

COMPARATIVE INVESTIGATIONS ON THE ACTIVITY OF SOME INTESTINAL AMINOTRANSFERASES, IN THE *ARISTICHTHYS NOBILIS* SPECIES, IN VARIOUS STAGES OF DEVELOPMENT

GABRIELA VASILE^{1*}, ELENA CIORNEA¹, COSTICĂ MISĂILĂ¹

Key words: bighead carp, alanine-aminotransferase, aspartate-aminotransferase

Abstract: The paper is devoted, on one side, to a comparative study of the length of the digestive tube *versus* both the total and the standard length of the body, on the other, to the activity of aspartate- and alanine-aminotransferase activity manifested in the median segment of the digestive tube, in one, and, respectively, four summer-old individuals of *Aristichthys nobilis*.

INTRODUCTION

In the living organisms, the aminotransferases (transaminases) catalyze the process of transamination, that is the reaction of reversible transfer of the aminic group between aminoacids and cetoacids, known as bi-component enzymes, with piridoxal-5'-phosphate and piridoxamine-5'-phosphate as a coenzyme. Out of the known aminotransferases, of special interest are the aspartate-aminotransferase or the glutamico-oxaloacetate-aminotransferase and the alanine-aminotransferase or the glutamico-piruvate aminotransferase.

In the adaptation reactions of the animal organisms to the ever-changing conditions of the external environment, a special part is played by the digestive apparatus, particularly by the enzymes taking part to digestion, the food being first subjected to the action of such enzymes (ARTENIE, 1990; ARTENIE *et al.*, 1995).

Numerous relatively recent studies have demonstrated the influence of food on the activity of the alanine- and aspartate-aminotransferase from the hepatic and sanguine tissue (FERNANDEZ *et al.*, 1999; REHULKA, 2000; LEE *et al.*, 2003; ZHAO *et al.*, 2006), while other investigations do not view the diet as a stimulating or activating factor of the aminotransferase enzymatic activity (GOMEZ - REQUENI, 2004; PERES and TELES 2005).

The data provided by the literature of the field indicate a striking dynamics of the alanine-aminotransferase as a function of tissue, category of age and season selected for investigation. In this respect, some researches have evidenced the existence of a positive correlation between the activity of alanine-aminotransferase and tissues' growing intensity, the enzymatic activity being more intense in the early stages of individual development, which may be explained by the intense growing rhythm of the period, based on an intense proteic synthesis (proteic anabolism) (MĂRGĂRINT *et al.*, 1980; MĂRGĂRINT, 1983; MISĂILĂ *et al.*, 1990).

MATERIALS AND METHOD

The experiments were performed on bighead carp representatives in various development stages (one and, respectively, four summer-old), from the Ezăreni Accumulation, district of Jassy, to which no additional food had been administered, the samples being taken over from the median part of the digestive tube, the rests of the intestinal content being removed through scraping.

The digestive tube was measured by biometry techniques (GROZEA and BURĂ, 2002), while the activity of aminotransferases was determined by the colorimetric method, with 2,4-dinitrophenyl-hydrazine, the results being expressed in UE/g/min. (COJOCARU, 2005). Mention is made of the fact that three parallel dosings have been performed for each sample, the data provided representing the average values of these repetitions; in a final step, the results obtained have been processed statistically (VARVARA *et al.*, 2001).

RESULTS AND DISCUSSION

The biometric aspects of the digestive tract have been analyzed on thirty individuals, for each one in part, on calculating the main statistical indices (Tables I - II).

TableI. Values of the main statistical indices of analyzed variables in one summer-old bighead carp individuals

Statistical indices	Analyzed variable		
	Ltd (mm)	L (mm)	ls (mm)
Average	36.193	12.19	10.01
Standard error	0.884	0.127	0.072
Median	36.5	12.3	10

GABRIELA VASILE et al – COMPARATIVE INVESTIGATIONS ON THE ACTIVITY OF SOME INTESTINAL AMINOTRANSFERASES, IN THE *ARISTICHTHYS NOBILIS* SPECIES, IN VARIOUS STAGES OF DEVELOPMENT

Mode	37.5	12.5	10
Standard deviation	4.842	0.699	0.397
Variance	23.445	0.489	0.158
Range	19.5	3	1.5
Minim	28	10.5	9.5
Maxim	47.5	13.5	11
Confidence intervals (95%)	1.808	0.261	0.148
Upper limit	38.001	12.451	10.158
Lower limit	34.385	11.928	9.861
CV%	13.378	5.741	3.973
m%	2.442	1.048	0.725

Ltd = digestive tube length, L = body total length, ls = body standard length,
CV% = mean variation coefficient, m% = precision coefficient mean

TableII. Values of the main statistical indices of analyzed variables in four summer-old bighead carp individuals

Statistical indices	Analyzed variable		
	Ltd (mm)	L (mm)	ls (mm)
Average	348.366	64.716	56.433
Standard error	7.259	1.453	1.189
Median	354.1	68	58
Mode	379.5	69	48
Standard deviation	39.764	7.961	6.516
Variance	1581.207	63.991	42.46
Range	142.5	22	18
Minim	270	53	48
Maxim	412.5	75	66
Confidence intervals (95%)	14.848	2.973	2.433
Upper limit	363.211	67.689	58.866
Lower limit	333.515	61.743	54
CV%	11.414	12.302	11.546
m%	2.084	2.246	2.108

Ltd = digestive tube length, L = body total length, ls = body standard length,
CV% = mean variation coefficient, m% = precision coefficient mean

In one summer-old bighead carp individuals, the average value of the digestive tube is of 36.193 cm, while, in four summer-old adults, it reaches an average value of 348.266 cm, a 9.625 increase being thus recorded.

As known, cyprinids are fish possessing no stomach, its absence being compensated by a long intestine, which exceeds the length of their body, thus offering a large surface for the absorption of the nutritive elements at intestinal level, as well as a highly complete valorization of the food, the retention time of the aliments thus increasing, once they had been subjected to the enzymatic action for a longer time.

As a consequence, in one summer-old *Aristichthys nobilis* representatives, the ratio between the length of the digestive tract and the total length of the body is of 2.969, while the ratio between the length of the digestive tube and the standard length of the body is somewhat higher, of 3.615.

Literature data (POJOGA, 1977; STEFFENS, 1985 cite by APETROAEI, 2007) have shown that, with the increase of the bodily length, the ratio between the length of the digestive tube and that of the body increases, as well, as evidenced in our studies, too. Consequently, in bighead carp representatives, the ratio between the length of the digestive tube and the total bodily length

gets modified from 2.969 in fry to 5.382 in four summer-old adults, while the ratio between the length of the digestive and the standard bodily length - from 3.615 in fry, to 6.173 in adults.

Another objective of the present study involved determination of the enzymatic activity of alanine- and aspartate-aminotransferase from the median segment of the digestive tube, for each development stage under analysis in part.

The experimental data on the activity of the alanine-aminotransferase in one summer-old individuals are listed in Table III.

Table III. Alanine-aminotransferase activity from the median part of the digestive tube in one summer-old *Aristichthys nobilis*

Samples	Individual activity (UE/g/min.)	Average activity (UE/g/min.)	Standard error	Standard deviation	LS	LI	CV%
1	0.1944	0.194	0.0006	0.001	0.197	0.197	0.544
	0.1936						
	0.1957						
2	0.1722	0.172	0.0002	0.0006	0.173	0.171	0.261
	0.1726						
	0.1731						
3	0.1777	0.177	0.0008	0.001	0.181	0.173	0.850
	0.1759						
	0.1789						
4	0.3805	0.380	0.0007	0.001	0.384	0.377	0.338
	0.3823						
	0.3798						
5	0.4305	0.431	0.0007	0.001	0.434	0.428	0.289
	0.4311						
	0.4329						
6	0.2416	0.241	0.002	0.003	0.251	0.232	1.593
	0.2455						
	0.2378						
7	0.35	0.351	0.0005	0.0009	0.353	0.348	0.271
	0.3511						
	0.3519						
8	0.2	0.207	0.003	0.006	0.223	0.191	3.065
	0.2116						
	0.2103						
9	0.4361	0.432	0.0002	0.0003	0.437	0.435	0.082
	0.4366						
	0.4359						
10	0.175	0.174	0.003	0.005	0.187	0.161	3.042
	0.179						
	0.1685						

LS = upper limit; LI = lower limit; CV% = variation coefficient average

As evidenced by the graphical representation (Fig.1), as well, the obtained values oscillate over the 0.172 - 0.432 UE/g/min.

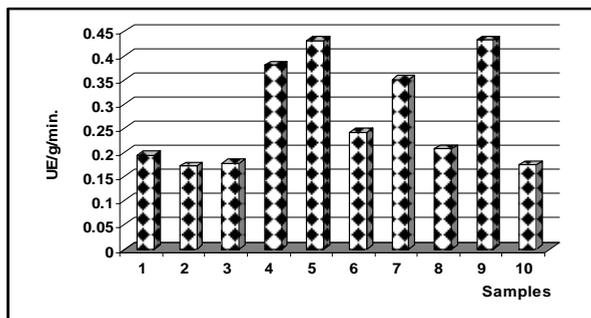


Fig.1. Representation of the average alanine-aminotransferase activity in the median part of the digestive tube in one summer-old *Aristichthys nobilis*

In four summer-old adults, the activity of alanine-aminotransferase record a significant increase, the minimum value being of 0.36 UE/g/min., while the maximum threshold was of 0.781 UE/g/min. - which agrees with the values provided by the literature of the filed (MISĂILĂ et al., 1990; VASILE et al., 2006).

Table IV. Alanine-aminotransferase activity from the median part of the digestive tube in four summer-old *Aristichthys nobilis*

Samples	Individual activity (UE/g/min.)	Average activity (UE/g/min.)	Standard error	Standard deviation	LS	LI	CV%
1	0.7831	0.781	0.002	0.005	0.794	0.768	0.655
	0.7756						
	0.7854						
2	0.4365	0.443	0.004	0.008	0.464	0.422	1.907
	0.4411						
	0.4529						
3	0.3598	0.360	0.0004	0.0007	0.362	0.358	0.208
	0.3611						
	0.3598						
4	0.4461	0.444	0.003	0.006	0.461	0.427	1.542
	0.4366						
	0.4499						
5	0.5256	0.529	0.003	0.005	0.543	0.516	1.004
	0.5359						
	0.5284						
6	0.4681	0.471	0.003	0.005	0.486	0.456	1.261
	0.4783						
	0.4679						
7	0.5483	0.548	0.009	0.016	0.588	0.508	2.925
	0.5331						
	0.5652						
8	0.5461	0.547	0.0006	0.001	0.549	0.544	0.193
	0.5482						
	0.5469						
9	0.4517	0.454	0.001	0.002	0.459	0.448	0.530
	0.4538						
	0.4565						
10	0.5391	0.535	0.007	0.012	0.565	0.505	2.270
	0.5217						

	0.5451					
--	--------	--	--	--	--	--

LS = upper limit; LI = lower limit; CV% = variation coefficient average

For an as complete as possibly image of the activity of alanine-aminotransferase in the median segment of the digestive tube in four summer-old *Aristichthys nobilis* adults, the obtained results have been graphically plotted (Fig.2).

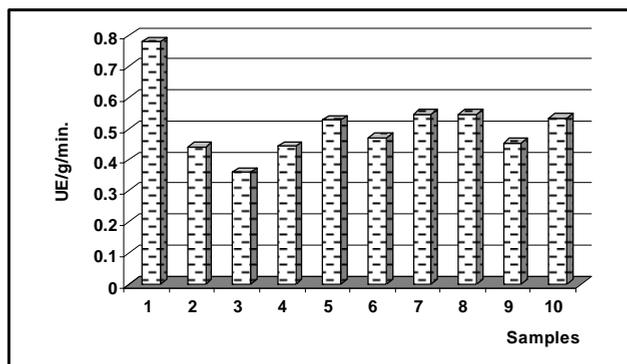


Fig.2. Representation of the average alanine-aminotransferase activity in the median part of the digestive tube in four summer-old *Aristichthys nobilis*

On the basis of the average values and of standard deviation, the (upper and lower) limits of the confidence intervals of α -amylase activity have been subsequently calculated as a function of a critical value $t(\alpha, n-1)$, given by $\alpha = 0.05$ (i.e., a probability ratio of 95%), and n degrees of freedom (where n represents the number of values within each sample), that is $t(0.05, 9) = 2.262$ (VARVARA *et al.*, 2001).

Figures 3 - 4 show that the limits of the confidence intervals are vary narrow, in both one and four summer-old individuals.

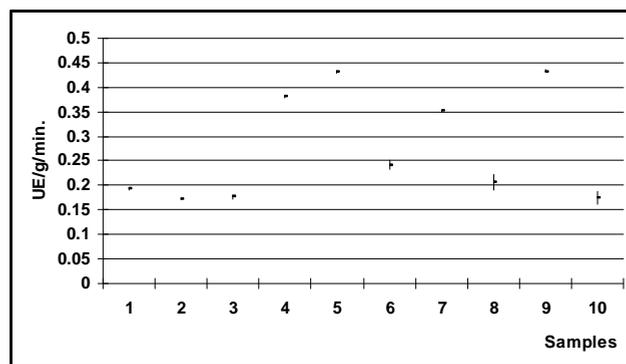


Fig.3. Confidence intervals of the alanine-aminotransferase activity in the median part of the digestive tube in one summer-old *Aristichthys nobilis*

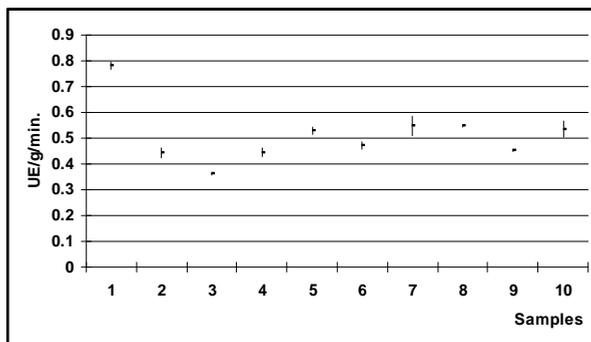


Fig.4. Confidence intervals of the alanine-aminotransferase activity in the median part of the digestive tube in four summer-old *Aristichthys nobilis*

The considerable increase of the activity of alanine-aminotransferase in the four summer-old representatives of the *Aristichthys nobilis species*, comparatively with the one summer-old ones, may be evidenced by the graphical representation of the individual enzymatic values (Fig.5).

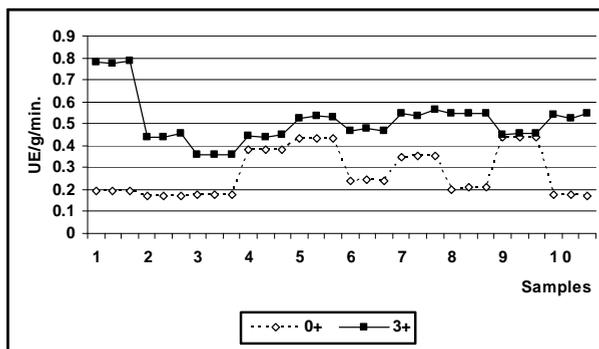


Fig.5. Comparative representation of the individual values of the intestinal alanine-aminotransferase in different stages of development

The second enzyme taken into study was aspartate-aminotransferase. The data listed in Table V and Figure 6 show that the activity of aspartate-aminotransferase in one-summer old individuals of bighead carp records quite ample oscillations, the minimum value being recorded in individual 6 (0.170 UE/g/min.), while the minimum one - 2.3 times higher - appears in no 7 (0.388 UE/g/min.).

Table V. Aspartate-aminotransferase activity from the median part of the digestive tube in one summer-old *Aristichthys nobilis*

Samples	Individual activity (UE/g/min.)	Average activity (UE/g/min.)	Standard error	Standard deviation	LS	LI	CV%
1	0.1888	0.189	0.0002	0.0004	0.0190	0.180	0.242
	0.1897						
	0.1891						
2	0.3333	0.333	0.001	0.0018	0.0338	0.328	0.559
	0.3356						

	0.3319						
3	0.3611	0.361	0.0006	0.001	0.363	0.358	0.295
	0.3625						
	0.3604						
	0.293						
4	0.2936	0.293	0.0004	0.0007	0.295	0.291	0.257
	0.2945						
	0.3333						
5	0.3365	0.334	0.0009	0.0016	0.338	0.330	0.477
	0.3349						
	0.1708						
6	0.1715	0.170	0.0003	0.0006	0.172	0.169	0.352
	0.1703						
	0.3888						
7	0.3867	0.388	0.0007	0.0013	0.391	0.384	0.355
	0.3893						
	0.2888						
8	0.2875	0.288	0.0005	0.0009	0.290	0.286	0.322
	0.2893						
	0.1944						
9	0.1956	0.194	0.0007	0.0012	0.197	0.191	0.643
	0.1931						
	0.2472						
10	0.2489	0.247	0.0007	0.0013	0.250	0.244	0.498
	0.2465						

LS = upper limit; LI = lower limit; CV% = variation coefficient average

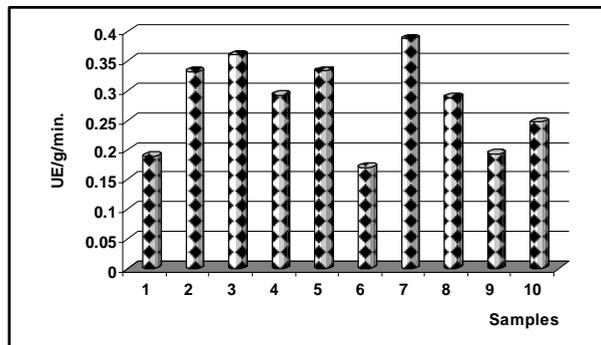


Fig.6. Representation of the average aspartate-aminotransferase activity in the median part of the digestive tube in one summer-old *Aristichthys nobilis*

In four summer-old representatives, the intestinal aspartate-aminotransferase has recorded higher values, which were also much more homogenous, ranging between 0.354 - 0.493 UE/g/min. (Table VI, Fig.7).

GABRIELA VASILE et al – COMPARATIVE INVESTIGATIONS ON THE ACTIVITY OF SOME INTESTINAL AMINOTRANSFERASES, IN THE *ARISTICHTHYS NOBILIS* SPECIES, IN VARIOUS STAGES OF DEVELOPMENT

Table VI. Aspartate-aminotransferase activity from the median part of the digestive tube in four summer-old *Aristichthys nobilis*

Samples	Individual activity (UE/g/min.)	Average activity (UE/g/min.)	Standard error	Standard deviation	LS	LI	CV%
1	0.3998	0.399	0.0003	0.0005	0.400	0.397	0.139
	0.3987						
	0.3994						
2	0.3961	0.396	0.0006	0.001	0.398	0.393	0.269
	0.3954						
	0.3975						
3	0.3751	0.373	0.001	0.0019	0.377	0.368	0.509
	0.3725						
	0.3714						
4	0.3947	0.395	0.0002	0.0004	0.396	0.394	0.119
	0.3956						
	0.3954						
5	0.3583	0.354	0.002	0.004	0.365	0.343	1.246
	0.3565						
	0.3499						
6	0.3985	0.393	0.002	0.004	0.404	0.382	1.156
	0.3924						
	0.3896						
7	0.4735	0.470	0.0008	0.015	0.508	0.432	3.231
	0.4538						
	0.4837						
8	0.3869	0.388	0.0009	0.0016	0.392	0.384	0.423
	0.3897						
	0.3898						
9	0.4841	0.481	0.0032	0.0056	0.495	0.467	1.169
	0.4753						
	0.4858						
10	0.4982	0.493	0.0026	0.0045	0.504	0.482	0.916
	0.4892						
	0.4929						

LS = upper limit; LI = lower limit; CV% = variation coefficient average

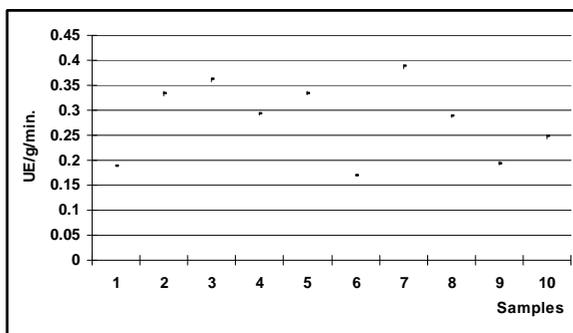


Fig.8. Confidence intervals of the aspartate-aminotransferase activity in the median part of the digestive tube in one summer-old *Aristichthys nobilis*

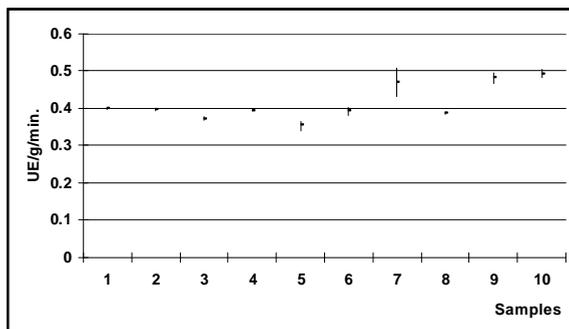


Fig.9. Confidence intervals of the aspartate-aminotransferase activity in the median part of the digestive tube in four summer-old *Aristichthys nobilis*

The individual values of the activity of aspartate-aminotransferase for the two categories of age are interfering, ranging over a much more homogenous domain (Fig.10).

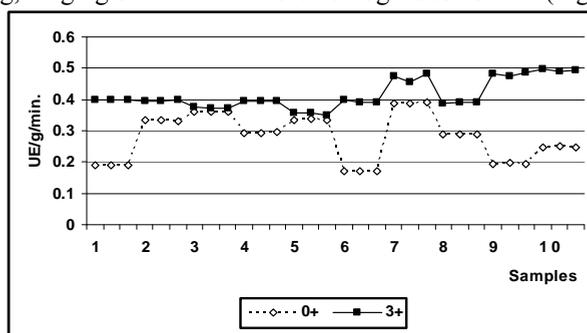


Fig.10. Comparative representation of the individual values of the intestinal aspartate-aminotransferase in different stages of development

For better evidencing the increase in the activity of the two transaminases, as a function of the development stage, a comparative graphical representation has been plotted, on groups of age. Thus, Figure 11 shows that, on one side, the activity of the two enzymes is higher in the four summer-old individuals while evidencing, on the other, the existence of certain differences between the two parameters taken into study, the alanine-aminotransferase being about 1.25 times higher.

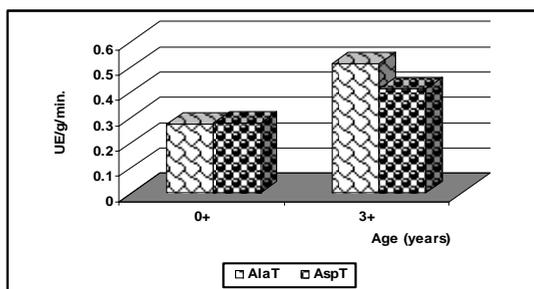


Fig.11. Comparative representation of the average transaminases activity on groups of age

CONCLUSIONS

Analysis of the experimental results obtained led to the following general conclusions:

The ratio between the length of the digestive tube and bodily length gets modified from 2.969, in the fry, to 5.382 in four summer-old individuals, while that between the length of the digestive tube and the standard bodily length is of 3.615 in fry and of 6.173, respectively, in adults.

The activity of the two transaminases increases with age, higher values of alanine-aminotransferase being recorded in four-summer old individuals.

Statistical analysis of the results obtained shows that the limits of the confidence intervals in the activity of the two biochemical parameters under investigations are extremely narrow for both categories of age.

REFERENCES

- APETROAEI, I. MARIA, 2007 - *Creșterea peștilor în sistem intensiv. Studiu asupra salmonidelor și ciprinidelor de cultură*, Ed. "Constantin Matasă", Piatra Neamț.
- ARTENIE, VL., 1990 - *Lucrările S. C. P. Piscicolă* - Iași, 1: 357 - 364.
- ARTENIE, VL., MISĂILĂ, ELENA-RADA, TĂNASE, ELVIRA, MISĂILĂ, C., TOMA, O., 1995 - *Acvacultura și pescuitul*, Vol. I, Galați, 242 - 245.
- COJOCARU, D.C., 2005 - *Enzimologie practică*, Ed. Tehnopress, Iași.
- FERNANDEZ, F., MIQUEL, A. G., MARTINEZ, R., SERRA, E., 1999 - *Journal of Nutrition*, 129 (5): 1053.
- GOMEZ - REQUENI, P., MINGARRO, M., CALDUCH - GINER, J. A., MEDALE, F., 2004 - *Aquaculture*, 232 (1 - 4): 493.
- GROZEA, A., BURĂ, M., 2002 - *Crapul: biologie, sisteme de creștere, patologie*, Ed. de Vest, Timișoara.
- LEE, S. M., LEE, J. H., KIM, K. D., 2003 - *Aquaculture*, 225 (1 - 4): 269.
- MĂRGĂRINT, IOLANDA, 1983 - *Cercetări comparative cu privire la nutriția naturală și artificială a unor ciprinide omnivore și erbivore*, Teză de doctorat, Univ. "Alexandru Ioan Cuza", Iași.
- MĂRGĂRINT, IOLANDA, PORUMB, SILVIA, MATEI, D., ZEILER, F., 1980 - *Cercetări agronomice în Moldova*, Limnologie, 3: 99 - 103.
- MISĂILĂ, C., ARTENIE, VL., TĂNASE, ELVIRA, MISĂILĂ, ELENA - RADA, 1990 - *Lucrările S. C. P. Piscicolă* - Iași, 1: 205 - 216.
- PERES, HELENA, TELES, OLIVA, 2005 - *Aquaculture*, 250 (3 - 4): 755.
- REHULKA, J., 2000 - *Aquaculture*, 190: 27 - 47.
- VARVARA, M., ZAMFIRESCU, Ș., NEACȘU, P., 2001 - *Lucrări practice de ecologie*, Ed. Univ. „Al. I. Cuza” Iași.
- VASILE, GABRIELA, CIORNEA, ELENA, COJOCARU, D. C., 2006 - *An. Șt. Univ. „Alexandru Ioan Cuza” Iași*, s. II a Genetică și Biologie Moleculară, Tom VII, Fasc. 1, 79 - 82.
- ZHAO, M., XIE, S., ZHU, X., YANG, Y., GAN, L., SONG, L., 2006 - *Journal of Applied Ichthyology*, 22 (1): 72 - 78.

1) "Alexandru Ioan Cuza" University of Jassy, Faculty of Biology

*) gabrielavasile2005@yahoo.com