Methods to Improve the Nutrition of Brook Trout (*Salvelinus fontinalis* M.) by Using Foder Additives (Bio-Mos, Nupro, Sel-plex)

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Abstract

The research aimed to determine the effects of some fodder additives (Bio-Mos, Nupro and Sel-plex) on growth and consumption indices, meat quality and survival rate in brook trout. The research has been carried out on a number of 1000 fishes, randomly distributed in 4 groups (250 fish/group): a control group, group 1E (Bio-Mos 0.2%), group 2E (NuPro 2%) and group 3E (Sel-plex 0.03%); the experimental period was 250 days. During the experiment the following parameters were recorded and analyzed: body mass evolution, weight gain, specific growth rate, feed conversion ratio (FCR), meat quality and survival rate. The best results were recorded in group 1E (Bio-Mos 0.2%), with a body weight of 248.45 g, a weight gain of 228.45 g and a FCR of 1.18 kg fodder/kg weight gain. The high values of meat Selenium content show the cumulative effect of organic Selenium in the fish meat; as a result, this meat can be considered a functional food. The highest survival rate was recorded in group 3E (95.60%), receiving dietary Selenium supplementation.

Keywords: *fodder additives, brook trout, growth and consumption indices, meat quality, survival rate*

INTRODUCTION

Prebiotics and organic minerals are of great interest in fish nutrition.

The positive effects of Bio-Mos prebiotic on salmonids have been reported by Staykov *et al.* (2005) and Dimitroglou *et al.* (2005). The use of Bio-Mos prebiotic leads to the improvement of the growth rhythm and bio-mass accumulation, to a better feed conversion and the subsequent reduction of FCR, and to an increased survival rate (Barbu, 2010; Hossu *et al.* 2005; Torrecillas, 2011). A new tendency in aquaculture is to replace the sources of animal proteins in feeds; thus the feed manufacturers are searching for alternative protein sources that are more digestible and palatable. Such an alternative is represented by yeasts extracts, such as the NuPro protein extract, which has favorable effects on production and

reproduction performances of fishes and also on their health status (Burrells *et al.* 2001; Gonzales-Vecino, 2002). The organic Selenium used in fish nutrition positively influences the growth rhythm, feed conversion, meat quality, maintains a good health status and reduces mortality rates (Yamb *et al.* 2006)

The aim of the research was to highlight the effects of these additives (Bio-Mos, NuPro and organic Selenium -Sel-plex) on the growth and consumption indices, meat quality and survival rates in brook trout.

MATERIALS AND METHODS

The experiment was carried out between August 21, 2012 and April 28, 2013 (over a period of 250 days) in a trout farm situated in the Upper Transilvania, Cluj county, on 1000 brook trout, divided in

4 groups, as follows: control group, group 1E –that received Bio-Mos supplemented foddors (0.2%), group 2E –that received NuPro supplemented foddors (2%) and group 3E that received organic Selenium enriched foddors (Sel-plex 0.03%). The fishes from the experimental groups were reared in the same environmental conditions (water quality, stocking density, feeding timetable and fodder quality). The values for the physical and chemical parameters of water are within the normal limits for the species, cited by the literature. The feed used was a granulated fodder (Bărbieru, 2012) acquired from *Aqua-Garant* Company (Austria), having the following nutritional characteristics: crude protein 42%, crude fat 16%, crude fiber 3.5%, crude ash 2.5%, calcium 1%, phosphorous 1%, sodium 0.20%. Throughout the experimental period the following parameters were recorded: body mass evolution, weight gain, specific growth rate, FCR, meat quality and survival rate.

The determination of meat quality was based on the chemical composition of meat (water, dry matter, crude protein, and crude fat) and was carried out in the Laboratory of Feed Quality Control from UASVM Cluj Napoca. The Selenium content of meat was determined using the atomic absorption spectrophotometer method and was carried out at the Institute of Hygiene Cluj-Napoca.

The experimental data were statistically analyzed by means of the Student test, using the GraphPad Instat software, v3.10.

RESULTS AND DISCUSSION

The mean values and the variability of body mass in the brook trout at the beginning and at the end of the experimental period are shown in *Table 1*. By analyzing the recorded results regarding the body weight of the trout from the 4 experimental groups, at the end of the experimental period,

a 11.59% improvement can be seen in group 1E (Bio-Mos 0.2%) compared to the control group, results comparable to those of Staykov *et al.* (2005). The other experimental groups showed more tight values, as follows: 235.35 g in group 2E (NuPro 2%), 223.46 g in group 3 E (SelPlex 0.03%) and 214.35 g in the control group. All the groups presented a medium variability ($10\% < V\% < 20\%$) regarding the body weight.

At the end of the experimental period distinctly significant differences were recorded between group 1E (Bio-Mos 0,2%) and the control group regarding the body weight, these differences certifying the positive influence of mannan-oligosaccharides (Bio-Mos) on growth rhythm and bio-mass accumulation in brook trout. For a real estimation of the growth dynamics of the trout from the 4 experimental groups, the weight gain and the specific growth rate were determined, these being the main indicators of the bio-mass accumulation rhythm.

The effects of these additives (Bio-Mos, NuPro, Sel-plex) on the growth and consumption indices recorded in the 4 experimental groups, are shown in *Table 2*. The main growth indices recorded throughout the experimental period show a favorable influence of the bio-additives administered (Bio-Mos 0.2%, NuPro 2% and Sel-plex 0.03%) on the weight gain. A 17.54% improvement was recorded in group 1E (Bio-Mos) compared to the control group (228.45 g in group 1E vs 194.35 g in the control group) and the improvement of the weight gain for group 2E and 3E by 10.80% and 4.68%, compared to the control group. The highest value of the growth rate was recorded in group 1E (0.91 g/day), 18.18% higher than the one recorded in the control group. The other two experimental groups had superior growth rates, compared to the

Tab.1. Body weight of brook trout at the beginning and at the end of the experimental period

Group	n	Initial body weight (g)	Final body weight (g)	V%
		$\bar{X} \pm S_x$	$\bar{X} \pm S_x$	
Control	30	20	214.35 $\pm$ 5.90	12.80
1E (Bio-Mos)	30	20	248.45 $\pm$ 7.97**	14.54
2E (NuPro)	30	20	235.35 $\pm$ 6.21*	12.38
3 E (SelPlex)	30	20	223.46 $\pm$ 7.14	15.18

** - $p < 0.01$ - distinctly significant differences

* - $p < 0.05$ - significant differences

Tab. 2. The main growth and consumption indices, recorded at the end of the experimental period, in brook trout

Issue	U.M.	Control group	Group 1E (Bio-Mos 0.2%)	Group 2E (NuPro 2%)	Group 3E (Sel-plex 0.03%)
Weight gain	g	194.35	228.45	215.35	203.46
	%	100.00	117.54	110.80	104.68
Specific growth rate	g/day	0.77	0.91	0.86	0.81
	%	100.00	118.18	111.68	105.19
FCR Feed conversion rate	kg feed/ kg body weight	1.27: 1	1.18: 1	1.35: 1	1.29: 1

Tab. 3. The chemical composition of meat in brook trout

Issue	n	S.U. %	Water content %	CP %	CF %
Control group	10	24.74±0.40	75.25±0.4	17.59±0.33	6.30±0.36
Group 1E (Bio-Mos 0.2%)	10	26.05±0.44	73.94±0.44	18.04±0.37	6.80±0.15
Group 2E (NuPro 2%)	10	25.92±0.39	74.07±0.39	17.57±0.28	6.72±0.29
Group 3E (Sel-plex 0.03%)	10	25.76±0.55	74.22±0.56	18.09±0.40	6.40±0.47
Reference values		22.97	80.00	14.00-18.90	2.70-10.60
Source		Bud and Mireşan, 2008	Stephen <i>et al.</i> , 2005	Savic N 2008	www.fao.org

Tab. 4. The meat Selenium content in brook trout (µg/kg)

Issue	Control group	Group 3E (Sel-plex 0,03%)
n	10	10
Se (µg/kg) X± Sx	63.83± 1.21	224.673± 4.48***

***- p<0.001 very significant differences

Tab. 5. Survival rates recorded at the end of the experimental period, in brook trout

Issue	Control group	Group 1 E (Bio-Mos 0,2%)	Group 2E (NuPro 2%)	Group 3E (Sel-plex 0,03%)
Initial number	250	250	250	250
Final number	198	216	206	239
Survival (%)	79.20	86.40	82.40	95.60
Losses (%)	20.80	13.60	17.60	4.40

control group (0.86 g/day in group 2E, and 0.81 g/day in group 3E).

The recorded feed conversion ratio values (FCR) were higher in group 2E (NuPro) 1.35:1 compared to group 1 (Bio-Mos)–1.18:1 and 1.27:1 and 1.29:1 in group 3E and in the control group respectively. The addition of 0.2% Bio-Mos in the feeds administered to group 1E determined a

7.09% lower FCR. This drop was also confirmed on other fish species that received 0.2% Bio-Mos in their feeds (Staykov *et al.* 2005; Culjak *et al.* 2006; Bogut *et al.* 2006; Torrecillas Silvia, 2011).

Besides the growth and consumption indices, the effects of the additives on meat quality were also determined. The results recorded after the chemical analysis of meat are presented in *Table 3*.

The addition of the three additives did not influence the chemical composition of meat, the differences recorded being non-significant. The use of additives led to a minor increase in protein content in the experimental groups 1E (Bio-Mos 0.2%) and 3E (Sel-plex 0.03%) –18.04% PB and 18.09% PB respectively and also a decrease in meat water content in all the experimental groups, compared to the control group. The meat Selenium content was significantly higher in group 3E (Sel-plex, 0.03%) who's feeds were supplemented with organic Selenium (Tab. 4).

The recorded meat selenium content showed a very significant increase as a result of Selenium supplementation (as Sel-Plex); this could be the first step in the creation of a functional feed.

A very important parameter, one that is closely monitored in a trout farm, is the survival rate of fishes. The survival rates of the fishes in the four experimental groups were recorded throughout the experimental period and are presented in Table 5.

The use of additives led to the improvement of the survival rates in all the experimental groups –by 7.2% for group 1E (Bio-Mos 0.2%), by 3.2% for group 2E (NuPro 2%) and by 16.4% for group 3 E (Sel-plex 0.03%), results comparable to those reported by Yambo *et al.*, 2006).

CONCLUSION

The best result regarding the body mass evolution were recorded in group 1E (Bio-Mos 0.2%), followed by groups 2E (NuPro 2%) and 3E (Sel-plex 0.03%). The weight gain was improved by 17.54% for group 1E (Bio-Mos 0.2%) and by 10.80% in group 2E (NuPro 2%) compared to the control group. The most efficient FCR was recorded in group 1E (Bio-Mos 0.2%) (1.18:1). Regarding the meat quality, a minor increase in protein content was recorded in groups 1E (Bio-Mos) and 3E (Sel-plex). The highest selenium content of meat was recorded in group 3E that received Selenium supplemented fodders. The use of the additives led to the improvement of the survival rate. The highest survival rate was recorded in group 3E (Sel-Plex) (95.6%), 16.4% higher than the control group.

Based on the recorded results and based on the formulated conclusions, we recommend the use of Bio-Mos prebiotic, in a dose of 0.2%, organic Selenium, in a dose of 0.03% and NuPro protein

extract, in a dose of 2%, in salmonids, separately, based on the desired productive indices.

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