MORPHOLOGICAL AND BIOCHEMICAL STUDY OF THE DIGESTIVE TUBE IN COMMON CARP, PRUSSIAN CARP AND BIGHEAD CARP

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Abstract

The present paper proposed to realize the comparative morphological and biochemical study of the digestive tube for two-summer old Cyprinus carpio, Carassius auratus gibelio and Aristichthys nobilis representatives, grown in a supervised system, using for biometrical and gravimetrical analysis classical methods, and for alanine- and aspartate-aminotransferase, the colorimetric method with 2,4-dinitrophenylhydrazine. The resulted data were processed and interpreted statistically, obtaining a whole tableau of statistical indices which reflects to the best the real situation. In parallel, were analyzed the regression equations drawn on the bases of the Pearson parametrical correlation index, pointing each time on one hand, the degree of reciprocal influence of the two pears of compared variables, and on the other hand the proportion in which the respectively relation is respected. The research's results evidenced, for all the three cyprinid species taken in this study, positive correlations for both pears of variables (the body's standard length-the digestive tube's length, the body's weight-the digestive tube's weight), the registered transaminasic activity presenting higher values for common carp and bighead carp, the minimal level registering in both cases for alanine- so as for aspartate-aminotransferase in Prussian carp (9.82 UE/g/min., respectively, 8.02 UE/g/min.).

Key words: digestive tube, cultured cyprinids, transaminases

INTRODUCTION

In natural dietary, the cyprinids use depending the species, almost without preferences, starting with the first year of life, from planktonic organisms, organisms from fitocenoses and the benthonic ones, up to the aquatic plants' seeds, the leaves' plants buds and the organic detritus. The natural food is found in any moment of the forage period, mixed with pickings of distributed food, either before, either after forage, on some portions of intestinal tractus [10].

The natural food plays, for common carp, an important role in digestion's processes and in special in proteins digestion, in presence of own enzymes, from literature data on the field [5], underlining the fact that this species consumes elements of zoooplanktonophagous origin (in order of preference: polichetes, barnacles, hirudinees, turbelariates, bedbug on water, as well as insects larva and amphibians larva), as well as phytoplanktonophagous.

The Prussian carp, a typical species of slough and calm water, littler pretentious, feeds with plankton, organic rests, water insects and their larva, earthworms, eelworms, little mollusks, seeds and buds of plants, fish spawn, becoming thus a competitor for the food of common carp [5].

The zooplankton represents the preponderant food for common carp, so as for early stage of development, as well as for adult, which consumes more rarely phytoplankton, the trophical spectrum influencing the rhythm of development and the enzymes' activity involved in the proteic's substances metabolism and that of carbohydrates.

The present study aimed the analysis of some biometrical, gravimetrical and biochemical characters of digestive tube at two-summer old cyprinids, derived from the Vlădeni Piscicultural Farm, Iasi county.

MATERIALS AND METHOD

It has been working on a number of 100 representatives of two-summer old common carp (*Cyprinus carpio*), Prussian carp (*Carassius auratus gibelio*) and bighead carp (*Aristichtys nobilis*) grown in a supervised system, the researches following the bodily standard length, the digestive tube length, the body and the digestive tube weight, all the obtained values being statistically processed and interpreted [3, 4], calculating a big number of indices in this sense (average value, error and standard deviation of the average value, variance, range, confidence interval, coefficient of precision and of variation of the average value).

Subsequently it had been passed on the analysis of regression equations between two pears of variables (the standard length of the body - the length of digestive tube, respectively, the weight of body - the weight of digestive tube), indicating in percentage the number of cases in which the relations are respecting each one [9, 12, 13].

From biochemical point of view, the realized study aimed at the determination of some intestinal transaminases activity, namely alanine- and aspartate-aminotransferase, enzymes implicated in the metabolism of exogenous proteins, using the colorimetric method with 2,4-dinitrophenylhydrazine [2].

RESULTS AND DISCUSSION

The cyprinids are omnivore or herbivore species of fish, in which the digestive apparatus is composed from digestive tube and annexes glands, being organisms without stomach, in the structure of digestive tractus differencing three distinct regions: the anterior intestine (esophagus, prestomach), the medium intestine (sleazy) and the posterior intestine (thick). Because of the lack of stomach, at these fishes, the esophagus, which is presented under the form of a short and extensible tube whose walls are composed of knurled muscles, gets directly into the intestine being difficult delimited of this one. The absence of stomach is compensated of a long intestine which overtakes over and over the length of the body. In the fry, this one is presenting as a right tube, whose length doesn't get over 50% from the body's length, once with the growth in age appearing the elbows, so that the intestine presents more cambers [1, 5].

At the population of two summer-old *Cyprinus carpio* the digestive tube length is between 43.293 - 56.906 cm, the value of the rapport between this one and the standard length being approximately 2:1. As regards the digestive tube weight, this oscillates between 9.159 - 13.24 g, what means a rapport of 44:1 towards the bodily weight (Table I).

The analysis of the statistical indices taken into study evidenced the fact that bigger values of average variation and precision coefficients were registered in the case of bodily weight (20.327%, respectively, 9.09%), and the minimum values for the standard length of the body (2.355%, respectively, 1.053%).

Table I. Values of the main statistical indices in two summer-old *Cyprinus carpio* species

Statistical indices	ls (cm)	ltd (cm)	G (g)	Gtd (g)
Average	26	50.1	496.8	11.2
Standard error	0.273	2.451	45.162	0.734
Median	26	50.5	480	12
Standard deviation	0.612	5.481	100.986	1.643
Variance	0.375	30.05	10198.2	2.7
Range	1.5	14	258	4
Minimum	25.5	42	379	9
Maximum	27	56	637	13
Confidence level (95%)	0.761	6.806	125.391	2.041
Upper limit	26.761	56.906	622.19	13.24
Lower limit	25.239	43.293	371.409	9.159
VC%	2.355	10.941	20.327	14.671
m%	1.053	4.893	9.09	6.561

ls = standard length, ltd = length of the digestive tube,
G = weight of the body, Gtd = weight of the digestive tube
VC% = average variation coefficient, m% = average precision coefficient

The next stage in our study was to identify the correlation relations and the drawing of regression equations for a series of pears of variables, on the basis of the Pearson parametric correlation index establishing the degree of connection which may exist between them.

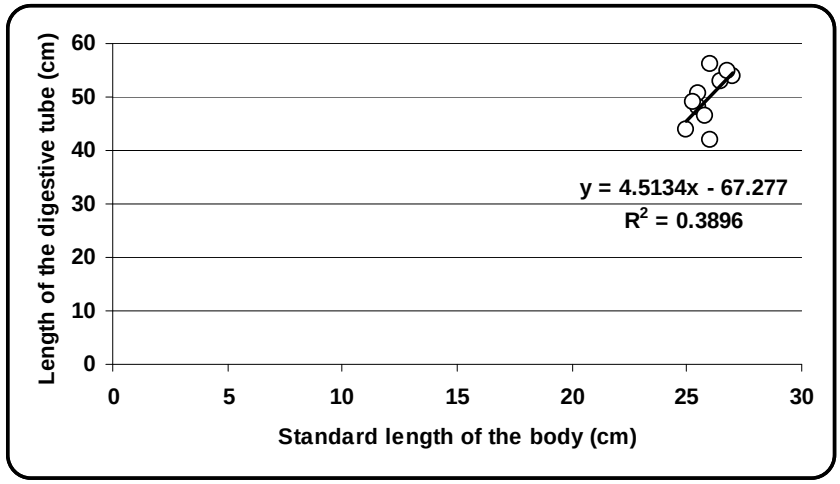

Fig.1. Graphical representation of the regression between standard bodily length and digestive tube length in two summer-old *Cyprinus carpio*

Thus, a first pear of variables analyzed was the standard length - the digestive tube length, Pearson index indicating a positive correlation (r = 0.353), the relation being valid for 38.96% of cases (Fig. 1). The regression coefficients calculated showed that at an 1 cm increase of the standard length of the body, the length of digestive tube increases with 3.166 cm, whereas, at an 1 cm increase of the last one, the standard length of the body increases with just 0.039 cm.

A strongly positive correlation (r = 0.929) was remarked also in the case of the second pear of investigated characters, the values taken of the dependent variable (the weight of the body) being determinate of those taken from the independent variable (the weight of digestive tube) in 63.69% of cases (Fig. 2). So, were estimated the next ones:

- at an1 g increase of bodily weight, the digestive tube weight increases with 0.015g;
- at an 1 g increase of digestive tube, bodily weight increases with 57.148 g.

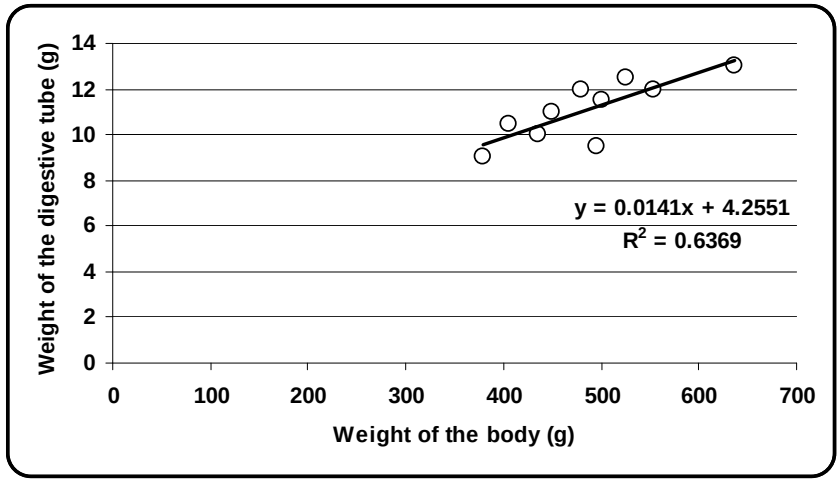

Fig.2. Graphical representation of the regression between bodily weight and digestive tube weight in two summer-old *Cyprinus carpio*

As to the individuals of *Carassius auratus gibelio* species (Table II), we can mention the existence of a value rapport more diminished that than in the case of the common carp concerning the length of digestive tube and the standard length of the body, of just 3:1.

Table II. Values of the main statistical indices in two summer-old *Carassius auratus gibelio* species

Statistical indices	ls (cm)	ltd (cm)	G (g)	Gtd (g)
Average	18.8	60.4	197.6	2.9
Standard error	0.717	9.468	23.892	0.509
Median	18	63	180	3
Standard deviation	1.604	21.173	53.425	1.141
Variance	2.575	448.3	2854.3	1.3
Range	4	55	134	2.5
Minimum	17.5	35	156	1.5
Maximum	21.5	90	290	4
Confidence level (95%)	1.992	26.289	66.336	1.415
Upper limit	20.792	86.689	263.936	4.315
Lower limit	16.807	34.11	131.263	1,484
VC%	8.535	35.054	27.037	39.316
m%	3.817	15.676	12.091	17.582

ls = standard length, ltd = length of the digestive tube,
G = weight of the body, Gtd = weight of the digestive tube
VC% = average variation coefficient, m% = average precision coefficient

With a probability of 95%, at the Prussian carp the medium length of digestive tube oscillates between 34.11 and 86.68 cm, whereas the weight takes values between 1.484 and 4.315 g, which differences net this species to the common carp, in the sense that in the population of Prussian carp exists a pronounced interindividual variability (the limits of confidence interval in the case of digestive tube length being of 34.11 - 86.68 cm in the Prussian carp and just 43.293 - 56.906 in the common carp).

This time too, the Pearson parametric analysis underlined the existence of a positive correlation between the standard length of the body and the length of digestive tube, the determination coefficient indicating a validity of the relation in approximately 70% of cases. In the same time, we can point out the fact that at an 1 cm increase of the standard bodily length, the length of digestive tube increases with 8.533 cm, and at an 1 cm increase of the digestive tube length, the standard length of the body increases with 0.049 cm (Fig. 3).

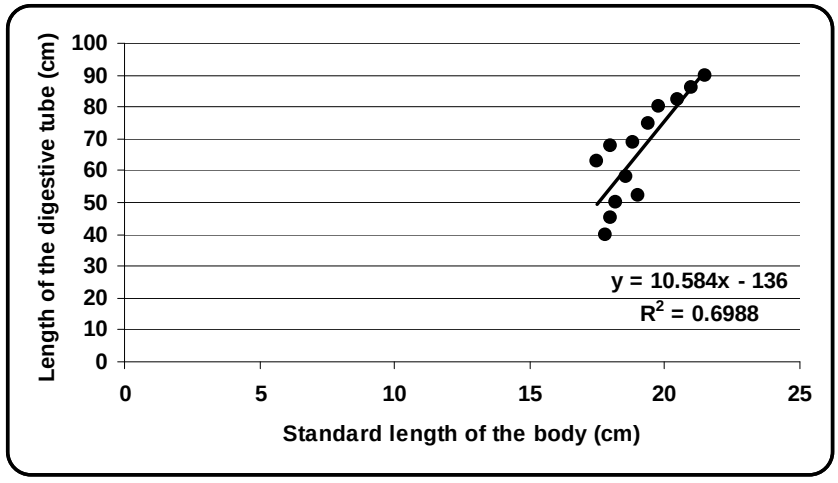

Fig.3. Graphical representation of the regression between standard bodily length and digestive tube length in two summer-old *Carassius auratus gibelio*

From figure 4 it can be seen that the weight of the two analyzed variables are inducing reciprocal in 75.46% of cases, the Pearson correlation index being of the same range of size like in the case above. On the basis of the regression coefficients it could be appreciated that:

- at an1 g increase of bodily weight, the weight of the digestive tube increases with 0.014 g;
- at an 1 g increase of digestive tube weight, the weight of the body increases with 31.881 g.

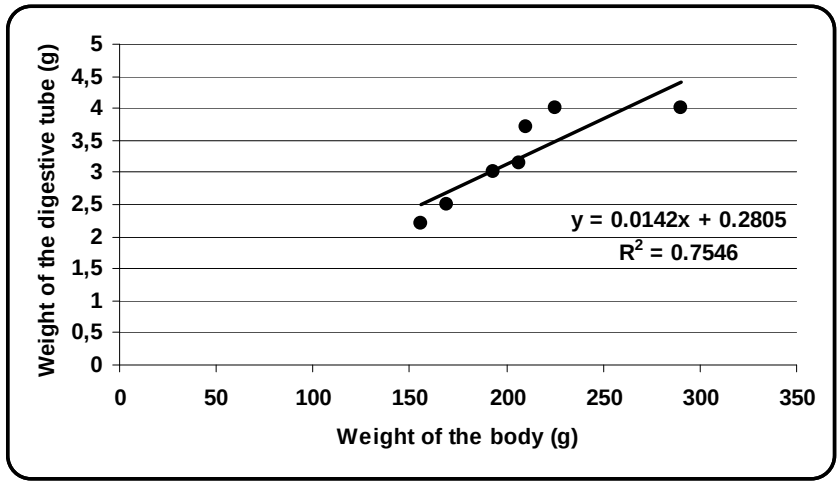

Fig.4. Graphical representation of the regression between bodily weight and digestive tube weight in two summer-old *Carassius auratus gibelio*

The literature data on the field indicates a variability of the digestive tube length on the one hand in function of species, and on the other hand in function of the stage of development of each representative in part, the peaceful species presenting bigger dimensions due to the food hardly to digest which requires a bigger absorption area. In addition, at this aspect contributed also to the growth of cyprinids in supervised arrangements, the administration of rich food in carbohydrates conducting to the elongation of the digestive tube, in comparison to those which consume natural food [1, 11].

Unlike the representatives of species anterior researched, it can be remarked in the case of the bighead carp a favorable net rapport concerning the length of digestive tube and the standard length of the body, the digestive tube overtaking as dimension of 4.56 times the body's length (159 cm, respectively, 34.8 cm). On the basis of the data presented in Table III we can mention that at the individuals of *Aristichthys nobilis* species, the length of digestive tube, in this stage of development oscillates between 143.442 and 174.558 cm, whereas the weight of the intestine takes values between 12.909 - 18.891 g.

Comparatively with the two species taken in study, in the bighead carp the strongest correlation is registered between the standard length of the body and the length of digestive tube (r = 0.887), the two variables influencing each one reciprocally in 76.28% of cases (Fig. 5).

Table III. Values of the main statistical indices in two summer-old *Aristichthys nobilis* species

Statistical indices	ls (cm)	ltd (cm)	G (g)	Gtd (g)
Average	34.8	159	802	15.9
Standard error	0.784	5.603	55.426	1.077
Median	34.5	152	769	15
Standard deviation	1.753	12.529	123.937	2.408
Variance	3.075	157	15360.5	5.8
Range	4.5	27	310	6
Minimum	32.5	148	640	14
Maximum	37	175	950	20
Confidence level (95%)	2.177	15.558	153.888	2.991
Upper limit	36.977	174.558	955.888	18.891
Lower limit	32.622	143.442	648.111	12.909
VC%	5.038	7.881	15.453	15.146
m%	2.253	3.524	6.911	6.773

ls = standard length, ltd = length of the digestive tube,
G = weight of the body, Gtd = weight of the digestive tube
VC% = average variation coefficient, m% = average precision coefficient

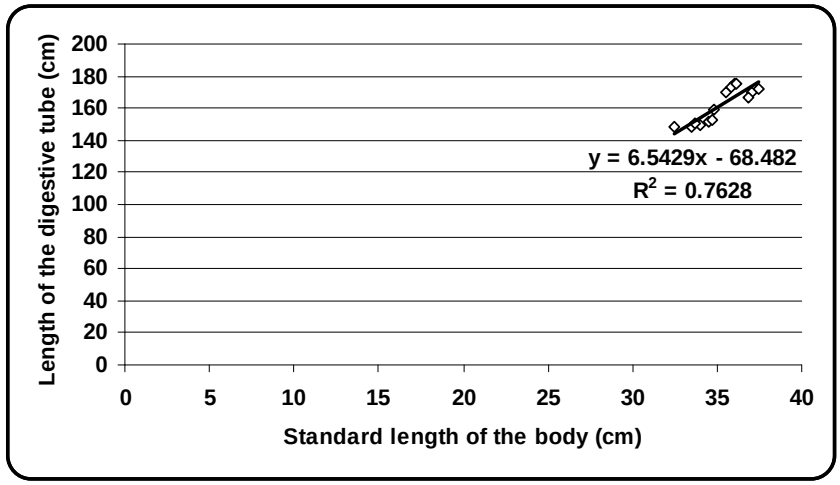

Fig.5. Graphical representation of the regression between standard bodily length and digestive tube length in two summer-old *Aristichthys nobilis*

The values of regression coefficients showed that:
- at an 1 cm increase of the standard bodily length, the length of digestive tube increases with 6.341 cm;
- at an 1 cm increase of the digestive tube length, the standard length of the body increases with 0.124 cm.

The values taken of the body's weight and that of the digestive tube's are influencing each one reciprocal in 50.08% of cases, the regression coefficients indicating a increase with 27.347 g of the corporal weight then when the digestive tube's weight increases with 1 g and just with 0.01 g in the reciprocal situation (Fig. 6).

The last stage of our study was the determination of the alanine- and aspartate-aminotransferase activity at the level of medium intestine, after a prior removal of the intestinal content residue. For this it were taken into study five representatives of common carp, Prussian carp and bighead carp, and for a much better fidelity of the obtained results, for each sample of tissue in part performing three parallel determinations.

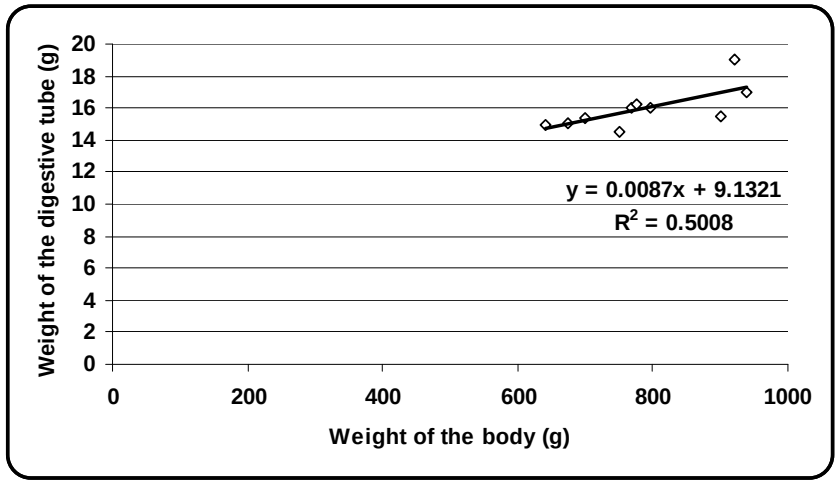

Fig.6. Graphical representation of the regression between bodily weight and digestive tube weight in two summer-old *Aristichthys nobilis*

At the fishes without stomach, the digestion of the proteins is catalyzed of special enzymatic systems, an important role presenting the proteinases and peptidases (trypsin, chimotrypsin, pancreatic enterase, but also the erepsine from the intestinal wall), the digestive tractus having a small alkaline reaction, the cyprinids being specialized in special in the digest with easiness of the fats from the food, but, smaller, and of proteins from it.

After the digestion of exogenous proteins it forms simpler compounds, as tripeptids, dipeptids, respectively, aminoacids, subdue on metabolic transformations, an all-important role having the transamination, realized under the action of specific enzymes.

As regards the glutamate-piruvate-transaminase activity in the representatives of the three species of cyprinids analyzed, we can mention oscillatory values from one specie to another, with a maximum in the case of the common carp and that of the bighead carp (13 UE/g/min., respectively, 12.84 UE/g/min.), whereas at the Prussian carp the enzyme presents an activity of just 75.73% from that registered at the common carp (Fig. 7).

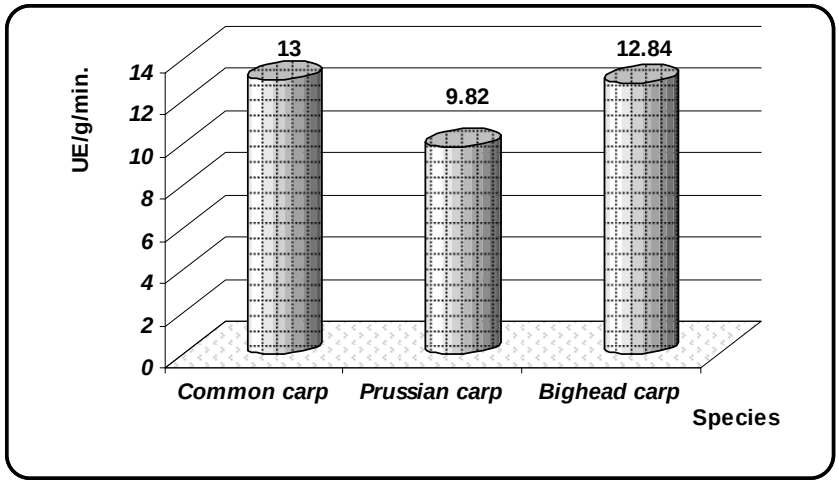

Fig.7. Alanine-aminotransferase activity from the digestive tube in common carp, Prussian carp and bighead carp

It is known the fact that, the alive food of the cyprinids, represented through zooplankton and algal biomass, is a complete food, physiological equilibrated so as to satisfy the nutritive demands of this family, both through the high content in elements with plastically and energetically role in natural food of fishes [6, 7, 8].

The glutamate-oxaloacetat-transaminase presents o fluctuant activity on the one hand from one specie to another, and on the other hand smaller that alanine-aminotransferase of the same individuals. So, the maximum level was registered this time in the case of bighead carp (9. 36 UE/g/min.), followed by the common carp (9.04 UE/g/min.), so as to, also in this case, the minimum activity to be again in the case of the Prussian carp where represents 85.68% from the maximum value (Fig. 8). We can also underline that in the case of this enzyme the activity is smaller comparatively with the transaminase previously analyzed, with 4 units in the common carp, 3.5 in the bighead carp and just 1.8 units in Prussian carp.

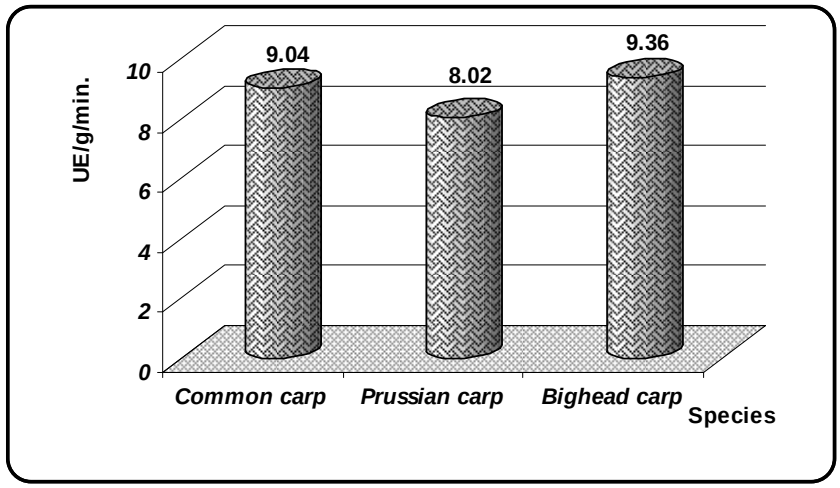

Fig.8. Aspartate-aminotransferase activity from the digestive tube in common carp, Prussian carp and bighead carp

CONCLUSIONS

The obtained results led us to formulate the next conclusions:

- The length of digestive tube is different in function of species, the biggest dimensions evidencing in the case of the bighead carp, in the Prussian carp noticing an pronounced interindividual variability, the population of common carp being, from this point of view, more homogenous.

- The Pearson correlation index indicated the existence of some positive correlations both between the standard length of the digestive tube, as also between the bodily and the intestinal weight, the number of cases in which the relations are respecting each other differing from one species to another.

- At all species of cyprinids taken into study was evidenced an intestinal transaminasic activity, easily differentiated, from one hand to one species to another, and on the other hand in function of the substratum on which acts.

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