EVALUATION OF SOME INDICATORS OF GROWTH OF RAINBOW TROUT (*ONCORHYNCHUS MYKISS* WALBAUM, 1792) IN CASES OF APLICATION OF THREE ALTERNATIVE METHODS OF FEEDING

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Abstract

Three groups of rainbow trout were fed for 75 days with a commercial diet using the manual way of giving the food and its distribution with equipments Demand Feeder and Belt Feeder. Executing mathematical models of calculating, values of allometric coefficient b in length-weight report, condition factor (K) according to Fullton and specific rate of growth (SRG) are determined. The values of coefficient b were allometric positive for the trouts of two experiment groups (b=3.065 for the trouts that took the food at request, and b=3.120 for those that took the food from equipment Belt Feeder) and allometric negative for the trous of control group (b=2.902). The K and SRG values for the trouts that took food from equipment Demand Feeder, for them fed using equipment Belt Feeder and for trouts of control group were respectively 1.113 and 1.8, 1.111 and 1.79, 1.094 and 1.68. The group of trouts that took the food at request had the higher values of growth index.

Key words: rainbow trout, diet, growth index, equipments

INTRODUCTION

The calculation of some indicators of growth is considered as an adequate solution to judge the effectiveness of the execution of the protocols of feeding in the systems of the ictic cultivation [2]. The condition factor (K), the analysis of the regression length-weight and the index of the specific growth (SGR) have been used to evaluate the state of the health of special fish, conditions of the environment, performances of growth of the ictic population, and in general the well-being of the fish that are treated in a cultivation system. The indicators of the growth are parameters enough valid to understand real changes that undergo biologic features of fish populations [3]. The mathematic models of calculation of the indicators of growths offer an objective and practical solution to understand the changes that the intensity of the growth of fish undergoes in the conditions of change of features of the environment or the execution of the alternative practices of cultivation. Diverse version exist which use different variables and concepts to realize the mathematic characterization of growth. It is important to calculate the growth for the specific conditions of an aquaculture, since the rhythm of the increase depends a lot on the type that is being cultivated, the genetic features of the race, the feeding, the quality of the environment, technology which is based on the plant and on some other factors [5].

MATERIAL AND METHOD

The study has been held in the plant of Lin (Pogradec). The trouts have been kept and treated in vetrorezine containers with a capacity of 5m³. The containers were supplied with 1.5 l/min/kg fish, in water the temperature of which is 10-11.3ºC. The experimentation of the usage of the mechanical equipment for the feeding started in mid-May 2012. In three containers were placed 100 trouts with average

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individual weight (M±m) 50.67±1.954 g and average zoological length 16.71±0.210 cm. In one of the containers of the test, the Demand Feeder was mounted (Demand Feeder) while in the other container was mounted a Belt Feeder (Belt Feeder). The trouts of the third container served as a group of control since they were fed by manual spreading of the food.

● **The evaluation of the growth through the analysis of the allometric relation length-weight (L-W)**

The relation through the wet weight (Wg) and the zoological length (Lcm) has the allometric typical form [11]:

$$W = aL^{b}$$

This equation can be expressed in a linearized form, as it has been suggested from [10]:

$$\text{Log } W = \text{Log } a + b\text{Log } L$$

where "a" is the initial coefficient of the growth and "b" is the allometric coefficient or the slope.

The values of the parameters of the report length weight have been calculated through the aggressive linear analysis. The scale of the attachment through the variables was evaluated through the calculation of the coefficient of the correlation (r). The data of the tests were used for the analysis of the variance (ANOVA) for determining the limits of the coefficient 95% and the statistic significance of the values of the elometric coefficient "b"[12]. So as to confirm if the values gained for the coefficient "b" in the equation of the regression were different by the isometric values (b=3) we have applied t-test (*H*o,b=3), with the level of the coefficient from ±95%, expressed in the following equation:

ts = (b-3)/mb

ts–value of t-test; b-value of the allometric coefficient; mb-the standard mistake of the coefficient b.

Later on the comparison of the values gained of the t-test in order to determine the statistic significance of the values of "b" and their positioning in the isometric and allometric orders.

Three samplings have been held during the period of the study. The general length of every trout was measured (Lcm) and the weight was determined (Wg) with accuracy 0.1g. The general length was measured with the metal tape meter, from the top of the upper jaw up to the perpendicular imaginary line which joins the two edges of the feather of the tail. For the two measured parameters the average value was calculated (M), the standard deviation (SD), the standard mistake of the average (m) and the variance (Var).

● **The evaluation of the technology applied for the feeding of through the analysis of the conditioning factor (K) and the index of specific of the specific growth (SGR):**

The factor of the conditioning is calculated using the formula [7]:

$K = (W/L^3) * 100$

K-the conditioning factor

W-the wet weight of the fish (g)

L-the zoological length (cm)

The zoological length cube is calculated because of the fact that the growth of the fish is proportional with the growth of its volume.

The specific growth index was calculated using the formula [13]

SGR= [(lnWt2) - (lnWt1)]/ (t2-t1) x 100

SGR-the specific growth index (% W/days)

W1-the wet weight of the fish in the time t1

W2- the wet weight of the fish in the time t2

(t2-t1)-the time interval or the number of the days between the two following measuring of the weight of the fish.

RESULTS AND DISCUSSIONS

Analysis of the values of the allometric coefficient "b" in the relation length-weight:

In the Ne diagrams of the Figures No. 1, 2 and 3 we have shown the regressions of the relations length weight for the trouts that have been treated in the control group and the two groups of the experiment.

In the Table No.1 we have presented some results of the statistic processing of the data on the length (Lcm) and the weights (Wg) average of the trouts that are cultivated in the group of control and in the two versions of the experiment, after 75 days from the start of the test.

In the diagram of the Figure No. 4 we have shown the average values calculated on the allometric coefficient "b" in the relation length-weight, for a cultivation period of 75

days, for the trouts of the control group and for those two of the test group.

In the test of 75 days that we held from the average values of the allometric coefficient "b", in the relation length-weight, have been b=3.065 for the trouts that have been fed according to the request, b=3.120 for the trouts which were given food with the equipment Belt Feeder and b=2.872 for the trouts of the group of control. The interval of change of the values of this indicator is from the minimum level b=2.604 up to the maximum level b=3.340 [14]. The minimal value calculated for us is in compliance with the calculated value from [4] while the minimal value is close to the figure that is given by [6].

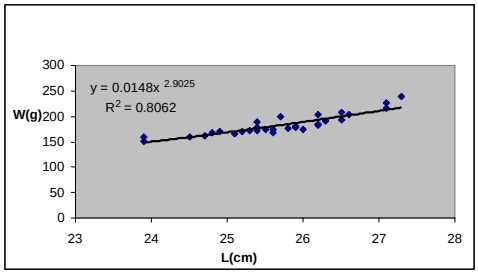

Fig. 1 The regression of the relations length weight for the trouts that have been treated in the control group 75 days from beginning of the experiment (r=0.898)

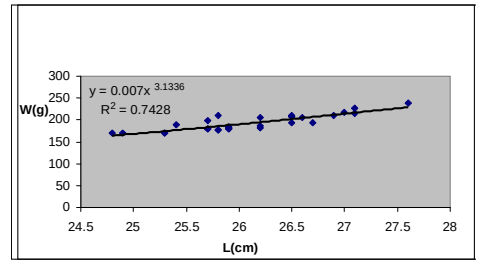

Fig. 2 The regression of the relations length weight for the trouts that have been treated in the experiment group (with Belt Feeder) 75 days from beginning of the experiment (r=0.862)

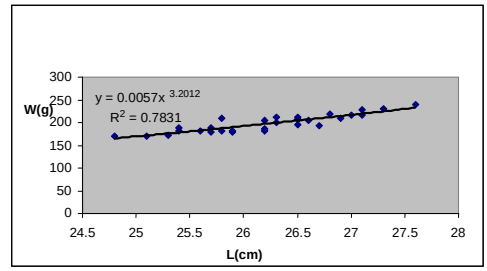

Fig. 3 The regression of the relations length weight for the trouts that have been treated in the experiment group (with Demand Feeder) 75 days from beginning of the experiment (r=0.885)

Table 1 Results of the statistic processing of the data on the length (Lcm) and the weights (Wg) average of the trouts that are cultivated in the group of control and in the two versions of the experiment, after 75 days from the start of the test

No.	Variant	Wmes (g)	Lmes(cm)	σ (W)	M (W)	σ² (W)
1	Control	183.05	25.68	20.67	3.78	427.25
2	Demand feeder	198.13	26.23	18.9	3.46	357.21
3	Belt feeder	193.4	26.1	18.3	3.35	334.89

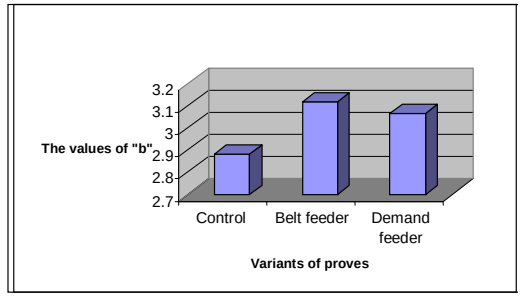

Fig. 4 The diagram of the average values calculated on the allometric coefficient "b"

The figures that resulted form the calculation of the coefficient "b" in the report length-weight, after the conclusion of the experiment, proved that the values of this indicator were positively allometric for the trouts of the two groups of the experiment and the negative allometric for the trouts of the group of control. The significant changes of the values of the coefficient "b", proven during the comparison of the two versions of the experiment with the version of the control, prove the fact that the growth of the trouts that took the food according to the request and those that were given food by the equipment with timer has been better than the comparison of the growth of the trouts of the group of control, which were manually fed.

The certified differences from the statistic elaboration of the data in the values of the allometric coefficient "b", between the trouts of the group of control, were in reality a consequence of the changes that were created in the values of the average weight during 75 days of the execution of the test. After the calculation of the final average weight of the trouts that were treated in the two groups of the test, statistically proven differences were noticed compared to the group of control ($t=2.05$; $P\geq0.95$ for the comparison of Wmes between the group BF and the group K and $t=2.94$; $P\geq0.999$ for the comparison of Wmes between the groups DF and K). The highest individual average weight (198.13 ± 3.46 g) was attained in the version were the trouts took the food according to the request activating the trigger of the equipment Demand Feeder. The best growth of fish that took food as a result of their request, compared to the fish which were manually fed was proven also in other studies [8].

The analysis of the variance confirmed higher values of heterogen of the body sizes of the group of the trouts of the control compared to the two groups of the experiment while the trouts which took the food according to the request were a group that was distinguished for smaller values of the variability of the individual weight of the variability of the individual weight of the body (Wg) compared to the trouts that took the food in limited times from the equipment Belt Feeder.

The factor of the conditioning (K) and the index of specific growth (SGR)

In Figure No.5 we have presented a diagram of average values of the factor of conditioning (K) and the index of specific growth (SGR), for the trouts of the group of control and for those of the two groups of the test.

The values of the conditioning factor, calculated for the groups of the trouts of the experiment have been: (M±m) $K=1.113\pm0.021$ for the trouts that took the food as a result of their request and $K=1.111\pm0.024$ for the trouts which were fed using the equipment with the times. For the trouts of the groups of control the value of the factor of the conditioning was $K=1.094\pm0.011$. Just as the average higher value of the conditioning factor can be noted, it has been calculated for the group of the trouts that took the food according to request, although the differences through the three groups have been small. Even the statistical analysis has not proved significant changes during the comparison of the proof with the group of control, for the average values of this indicator.

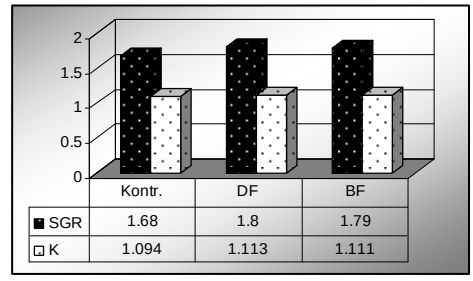

Fig. 5 The values of the factor of conditioning (K) and the index of specific growth (SGR), for the trouts of the group of control and for those of the two groups of the test

The values calculated for the conditioning factor (K) have been in all the cases higher than 1.0. [14], studying the factor of the conditioning of the "rainbow" trout in the plants of the cultivation have proven that the fish has a better conditioning when the value of the factor of conditioning is higher than 1.0 and the worst conditioning worse than the average value, for the same group-length, when the value of K is smaller than 1.0. The researchers mentioned have calculated for the female

individuals of the "rainbow" trouts an average value of K equal to (M±σ) 1.15 ± 0.111. This value is sufficiently close with the figures that have been calculated in this study. [2], experimenting feeding of the three groups of the small trouts with dry food, wet foods and alive foods, have found values of the factor of the conditioning that changed in the interval 1.14-1.18 depending on the temperature of the water and the type of used food.

The average values calculated for the index of the specific growth (SGR) have been 1.80±0.290 for the group of trouts that were fed according to their request, 1.79±0.338 for the group of trouts that took the food from the equipment from the equipment Belt Feeder and 1.68±0.267 for the group of control. Even this indicator has had higher values for the trouts that were self-fed compared to the significant changes through the fish of the two groups of the experiment and those of the group of control have not been proven from the statistical analysis.

The intervals of the values of SGR for the "rainbow" trout, that are met in literature sources, are different. The values of this indicator are affected widely by the age of the individuals that are analyzed, the conditions of the environment and the practiced of the cultivation, implying with the latter in one way the feeding protocols. The size of SGR in the interval 1.47-4.19 have been calculated for the small "rainbow" trouts [9], while the value in the order from 0.40 to 4.8 have been found for trouts that are cultivated in the food plants [2]. For the trouts with initials weight 52.1g a SGR value equal to 1.11 has been determined [1]. This value is 35% smaller than the values calculated in our study for the trouts that have had the same weight at the start of the cultivation. The difference is justified by the fact that our results are referred to trouts that are treated in experimental conditions.

CONCLUSIONS

1. The calculation of the analytical indicators of growth have been applied (the allometric coefficient "b" in relation to length-weight, the conditioning coefficient – "K" and the index of specific growth "SGR") in order to judge the effectiveness of the protocols that are used to feed the fish in the cultivation systems.

2. The figures that resulted from the calculation of the coefficient "b" in the relation length-weight, proved that the values of this indicator were positively allometric for the trouts of the two groups of the experiment and the negatively allometric for the trouts of the group of control. The significant changes of the values of the coefficient "b", proven during the comparison of the two versions of the experiment with the version of the control, prove the fact that the growth of the trouts that took the food according to the request and those that were given food from the equipment with the timer has been better compared to the growth of the trouts of the group of control.

3. The feeding according to the request has guaranteed a better conditioning and a daily weight gain of the trouts compared to the manual feeding or the distribution of the food with the Belt Feeder. The manual feeding according to the request created populations from uniform individuals while in the cases of the feeding while in the cases of the manual feeding, the heterogeneity of the sizes could oblige the cultivators to make frequent selections in order to avoid the food concurrence.

4. The results of this study show that the indexes of production can be improved if farmers feed the trouts with commercial pelleted foods, executing feeding protocols that include the usage of mechanisms which guarantee the feeding according to the request.

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