MAINTENANCE STATUS OF RAINBOW TROUT (*ONCORHYNCHUS MYKISS)* REARED IN RECIRCULATING SYSTEM AND IN EARTH PONDS

M.D. Popa[1*], Magdalena Tenciu[1], N. Patriche[1], Elena Mocanu[1], Viorica Savin[1], Desimira Stroe[1]

[1]Institute of Research and Development for Aquatic Ecology, Fishing and Aquaculture, Galați, Romania

Abstract

The aim of this study is the comparative analysis of the anatomical components and the biochemical profile of one-year-old Oncorhynchus mykiss specimens, reared in recirculating system and in earth ponds.

The analysis was performed by portioning the biological material in the main anatomical sections, followed by determining the biochemical parameters (moisture, ash, proteins and lipids), through standard methods of analysis corresponding to each parameter.

Rainbow trout reared in a recirculating system has the meat percentage by 8.43%, the protein percentage by 19.93% and the fat percentage by 26.29% higher, compared to the rainbow trout reared in earth ponds.

Rearing rainbow trout in a recirculating system is advantageous both due to the high production and the high quality of its biological value.

Key words: rainbow trout, technological production, biochemistry

INTRODUCTION

The fish resources found in the natural continental and oceanic waters, throughout time, have covered the food needs of humanity. In the context of the demographic explosion in recent decades and today's upward trend of population growth, there is a risk of permanent destruction of the fragile balance of ecosystems due to their uncontrolled exploitation.

Thus, the necessity to find alternative methods to meet the demand for fishery products arise, as a result of which new methods of rearing fish in fresh, brackish or salty waters, in man-made and controlled environments.

The salmonids production represents, as importance, the second branch of continental fish farming after cypriniculture, and Romania benefits from appropriate conditions for the growth and development of salmonids.

The rainbow trout *Oncorhynchus mykiss*, is an important source of omega 3 unsaturated fatty acids EPA (eicosapentaenoic acid) and DHA (docosahexaenoic acid), but also of proteins with a high degree of digestibility.

The production of rainbow trout at national level shows a significant increase, the National Agency for Fisheries and Aquaculture (ANPA) reported for 2019 a production of 2690 tons [1]. This favourable development is justified not only by the sustainable growth of the species *Oncorhynchus mykiss*, but also by the consumers demand of fishery products with a high biological value. This species reaches both the primary processing sector and canned and semi-canned food products.

Being a fish more resistant and less pretentious to the levels of oxygenation of the water than other trout species, rearing this species can be achieved from the mountainous area of Romania to near the plain area, for growing in earth or concrete ponds on impracticable lands for agriculture or in natural mountain lakes in floating

[*]Corresponding author:
popa.marceldaniel@gmail.com
The manuscript was received: 29.07.2020
Accepted for publication: 08.08.2020

ponds. Rainbow trout can be successfully grown in a recirculating system, which has led to an increase in production volume [5].

The aim of this study is the comparative analysis of the distribution of the anatomical segments and the biochemical profile of the rainbow trout species (*Onchorhynchys mykiss*), aged one year in recirculating system and in earth ponds.

MATERIALS AND METHODS

The biological material studied was the rainbow trout (*Oncorhynchus mykiss*). We analysed 10 fish reared in a recirculating system and another 10 fish reared in earth ponds. The studied specimens were 1 year old.

The recirculating system consists of concrete basins (6m x 6m x 1.5m). The water supply source is made by drilling at a depth of 200 m, with an operating flow Q = 18.6 m^3 / h and a nearby drinking water supply source (40 m^3 / h).

The mountain trout farm has 4 earthen ponds with 1000 m^2 of water surface, which can accumulate a volume of 900 m^3 of technological water. The water supply is provided by a stream from the Siret river basin.

Anatomical weight analysis was performed by portioning the biological material into anatomical sections: head, fins, skin with scales, liver, viscera, meat and bones.

The biochemical analysis of the fish meat was performed according to the standards specific to each biochemical parameter.

Humidity was determined by official standard analysis methods from AOAC (1990) [2].

Total ash was determined by kiln calcination described by AOAC (1990) [2].

The crude protein content of the samples was determined using the Kjeldahl AOAC method (edition 17), which involved the digestion and distillation of proteins, where F (conversion factor) is equivalent to 6.25 [3].

Total fats were determined using the Soxtherm apparatus, equipped with Gerhardt Brand Multistate Controller, with modified AOAC ether extraction methods (edition 17) [3].

Statistical analysis. All analyses were performed in duplicate. Statistical analysis was performed using Excel tools. Mean values are reported along with standard deviations. The coefficient of variation was used to compare the relative variability of the two sets of experimental data obtained. It was determined by evaluating the standard deviation from the arithmetic mean of each sample and was expressed as a percentage. Values between 0 and 15% show a very small data spread, characteristic of a homogeneous sample, the average being representative. Values between 15-30%, show an acceptable data spread, the average being sufficiently representative. Values above 30% characterize an inhomogeneous sample, the average not being representative.

Statistical interpretation of the data was performed according to a significance threshold of $P < 0.05$.

RESULTS AND DISCUSSIONS

The fodder selected to feed the fish complied with FAO specifications for the one-year-old protein content of *Oncorhynchus mykiss*.

In the recirculating system, the trout were fed a 46% protein fodder. In the earth ponds, trout were fed age and species appropriate feed with a 44% protein content.

In the recirculating system, a feed with a higher protein content was used to provide the caloric needs of the fish. In earth ponds, rainbow trout feed on both fodder and zooplankton and macroinvertebrates (insects, snails, crustaceans, etc.).

Growth parameters for rainbow trout in both rearing systems were within the permissible limits for *Oncorhynchus mykiss*, according to the FAO. [7]

Anatomical weight analysis

Following the anatomical weight analysis of the biological material represented by the rainbow trout species (*Oncorhynchus mykiss*), the values presented in table 1 were obtained.

Rainbow trout reared in the recirculating system has an average percentage of meat 4.99% higher than rainbow trout reared in earth ponds. The amount of meat from the rainbow trout considered in the experiment was higher than the values obtained by Skałecki P. et al. for rainbow trout of the same age, reared in 2 farms from Poland, in an intensive system. [10]

Table 1 Anatomical weight distribution for the species *Oncorhynchus mykiss*, reared in recirculating system or in earth ponds

		Weight (g)	***Head (g%)***	***Meat (g%)***	***Skin. scales (g%)***	***Fins (g%)***	***Bones (g%)***	***Viscera (g%)***	***Liver (g%)***
Rainbow trout reared in recirculating system (10 specimens)	Min	357.50	18.23	58.53	6.40	1.45	6.25	6.59	0.47
	Max	365.30	19.00	59.80	7.09	1.55	6.49	6.94	0.58
	Avg±sd*	361.63±2.76	18.61±0.28	59.05±0.44	6.73±0.24	1.49±0.03	6.36±0.07	6.73±0.11	0.51±0.04
	CV**	0.76	1.51	0.74	3.53	2.11	1.17	1.68	7.22
Rainbow trout reared in earth ponds (10 specimens)	Min	325.70	19.51	52.46	6.58	1.56	7.15	6.64	0.37
	Max	346.90	20.32	56.30	7.25	1.87	7.78	10.56	0.55
	Avg±sd*	333.71±7.20	19.86±0.28	54.06±1.48	6.94±0.24	1.72±0.09	7.58±0.18	8.65±1.38	0.48±0.07
	CV**	2.16	1.42	2.73	3.49	5.32	2.33	16.00	13.51

* average value ± standard deviation
** coefficient of variation

In earth ponds, rainbow trout had significantly higher average values for the amount of viscera (1.92% higher) and bone mass (1.21% higher) compared to the biological material in the recirculating system, $P < 0.05$.

Insignificant differences were recorded for the head weight, in the recirculating system the trout having a value by 1.25% lower than the head weight of the specimens from the mountain trout farm.

From the point of view of the values obtained when dividing the rainbow trout reared in earth ponds by anatomical segments, the results are homogeneous, the coefficient of variation being below 15% for each anatomical segment. In rainbow trout reared in a recirculating system, the value of the coefficient of variation exceeds the homogeneity threshold, but the average value remains representative.

Biochemical analysis

Following the biochemical analysis of rainbow trout, the values presented in table 2 were obtained.

Table 2 Biochemical profile of rainbow trout Oncorhynchus mykiss reared in recirculating system or in earth ponds

		Humidity (g%)	Ash (g%)	Proteins (g%)	Lipids (g%)
Rainbow trout reared in recirculating system (10 specimens)	Min	74.21	0.89	17.76	5.38
	Max	74.89	0.93	19.44	5.81
	Average ± sd*	74.56±0.26	0.91±0.01	18.11±0.49	5.59±0.15
	CV**	0.35	1.44	2.73	2.72
Rainbow trout reared in earth ponds (10 specimens)	Min	77.36	1.25	12.60	3.10
	Max	82.29	1.61	15.70	4.80
	Average ± sd*	79.13±1.31	1.45±0.11	14.50±0.81	4.12±0.51
	CV**	1.65	7.47	5.57	12.42

* average value ± standard deviation
** coefficient of variation

The value of proteins was 3.61% higher for rainbow trout reared in recirculating system, compared to rainbow trout reared in earth ponds. The percentage of protein obtained in the experiment in Pakistan, conducted by Naeem M. et al. following the biochemical analysis of 84 rainbow trout with lengths between 4.8-38.5cm and weights

between 1.11-725g, was close to the percentage of protein of the biological material reared in earth ponds in the current experiment but significantly lower than the percentage of proteins for the fish reared in the recirculating system [8].

The percentage of lipids was 1.47% higher in the biological material taken from the recirculating system compared to the biological material reared in earth ponds, but the average values were lower than those obtained by Souza M. L. R. et al. for rainbow trout reared in an intensive recirculating system, with a similar weight [11].

The percentage of humidity was lower by 4.57% for the biological material reared in recirculating system compared to the trout in the earth ponds, values comparable to those obtained by Nistor C. E. et al. when analysing the chemical composition of meat for 3 trout species (including *Oncorhynchus mykiss*) from 2 trout farms in Moldova in 2013 [9], but higher than the values obtained by Celik M. et al. for rainbow trout of the same size caught in Turkey [4].

The ash recorded values by 0.54% higher in the rainbow trout reared in the earth ponds compared to the fish from the recirculating system, values comparable to those obtained by Coroian C.O. et al. in 2014 in the experiment in which the cheese was used as a substitute for lipids from a classic fodder used to feed rainbow trout in a family farm in Suceava [6].

The differences were significant for all biochemical parameters analysed, $P < 0.05$.

The coefficient of variation regarding the biochemical components was below 15% for all the analysed parameters, a property characteristic for homogeneous results.

It can be observed an increase in humidity in rainbow trout reared in earth ponds to the detriment of proteins and lipids content.

CONCLUSIONS

One-year-old rainbow trout (*Oncorhynchus mykiss*), reared in a recirculating system, has a higher technological yield due to better assimilation of fodder, compared to rainbow trout reared in earth ponds.

The rearing in the recirculating system favourably influenced the nutritional quality of the rainbow trout involved in the experiment.

REFERENCES

[1] National Agency for Fisheries and Aquaculture, http://www.anpa.ro/
[2] AOAC,1990: Official methods of analysis of the AOAC, 15th edition.
[3] AOAC 17th edition, 2000, „Official methods 928.08 Nitrogen present in meat”
[4] Celik M., Gökçe M. A., Başusta N., Küçükgülmez A., Taşbozan O., Tabakoğlu Ş. S., Nutritional quality of rainbow trout (*Oncorhynchus mykiss*) caught from the Atatürk Dam Lake in Turkey, Journal of Muscle Foods 19 (2008) 50–61. Blackwell Publishing
[5] Cocan D. I., 2008, Rearing of rainbow trout in recirculating system and controlled environmental conditions, publisher Bioflux, Cluj-Napoca
[6] Coroian C. O., Coroian A., Răducu C. M., Atodiresei A. C., Cocan D. I., Mireşan V., Influence of various fat levels on meat quality în rainbow trout (*Oncorhynchus mykiss*) and brook trout (*Salvelinus fontinalis*), Aquaculture, Aquarium, Conservation & Legislation International Journal of the Bioflux Society, 2015, Volume 8, Issue 6.
[7] FAO - http://www.fao.org/fishery/affris/ species-profiles/rainbow-trout/rainbow-trout-home/en/
[8] Naeem M., Salam A., Zuberi A., Proximate composition of freshwater rainbow trout (*Oncorhynchus mykiss*) in relation to body size and condition factor from Pakistan, Pak. J. Agri. Sci., Vol. 53(2), p. 468-472; 2016
[9] Nistor C. E., Pagu B. I., Albu A., Păsărin B., 2014, Study of meat physical-chemical composition of three trout breeds farmed in salmonid exploitations from Moldova, Animal Science and Biotechnologies, 2014, 47 (2), p. 190
[10] Skałecki P., Florek M., Litwińczuk A., Staszowska A., Kaliniak A., The nutritional value and chemical composition of muscle tissue of carp (*Cyprinus carpio* L.) and rainbow trout (*Oncorhynchus mykiss* Walb.) obtained from fish farms in the Lublin region, Scientific Annals of Polish Society of Animal Production - Vol. 9 (2013), No 2, p 57-62
[11] Souza M. L. R., Macedo-Viegas E. M., Zuanon J. A. S., Carvalho M. R. B., Souza dos Reis Goes E., Processing yield and chemical composition of rainbow trout (*Oncorhynchus mykiss*) with regard to body weight, Acta Scientiarum. Animal Sciences v. 37, n. 2, p. 103-108, Apr.-June, 2015.