

# THE BIOCHEMICAL EVALUATION OF AQUACULTURE RAINBOW TROUT MEAT, IN CONDITION OF PROBITICS ADMINISTRATION

Mirela Mocanu (Crețu)<sup>1\*</sup>, V. Cristea<sup>1</sup>, Lorena Dediu<sup>1</sup>, Angela Docan<sup>1</sup>,  
Săndița (Ion) Plăcintă<sup>1</sup>, Alina Antache<sup>1</sup>, M.T. Coadă<sup>1</sup>

<sup>1</sup> "Dunărea de Jos" University of Galati, Romania

## Abstract

The purpose of this experiment was the evaluation of biochemical composition of juvenile rainbow trout meat, in condition of BioPlus2B® probiotic administration (*Bacillus licheniformis* (DSM 5749) and *Bacillus subtilis* (DSM 5750), in proportion of 1:1) in feed, in different concentrations: V<sub>1</sub>:22.4x10<sup>9</sup>, V<sub>2</sub>:38.4x10<sup>9</sup> and V<sub>3</sub>: 70.4x10<sup>9</sup> CFU g<sup>-1</sup>. The analyses were performed in the research laboratory of Aquaculture, Environmental Science and Cadastre Department, Faculty of Food Science and Engineering, Galati and consist in various determinations that aim to evaluate the meat content in protein, lipids, dry matter and ash, for this species. At the end of the experiment it was found that introducing of probiotic BioPlus2B® in rainbow trout feed, increased the protein content in meat (from 13.86% to 16.89% in version V<sub>1</sub>), decreased the lipids content (from 6.59% to 4.32% version V<sub>1</sub>) and moisture (from 78.17 to 77.19% in version V<sub>1</sub>). So, we can say that an optimal dose of probiotic can lead to meat nutritive quality improvement.

**Key words:** rainbow trout, biochemical composition, recirculating aquaculture system

## INTRODUCTION

Rainbow trout is appreciated by consumers due to the particular organoleptic characteristics of meat. The biochemical knowledge of fish meat presents a special importance being the base for several considerations regarding general physiological status of fish, over the feed capitalization. Biochemical composition is the main element based on which we can evaluate the nutritional value of meat.

Probiotics are usually live microorganisms which when administered in adequate amounts confer a health benefits on host. [3]

Probiotics in aquaculture has been shown to have several modes of action: competitive exclusion of pathogenic bacteria through the production of inhibitory compounds; [10] improvement of water quality; [6] stimulates the digestive process by producing enzymes, improves the resistance of fish to diseases [2].

*Bacillus* species are capable of secreting enzymes such as protease and can result in faster digestion of the protein components in the diet and convert them to simpler peptides and amino acids by peptilytic and proteolysis enzymes [4].

The purpose of this experiment was to determine the biochemical composition of juvenile rainbow trout meat in conditions of feeding them with feed embedded with Probiotics BioPlus®2B, for 4 weeks.

## MATERIAL AND METHODS

The experiment was conducted between February and March 2011 in the pilot recirculating system of Aquaculture, Environmental Science and Cadastre Department. The recirculating system consists in 4 rearing units with a volume of 0.320 m<sup>3</sup> each (40 × 80 × 100 cm) and a water quality conditioning unit. The purpose of the conditioning unit is to control and maintain in an optimum domain the main physical-chemical parameters of the water: oxygen content, the concentration of

---

\*Corresponding author: cretu\_mirela2003@yahoo.com  
The manuscript was received: 24.04.2012  
Accepted for publication: 06.05.2012

ammonia nitrite, the concentration of solid particles, the pH and the carbon dioxide.

The biological material used for this experiment was represented by juvenile rainbow trout with a initial average weight ( $\pm$ SEM) of  $101.96 \pm 2.26$  g, was fed with 1P Extra Classic feed, pellets, containing 41% crude protein (Table 1), in which has been incorporated/supplement of a probiotic product of different concentrations BioPlus® 2B: V<sub>0</sub> - 41% crude protein pellets without probiotic; V<sub>1</sub> - pellets with 41% crude protein with probiotic concentration of  $2224 \times 10^9$  CFU / kg feed; V<sub>2</sub> - pellets 41% crude protein with probiotic concentration of  $38.4 \times 10^9$  CFU / kg feed; V<sub>3</sub> - pellets with 41% crude protein with probiotic concentration of  $70.4 \times 10^9$  CFU / kg feed. Feeding ratio was 3% BW/day. The daily amount of feed was distributed in three meals/ day.

Table 1 The biochemical composition of Classic extra 1P pellets

Composition	Quantity
Crude Protein %	41,0
Crude fat%	12,0
Crude cellulose %	3,0
Crude ash %	6,5
Phosphorus %	0,9
Digestible energy (MJ/kg)	14,2
Vitamin A (UI)	10000
Vitamin D3 (UI)	1250
Vitamin E (mg)	150
Vitamin C (mg)	75
Cystine%	0.6
Lysine %	2.4
Methionine %	0.75

*Note: Fish meal, fish oil, haemoglobin, full fat soybean, soybean oil, wheat gluten, sunflower flour, wheat and wheat products, BHT.*

To determine the biochemical composition of rainbow trout meat, biological material samples were taken both in the initial and final stage of the experiment. When the samples were collected we ensure about the uniformity of specimens in order to eliminate errors due to differences in mass of the specimen. The biochemical determinations were performed on muscle tissue samples and later, from the mixture, homogeneous samples were taken.

Proteins were determined with Gerhardt type equipment by using Kjeldahl method, fats were determined by Soxhlet solvent extraction method (petroleum ether) with Raypa extraction equipment, dry matter was determined by heating at temperature of  $105 \pm 2^\circ\text{C}$  using Sterilizer Esac and ash was evaluated by calcification at temperatures of  $550 \pm 20^\circ\text{C}$  in a Nabertherm furnace.

The rearing indicators of experimental biologic material in those are involved the biochemical parts as: protein rate or retained protein RP and rearing efficiency (PUE), these have been calculated based on following formulas:

- Protein efficiency ratio (PER)

$$\text{PER} = (B_f - B_i) / (F \times P_B), \text{where:}$$

F=quantity of fed administrated (Kg)

P<sub>B</sub>=amount of protein fed (%)

- Protein utilisation efficiency (PUE)= $100(B_f \times P_f - B_i \times P_i) / (F \times P_B)$  (%), where:

P<sub>f</sub>=final body protein (%)

P<sub>i</sub>=initial body protein (%)

- Retained protein (RP):

PR=final individual weight x P<sub>f</sub> -initial individual weight x P<sub>i</sub>.

- Retained lipids (RL):

LR= final individual weight x L<sub>f</sub> - initial individual weight, where:

L<sub>f</sub>=final body lipids (%)

L<sub>i</sub>=initial body lipids (%)

## RESULTS AND DISCUSSIONS

The biochemical composition of meat is influenced by several factors such as fish size, age, environmental and feeding conditions. Regarding water quality, for our experiment the physical-chemical parameters were maintained within the optimal values for *Oncorhynchus mykiss* species, the equipment for the conditioning of the quality succeeded in treating and reusing the technological water. Thus, nitrates recorded value of  $77.08 \pm 18.65$  mg / l, nitrites  $0.01 \pm 0.09$  mg / l and ammonium  $0.05 \pm 0.08$  mg/l. The growth conditions provided by the recirculating system, the feed quality and the manner of distributed feed administrated, was assessed by analyzing of the main

biochemical parameters: crude protein, fats, moisture and ash, biochemical results being shown in the Table 2. Regarding trout meat protein content, this registered a growth with almost 2-3% in the variants feed with probiotic in comparison with the beginning

of the experiment, so in the case  $V_1$  it was registered the biggest percent of protein (16.89%) reported to other variants (16.05% in  $V_2$  case and 15.87% in at  $V_3$ ) and also to the control variant where the protein amount was the smallest, 14.95%.

Table 2 The biochemical composition of rainbow trout meat, fed with BioPlus® 2B probiotic in different concentrations

Initial		Ash (%)	Lipid (%)	Protein (%)	Moisture (%)	M/P
		1.35	6.59	13.86	78.17	5.64
Final	$V_0$	1.29	5.28	14.95	78.51	5.25
	$V_1$	1.36	4.32	16.89	77.19	4.57
	$V_2$	1.34	4.67	16.05	77.85	4.85
	$V_3$	1.32	4.83	15.87	77.93	4.91

At fish, protein represents 12.3-28% of the total weight of meat, being a direct correlation between water content and protein amount [1]. The report between the percentage of water and protein (M/P) from muscular fish tissue reflects its nutritional value.

The ratio M/P characterizes the biological material in terms of nutritional value and state of maintenance. As the value of M/P ratio is lower, the nutritional value is higher.

At the beginning of the experiment, the biological material was characterized by an M/P ratio equal to 5.64 and on the end of the experiment, this ratio decreased at all four groups, reaching to 5.25 in case of  $V_0$  group, 4.57 at  $V_1$ , 4.85 at  $V_2$  and 4.91 at  $V_3$  group. The report M/P is still an insufficient criterion for establishing the fish nutritional value and therefore also the content of fat from fish meat must be taken into consideration

As shown in the table above, the smallest amount of fat from carcass was at specimens from  $V_1$  and  $V_2$  variants where final fat percentage was 4.32%, respectively 4.67%.

Lipids from fish meat varies widely (0.1 to 28.0%), fish being classified in fatty ones, with more than 8% fat, fish with average fattening state, with a content of fat between 4.8% and so called „light fish” with less than 4% fats [8].

The values obtained confirm those presented in literature, regarding the biochemical composition of trout meat (Table 3) [11], and also those reported by other authors which showed that introduction of probiotic BioPlus®2B in different concentrations in rainbow trout feed, leads to an increase of protein content and a decrease of fats and water percentage from meat.

Table 3 The biochemical composition of rainbow trout meat

(%)	<i>Philips and Brockwey, 1956</i>	<i>Bud et.al, 2008</i>	<i>Celik et.al, 2008</i>	<i>Grujić 2000</i>	<i>Plavša et al., 2000</i>	<i>Savić et al., 2004</i>	<i>Čirkvić et al., 2002</i>
Protein	13.70	18.88	19.60	20	18.33	17.13	19-20
Lipid	5.50	2.94	4.43	3.8	7.64	9.07	2.70
Moisture	77.20	77.03	71.65	75	73.52	71.95	76.30
Ash	2.0	1.15	1.36	1.2	1.28	1.45	1.5

In order to evaluate the efficiency of nutrient retention at juvenile rainbow trout, for each experimental variant were calculated the most suitable indicators as follows: retained protein (RP), retained lipid (LR), protein utilisation efficiency (PUE) and protein efficiency ratio (PER).

As shown in figure 1, the smallest amount of retained protein was recorded at fish from control variant (14.14 g / sample), but where it was also retained the largest amount of fat (3.28 g / sample).

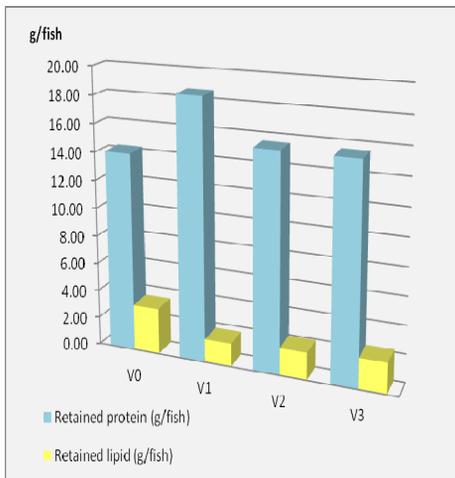


Figure 1 Graphical representation of protein and fat ratio

The protein efficiency ratio (PER) depends by the increasing of body weight and by feed protein content, so the higher the individual growth is, the more PER value increases.

Regarding the efficiency of protein or their productive value (PUE), this is an indicator that does not takes into account the increase of body mass itself, but the addition of fish meat protein [7].

From Figure 2 it can be seen that PER and PUE values significantly increased in V<sub>0</sub>, V<sub>1</sub> variants, where probiotic feed was given, in rapport with control variant, but they decrease with the increasing concentration of probiotic, in feed.

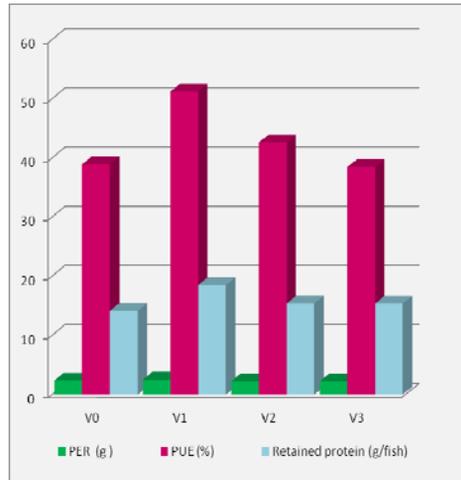


Figure 2 The protein retention efficiency (PER) and protein utilization efficiency (PUE) in relation to total protein intake

## CONCLUSIONS

The increase of protein retention efficiency is a key objective in aquaculture, knowledge of all issues involved in this process representing a successful foundation in this direction.

As a result of trout meat biochemical composition evaluation, it was found that fish from V<sub>1</sub> variant showed a superior quality of meat, reflected by higher protein content and lower fat. Thus, we can say that adding probiotics in fish feed, in very high doses, does not improve biochemical composition of meat, but an appropriate dose of probiotic can induce an improvement in the nutritional qualities of meat.

## AKNOWLEDGEMENTS

The work of Mirela MOCANU (CREȚU) was supported by Project 76822/2010 SOP HRD – TOP ACADEMIC and the work of Sandita (ION) PLĂCINTĂ and M.T. COADĂ by Project SOP HRD–EFICIENT 61445/2009”. The authors thank to the management staff of the project for their financial support.

## REFERENCES

- [1] Ionescu Aurelia si colab. - Procesarea industriala a pestelui, Editura Fundatiei Universitare „Dunarea de Jos”, Galati, 2006.
- [2] Irianto, A., Austin, B., 2002. Use of probiotics to control furunculosis in rainbow trout, *Oncorhynchus mykiss* (Walbaum). *J. Fish Dis.* 25, 333–342.
- [3] Fuller R (1992). History and development of probiotics. In: Fuller R (Ed) *Probiotics: The Scientific Basis*. Chapman and Hall, London. Pp. 1-45.
- [4] Fuller, R. and Perdigón, G. 2003. Gut flora, immunity and health. Blackwell publishing, 276 pp.
- [5] Moreza Alizadeh, Ali Farzanfar, Mahmood Nafisi-Bahabadi, The effect of probiotic Bioplus 2B on growth performance and carcass composition of rainbow trout, *Oncorhynchus mykiss* (Walbaum, 1792) larvae, *Indian J. Fish.*, 58(4) : 55-59, 2011
- [6] Moriarty, D.J.W., 1997. Interactions of microorganisms and aquatic animals, particularly the nutritional role of the gut flora. In: Le´sel, R. (Ed.), *Microbiology in Poecilotherms*. Elsevier, Amsterdam, pp. 217–222.
- [7] Oprea L., Georgescu Rodica-Nutritia si alimentatia pestilor, Editura Tehnica, Bucuresti, 2000.
- [8] Paltenea Elpida, Talpes Marilena, Ionescu Aurelia, Zara Margareta, Vasile Aida, Mocanu Elena, 2007-Evaluarea calitatii carnii sturionilor de cultura in stare proaspata si refrigerata, *Lucrari stiintifice, Zootehnie si Biotehnologii*, Vol 40 (2) 433-443, Timisoara
- [9] Sahu, M.K., Swarnakumar, N.S., Sivakumar, K., Thangaradjou, T., Kannan, L. 2008. Probiotics in aquaculture: importance and future perspectives. *Indian J Microbio* 48: 299-308.
- [10] Vine, N.G., Leukes, W.D., Kaiser, H., 2004a. In vitro growth characteristics of five candidate aquaculture probiotics and two fish pathogens grown in fish intestinal mucus. *FEMS Microbiol. Lett.* 231, 145–152.
- [11] Vranić Danijela, Đinović-Stojanović Jasna, Spirić Aurelija, Rainbow trout (*Oncorhynchus Mykiss*) from aquaculture– meat quality and importance in the diet, *Tehnologija mesa* 52 (2011) 1, 122–133.