ISSN: 0975-8585

Research Journal of Pharmaceutical, Biological and Chemical Sciences

Morphological And Physiological Indices Of Immune Organs Of Silver Carp-Hybrid In Aquaculture Of Belgorod Region.

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ABSTRACT

Aquaculture is the cultivation, maintenance, cultivation of fish in artificially created conditions or natural habitat. This industry is now becoming very important and contributes to the food supply of the population with quality and safe products. Aquaculture is rapidly expanding its geographical boundaries, and its products are gaining markets and increasing their share in the global fish market. According to the data published in the literature, the annual growth of world aquaculture production exceeds 1 million tons. FAO experts predict that by 2030 its production will exceed the volume of fish caught from natural reservoirs. In Russia, it is possible to develop various areas of fish farming: warm-water, cold-water, freshwater and marine, as natural and climatic conditions allow developing this direction. In Belgorod region now objects of pond fish farming are carp scaly, mirror carp, carp, silver carp, and whiteamur. This article discusses the development of immune-competent organs in the process of ontogenesis. As a result of researches it was established that at commodity silver carp hybrids the most changeable morphophysiological index of bodies of immune system was the index of a spleen in comparison with the index of a liver and the index of gills. Linear-dimensional indicators, the output of the most valuable part of the body – carcass, fatness and index of fleshiness corresponded to the parameters of absolutely healthy fish, effective immunity of fish and favorable habitat.
Keywords: silver carp hybrid, immune organs, morphophysiological indices, immunity, health, productivity.

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ISSN: 0975-8585

INTRODUCTION

In the aquaculture of Belgorod region for the development of the reserve of reservoirs and the cultivation of commercial fish silver carp-hybrid – fast-growing fish is widely used. This type of fish feeds natural food – phyto-and zooplankton, the amount of which is quite enough in the ponds of the region. Silver carp is a high protein (protein content more than 15%) product. Quality of proteins of meat of this fish characterize the irreplaceable and interchangeable amino acids containing in it which total quantity makes, according to different authors, from 16,9 to 17,196 g/100g (including irreplaceable 6.304-6.8 g and interchangeable 10.1-10.892 g/100) [7, 8, 10, 12].

The greatest danger in the cultivation are illness (pseudomonosis, myxobolus etc.), as well as contamination of the environment by toxic substances. The degree of stability of the body of this type of pond fish is determined by the ability of the immune system to effectively remove toxic substances entering the body and destroy pathogens [2, 5, 14, 15]. Therefore, in assessing the physiological state of fish, pathological changes in the organs of the immune system are important, which are an indicator of violations of the "health" of the ecosystem as a whole. They allow determining the level of toxicity of the aquatic environment, to identify cumulative effects and potential danger of toxic substances not only for fish, but also for humans [1, 2,]. The attention is focused on the use of the method of morphophysiological indicators, which allows giving an accurate idea of the functioning of the body, its adaptability to specific conditions of existence, to identify the earliest stages of pathological processes occurring in the body [11, 13, 14].

According to the data published by A.V. Degtyar, O.I. Grigoryeva, R.Yu. Tatarintsev (2016), 45.6% of the area of Belgorod region is environmentally unstable [3]. In this regard, the aim of the research was to study the morphological and physiological indices of immune organs and health of silver carp-hybrid when grown in pond polyculture in the zone of unstable ecological situation and increased anthropogenic load.

The objectives of the research were to determine the natural food base of the reservoir, the body weight of fish and the absolute weight of the immune organs with the calculation of morphophysiological indices, as well as to study macrodiagnostic parameters of organs, the assessment of the physiological state and productivity of silver carp for a general idea of the mechanism of implementation of immunity in relation to growing conditions.

METHODS OF RESEARCH

The object of research was commercial silver carp-hybrids, pond water.

The development of the natural forage base of the reservoir was assessed by biomass of phyto - and zooplankton by methods generally accepted in fish breeding practice. To examine the state of organs of immune system of fish informative indicators and methods, including the total mass of the fish body and absolute organ weights (weighting method), morphological and physiological indexes of organs (calculation method of dividing the organ weight on body weight of fish in grams × 1000) [11, 14], the sensitivity of the individual organs to the changing conditions of environment on the magnitude of "factor" (by dividing the maximum mass of the body at a minimum), color, texture, structure, damage, correctness of the topographic location of organs (microdiagnostics method). The liver, spleen, gills and skin of fish were subjected to research. In assessing the health of fish also the piece size and weight of silver carp of autumn catch, physiological stability, fatness, carcass yield as the most valuable part, and the index of fleshiness were taken into account [10].

RESEARCH RESULTS

In the fisheries development of reservoirs and the study of fish habitat, attention is paid to the state of the natural food supply and to the nutritional spectrum of fish of different species and ages in order to maximize the use of natural food resources. According to our data, the reserves of natural food in the studied pond, where silver carp were grown, reach the maximum biomass in June, due to the increase in the flow of solar energy and warming the water to a temperature of 14-15°C and its further increase, as well as changes in water transparency, the development of green and blue-green algae. In 2014, in June, phytoplankton biomass

in the pond was 5.9 g / m^3, and in 2015 – 5.93 g/m^3. Fluctuations in zooplankton biomass in 2014 ranged from 0.449 to 5.023 g / m^3. The maximum biomass of zooplankton is established by us in July.

Average seasonal biomass of zooplankton fluctuated in 2015 in the range of up to 5,374 0,543 g/m^3. According to the literature, the largest biomass of zoobenthos in the reservoirs of Belgorod region was found in the spring and is approximately equal to 4.6 g/m^3 (Shmakova, 2014).

Seasonal changes in zooplankton biomass scientists explain by the seasonal succession of plankton and desynchronization of the life cycle of zooplankton.

Table 1: Average seasonal changes in phyto-and zooplankton in the pond in 2014 and 2015

Year of study	Pondbio mass, g/m^3	
	Phytoplankton	Zooplankton
2014	4,97 ± 0,65	2,89 ± 1,72
2015	5,1± 0,62	3,7± 1,87

There are no significant changes in phytoplankton and zooplankton biomass by years of study.

The ratio of biomass of these natural feeds in the reservoir varies from year to year and is in 2014 1.72 / 1, in 2015 the ratio is lower– 1.38 / 1.

In the process of growing silver carp changes in behavior, constipation and disease were not noted, as evidenced by the following data.

As a result of studies the changes in the configuration of the body of the silver carp is not installed. It had a characteristic shape and color. Scales are small, firmly attached. The surface of the skin is evenly covered with thick transparent mucus, without damage and the presence of various kinds of cysts and tumors. It is important to note that the skin is located on the border of the external and internal medium of the fish and acts as a factor of nonspecific immunity. Under normal conditions, it is impervious to most bacteria and viruses.

However, when the skin is damaged, the resistance of fish to infection is sharply reduced. Mucus produced by the skin is also a barrier to microbes. The presence and condition of mucus is important in protecting fish from adverse effects due to its high bactericidal activity, the content of a large number of humoral factors of natural resistance: lysozyme, complement, properdine, interferon, non-immune globulins and transferin. Depending on various types of stress, skin mucus, according to the literature, may contain 0.25-3.0 g/l protein, 2-5g/l hemoglobin, 0.1-0.4 mmol/l ketones, as well as carbohydrate complex composition (hexoses, mucopolysaccharides, sialicacids), nucleic acids, red blood cells and leukocytes.

It is known that the adaptation of fish to the environment changes occur at both the organismic and organ and cellular levels. A special role in the adaptation of fish to habitat conditions belongs to the liver [4, 5, 9]. About 80% of the population of liver cells is hepatocytes parenchyma, performing most of its functions. The barrier function of the liver (purification of blood from foreign proteins and poisons caught with food) determines its important role not only in digestion, but also in blood circulation. The liver supplies amino acids and proteins to the working immune system for the synthesis of immunoglobulins, interferon, antibodies, provides the production of biochemical substances necessary for digestion. In conditions of pathology, liver functions are disturbed, and morphological signs of these disorders are often dystrophy.

Monitoring the morphological state of the liver of fish in natural water bodies subjected to anthropogenic impact, it is possible to detect violations of the ecological balance of the pond and to take measures for the prevention of illness and the preservation of the ichthyofauna associated with environmental pollution. As you can see, the weight of the liver is an important morphophysiological indicator.

According to our studies, the weight of the liver in commercial silver carp hybrid with an average body weight of 959.2 g ranged from 14 to 22g (table 2).

ISSN: 0975-8585

Table 2: Morphophysiological parameters of the liver of a silver carp hybrid

Parameters	M ±m	Measurement range, Lim
Absolute weight of liver, g	16,9±3,17	14-22
Index of the liver	17,6±2,4	14,3-20.2
The "factor" value of the liver index	1,41	
The weight of the viscera, g	56,8±7,68	52-72
Liver mass from the mass of the viscera, %	29,79±4,22	25,45-34,9

Its relative mass to the total mass of the viscera was 29.79%. The size of the organ varies greatly depending on the habitat conditions, age, season, lifestyle of fish; feeding regime and physiological state, as well as the degree of filling the gallbladder with bile (we studied the liver together with the gallbladder). The "factor" value for changes in body weight of the studied silver carp is 1.57. Individual fluctuations in the liver index of the studied fish are less significant (the "factor" value is equal to 1.41).

The weight of the spleen varies more intensively than the mass of other internal organs of fish, so this indicator is not used as an interior to characterize the population. The spleen is actively involved in the immune response – its cells recognize foreign antigens for the body and synthesize antibodies – specific protective substances that play an important role in humoral immunity. Antibodies are formed in response to the penetration of foreign organic substances, called antigens. Antigens can be viruses, bacteria, animal parasites, excreted toxins, foreign proteins. Antibodies are specific, i.e., react with the antigens against which they developed. They cause agglutination (gluing), precipitation (settling) of microbes, their lysis (dissolution) or neutralize the released toxins and along with phagocytes are powerful factors of immunity.

In this regard, the spleen rapidly changes volume under the influence of external conditions and the state of the fish [5]. For example, at carp it increases in winter, when due to reduced metabolism the blood flow slows down and it accumulates in the spleen, liver and kidneys, the same is observed in acute diseases.

At silver carp, which we investigated, the relative mass of the immune organ ranged from 0.10-0.21%. The absolute mass of the spleen is small (table 3). The "factor" value of the morphophysiological index of the spleen is lower than for the liver (1.37 vs. 1.41).

Table 3: Morphophysiological parameters of the spleen of the silver carp –hybrid

Parameters	M ± m	Measurement range, Lim
Absolute weight of spleen, g	1,33 ± 0,52	1-2
Index of the spleen	1,37 ± 0,05	1,0-2,1
The "factor" value of the spleen index	2,1	
Spleen mass from the mass of the viscera, %	2,34±0,83	1,75-3,85

In the macro diagnostic study of the liver and spleen, changes in size, consistency, color, blood filling, the presence of hemorrhages, necrosis foci, signs of parasitic diseases were not noted.

Gills are considered to be the body of direct protection with barrier functions [5]. In the conditions of modern pollution of water objects the greatest number of deviations of morphological character is found in gills [6]. This is explained by the fact that gills are involved not only in gas exchange, but also are the main organ of protein catabolism, help fish to exchange water-salt substances [5, 6], provide thermoregulation, which is important for the health and survival of fish. Various toxicants have a reflex and irritating effect on the gills, which in most toxicoses is manifested by detachment and swelling of the respiratory epithelium, hypertrophy and proliferation of mucous and chloride cells, dystrophy of the epithelium. In the macrodiagnostic study, the presence of thickening of the petals, smoothing of the pattern, increasing the volume and laxity of the gills, protrusion from under the gill covers, desquamation of the epithelium and tissue necrosis are determined [6]. When conducting research, we drew attention to the fact that the gill apparatus has at a silver carp and a special device – a plankton grid (Gill sieve), which is collected in a large number of small single celled algae–microscopic food of silver carp. According to the data of Yu.A. Privezentsev, V.A. Vlasov (2007), the species specificity of this

fish food is clearly manifested already at a mass of 3-6g, when the differences in the structure of the filtration apparatus become clear [10].

Separated by "the Gill sieve" microalgae in the oral cavity are compressed in the food clod with the help of special pharyngeal teeth, covered with soft mucosa, and then go to the intestine. The millstone is well developed. Its mass, at studied silver carp averaged 17.17 g or 7.1% of the mass of the head, which characterizes the active feeding of the fish to ensure an intensive exchange of substances, high productivity and effective immunity.

From the data of table 4 it can be seen that the absolute mass of gills ranged from 21 to 26g, gills index – from 21.4 to 26.1. Changes in the "factor" value for the gills index in our case are lower than those for the liver and spleen (1.22 – against 2.1, respectively).

Table 4: Morphophysiological parameters of gills of silver carp

Parameters	M ± m	Measurement range, Lim
Absolute weight of gills, g	22,67±2,07	21-26
Index of the gills	23,7±1,6	21,4-26,1
The "factor" value of the gills index	1,22	
The weight of the head, g	240,8±23,15	217-280
Gills mass from the mass of the head, %	9,45±0,92	8,23-10,43

At macrodiagnostic study of the gills we noted a normal degree of osoznanie, without changing the color and pattern of violation of the integrity of the petals, presence of hemorrhage, overlays, foci of necrosis, cysts, parasites, etc.

At body weight from 878 to 1135r linear indices correspond to the configuration of normally developing healthy silver carp: body length is equal to 43.2 cm; head length 10.2 cm; the circumference is 26.3 cm and the height is 10.8 cm. This was confirmed with indicators of fatness (of 1.81 with a standard of 1.70), physiological stability (1.64) and productivity of fish (carcass yield of 64.5%, the fleshiness index of 22.7).

CONCLUSIONS

1. The natural forage base of the studied pond was characterized by the content of phytoplankton biomass of 5.03 g/m^3, zooplankton -3.29 g / m^3 and corresponded to mesotrophic ponds suitable for growing silver carp hybrid.

2. In commercial silver carp hybrids with an average body weight of 959.2 g, the morphophysiological index of the liver was 17.6, spleen – 1.37 and gills – 23.7. Most variable morphological and physiological index of immune organs were the spleen index (the "factor"value is equal to 2.1) compared with the index of the liver (the "factor"value is equal to 1.41) and gills index (the "factor"value is equal to 1.22).

3. The morphofunctional indices of the immune system organs determined by us should be considered as an adaptive norm, which was confirmed by the absence of pathoanatomical changes in the body configuration, skin condition, cardiac and abdominal cavities, internal organs and muscles.

4. Linear-dimensional indicators of commercial silver carp, the output of the most valuable part of the body – carcasses and physiological indicators such as fatness and fleshiness index corresponded to the parameters of absolutely healthy fish, the effective implementation of the mechanism of immunity of fish and a favorable habitat.

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