Bulletin UASVM Animal Science and Biotechnologies, 65(1-2)/2008
pISSN 1843-5262; eISSN 1843-536x

THE EFFECTS OF SOME FODDER ADDITIVES ON PRODUCTION PERFORMANCES OF DIFFERENT FISH SPECIES

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Key words: pro-nutrients, mannan oligosaccharide, Bio-Mos, NuPro, functional nutrient, nucleotides

Abstract. In the last years many researches worldwide have focused on the competition regarding the nutritional requirements of the fish and the benefits of the pro-nutrients. One of those pro-nutrients is Bio-Mos. Bio-Mos added in carp, rainbow trout and European catfish feed in a dosage of 0.2%-0.6% led to a superior weight gain (11.6%-24%), the reduction of FCR (from 2.00 to 1.6) and to the reduction of mortalities percent, 1.92% vs. 3.59% for carp. The growth in trout fed Bio-Mos was 10% higher than the control and the FCR decreased by 11.2% to 1.07 with Bio-Mos addition. Mortalities also decreased from 5 to 2.95%, a reduction of 41%. The addition of Bio-Mos to other freshwater species such as European catfish (*Silurus glanis)* juveniles (Bogut *et al.*, 2006) has shown similar improvements in growth from 22 to 76 g in the control groups respesctivly 83 g for the Bio-Mos treatment group. The FCR was also lower by 11.6% and mortality decreased from 28.33 to 16.67%. Bio-Mos also improved anterior gut morphology and the immune status was also improved in carp and trout in response to Bio-Mos. In aquatic organisms nutrition, in the last years has also developed the concept of functional foods. The functional foods are a group of foods that contain in their structure biologically active components that may improve the health status and that can have an impact on some physiological effects in addition to their nutritional function. One of those functional foods is represented by NuPro, that is a yeast extract. The addition of NuPro in tilapia fed led to the improvement of the weight gain.

INTRODUCTION

Bio-Mos is a mannan oligosaccharide derived from the outer cell wall of a specific strain of *Saccharomyces cerevisiae.* Recently, its effectiveness in aquaculture has been established. Improvements in the growth performances and health status of several species of fish are being seen as a result of supplementing the fish feeds with mannan oligosaccharide.

NuPro is a yeast extract derived from a select strain of yeast that provides an excellent source of protein, amino acids, nucleotides and vitamins. NuPro is a complex ingredient because it combines nutritional components (protein and vitamins) with functional components (nucleotides and free amino acids). The benefits of using this yeast extract in feeds are both nutritional and as a functional nutrient.

Staykov *et al.* (2005) added 0.2 % Bio-Mos into a standard commercial extruded diet for carp (*Cyprinus carpio L.*). From a start weight of 140 g, carps given Bio-Mos grew to an average weight of 480 g vs. 430 g in controls, an 11.6 % higher weight gain ($P<0.001$). FCR (feed conversion ratios) were also improved with Bio-Mos, 1.69 vs. 2.05 in controls, by 17.6 % ($P<0.01$). Lower mortalities were also reported in the Bio-Mos-fed carps, 1.92 % vs. 3.59 % for the control ($P<0.001$). Similar improvements in weight gain, in response to Bio-Mos, have been reported by Culjak *et al*. (2006). In the diet used in this trial, Bio-Mos was added at 0.6 %. The carps grew from an average weight of 5.28 g to 31.23 g in controls vs. 38.73 g in

the Bio-Mos treatment, a 24 % higher weight gain (P<0.01). Bio-Mos also improved FCR from 2.06 to 1.60 (P<0.05); and mortality from 50.0 to 16.7 % (P<0.01).

Similar trials were conducted with Rainbow trout (Staykov *et al.*, 2005) with a 0.2% Bio-Mos inclusion rate in commercial feeds resulting in increased average weights of 13.7% (P<0.001) in fish grown from 30 g to just under 100 g. Mortalities and FCRs were significantly improved in response to Bio-Mos. FCR decreased from 0.91 in controls to 0.83 in trout given Bio-Mos (P<0.05). Mortalities decreased from 1.68% in controls to 0.58% in fish given Bio-Mos (P<0.001). Fish grown from 100 g to approximately 310 g also showed improved performances. The growth in trout fed Bio-Mos was 10% higher than the control (P<0.01) and the FCR decreased by 11.2% to 1.07 (P<0.001) with Bio-Mos addition. Mortalities also decreased from 5 to 2.95%, a reduction of 41% (P<0.001).

The addition of Bio-Mos to other freshwater species such as European catfish (*Silurus glanis)* juveniles (Bogut *et al.*, 2006) has shown similar improvements in growth from 22 to 76 g in the control groups and 83 weight (P<0.01). The FCR was also lower by 11.6% (P<0.01) and mortality decreased from 28.33 to 16.67% (P<0.01). These data support findings of Hanley *et al.* (1995) who also demonstrated that hybrid red tilapia juveniles fed 0.6% Aqua-Mos (Alltech Inc.) in their hatchery diets had a 22.5% improved survival with a 27.2% increase in weight gain.

Bio-Mos improved anterior gut morphology and electron microscopy showed more dense and more complex microvilli structures together with more regular and deeper intestinal foldings (villi) in the Bio-Mos-treated fish. In addition, fewer damaged areas were noticed at the electron microscopic level with the Bio-Mos-treated fish (Figures 1 and 2).

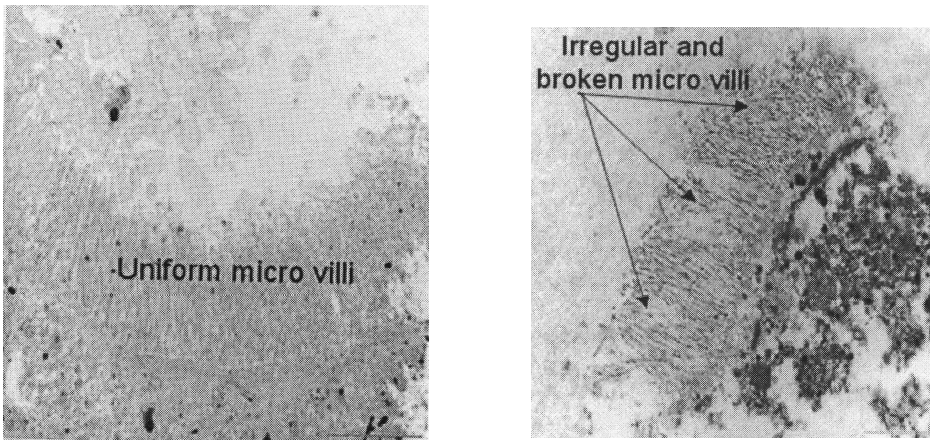
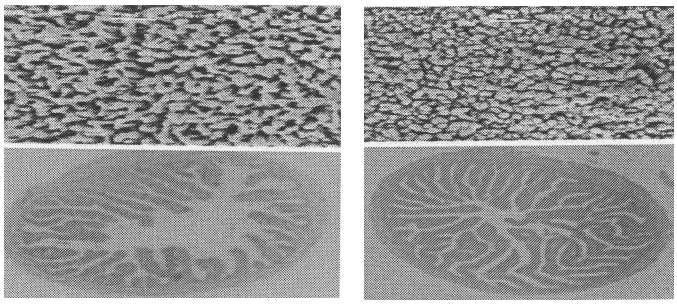


Fig. 1 Improved gut villi morphology in *Diplodus sargus* (Dimitroglou, 2005).



Control diet Bio-Mos

Fig. 2 Effect of Bio-Mos on anterior gut morphology (Sweetman, 2006)

The immune status of trout and carp has been investigated in the previously mentioned trials using standard blood sera methods including bactericidal activity, antibody titres, lysozyme concentration, alternative pathway of complement activity (APCA) (Sotirov, 1986) and classical pathway of complement activation (CPCA). The results shown in Table 1 indicate that the immune status was improved in carp and trout in response to Bio-Mos.

Table 1

The effects of Bio-Mos on immune system indicators (Sweetman and Davies, 2006)

Issue	Carp (*Cyprinus carpio*)		Rainbow trout (*Onchorhynchus mykiss*)	
	control	Bio-Mos	control	Bio-Mos
Antibody titre	4.2	7.4**		
Bactericidal activity	3.5	4.8**		
Lysozyme mg/l	7.25	8.0**(+15.1%)	7.59	10.62**
APCA	200	206.68**(+3.45 %)	195.64	226.12*
CPCA	64	73.64**(+17.22 %)	64.92	71.86*

**P<0.001
*P<0.05

Torecillas *et al*., 2006, after a series of trials regarding the use of Bio-Mos in European sea bass (*Dicentrarchus labrax*) diets, recorded the followings: no mortalities were recorded during the feeding trial. Results for growth, biometry and feed utilization are shown in Table 2. After 36 and 67 days of feeding, fish fed diets containing 2 or 4 ppt Bio-Mos had significantly higher body weight and relative growth. Total length was also significantly higher in fish fed Bio-Mos after 36 days of feeding. Feed conversion ratio was not significantly affected by Bio-Mos. Morphologic analyses for fish fed diets containing Bio-Mos revealed qualitatively a regular-shaped morphology of the hepatocytes around sinusoidal spaces and a reduction of the lipid vacuolization of the cytoplasm that decreased the number of hepatocytes with the nuclei displaced to the cellular periphery.

Table 2

Growth performance, nutrient utilization and somatic parameters of European sea bass fed commercial extruded diets containing 0, 2 or 4 ppt Bio-Mos (Torrecillas *et al*., 2006)

Issue	Days of feeding	Control	2 ppt Bio-Mos	4 ppt Bio-Mos
Average weight (g)	0	34.01	34.04	33.56
	36	59.17[a]	63.30*	62.17*
	67	93.17[a]	102.41*	102.38*
Lenght (cm)	0	13.48	13.55	13.41
	36	15.76[a]	16.26*	16.50*
	67	18.16	18.73	18.63
Relative growth (%)	36	73.18[a]	84.62*	83.81*
	67	56.90[a]	58.57*	59.75*

[a]* Means differ, P<0.05

Other trials examined the possibility of replacing traditional protein sources (fish and soybean meals) in aquafeeds with an alternative, organically certified yeast protein (NuPro). Diets were formulated using graded levels of NuPro (0-100%), in place of soybean meal. The target species was Tilapia (*Oreochromis niloticus*)(~15 g) were fed diets (n=10 fish/tank in triplicate) for 8 weeks. Fish were fed 6% BW per day. At trial termination fish were examined for percent weight gain, feed efficiency and biological indices (n=15/treatment). Muscle and liver lipid concentrations also were examined (n=9/treatment) to examine the potential impact of NuPro upon production characteristics.

Weight gain in tilapia fed diets containing NuPro ranged from 319-458%, compared to 277% for fish fed the commercial feed. However, the commercial feed returned better feed conversions. Graded replacement of soybean meal with NuPro resulted in superior ($P<0.05$) performance at NuPro levels of 20, 40 and 80%. When NuPro served as the only protein source, no difference was observed in weight gain compared to animals fed control and commercial diets. Visceral index and muscle ratios were unaffected by diet. Hepatic lipid levels were all lower ($P<0.05$) when compared to fish fed commercial feed. Excepting the 80% diet, muscle lipid was lower in fish fed NuPro-based diets compared with commercial feed. This trial indicated that NuPro could effectively replace 100% of the protein source in tilapia aquafeeds (Craig, McLean, 2005).

Bio-Mos can improve the production indices of cultured fish; it can reduce the FCR, it leads to superior weight gains and also reduces the mortality percent of the fish. The addition of Bio-Mos in fish feed formulations leads to the improvement of the anterior gut morphology through the improvement of gut villi morphology and the improvement of microvilli structures. The immune status was also improved in carp and trout in response to Bio-Mos.

NuPro represents a certified, fully traceable organic protein source. NuPro significantly reduces muscle lipid levels in the edible component of the fish, which provides a leaner and potentially healthier product. NuPro is responsible for a reduction in hepatic lipid levels, which can prove to be beneficial to the health status of cultured fish.

BIBLIOGRAPHY

1. Bogut I., Z. Milakovic, J. Pavlicevic and D. Petrovic, 2006, Effect of Bio-Mos® on performance and health of European catfish. In press.
2. Craig S.R. and E. Mclean, 2005, The organic aquaculture movement: a role for NuPro as an alternative protein source. In: NutritionalBiotechnology in the Feed & Food Industries: Proceedings of Alltech's 21st AnnualSymposium (T.P. Lyons and K.A. Jacques, eds), Nottingham University Press, UK, pp. 285-294.
3. Culjak V., I. Bogut, E. Has-Schon, Z. Milakovic and K. Canecki, 2006, Effect of Bio- Mos® on performance and health of juvenile carp. In press.
4. Dimitroglou A., S. Davies, P. Divanach and S. Chatzifotis, 2005, The role of mannan oligosaccharide in gut development of white sea bream, Diplodus sargus. In: Nutritional Biotechnology in the Feed & Food Industries: Proceedings of Alltech's 21st Annual Symposium (Suppl. 1) (Abstracts of posters presented). Lexington, KY, May 23-25.
5. Hanley F., H. Brown and J. Carberry, 1995, First observations on the effects of mannan oligosaccharide added to the hatchery diets for warmwater Hybrid Red Tilapia. In: Nutritional Biotechnology in the Feed & Food Industries: Proceedings of Alltech's 11thAnnual Symposium (Suppl. 1) (Abstracts of posters resented). Lexington, KY, Ma
6. Sotirov L.K., 1986, Method for determination of the alternative pathway of complement activation in some animals and man. In: Fourth Scientific Conference of Agriculture. Stara Zagora, pp. 1-10.
7. Staykov Y., S. Denev and P. Spring, 2005, The effects of mannan oligosaccharide (Bio-Mos®) on the growth rate and immune function of rainbow trout (Salmo gairdneri irideus G.) grown in raceways. In: Lessons from the Past to Optimise the Future (B. Howell and R. Flos, eds). European Aquaculture Society, Special Publication No. 35, June 2005, pp. 429-430.

8. Staykov Y., S. Denev and P. Spring, 2005, Influence of dietary mannan oligosaccharides (Bio-Mos®) on growth rate and immune function of common carp (*Cyprinus carpio* L). In: *Lessons from the Past to Optimise the Future* (B. Howell and R. Flos, eds). European Aquaculture Society, Special Publication No 35, June 2005, pp. 431-432.
9. Sweetman J., S. Davies, 2006, Improving growth performance and health status of aquaculture stocks in Europe through the use of Bio-Mos. In: *Nutritional Biotechnology in the Feed & Food Industries: Proceedings of Alltech's 22nd Annual Symposium* (T.P. Lyons, K.A. Jacques, and J.M. Hower eds), Nottingham University Press, UK, pp. 445-452.
10. Torrecillas S., A. Makol, M. J. Caballero, D. Montero, J. Sweetman, L. Robaina and M.S. Izquierdo, 2006, Does feeding Bio-Mos enhance immune system function and disease resistance in European sea bass (*Dicentrarchus labrax*)? In: *Nutritional Biotechnology in the Feed & Food Industries: Proceedings of Alltech's 23rd Annual Symposium* (T.P. Lyons, K.A. Jacques, and J.M. Hower eds), Nottingham University Press, UK, pp. 365-386.