STUDY OF SOME BLOOD INDEXES IN TWO-SUMMER CARPS, REARED UNDER DIFFERENT TECHNOLOGICAL APPROACHES

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Abstract: The study of some blood parameters in two-summer scaly and mirror carps from local population, reared under different technological approaches in indigenous and non-native ecosystems was carried out on the experimental site of the Institute of Fisheries and Aquaculture – Plovdiv and at the Biochemical Laboratory of the Department of Animal Sciences of the Agricultural University – Plovdiv. The blood indexes of the fish are important indicators not only for their physiological condition, but also for the assessment of the technological parameters of their cultivation.
The blood sugar and total protein levels in two-summer scaly and mirror carps reared in experimental ponds are within the reference values indicated in the literature whereas hemoglobin ($p \leq 0.001$) levels are above those values.
Keywords: blood, carp, natural food, organic farming.

1. INTRODUCTION

The hydrobionts well-being is one of the major factors which are taken into account upon developing modern aquaculture technologies. Along with other growth medium factors, the stocking density and its structure as well as the feeding manner are of equal importance for the condition of the fish. It is vital for the fish to consume food which is typical for them. Carps are omnivorous species whose main natural food resource is comprised of benthic organisms. Due to its biological characteristics, the carp also successfully consumes plant feeds which are supplemented in the pond by men (Szelei, 2010).
The blood indexes are important indicators for the condition of fish. They are used for the examination of warm-blooded animals, however, these analyses have not been routinely used in the aquaculture. One reason for that is the lack of data regarding blood indexes norm for different hydrobiont species reared under different conditions. (Nicula et al., 2010).
The aim of the present study is to examine some blood indexes in two-summer scaly and mirror carps from an indigenous population, reared in a combined monoculture under different technological approaches.

2. MATERIALS AND METHODS

The study was carried out in the Institute of Fisheries and Aquaculture - Plovdiv within the research task of ''Studying the productive characteristics of young carps, reared in low level of production intensification conditions''. The blood tests were performed in the biochemical laboratory of ''Animal Breeding Science'' department of the Agricultural University- Plovdiv. The experiment involved three separate technological variants: I variant- Scale carp K_1- 500 p-ces. ha^{-1} and Mirror carp K_0 – 30,000 p-ces.ha^{-1}; II variant- Scale carp K_1 – 500 p-ces.ha^{-1} and Mirror carp K_0 – 60,000 p-ces.ha^{-1}; III variant- Scale carp K_1 – 1,000 p-ces.ha^{-1} and Mirror carp K_0 – 30,000 p-ces.ha^{-1}. In I variant, the fish fed on natural food from the pond only, and in the II and III variants, concentrated feeds (wheat and sunflower meal) were supplemented to the ponds. In order the natural productivity to be stimulated, the three ponds were fertilized with 3,000 kg.ha^{-1} cattle manure each. The average weight of the one-year old carps upon restocking was 42.3 g.
A constant monitoring of the water in the ponds was performed during the entire vegetation period.
The average-seasonal figures of the main water parameters were the following: temperature- 20.9 - 21.7^{o}C; pH - 7.91-8.11; oxygen dissolved in the water-4.06 - 9.14 mg.l^{-1}; permanganate oxidizability- 6.50 - 9.53 mg.l^{-1} O_2. A random set of fish was taken out from the ponds (6 pieces of each type of scaling). The same fish were placed in flow-through reservoirs, and the blood for their testing was acquired through a direct heart puncture. Depending on the purposes of testing, we acquired serum or whole blood which was stabilized with 1% heparin solution. We determined the values of the hemoglobin, blood sugar and total protein by using test sets supplied by the firm ''Biomed''. The results were reported via a semi-automated biochemistry analyzer.

The data received were statistically processed.

3. RESULTS AND DISCUSSIONS

Not only are the blood indexes in fish an important indicator for their condition but they are also a corrective with reference to the technological parameters under which the respective fish are reared (Kebus et al., 1992).

The blood sugar levels vary both between the separate variants and within one and the same variant but with a different type of fish scaling. While in variant II and III, where supplementary feed is supplied, the blood sugar content is almost equal in the fish with different scaling, in variant I, where fish consume the natural food available in the pond only, the difference between the different types and between the scaly and mirror type is considerable (Figure 1).

The results of the blood sampling of carps, reared in a combined monoculture, based on natural feeding are presented in Table 1.

Table 1. Biochemical blood indices of too-year old carp of a local population reared in mixed monoculture

Characteristics	Hemoglobin, $g.l^{-1}$		Blood glucose, $mmol.l^{-1}$		Total protein, $g.l^{-1}$	
	Scale carp	Mirror carp	Scale carp	Mirror carp	Scale carp	Mirror carp
First variant						
$\bar{X}$	104.42	105.25	3.83	4.26	39.50	41.32
$s_{\bar{x}}$	0.57	2.23	0.12	0.17	1.45	1.68
V%	1.22	4.74	6.83	8.80	8.20	9.07
Second variant						
$\bar{X}$	99.3	103.06	3.26	3.52	39.69	38.53
$s_{\bar{x}}$	1.63	2.04	0.10	0.21	0.63	0.62
V%	5.45	6.58	10.03	19.75	5.27	5.35
Third variant						
$\bar{X}$	99.38	87.16	3.40	3.38	41.31	41.32
$s_{\bar{x}}$	2.70	1.93	0.10	0.08	1.01	1.29
V%	9.00	7.36	9.90	7.92	8.14	10.37

Table 2. Influence of the variant on examined hematological parameters of scale and mirror carp

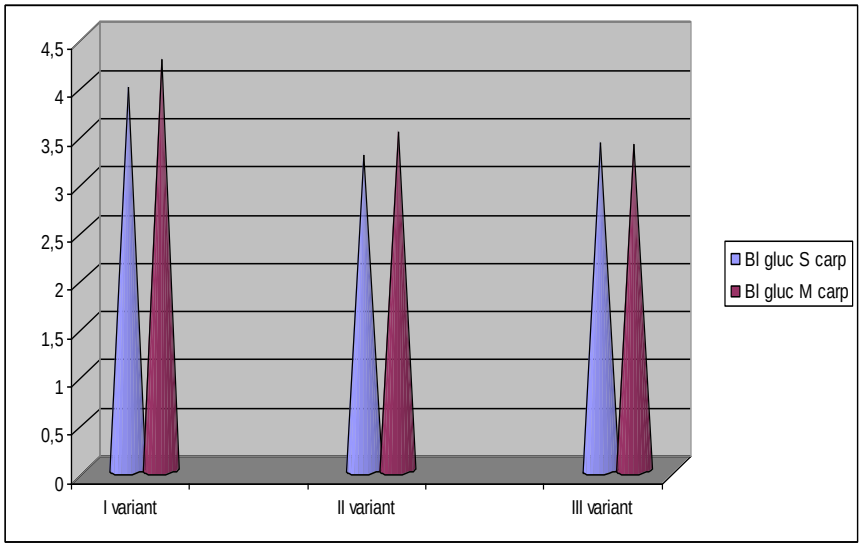
Specifications	Hematological parameters	F-criterion and degree of significance
Scale carp	Hemoglobin, $g.l^{-1}$	2.89*
Mirror carp	Hemoglobin, $g.l^{-1}$	27.7***
Scale carp	Blood glucose, $mmol.l^{-1}$	10.3**
Mirror carp	Blood glucose, $mmol.l^{-1}$	13.6**
Scale carp	Total protein, $g.l^{-1}$	0.67
Mirror carp	Total protein, $g.l^{-1}$	2.8*

Note: ***P<0.001; **P<0.01; *P<0.05

The scaly carps from I variant have higher blood sugar values, while they are lower with reference to the fish from II variant. The difference between the fish from variant I and II is 14.9% ($p \leq 0.001$), and between I and III- 11.2 % ($p \leq 0.01$).

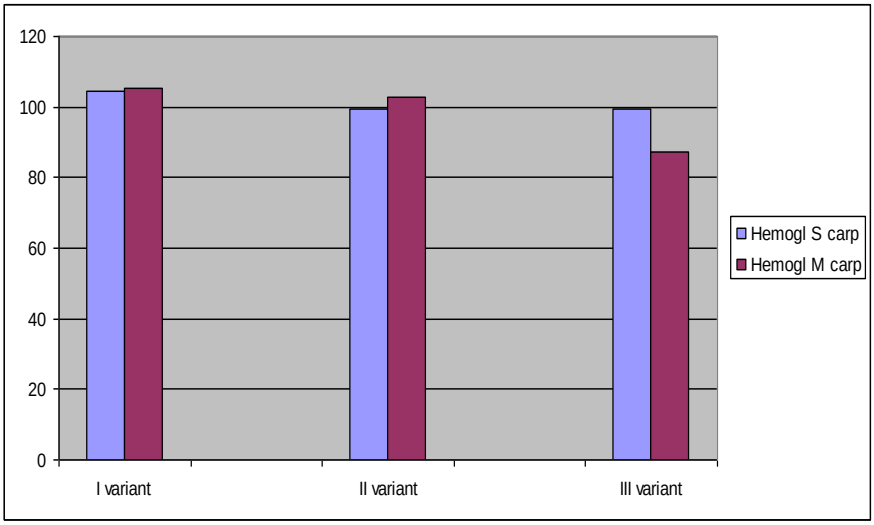
Similarly, the mirror carps from variant I indicate the highest values, and those of variant III have the lowest. The difference between the fish from variant I and II is17.4% ($p \leq 0.01$), and between I and III is 20.7% ($p \leq 0.001$).

Figure 1. Blood sugar (mmol.l^{-1}) level of scale and mirror carp, grown under different technological approaches



The blood sugar levels we reported in carps reared in experimental ponds, with the exception of the fish from variant I, are within the scope considered acceptable and recommended by many other authors (Misaila et al., 2009; Nicula et al., 2010). In most cases, the blood sugar levels increase is related to the influence of particular stress factors such as the paratype ones (Yarzhombek et al., 1986). The highest levels of hemoglobin were reported in fish from I variant (104.4 and 105.2 g.l^{-1}). The results of the scaly carps from variant II and III were almost the same (99.3 g.l^{-1}), while in the case of mirror carps, the fish from variant II had higher levels (respectively 103.06 against 87.16 g.l^{-1}) (Figure 2).

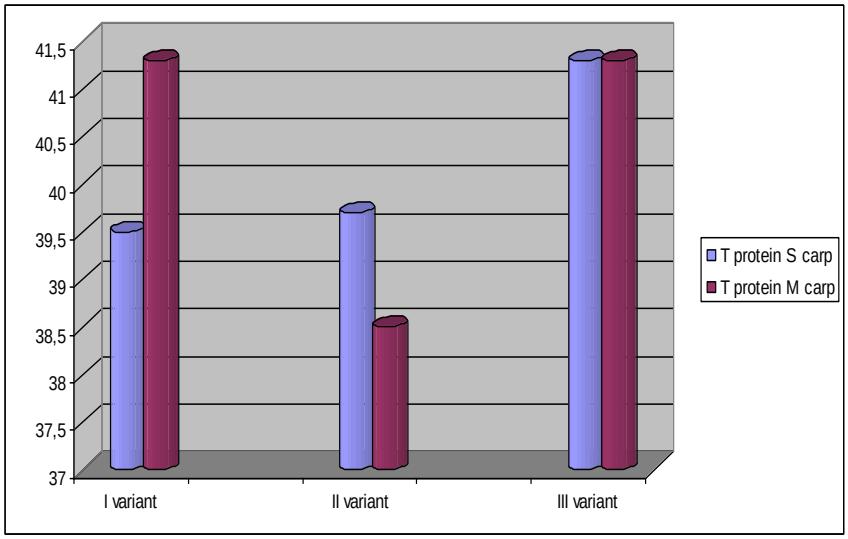
Figure 2. Hemoglobin (g.l^{-1}) level of scale and mirror carp, grown under different technological approaches



The level of hemoglobin in the blood is an important indicator in fish, showing the level of metabolic processes and the state of the organism (Komarova & Nikitina, 2000; Yarzhombek et al., 1986). It is likely that his level adapts to different metabolic needs of the organism with constant environmental changes (Riggs et al., 1976). The data we obtained regarding the hemoglobin at both ages are close to that reported by other authors (Komarova & Nikitina, 2000), however, when compared to those reported by Hadzhinikolova & Atanasova (2008), the values of carps are higher. Hemoglobin, as a link between the organism and the environment, is important in the adaptation of fish because they live in a highly variable environment with fluctuations in oxygen levels. (Landini et al., 2002). No difference was observed both in the scaly carps from variant I and II and those from variant I and III - 4.8% - 4.9% ($p \leq 0.01$). With reference to the mirror carps at the same age, the differences varied with respectively 2%; 17.2%

($p \leq 0.001$) and 15.4% ($p \leq 0.001$). Kovacheva et al. (1995), also observe increase in the hemoglobin levels up to 70 - 81 $g.l^{-1}$ at the end of the vegetation.
The total protein levels in the blood of the two-summer scaly and mirror carps vary up to 41.32 $g.l^{-1}$ remaining about 0,7-0,8 $g.l^{-1}$ lower in the carps from variant II (Figure 3).
To sum up, the blood indexes of fish are an important indicator not only about their physiological condition but also as an assessment index for the technological parameters of rearing (Kebus et al., Misaila et al., 2005). The results we obtained with reference to the total protein in the blood of the different scaled two-summer carp are within 39.53 and 41.32 $g.l^{-1}$, but these differences can be considered negligible. The total protein content levels of fish are usually within reference values. The fish organism may be considered generally damaged when the total protein content levels drop below 1.8 $g.dl^{-1}$.
According to Yarzhombek et al., (1986) the fish condition is good when their blood protein content is above 30-35 $g.l^{-1}$. Atanasova (2003) even recommends that in the autumn, the total blood protein content of the one-summer carp be within 32.3 - 40.2 $g.l^{-1}$. During our previous researches (Ivanova et al., 2012a, 2012b) we ascertained that the blood protein levels of naturally fed one-summer and two-summer carps, were lower than that of the above mentioned reference values.
The results obtained during the present experimental year, however, have been within these reference values and close to the maximum reference norms (Hadzhinikolova & Atanasova, 2008; Misaila et al., 2005).

Figure 3. Total protein ($g.l^{-1}$) level of scale and mirror carp grown under different technological approaches



The data regarding the physiological and pathological norms of blood biochemical indexes in poikilothermic animals in the routine practice are relatively limited (Nicula et al., 2010). The high variability of the fish blood indexes requires these researches to be carried out under the use of specific technologies and rearing conditions which in turn will provide more possibilities to the practical fish farming itself.

4. CONCLUSIONS

The blood sugar levels vary both between the separate variants and within one and the same variant but with a different type of fish scaling.
In variant I, where fish consume the natural food available in the pond only, the difference between the different types and between the scaly and mirror type is considerable.
The highest levels of hemoglobin were reported in fish from I variant (104.4 and 105.2 g.l-1).
The blood sugar and the total protein levels in the two-summer mirror and scaly carps reared in experimental ponds are within the reference values recommended by the literature sources, while the hemoglobin levels are above those values

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