The Influence of Extruded Feed with a high Protein Level Upon the Bioproductive Performances Obtained on the Rainbow Trout Females (*Oncorhynchus mykiss*)

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Abstract

The succes of artificial reproduction in the rainbow trout (*Oncorhynchus mykiss*), the development of gonads and the results obtained at incubation are significantly affected by the feeding of the breeders. The use of quality sexual products is decisive for the assurance of the production of viable larvae and further more estimated fish production, so that in addition to the assurance of optimal environmental parameters, the proper feeding of the breeders is required. Starting from the current stage of knowledge in the field, the main objective of the working paper was to highlight the way that differentiated feeding of the rainbow trout females (*Oncorhynchus mykiss*) influences their growth and development. Also, have been followed the effects of the extruded granulated feed with a high protein level on egg weight and the gonosomatic index. The results obtained were structured according to the administrated feed and the age of the females, in identical growing conditions. The body development and performance of breeding obtained in rainbow trout females (*Oncorhynchus mykiss*) were significantly influenced by the quality of the administered feed. The extruded peeled feed with 53% protein proved to be highly effective, materialized trough high growth performances, a better conversion and the growth of gonadal weight.

Keywords: *extruded feed, protein levels, rainbow trout.*

INTRODUCTION

In breeding salmonids, as well as in other branches of aquaculture, the costs of food and feed account for 50-60% of the final production cost (Aba *et al.*, 2012; Kaushik, 2000) and the chemical composition of the feed influences the energy recovery and implicitly the growth rate of fish (Azevedo, 1998; Boaru, 2007). Adjusting feed consumption in fish is influenced by digestibility and energetic value of the mixed fodder (Kaushik and Luquet, 1984), so that in order to satisfy protein and aminoacid needs, the relation digestible protein/digestible energy from the feed (Oprea,

2000) is very important. The energy requirements for the process of reproduction in fish can only be assessed in the long term, through the effort which corresponds to the energy stocked in gonads, in relation with the quantity of ingested energy.

For the majority of fish species, at maturity, the male gonads represent approximately 10% of the entire body weight, and in females they can represent up to 30% of the entire body weight. The average energy content of the eggs, in the majority of fish species is aproximatly 23.5 Kj/g dry matter, regardless of their size. In salmonids, the quantity of stored energy in eggs represents 8-15% of the

entire body energy, which corresponds to the gonosomatic index (Boaru, 2010; Guillaume *et al.*, 1999).

The effects of feeding level, water temperature, composition and preparation mode of the feed on the growth performances and on the use and nutrient assimilation and energy by the salmonids, have been the subject of many studies and speciality research and the results obtained are different (Blom, 1995; Bozkurt, 2006; Gavriilidou, 2003; Memis, 2004). The success of artificial reproduction, the development of gonads, the fecundity and the results obtained during incubation are highly affected from the feeding of the breeders (Izquierdo *et al.*, 2001). Under this aspect, an important part is played by nutrients which are contained in the feed and the quantity and quality of the sexual products can be improved through the insurance of the nutritive quantity and quality of the breeders feed (Boaru, 2010). This can be tackled by using the granulated feed, the reduction of the specific consumption and reduction of nutrient losses. Extruded feed offers the advantage of increasing the digestibility, proper texture, low friability and better floatability (Aba *et al.*, 2012; Oprea, 2000).

The main objective of the study is to highlight the way that the differential feeding of rainbow trout females (*Oncorhynchus mykiss*) has influenced their growth and development. Also, the effects of the extruded granulated feed with a high protein level on egg weight and the gonosomatic index have been followed.

MATERIALS AND METHODS

The research has been conducted at the Remeti trout farm (Bihor county, Romania), and the biological material was rainbow trout (*Oncorhynchus mykiss*) female, which represented the breeding nucleus during 2004-2006. Located at an altitude of 435 m, the Remeti trout farm has two sources of water, providing an average annual

flow rate of 600 L/min, while the temperature of the water has values between 0-21°C, the annual average being 11°C (Tab. 1). The basins are built of concrete and are most likely to be found in many classic trout farms in Romania. Two experimental groups have been designed (C-control, E-high protein), each one formed of 100 females, which have been distributed in the breeders basins at a density of 3 specimens/m². For the feeding of the fish, two types of granulated feed have been used, differentiated both in terms of chemical composition and method of production. The first group (C) has been fed with a classic natural feed with a proteic level of 46%, and for the second group (E), an extruded feed with a proteic level of 53% has been used (Tab. 2).

The differentiated feeding of the rainbow trout females has started in 01.01.2004 and has ended in 2005, along with the triggering of the artificial reproduction process (21.01.2005). As a next step, the 3 year old females have been continually fed with the two feeds for one year, until the triggering of the reproductive process started (20.01.2006). The quantitative level of the feed has been established according to the water temperature and quantity of fish (% of the entire body weight). Prior and during the breeding period body measurements have been performed on a total number of 30 specimens, randomly selected from each constituted group, while sexual products were collected, as well. The following traits were targeted: total length (cm) Lt = the distance from the top of the snout till the top of the lobes of caudal fin; the large perimeter (cm) Pm = the circumference of the body in the right largest height; the body weight Mc = the fish were weighed before the harvesting of eggs; the eggs weight (g) Mi = the harvested eggs were weighed; the gonosomatic index (%) IG = the procentual reporting of the egg weight and the entire body weight.

Tab.1. The water temperature from the trout farm in Remeti according to season

Season	Minimum temperature°C	Maximal temperature °C
Spring	7	12
Summer	14	21
Autumn	12	14
Winter	0	10

The results obtained were structured according to the administrated feed and the age of the females, in identical growing conditions. The growth dynamic of the female rainbow trout from 2 years to 3 years and further up to 4 years was also recorded. The results regarding the mass eggs and gonosomatic index were also analyzed for the two reproductive cycles. Data were statistically analyzed using the Graph Pad Inst 3 programme to highlight the statistical differences between the averages of the two groups (test „t” $p < 0.05$).

RESULTS AND DISCUSSION

In terms of the chemical parameters of water (Tab. 3), the results obtained on the Remeti trout farm fall into category of water suitable for breeding rainbow trout, as the values correspond to the biological and physiological needs of rainbow trout (Order 161/2006).

The growth dynamic of the female rainbow trout (Pc♀) from 2 to 3 years shows significant differences ($p < 0.001$) in favor of the second group (E), for every feature followed (Tab. 4). The ascending evolution shows the fact that the

investments with feed and the energy from the content of the food were used efficiently, but the big differences between those two groups overtly show the performance of group E which was fed with pelleted feed and highest protein level of 7%. The results obtained in increasing body weight reveal the results provided by studies and research performed by Blom and Dabrowski (1995) or Memiş (2004), differences which claim the special influence and the effects of high protein levels from feed on growing performance in rainbow trout (*Oncorhynchus mykiss*).

Referring to the evolution of the females from 3 to 4 years old, the results obtained also highlighted the differences we followed (Tab. 5) and we observed, namely that the biological material continued its growth and development after the first artificial reproduction. For the second group (E), the 4 year old females grew with approximately 5 cm more than the first group (C), in terms of the large perimeter and the body weight, there were really significant differences ($p < 0.001$) between the two groups. We assessed the fact that the extruded feed with a high protein

Tab.2. The chemical composition of the two feeds, expressed as weight of the substance % for a grain size of 8 mm

Specification	Classic peeled feed	Extruded peeled feed
Crude protein (Nx6.25)	46	53
Crude fats	16	20.40
Crude fibers	1.70	1
Ash	9	9
Total phosphorus	1.30	1.40
Digestible energy (MJ/kg)	18	20.8
Raport CP/DE	2.55	2.55

N = nitrogen; CP = Crude protein; DE = Digestible energy.

Tab. 3. Chemical parameters of the water upon entrance and evacuation of the basins

Determined parameters	Entrance	Evacuation
pH unit.pH	7.24	7.74
Hardness dH°	8.68	7.00
Sulphates mg/L	10.00	10.00
Chlorides mg/L	24.00	26.00
Nitrates mg/L	-	3.43
Nitrites mg/L	0.005	0.05
Ammonia mg/L	<0.005	0.10
Iron mg/L	<0.005	0.10
Organic substance mg/L	7.44	9.16
Oxygen mg/L	11.00	9.00

level assures the optimum level of energy with an assured effect on the growth performances in this species, aspect highlighted by Jobling (1993), quoted by Memis (2004).

For egg weight, we also recorded a difference between the two reproductive cycles and between the two groups. The largest egg quantity was obtained in the second reproductive cycle, at the age of 4 years, for both groups. As for the first group, a difference of 43 g was found between the two reproductive cycles under analysis and which is statistically significant ($p < 0.01$). For the second group, the difference was 75 grams higher, which proved to be highly significant statistically ($p < 0.001$). For the gonosomatic index, the difference is highly significant statistically ($p < 0.001$), while an insignificant statistical difference has been observed in the first group (C). For the second group (E), a difference in the favor of the 4 year old females was noticed.

The evolution from 3 to 4 years highlight the fact that the administration of high protein peleted feed greatly influenced the body development and egg quantity obtained from rainbow trout

females. In the case of the extruded peeled with a high protein level of 53%, the performances have been superior to the ones obtained in the first group (C), which was fed with classic peeled feed with a protein level of 46%.

CONCLUSION

The body development and performance of breeding obtained in rainbow trout females (*Oncorhynchus mykiss*) were significantly influenced by the quality of the administered feed and the best results were obtained when the peleted feed with the high protein level of 53% was used. Apart from the growth differences, the influence of high protein level and the type of administered feed on the quantity of the eggs obtained can also be observed, the best performance being achieved by the second lot.

The growth rate and body weight accumulated was higher in the 2-3 years interval for both cases. In the case of the extruded peleted feed, the high energy content was mostly due to the production technology, but also because of the high protein level has significantly contributed to the obtaining

Tab. 4. Differences between females Pc ♀ 2 and 3 years

Feature		Pc ♀ 2	Pc ♀ 3	d	t	Statistical significance	
Lt	C	22.17±0.47	38.73±0.82	16.56	17.52	***	$p < 0.001$
	E	22.39±0.47	50.48±0.38	28.09	46.48	***	$p < 0.001$
Pm	C	12.44±0.16	23.17±0.48	10.73	29.21	***	$p < 0.001$
	E	12.71±0.16	21.29±0.44	8.58	39.68	***	$p < 0.001$
Mc	C	466.99±1 21	833.90±34.23	366.91	10.09	***	$p < 0.001$
	E	471.65±12.26	1494.68±24.92	1023.03	36.84	***	$p < 0.001$

Pc ♀ 2=rainbow trout females 2 year; Pc ♀ 3=rainbow trout females 3 year; Lt=Total length (cm); Pm=Large perimeter (cm); Mc=Body weight (g).

Tab. 5. Differences between females Pc ♀ 3 and 4 years

Feature		Pc ♀ 3	Pc ♀ 4	d	t	Statistical significance	
Lt	C	38.73±0.82	41.67±0.40	2.94	3.22	**	$p \geq 0.01$
	E	50.48±0.38	55.43±0.56	4.95	7.31	***	$p < 0.001$
Pm	C	23.17±0.48	28.96±0.37	5.79	9.55	***	$p < 0.001$
	E	31.29±0.44	33.13±0.39	1.84	3.13	**	$p \geq 0.01$
Mc	C	833.90±34.23	1017.40±26.44	183.50	4.24	***	$p < 0.001$
	E	1494.68±24.92	2345.13±33.03	850.45	20.55	***	$p < 0.001$
Mi	C	150.43±15.96	193.47±12.38	43.04	2.13	*	$p < 0.01$
	E	264.93±11.64	339.93±11.88	75.00	4.51	***	$p < 0.001$
IG	C	10.86±0.36	11.44±0.49	0.58	0.95	ns	$p = 0.344$
	E	17.38±0.60	19.41±0.99	2.03	1.75	*	$p = 0.043$

Pc ♀ 3=rainbow trout females 3 year; Pc ♀ 4=rainbow trout females 4 year; Lt=Total length (cm); Pm=Large perimeter (cm); Mc=Body weight (g); Mi=Weight of roes (g); IG=Gonosomatic index (%). ns=not significant.

of performances in terms of growth and superior reproduction for rainbow trout females.

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