

HEMATOLOGICAL CHANGES IN SOME FARMING CYPRINIDS UNDER THE HIBERNATION CONDITIONS

MODIFICĂRI HEMATOLOGICE LA UNELE CIPRINIDE DE CULTURĂ SUB INFLUENȚA CONDIȚIILOR DE IERNARE

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*The study presents the hematological results of comparative determinations made before and after winter period (2006-2007 in one summer-old common carp, silver carp and bighead carp (C_{0+}). Our previous researches (Misăilă et al., 2004) show that, hypothermia and high storage density induce in farming fish a winter chronic stress state. So, in the two summer-old common carp, silver carp and bighead carp evidenced a pronouncedly hematological insufficiency, with the diminution of hemoglobin level at the end of winter with 11-26% against those from the winter beginning, as well as diminution of the hematocryte with 18-20% and of the number of erythrocytes with 25-45%. Also, Bejerano (1984) point out the diminution of Hb level from 4.5 to 3.8 g/dl in tilapia after a rapid acclimatization to under-lethal temperatures. The results of these researches made in one summer-old cyprinid fries: common carp (*Cyprinus carpio*), silver carp (*Hypophthalmichthys molitrix*) and bighead carp (*Aristichthys nobilis*), subjected to the wintering density of 15 t/ha and in unusual gentle winters conditions (2006-2007) evidenced a different response, suggesting the absence of conditions of stress installation, through the hematological indices values. In addition, was observed a differentiate response of three species in the experimental mentioned conditions. Thus, in common carp, the average of obtained values in the end of the winter (March) were comparable with the one from November-December, differences registered being situate below 3% in the case of Hb concentration (g/dl), hematocryte (%) and number of erythrocyte (mil./ μ l) and below 5% in the case of MCH and MCHC values. In silver carp, differences are situate below 3% in the Hb case, number of erythrocytes and MCH and of 7-11% in the case of Ht, MCV and MCHC. In bighead carp, the values from the end of the winter are less than prehibernation period ones with 5% to Ht, 16% to MCH and 30% in the case of MCHC, respectively, bigger values than these with 11.5% (Hb), 20% (MCHC) and 37% (number of erythrocytes).*

Key words: social stress, thermal stress, farmed cyprinids

Introduction

It is already known that, hypothermia and overdensity induce in farmed fish a *chronic winter state of stress*, which may be estimated through hematological insufficiencies and which is demonstrated commensurable in the stress intensity.

In our previous researches (Misăilă *et al.*, 2004) was demonstrated that, in the two summer-old common carp, silver carp and grass carp (C_{1+}), the severe wintering conditions (1996-1997) led to the diminution with 11-26% of hemoglobin level, with 18-20% in hematocyte percent and with 25-45% in number of erythrocytes/ μ l blood. Other researches (Bejerano, 1984) emphasized that the quick acclimatization of tilapia to under-lethal temperatures caused the diminution of hemoglobin level from 4.5 to 3.8 g/dl.

Present work analyses the hematological modifications induced by the gentle wintering conditions (2006-2007) in the one summer-old common carp, silver carp and bighead carp (C_{0+}). The work objectives assessed in instance, the comparative study of hematological response in farmed cyprinids, from different species and ages in the *unusual gentle winters conditions* and secondarily, the evaluation of *fish qualities for populate of the experimental ponds*, through hematological indices which define the metabolic-blood profile - (MBP) of the studied fish.

Materials and Methods

Stock of 12 t of one summer-old common carp (*Cyprinus carpio*), silver carp (*Hypophthalmichthys molitrix*) and bighead carp (*Aristichthys nobilis*) (C_{0+}) spent the winter in a pond of Tiganasi Fish Farm in a 15 t/ha density. The blood samples were taken before and after winter (December 2006 and March 2007), from 7-8 individuals from each species, through the resection of the caudal footstalks.

Hemoglobin (g Hb/dl) was dozed with Sahli hemoglobinmeter, hematocyte (Ht%) assessed through the centrifugation of capillaries to 12.000 rpm, and the number of erythrocytes (E mil./ μ l) microscopically counted, in a Bürker-Türk hemocytometer, using the Hendricks reagent as dilution way. The erythrocytary constants were determinate by calculus: $MCV (\mu m^3/erythrocyte) = Ht \times 10/E$, $MCH (pg Hb/erythrocyte) = Hb \times 10/E$ and $MCHC (g Hb/100 ml erythrocyte mass) = Hb \times 100/Ht$.

Results and Discussions

Generally speaking, the fish storage in a large density in conditions of a prolonged winter, with temperatures situate under the frost limit exhibits the pond reared fish to the environment factors action which realize the condition of chronic stress. Data from literature consign that, on the background of long inanition and on descending of available oxygen, the fish evidenced a state of pronouncedly

hematological insufficiency, with the diminution the hemoglobin level, hematocyte and the erythrocytes number.

Our current results, obtained from the experiment in one summer-old cyprinids, exposed in a winter density of 15 t/ha and in the thermal conditions of unusual gentle winter (2006-2007), suggest the absence of stress condition, through the hemoglobin value, hematocyte and the number of erythrocytes.

Thus, from data presented in Figure 1, noticed that, in common carp and silver carp, the concentration of hemoglobin values from the moment of winter beginning and one from the end of cold season are comparable, therefore the fish crossed without discomfort from the cold season of year. Increase with 15% of hemoglobin from March in bighead carp can be associated with the more dynamic behavior of this species in the activity of zooplankton filters along the opening days of active feed season.

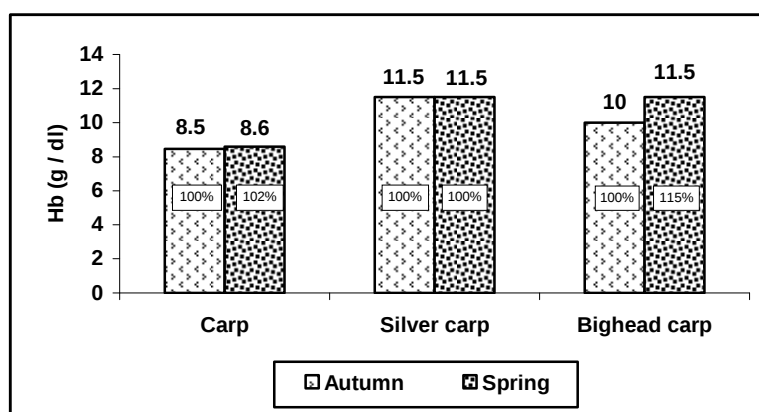


Fig. 1. Comparative level of hemoglobin (g / dl)

In agreement with this evolution is placed the hematocyte values (fig. 2) which notice less difference between two sampling moments. Thus, the hematocyte values from spring are with 3% less than one from the beginning of winter in common carp and with 5% in bighead carp. Generally, the hematocyte values in fish decrease during the cold season, fact observed both in trout adults (Lane, 1979) and in the farmed salmon (Sadnes *et al.*, 1988).

On the other hand, there is literature data which point out a decrease of fish hematocyte values in stress conditions (Parent, 1976; Scott *et al.*, 1981), presuming that fish respond to stress through spleen overachievement, which delivers in peripheral circulation excedentary amounts of erythrocytes. In our experimental conditions (fig. 2), only in the case of silver carp appears an easy increase of hematocyte in spring, the value registered exceeding with 9% the level from the winter beginning.

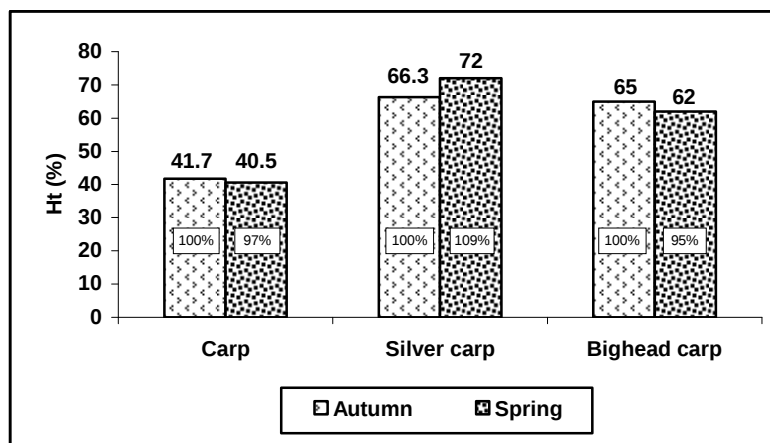


Fig. 2. Average values evolution of hematocrite (%)

Concerning the evolution of average number of erythrocytes in the wintertime (fig. 3), it is opportune to point out, both in common carp and in silver carp existence of some comparable value couples between the two sampling moments, levels from spring being with 2-3% less than one from the winter beginning.

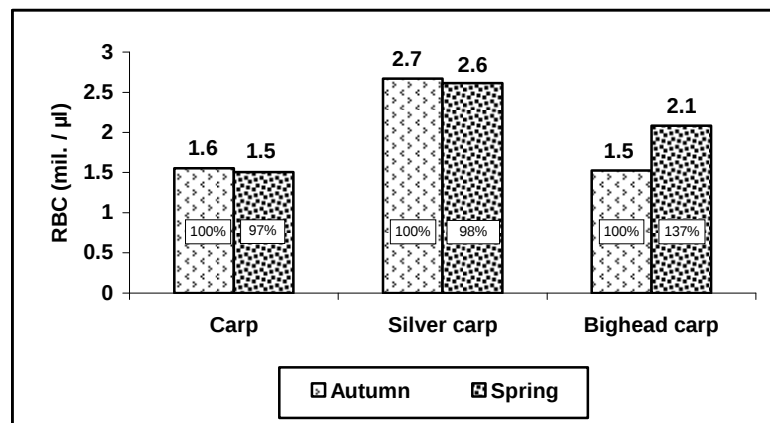


Fig. 3. Erythrocytes number (mil. / µl)

In bighead carp, the differences are more consistent, the average value from spring exceeding with 37% *versus* the control one, which is suggesting an erythropoiesis stimulation, likely pursuant to excess of hypoxia. This difference is correlated to the mean cell volume (MCV) values, which in common carp and silver carp are comparable, while in bighead carp decrease with 30% against one from the winter beginning. This manifestation may be noticed as a tendency of adaptation the respiratory function in bighead carp, through the stimulation of

erythropoiesis way, so that to achieved a respiratory surface sufficient of large through the summarization of partial surfaces belong from a higher number of red blood cell, each of them with a less mean cell volume (fig. 4).

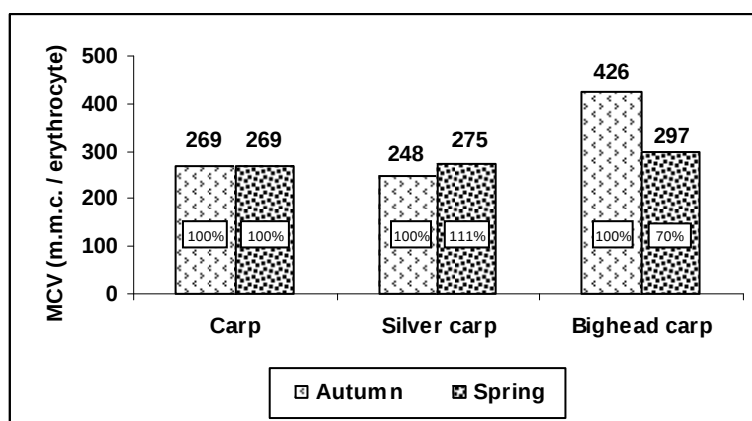


Fig. 4. Mean cell volume (MCV)

The MCH values (fig. 5) correlate to one of the MCV, the common carp and silver carp having a comparable loading of erythrocytes with hemoglobin both in autumn and in spring (53-57 pg Hb/erythrocyte in common carp and 43-44 pg in silver carp), while bighead carp has with 16% less Hb/erythrocyte in spring, because the individual red cell volume is, also, with 30% less than in the winter beginning. In addition, in bighead carp, the MCHC values are with 20% bigger against the winter beginning ones, correlate with the hemoglobin level (fig. 1) which is comparable between two sampling moments in common carp and silver carp and with 15% bigger in spring in bighead carp (fig. 6).

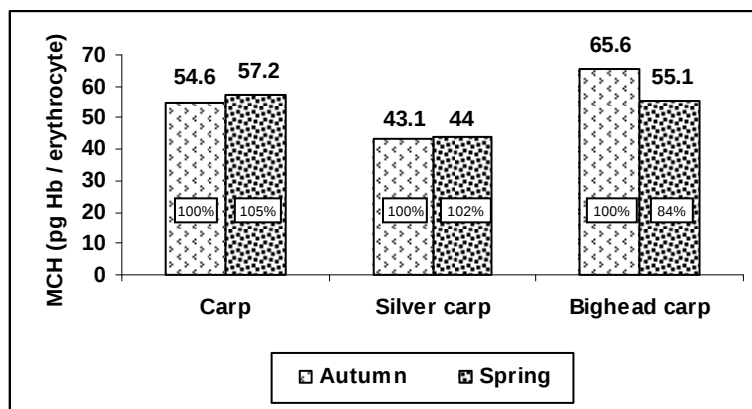


Fig. 5. Mean cell hemoglobin (MCH)

In conclusion it can be appreciated that, from the point of view of hematological indices values, the state of health of studied fish was good, there is not evidences of a drastic hematological insufficiency, generate of the winter conditions.

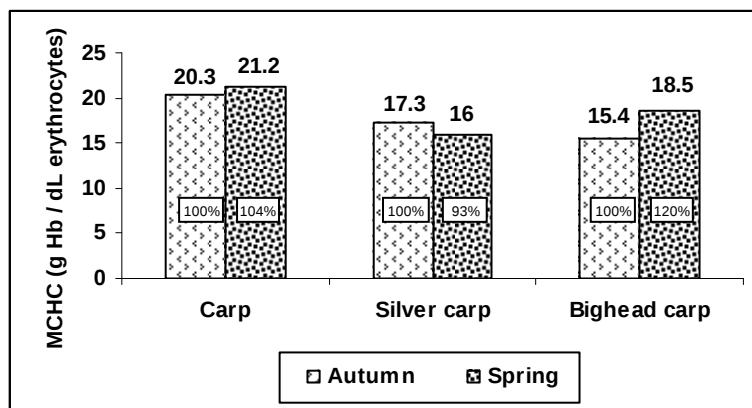


Fig. 6. Mean cell hemoglobin concentration (MCHC)

Conclusions

1. The response of young cyprinids C_{0+} to the gentle winter conditions (2006-2007) reflects a hematological insufficiency much attenuate against the values obtained to cyprinids C_{1+} in the end of severe winter (1996-1997).
2. The absence of hypothermia stress conditions is best noticed in common carp, in which the autumn - spring differences do not exceed 3% to Hb, Ht, MCV and number of erythrocytes and 5% in the case of MCH and MCHC. In silver carp, these differences do not exceed 3% to Hb, number of erythrocytes and MCH and 7-11% to Ht, MCV and MCHC.
3. In bighead carp, the values decrease in wintertime with 5% (Ht), 16% (MCH) and 30% (MCV) and increase against the autumn ones with 11.5% (Hb), 20% (MCHC) and 37% (number of erythrocytes).

Bibliography

1. **Bejerano, I.** (1984) - *Detection and control of stress conditions in warm water aquaculture*, Res. on Aquacult. European Mariculture Society, Bredene, Belgium, 56-68.
2. **Lane, H. C.** (1979) - *Progressive changes in haematology and tissue water of sexually mature trout (*Salmo gairdneri*) during the autumn and winter*, J. Fish Biol., 15, 425-436

3. **Misăilă, C., Misăilă, Elena Rada** (2004) - *Cercetări hematologice la unele ciprinide de cultură în condiții de stres cronic*, Lucr. Științifice, Seria Zootehnie, Edit. "Ion Ionescu de la Brad" Iași, vol. 47, 703-709.
4. **Misăilă, Elena Rada, Misăilă, C., Artenie, Vl., Simalcsik, F.** (2005) - *Effect of the chronic stress on some parameters of the metabolic-blood profile (MBP) of the farming Cyprinides* in: Fisheries and Aquaculture Development, XXX, HAKI, Hungary, 147-153.
5. **Parent, J. P.** (1976) - *Influence du facteur thermique sur quelques paramètres du métabolisme glucidique chez carpe commune (Cyprinus carpio)*, **These de Specialite, Univ. Paul Sebatier, Toulouse.**
6. **Patriche, Tanți** (2007) - *Cercetări imunologice la speciile de pești de cultură din România*, Teză de Doctorat, Univ. „Dunărea de Jos” Galați, p. 124.
7. **Sadnes, K., Lie, O., Waagbo, R.** (1988) - *Normal ranges of some blood chemistry parameters in adult farmed Atlantic salmon (Salmo salar)*, J. Fish. Biol., 32, 129-136.
8. **Scott, A. L., Rogers, S. W. A.** (1981) - *Hematological effects of prolonged sublethal hypoxia on channel catfish (Ictalurus punctatus)*, Raf. J. Fish Biol., 18, 591-601.