiang C.C.Y., Daud H.M., Yusoff F.M., Abdullah M. (2018). Immunity, feed, and husbandry in fish health management of cultured Epinephelus uscooguttatus with reference to Epinephelus coioides. Aquaculture and Fisheries. 2018. Volume 3.
УДК 504.054
DOI https://doi.org/10.32851/2226-0099.2021.119.35

НАУКОВЕ ОБҐРУНТУВАННЯ БІОРЕМЕДІАЦІЇ ЗАБРУДНЕНИХ НЕСАНКЦІОНОВАНИМИ ЗВАЛИЩАМИ ВІДХОДІВ ЗЕМЕЛЬ

Писаренко П.В. – д.с.-г.н., професор кафедри екології, збалансованого природокористування та захисту довкілля,
Полтавська державна аграрна академія

Самойлік М.С. – д.н., професор кафедри екології, збалансованого природокористування та захисту довкілля,
Полтавська державна аграрна академія

Тараненко А.О. – к.с.-г.н., доцент кафедри екології, збалансованого природокористування та захисту довкілля,
Полтавська державна аграрна академія

Середа М.С. – аспірант кафедри екології, збалансованого природокористування та захисту довкілля,
Полтавська державна аграрна академія

Проблема поводження з твердими побутовими відходами є надзвичайно актуальною для регіонів України. Звалища відходів займають цінні в сільськогосподарському значені земельні ресурси. Особливу небезпеку створюють несанкціоновані звалища твердих побутових відходів, які забруднюють землі сільськогосподарського призна-