Ontogenesis Evolution of Body Size Indices in Rainbow Trout (*Oncorhynchus Mykiss*) Reared in Different Growth Systems

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Abstract
Experiments were conducted throughout 2009 and 2010. At the beginning of experiments, both in 2009 and in 2010, were formed two groups (M-control group; E-experimental group), each group far 600 rainbow trout (*Oncorhynchus mykiss*). Control group M has been exploited in the Fiad trout farm, Bistriţa-Năsăud County, and the experimental group E was operated in a recirculating system arranged in Cluj-Napoca. Experiments were conducted over 210 days, both in 2009 and in 2010. Initial body weight of the specimens was 22.70±0.40 g – group M, and 22.68±0.39 – group E, in 2009. In the second experimental series (2010), the initial body weight of the rainbow trout specimens was 22.69±0.28 g – group M, respectively 22.56±0.31 g – group E. To determine the body size indices, we made measurements and weighings in all age groups exploited. Based on measurements, we calculated: K – Fulton condition factor; Ig – thickness factor; Ip – profile indices; Ica – quality indices; Ic1-meat index expressed as percentage of head lenght from standard lenght of fish; Ic2- meat index expressed as percentage of caudal peduncle lenght from standard lenght of fish. Analysing the value of body size indices in rainbow trout in the two test series (2009 and 2010) we found that they are directly proportional to fish weight, but are significantly influenced by the environmeltal conditions and the feeding rate. The mean values of body size indices (K, Ip, Ig, Ica, Ic1 and Ic2) in rainbow trout from the two experimental series, fall within the range cited in the special literature.

Keywords: body size indices, growth technology, ontogenesis, rainbow trout

1. Introduction

Given the interaction between hereditary and environmental factors, the improvement in salmonids can only continue to improve their conditions, according to morphological and physiological features and requirements of the biological material studied [1]. Besides breeding performance of breeding (gonadosomatics indices, sperm viability, hatching percentage, etc..), major importance are the indices on formed body, on which can be improved the morpho-productive performance for future breeding [2]. As defined by heredity, is the continuity of life forms in the succession of generations [3], and various characters own ancestors, are passed on to future generations. Thus, morphological characters will be found breeding in their offspring, thus generating higher fish production due to bio-potential of the individual. From measurements and weighing made, can be calculated some indices of physical format, which can be characterized by a stock of a particular holding or information can be obtained on the condition and form of fish [4].

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2. Materials and methods

Investigations were performed on indices of body form in rainbow trout (Oncorhynchus mykiss) operated in different farming systems: a classic system - Fiad trout, Nasaud County and an experimental recirculation arranged in Cluj-Napoca. Experimental groups (trout Fiad - control group M, recirculation system - experimental group E) were composed of 600 copies rainbow trout. Experiments were conducted in 2009 (the period from February to September) totaling 210 days experimental, being repeated in 2010, observing the same period. Given feed and feeding frequency was identical for both groups. Initial body weight of the specimens was 22.70 ± 0.40 g - 22.68 ± 0.39 M and group g - group E in 2009. In the second experimental series (2010), initial body weight of rainbow trout specimens was 22.69 ± 0.28 g - group M, respectively 22.56 ± 0.31 g - group E. In determining the format index body, we performed measurements and weightings in all age groups exploited. Based on measurements, we calculated the following indices of body format (Table 1): Fulton fattening index (K) also known as condition factor, thickness index (Ig) profile index (Ip), quality index (ICA); carnality index (IC1), expressed as a percentage of standard length and head length, carnality index (IC2), the share of caudal peduncle in standard length of fish (Table 1). Body formed indices (K, Ig, Ip, Ica, IC1, IC2) were determined following Anderson-Neumann methods [5], cited by Bud et al. [6] and Grozea [4].

Table 1. Body format indices of rainbow trout (*Oncorhynchus mykiss*) and the formulae used (according to Anderson-Neumann 1996)

	Body Format Indices	Symbol	Formulae	Abbreviations
1	Fulton Condition Factor	K	$K=\frac{mc}{L^3}\ x\,100$	K – Fulton condition factor; mc – body weight; L – total length
2	Thickness Indices	Ig	$Ig=\frac{Ac\ x\,100}{ls}$	Ig – thickness indices; Ac – body depth; ls – standard length
3	Profile Indices	Ip	$Ip=\frac{ls}{H}$	Ip – profile indices; ls – standard length; H – maximum height
4	Quality Indices	Ica	$Ica=\frac{ls}{P}$	Ica – quality indices; ls – standard length; P – great perimeter
5	Carnosity Indices 1	Ic1	$Ic1=\frac{lc}{ls}x\,100$	Ic1 – carnosity indices 1; lc – head length; ls –standard length
6	Carnosity Indices 2	Ic2	$Ic2=\frac{lp}{ls}x\,100$	Ic2 – carnosity indices 2; lp – caudal peduncle length; ls – standard length

3. Results and discussion

As shown in Figure 1, there is an upward movement of the Fulton condition factor on with age and body mass accumulation in groups M 2009 and M 2010. In terms but lots E 2009 E 2010 respectively, is observed reaching a maximum threshold level of April (K = 1352 - E2009, K = 1.358 - E2010). After this peak, condition factor values begin to decrease, reaching values at study is much lower (K = 1.290 - E2009, K = 1.334 - E2010). This may be due to specific body weight exceeding consumer trout (200-250 g) [7]. It is therefore confirmed that the optimal weight exceeded marketing and consumption, in addition to the drawbacks caused by excessive consumption of feed and lower feed conversion factor (RCF), lead to improperly formed and thus to decrease the amount of meat in carcass, weight relative to other body parts (bones, viscera, fat). Action is therefore required if recirculation systems, need to recover production when Fulton

condition factor reaches the maximum value, a weight of 200-250 g. Thickness index (Ig), expresses muscle width (depth of needle body in the most developed region of the body) against fish standard length (LS) (Figure 2).

If the value of this index will be higher, it will reflect better development of the lateral muscles of fish.

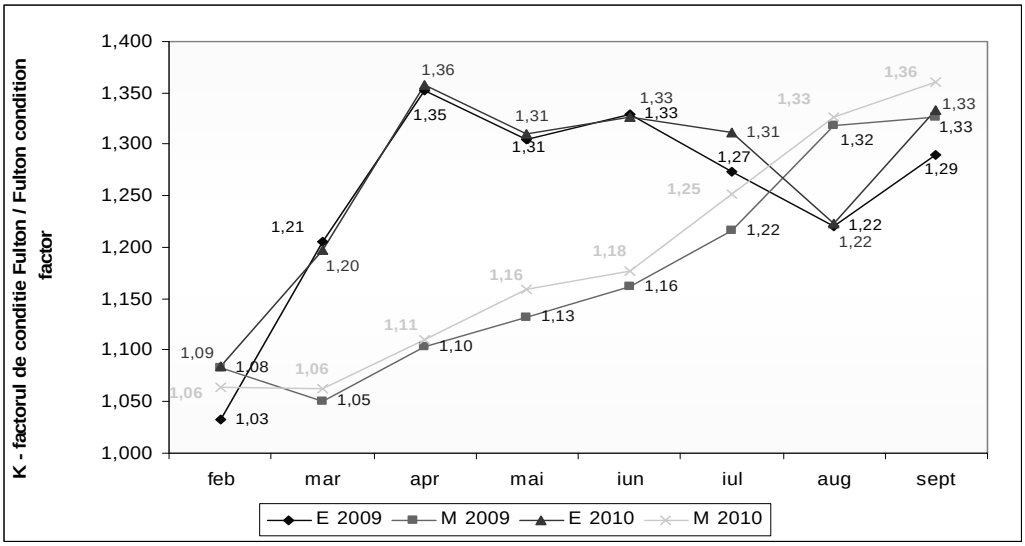

Figure 1. The evolution of Fulton condition factor (K) in rainbow trout (*Oncorhynchus mykiss*)

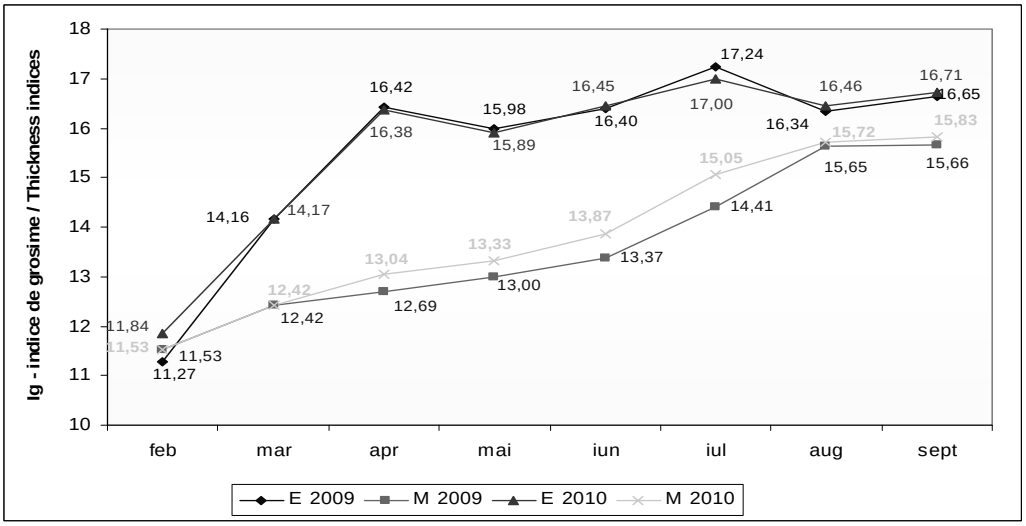

Figure 2. The evolution of thickness indices (Ig) in rainbow trout (*Oncorhynchus mykiss*)

Is observed in both groups and in both test series (2009-2010), a steady and gradual evolution of this index. However, index values of thickness (Ig) were higher in every month of the experiments conducted in the groups E 2009 and E 2010, compared with groups M 2009 and M 2010, showing better muscle development side of the trout in recirculation systems. Profile Index (Ip) highlights the fish body size (Figure 3). The value of this index declines with age and body mass accumulation, which is a progressive accumulation of muscle mass [8]. However, there is lots for E 2009 and E 2010, a fluctuation of the index after its values in April were most favorable (April 2009 Ip = E 3381, E 2010 Ip = 3.378). In Figure 4 is observed a favorable evolution of the quality index (ICA) for both groups (M and E) and both experimental series (2009-2010).

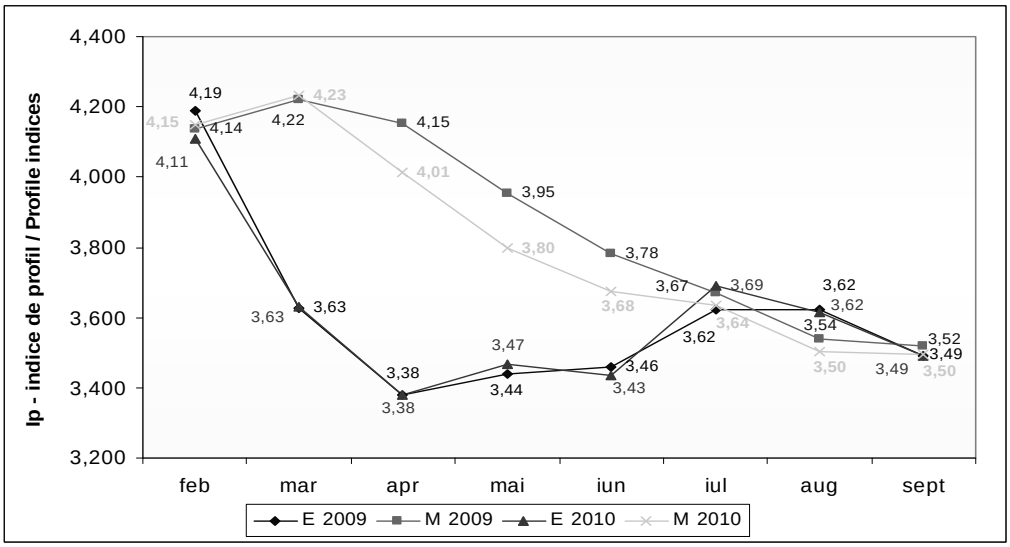

Figure 3. The evolution of profile indices (Ip) in rainbow trout (*Oncorhynchus mykiss*)

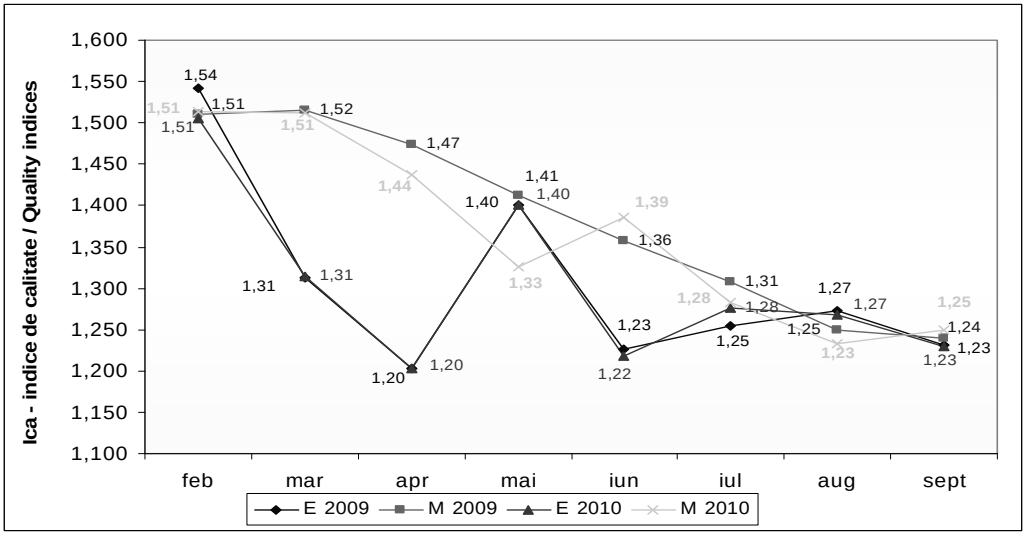

Figure 4. The evolution of quality indices (Ica) in rainbow trout (*Oncorhynchus mykiss*)

Again, however, is observed fluctuations in the index values within batches E 2009 and E 2010. Thus, after the month in April Ica = 1203 (E 2009) in September 1231 reached the value of this index which reflects a higher rate of standard length (LS) compared to the large perimeter (P). The same situation we find in sample E 2010: April Ica = 1.203; September Ica = 1.229. As shown in Figure 5 and 6, the carnality indices IC1 and IC2 were favorable in both groups (M and E) and in both test series (2009 and 2010). It notes, however, faster progress towards optimal values, the groups E 2009 and E 2010, the result of an accumulation of body mass faster than groups M 2009 and M 2010. If carnality index IC1 presented the most favorable values for groups E, in the month April (IC1 = 20 352 E 2009 E 2010 IC1 = 20,469), carnality index IC2 presented the most favorable values in May (IC2 = 16.056 E 2009, IC2 = 15440 E 2010). After time to achieve these favorable values the carnality indices shows a plateau phase (April-June-IC1, IC2-May to July), followed by an unfavorable fluctuation, which means that once exceeded body weights specific marketing rainbow trout (*Oncorhynchus mykiss*), its growth is no longer profitable.

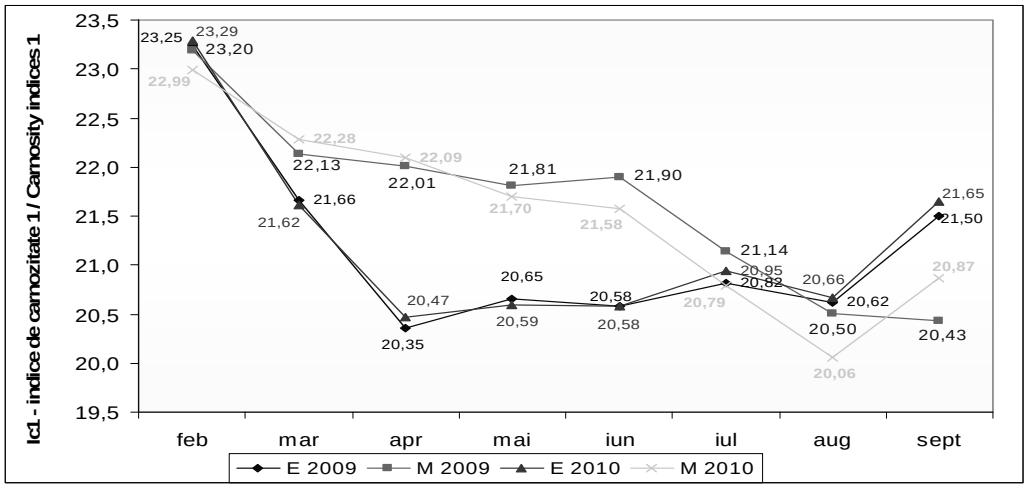

Figure 5. The evolution of carnosity indices 1 in rainbow trout (*Oncorhynchus mykiss*)

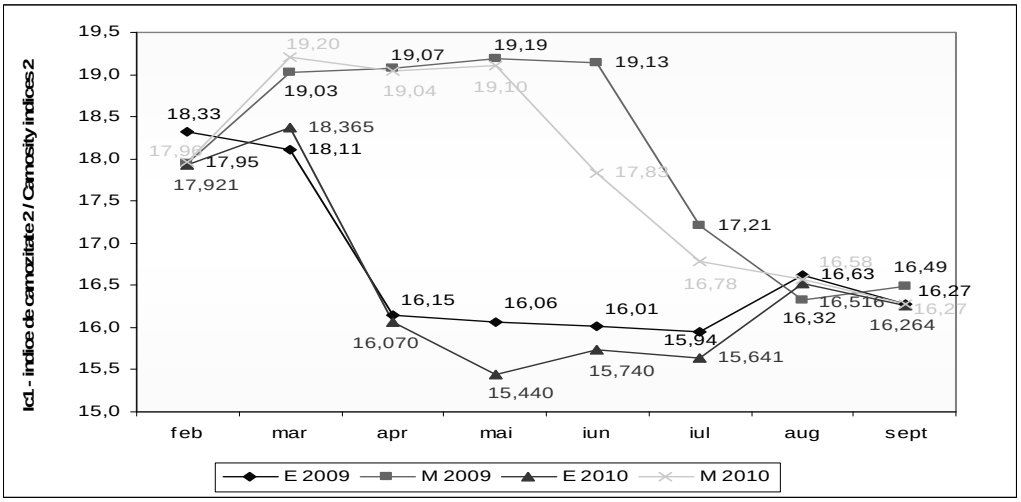

Figure 6. The evolution of carnosity indices 2 in rainbow trout (*Oncorhynchus mykiss*)

4. Conclusions

The results indicate that with the accumulation of body mass, body form studied indices have favorable values. These values were achieved faster in the experimental recirculation system (group E), faster accumulation of body mass (April-May) compared with the classical system operated group (group M). The latter presented the optimum miss August. It also notes that after exceeding the standard body mass marketing of rainbow trout (200-250 g), values of physical format, regardless of study group, entering a plateau phase, followed by positive and negative fluctuations. This indicates that growth in terms of trout for consumption on standard commercial weight should not be exceeded. The results obtained in 2010, confirmed those obtained in the year 2009.

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