

MODIFICATION OF SOME BIOCHEMICAL PARAMETERS AND OF THE CONCENTRATION OF SOME SERUM IONS IN *CYPRINUS CARPIO* L. SPECIES GROWN UNDER DIFFERENT SANITARY-VETERINARY CONDITIONS

COSTICĂ MISĂILĂ ^{1*}, ION NEACȘU ¹, ELENA RADA MISĂILĂ ²,
GABRIELA VASILE ¹, VLAD ARTENIE ¹

Key words: common carp, preventive anti-parasitary treatments, biochemical blood indices, serum ions

Abstract: The paper discusses the modifications produced in some biochemical indices as well as in the concentration of serum ions, in fry carp, during the period of active feeding, in two experimental ponds of the Iasi district, providing different conditions of ichthyo-pathological prevention.

The average values of glucose and alkaline phosphatase from the blood, as well as those of cholesterol, ureic nitrogen, Na⁺, Ca²⁺ and K⁺ from the serum, have been determined after 120 days of experiment (June - September), for 11 representatives of each basin.

For the two experimental variants, different preventive treatments - based on calcium chloride administered in three different moments of the growing cycle and on concentrated, drug-containing food for assuring antimicrobial prevention - have been applied.

The values recorded in the variant under analysis are lower than those of the reference, with 12.2% for glycemcy, 9.7% for total cholesterol, 17.5% for the total ureic nitrogen and 10.98%, respectively, for alkaline phosphatase. The levels of the determined ions show higher values in the experimental variant, with 23.3% for K⁺ and 4.1%, respectively, for Ca²⁺, while the average values for Na⁺ are lower in the fish from variant B, the Na⁺/K⁺, Na⁺/Ca²⁺ and (Na⁺+K⁺)/Ca²⁺ ratios showing inferior values - with 4 - 21% - than the reference ones.

INTRODUCTION

In recent years, investigation of the metabolic-sanguine profile (MSP) in culture fish has been largely developed, for the evaluation of the bioproductive performances of the technologies applied. Generally, the physiological state of the fish grown in an average and high density environment reflects faithfully the health condition of these organisms, as well.

A precocious diagnosis of the pathological states, as well a suitable preventive therapy of theirs represents main concerns of modern aquaculture technologies. In this respect, several investigations of ours tried to evaluate the efficiency of some preventive, anti-parasitary treatments, applied to carp (*Cyprinus carpio* L.) grown in ponds, by means of biochemical and ionic indices, besides the growth and food bioconversion ones.

MATERIALS AND METHOD

Experiment on fry carp growing were performed in the summer of 2006, in the ponds known as Dudău I (A) and Dudău II (B), from the Piscicultural Farm of Podu-Iloaiei, Iași district. Both ponds, populated with equal effectives of 10, 000 individuals of one summer-old carp, were supplied with water from the same source, which assured an identical quality of the piscicultural water. More than that, the alimentary regime of the fish, based on concentrated food, was also identical, both quantitatively and qualitatively, in the two variants. In the reference pond (A), 20 kg sodium chloride were administered, both in the moment of its filling with fish and after one month of growing, while the experimental pond (B) received 40 kg sodium chloride. The third treatment, administered in August, involved quantities of 30 (A) and, respectively, 50 (B) kg sodium chloride. Apart from this, in variant B, an oxytetracycline diet, incorporated in the recipe (50 mg/kg fish) has been administered at two intervals of seven days each, for anti-microbial prevention.

In the end of the experimental period, 11 fish have been extracted from each variant, for blood samples taking over through resection of the caudal peduncle, the results provided representing the arithmetic mean of the data collected.

As to the working procedures applied, determinations of Na⁺, K⁺ and Ca²⁺ concentrations were made by the flam-photometric method, while the biochemical determinations (glucose and alkaline phosphatase from the blood, cholesterol and ureic nitrogen from the serum) were performed on an EOS 880 PLUS-type biochemical blood analyzer.

RESULTS AND DISCUSSION

An important observation to be made is that, in variant A, fish survival was of 80% of the initial effective, *versus* 85% in variant B while, in the variant characterized by higher doses of preventive anti-parasitary treatments (B), the additional growth increase was of 18.2%, comparatively with the reference.

The clinical significance of the biochemical parameters taken into study (glycemy, cholesterolemia, level of ureic nitrogen and activity of alkaline phosphatase) is unanimously acknowledged, along with their value of constants, indicative of the degree of physiological comfort and, respectively, stress, the fish is exposed to.

The data obtained (Fig. 1) show that, in the fish from the experimental variant, the level of serum glucose (58.36%) is 12.2%, lower than in the reference (66.44%). A reduced glycemy in variant B may be correlated with the growth rhythm of the fish from this basin, in which the final average weight is of 65 g/ind. versus 55 g/ind. - the value recorded in the fish from the reference variant.

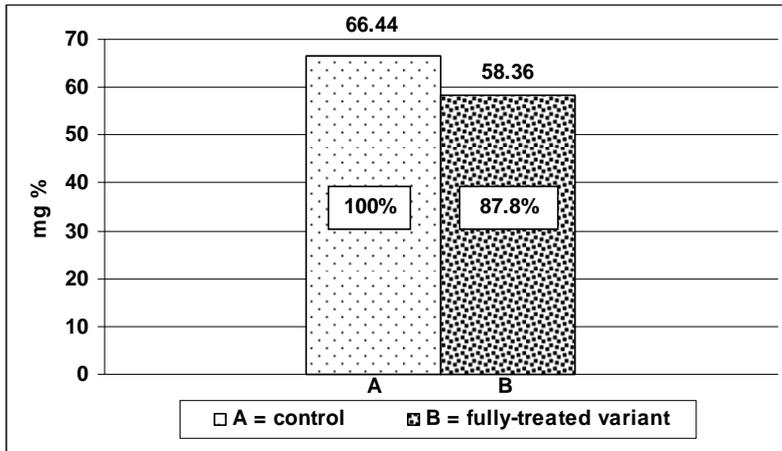


Fig.1. Glycemy in the carp under analysis

As known, a higher glycemy is usually associated with the occurrence of stress (Artenie *et al.*, 1995 b; Misăilă *et al.*, 2005; Vasile, 2008), which might explain why, in variant B, in which higher doses of treatment had been applied, the amplitude of the pathological phenomena - parasitary stress included - have been considerably blocked and, consequently, the glycemy level recorded was 12.2% below the value of the reference variant. In the reference variant, in which the stressing indices of algose, bacteriose (parasitose included) etc. type, are more intense, the fish mobilize the reserves of glycogen, which gets partially splitted to glucose, as an immediate energetic reserve against the action of stress, the parasitary one included.

As to the cholesterol content of the blood serum (Fig. 2), the registered values are relatively close in the two experimental variants. Cholesterolemia values lower with about 10% in the carp from variant B, comparatively with those of the reference, express an increased degree of physiological comfort - even at the level of lipidic metabolism - induced by the preventive sanitary-veterinary treatments applied to the experimental variant.

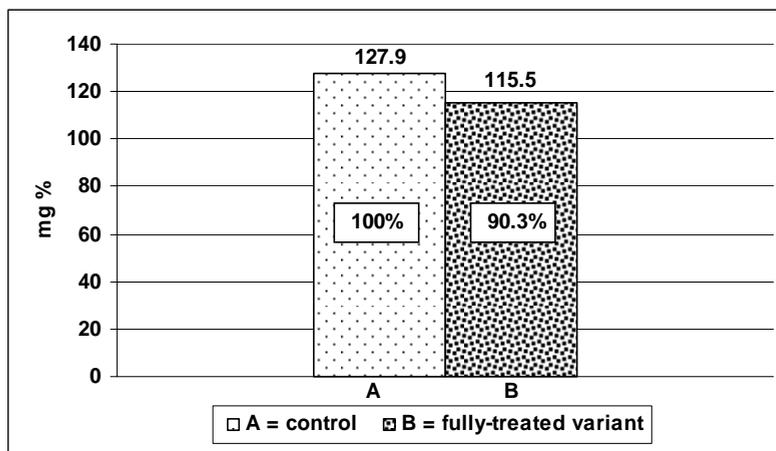


Fig.2. Serum total cholesterol in the carp under analysis

The concentration of ureic nitrogen in blood is a synthetic index, also defined as azothemy or BUN (Blood Ureic Nitrogen), providing functional information from the blood areas, as well as from liver, kidneys, etc.

The presence of urea in blood, as a product resulted from the catabolization of proteins and aminoacids, is not accidental as, being a low-molecular mass substance, it plays a special part - together with other substances - in adjusting osmotic pressure.

In fishes from variant B (Fig. 3), the concentration of ureic nitrogen (24.27 mg %) is lower with 17.5% than in the reference (29.42 mg %), which might be also explained by a more economic metabolism - in this variant - of the aminoacids resulted from the digestion of the present proteins. In this case, it is expected that a larger amount of aminoacids will participate to the biosynthesis of the proteins specific to different tissues from fish organisms. Actually, this might be correlated with the additional growth increase of the carp from variant B.

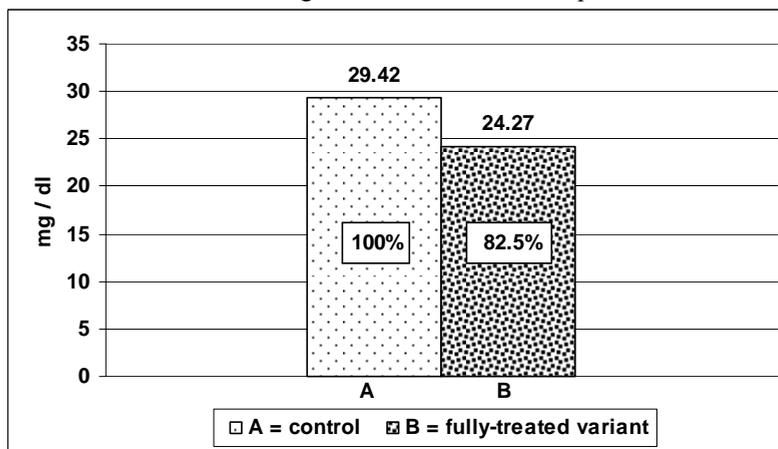


Fig.3. Blood ureic nitrogen in the carp under analysis

As to the average values of the activity of alkaline phosphatase (an especially important enzyme in the metabolism of the organic esters from the phosphoric acid), the data obtained evidence 11% lower levels in variant B, comparatively with those of the reference (Fig. 4). This fact agrees with literature, which makes mention of a significant increase in the activity of blood alkaline phosphatase during various maladies (Artenie *et al.*, 1995 a).

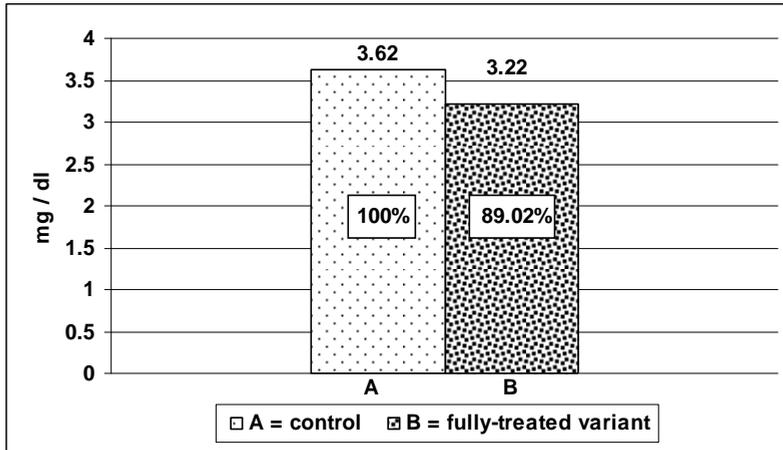


Fig.4. Blood alkaline phosphatase activity in the carp under analysis

The concentration values of the main cations (Na^+ , K^+ and Ca^{2+}) levels from the serum of the fish under analysis are presented in Figs. 5 - 7, while those expressing the calculated ionic ratios - in Figs. 8 - 11. A first observation to be made is that the level of the sodium ions from the serum samples is about 10 times higher than that of K^+ and Ca^{2+} , which is quite easy to explain if considering the higher values of Na^+ from the extra-cellular environment, compared to those of K^+ and Ca^{2+} . In variant B, the Na^+ levels are, on the average, 2.3% lower than in the reference, while the plasmatic K^+ and Ca^{2+} record higher values than those of the reference - with 23.3% and, respectively, 4.1%.

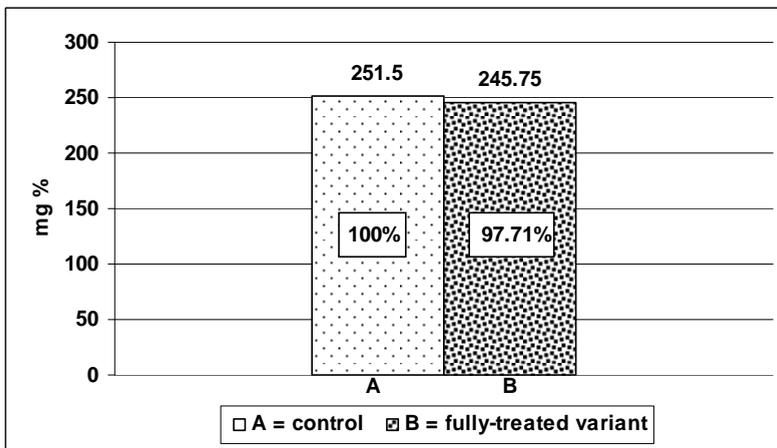


Fig.5. Serum Na^+ concentration in the carp under analysis

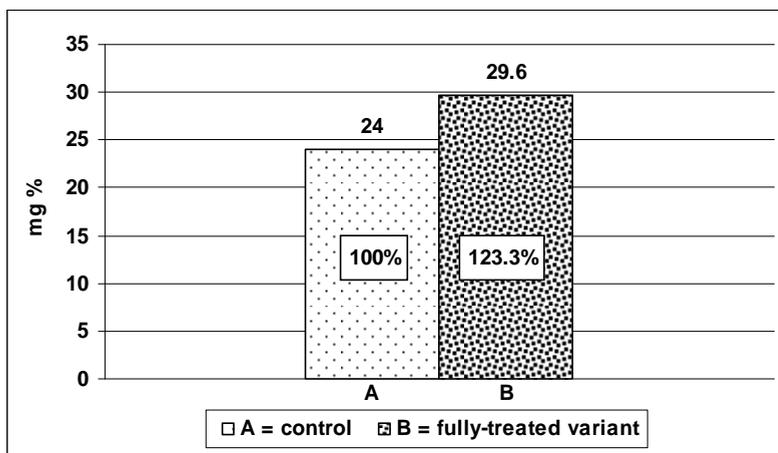


Fig.6. Serum K^+ concentration in the carp under analysis

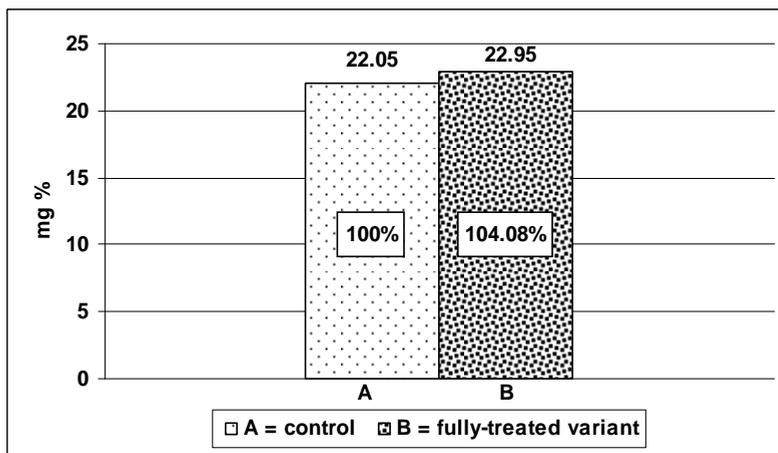


Fig.7. Serum Ca^{2+} concentration in the carp under analysis

If considering the multiple physiological roles, as well as the extra- and intracellular distributions of these ions, one may observe the especially important functional role of the ratios among them. For example, the values of the extra-cellular Na^+/K^+ ratio appear of special importance in the control of the cellular hydro-ionic and osmotic equilibrium, Na^+ being an ion with strong hydrophilic properties (Martin and Mihai, 1979). Also, the K^+/Ca^{2+} extracellular ratio is essential for maintaining membranary permeability and the resting electrical potential at normal values. The high values of this parameter indicate membrane destabilization, its depolarization and a higher passive permeability, while its low values evidence an increased concentration of the Ca ions on the external side of the cellular membrane, which brings about reserve effects - *i.e.*, its hyperpolarization (Alberts *et al.*, 1998).

The data obtained (Figs. 8 - 11) show that, in variant B, the Na^+/K^+ ratio has 21% low values than those recorded in the reference, which suggests a possibly higher passive

membrany permeability in the experimental variant, which should stimulate the active transport, *i.e.*, a more intense activation of the Na^+/K^+ pump *versus* the reference.

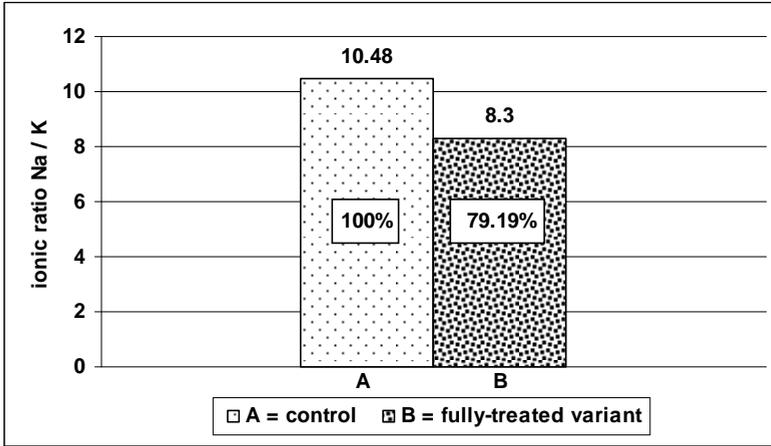


Fig.8. Serum values ratio Na^+/K^+ in the carp under analysis

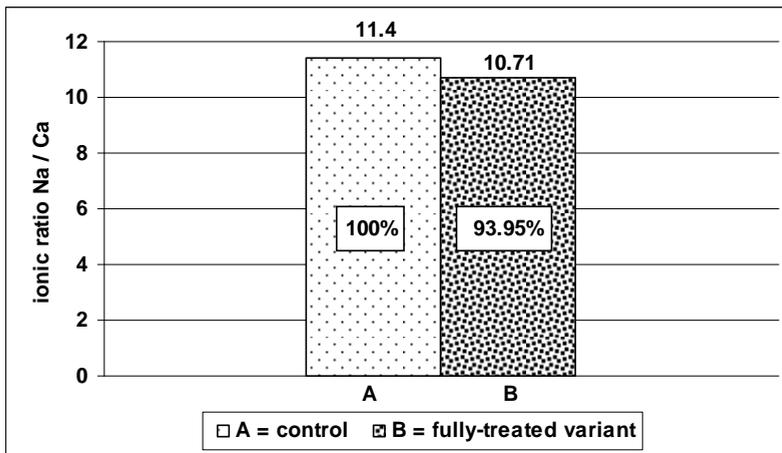


Fig.9. Serum values ratio $\text{Na}^+/\text{Ca}^{2+}$ in the carp under analysis

Such an observation is correlated and supported by the values of the $\text{K}^+/\text{Ca}^{2+}$ ratio, which is also 6.1% lower in variant B than in the reference. One may therefore deduce that, in the fish from variant B, the higher concentration of the plasmatic K^+ determines ionic ratios which induce destabilization of the cell membrane, that is a more pronounced passive permeability. Consequently, the subsequent increase of the active transport through the Na^+/K^+ pump, stimulated by a too high passive permeability, might favourize both intestinal absorption and filtration at the level of the renal tubes, and the breathing exchanges occurring the level of branchial epithelia. Intensification of the metabolic exchanges is closely correlated with a more efficient valorization of the administered food, as well as with the bodily weight increase which - in the fish from variant B - is about 18.2% higher than the values recorded in the fish from the

reference variant. Those results agree with the data obtained in previous studies, developed on other fish species, such as trout, pikeperch and silver carp (Crăciun *et al.*, 1980; Neacșu *et al.*, 1981; Trandafirescu *et al.*, 1999).

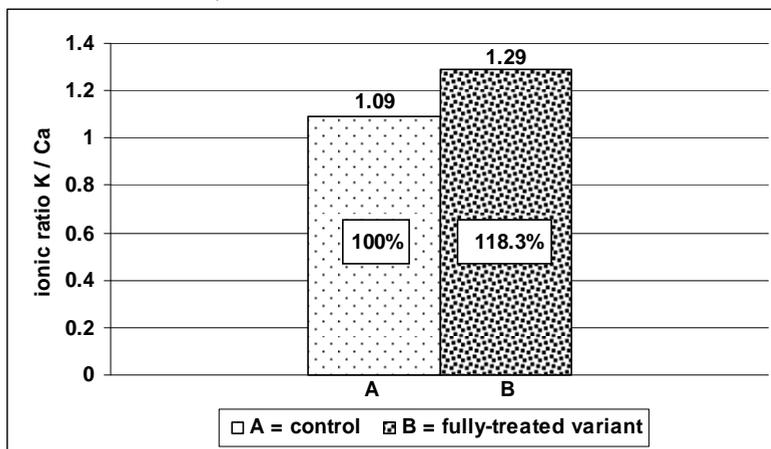


Fig.10. Serum values ratio K^+/Ca^{2+} in the carp under analysis

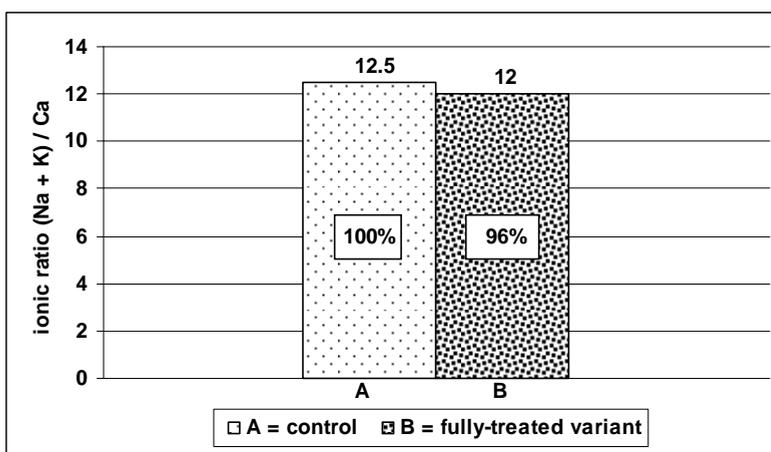


Fig.11. Serum values ratio $(Na^+K^+)/Ca^{2+}$ in the carp under analysis

The results of such investigations may be actually viewed as para-clinical arguments which demonstrate - in a biochemical and physiological language - that the additional prophylactic treatments applied both in the water of basin B and in the fodders from the experimental variant assure a better hygienic-sanitary protection to the fish, thus permitting an optimized metabolic valorification of the administered food, as well as orientation of the metabolic energy preponderantly towards growing and less against the attack of various noxious agents.

CONCLUSIONS

Application of preventive anti-parasitary treatments to one summer-old carp induces a more prosperous physiological condition to the fish, comparatively with the untreated variant, characterized by a 12.2% reduction of glycemy (blocking of the parasitary stress), along with a 9.7% diminution of total cholesterol (higher physiological comfort at the level of lipidic metabolism).

In the fish of the experimental variant, the ureic nitrogen level is 17.5% lower than in the reference (a more economic metabolization of the aminoacids present in food), while the activity of alkaline phosphatase is 10% lower than in the reference, an increased activity of this enzyme being associated with the installation of a discomfort characteristic to maladies.

In the experimental variant, the extra-cellular (plasmatic) levels of Ca^{2+} and K^+ are 4.08% and, respectively, 23.3% higher than in the reference, while those of Na^+ are 2.3% lower than the values recorded in the control variant.

In variant B, the Na^+/K^+ , $\text{Na}^+/\text{Ca}^{2+}$ and $(\text{Na}^+ + \text{K}^+)/\text{Ca}^{2+}$ ratios record lower values than in the reference, with 20.8%, 6.05% and, respectively, 4%, while the values of the $\text{K}^+/\text{Ca}^{2+}$ ratio exceeds the one of the reference with 18.3%.

REFERENCES

- Alberts, B., Bray, D., Lewis, J., Raff, M., Roberts, K., Watson, J. D., 1998. *Molecular Biology of the Cell*, 3rd edition, Garland Publish. Inc., New York, London.
- Artenie, Vl., Misăilă, Elena Rada, Tănase, Elvira, Misăilă, C., Toma, O., 1995 a. *Aquarom '95*, Galați, 242 - 245.
- Artenie, Vl., Tănase, Elvira, Misăilă, Elena Rada, Misăilă, C., 1995 b. *Aquarom '95*, Galați, 234 - 237.
- Misăilă, Elena Rada, Misăilă, C., Artenie, Vl., Simalcsik, Fr., 2005. *Scientific Conference on Fisheries & Aquaculture*, Szarvas, Hungary, **30**: 147 - 153.
- Crăciun, V., Crăciun, M., Neacșu, I., Telembici, A., Ioniță, R., 1980. *Recherches Marines*, IRCM Constanța, **13**: 191-198.
- Martin, V., Mihai, D., 1979. *Disminerelozele la animale*, Ed. Ceres, București.
- Neacșu, I., Crăciun, V., Crăciun, M., Trandafirescu, I., 1981. *Recherches Marines*, IRCM Constanța, **14**: 201-215.
- Trandafirescu, I., Neacșu, I., Crăciun, V., Crăciun, M., 1999. Sesiunea Științifică «Marea Neagră în cumpănă», Agigea - Constanța, 179-190.
- Vasile, Gabriela, 2008. *Studiul comparativ al unor caracteristici morfologice și funcționale la Cyprinidae de cultură în diferite stadii de dezvoltare*, Teză de doctorat, Univ. „Alexandru Ioan Cuza” Iași.

1) “Alexandru Ioan Cuza” University of Jassy, Faculty of Biology

2) Research and Development Station for Aquaculture and Aquatic Ecology, Jassy

*) cmisaila@uaic.ro