Journal of Animal and Veterinary Advances 8 (11): 2251-2255, 2009
ISSN: 1680-5593

The Effects of Commercial Diet Supplemented with Mannanoligosaccharide (MOS) and Vitamin B_{12} on the Growth and Body Composition of the Carp (*Cyprinus carpio* L. 1758)

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Abstract: Four hundred carp fries (*Cyprinus carpio* L. 1758) with average initial weight of 1.11±0.05 g and total average length of 4.04±0.04 cm, was fed for a period of 90 days with the addition of commercial feed Mannanoligosaccharide (MOS) and vitamin B_{12}. The carps were divided into four different groups and fed through different feeds (Control; group A with MOS, group B with vitamin B_{12}, group C with a the combination of MOS + vitamin B_{12}). The effects of feeding through MOS and vitamin B_{12} in different proportions on the parameters such as growth in view of live weight and total length, survival rate, feed conversion, condition factor and protein efficacy for the carp fries was studied. The best growth in view of live weight was maintained through MOS and vitamin B_{12} combination in group C (4.51±0.13 g), while the best growth in terms of length was obtained through MOS in group A (6.68±0.08 cm). As a consequence, the growth parameters of the carp fries fed through commercial feeds with the addition of MOS and vitamin B_{12} in different doses under empirical conditions shown affirmative effects on the survival rate, feed assessment, condition factor and protein efficacy.

Key words: Mannanoligosaccharide, vitamin B_{12}, carp (*Cyprinus carpio*), growth, body composition, breeding

INTRODUCTION

As in the case of the other animals, the fishes need aliments to lead their lives, keep their health and growth. It is a well-known fact that the aliments play an important role on the living organisms. Similar to the other species, the fishes are in need of basic aliments such as proteins, fats, carbohydrates as well as proteins for sufficient and balanced nutrition (Atay, 1990). Insufficiency or dearth of one of these may lead to several dysfunctions or even losses. The formation of the aliment cyst, reproduction, development and coloring substantially depend on available and sufficient nutrition. The balanced and sufficient aliment is of great concern for the fishes produced (Anonymous, 1993).

The most important protective action in aquaculture is the various prebiotics produced for defined purposes and several feeds with additives and vitamins, which develop immune system. Prebiotical feed additives have proven to be successful in functional and prophylactic nutrition. These additives increase the strength of the fishes against diseases and stress and provide optimal food intake through changing the microbiology of the same with bowel morphology (Sweetman and Davies, 2006).

Because of terminal mannose units within Mannanoligosaccharide (MOS) structure, it establishes sound ties with the attachment sections, which are known to be fimbriae of the pathogenic bacteria and which comprise lecithin and provides excretion without negative impact on the fish. Vitamin B_{12} is of particular importance out of the water soluble vitamins. Because this particular vitamin necessary for usual growth supports immune system and helps develop protection system. In addition, it acts as a coenzyme for metabolic events. The vitamin B_{12} deficiency leads to decrease in with anorexia and decrease of growth in the fishes (Bilguven, 2002). When folic acid and xanthopterin, which are ingredients of the crystallized vitamin B_{12} are injected for anemic salmon fish, affirmative progresses are observed in the blood cells within several days and the salmon fish shows the traces of recovery from anemia rapidly (Anonymous, 1987). Carp (*C. carpio*) is produced on large scale in Turkey after salmon fish. The wild carps and culture carps raised in

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temperate weather with economic value are resistant against cold. They need less oxygen and are not hooked up or caught through dip net and scaling; they are not easily wounded. They adapt to the water temperature varying between 4-30°C. Their adaptability to culture conditions is so high and developed in highly variable conditions that are preferred not just for their faster growth than a normal carp at a rate of 30-40%, which in turn lead to high rates of feed assessment and transformation of the feed into meat and for easy impregnation and breeding (Cagiltay, 2007).

MATERIALS AND METHODS

Empirical conditions: The carp fries used in the study were supplied from Mediterranean Aquaculture Research, Production and Training Institute, Kepez Station (AKSAM) Antalya, Turkey affiliated to the Ministry of Agriculture and Rural Affairs. The fishes were brought to the Ankara University, Faculty of Agriculture, Department of Aquaculture, Inland Water Fishes Research and Application Unit through carrying bags with oxygen support. Following adaptation phase, lasting 15 days, all fishes were individually weighed and measured length wise. The fishes were stocked as per empirical application plan the details of which are specified in Table 1.

Diets: The feeds used in the study were supplied from Pinar Yem AS Turkey. As a trial, granulated feed, produced specifically for the freshwater fishes with 55% crude protein, 12% crude fat and metabolic energy of 4900 kcal was used. The other additives added to the trial feed were Aqua-Myces (Vitomix Ltd. Colombia), which contains 100% pure Mannanoligosaccharide (MOS) as well as vitamin B_{12} (Sigma Aldrich St. Lo. Mo).

Within the trial period, the fishes were fed 3 times a day manually at a rate of 3% of their body weight (Celikkale, 1994). For this purpose, Mannanoligosaccharide (MOS) and vitamin B_{12} additives were dissolved in water prior to addition of mixed feed for both groups added to the feed through spray method and was homogenously mixed for 5 min. Taking into account the granularity of the feeds to be in-taken by the carp fries, such feeds were placed in different cups as granule powder and the feeds remain were re-weighed within each period to calculate the consumed feed. Arrangement of the rate of MOS and vitamin B_{12} within trial feeds for each group was planned as given in Table 1.

Length and weight measurements: Individual length and weight of the fishes were measured upon initiation of the experiment and expiration of each subsequent 30 days period as well as the amount of feed consumed. The data thus, obtained enabled calculation of the live weight and lengthwise increases, feed assessment and survival rates upon completion of each 30 days period.

Statistical analysis: Variance Analysis (ANOVA) was used to evaluate the data acquired through the trials and separation of treatments was made by Duncan's multiple range test ($p<0.05$). For this specific purpose, MINITAB for Windows 10.5 and MSTAT-C package programs was used.

RESULTS

Growth performance: Out of growth performance parameters for trial groups of carp fries, the best weight-wise growth as of the completion of the trial period was attained in group C (4.51±0.13 g), where mannanoligosaccharide and vitamin B_{12} were used together. This group was followed by group A, B and control group, respectively with the respective values of 4.39±0.14; 4.16±0.13 and 4.05±0.07 g (Table 2). The best lengthwise growth was observed in group A (6.68±0.08 cm), where diet was supplemented with mannanoligosaccharide, followed by group B with vitamin B12 and control group with respective values of 6.63±0.07; 6.49±0.07, 6.37±0.06 cm (Table 3).

Condition factor: The condition factor values for the initiation period and the subsequent periods by which time the carp fries were subject to experiment are given in Table 4. In pursuance, with the variance analysis and Duncan test conducted for condition factor for carp, the statistical differences between the trial groups proved significant ($p<0.05$).

Table 1: Experimental plan for raising carp fries

	Trial groups			
Carp fries	Control	Experimental A	Experimental B	Experimental C
Weight of the stocked fish (g)	~1	~1	~1	~1
Number of fishes within the group	30	30	30	30
Number of replications	3	3	3	3
Rate of MOS in the feed (MOS kg^{-1} feed)	0	5 g MOS	0	0
Rate of Vit. B_{12} in the the feed (Vit. B_{12} kg^{-1} feed)	0	0	0.5 mg Vit. B_{12}	0
Rate of MOS+ Vit. B_{12} in the feed (MOS kg^{-1} feed)	0	0	0	5 g MOS + 0.5 mgVit. B_{12}

Table 2: Average live weights (g) for the carp fries subjected to test according to the periods involved

	Trial groups for carp fries			
Groups periods	Control	A	B	C
N	90	90	90	90
Commencement (11.10.2008)	1.14±0.02a	1.11±0.03b	1.12±0.03b	1.10±0.03b
N	90	90	90	90
I	1.63±0.04a	1.67±0.04a	1.63±0.04a	1.74±0.04a
N	90	90	90	90
II	2.76±0.08a	2.74±0.09a	2.61±0.08a	2.73±0.07a
N	90	90	90	90
III	4.05±0.07b	4.39±0.14ab	4.16±0.13ab	4.51±0.13a

The difference between the averages denominated in small letters within the same column is important ($p<0.05$); N: Number of fishes

Table 3: Total average length (cm) of the carp fries subjected to test based on periods

	Trial groups for carp fries			
Groups periods	Control	A	B	C
Number of fishes	90	90	90	90
Commencement (11.10.2008)	4.13±0.03a	4.03±0.04b	4.04±0.03b	4.03±0.03b
N	90	90	90	90
I	4.84±0.04b	4.81±0.03b	4.82±0.04b	4.95±0.03a
N	90	90	90	90
II	5.71±0.06a	5.82±0.06a	5.83±0.06a	5.81±0.05a
N	90	90	90	90
III	6.37±0.06b	6.68±0.08a	6.49±0.07ab	6.63±0.07a

Values within a column followed by different letters are significantly different at $p<0.05$ level of significance using; Duncan's multiple range test; N: Number of fishes

Table 4: Condition factor values for the bay fishes subjected to test depending on the period

	Trial groups for carp fries			
Groups periods	Control	A	B	C
N	90	90	90	90
Commencement (11.10.2008)	1.62±0.02b	1.73±0.05a	1.67±0.02ab	1.66±0.03ab
N	90	90	90	90
I	1.43±0.02ab	1.49±0.02a	1.43±0.02ab	1.42±0.02b
N	90	90	90	90
II	1.46±0.02a	1.35±0.01b	1.29±0.01c	1.38±0.02b
N	90	90	90	90
III	1.58±0.02a	1.45±0.02c	1.50±0.02bc	1.52±0.02b

Values within a column followed by different letters are significantly different at $p<0.05$ level of significance using; Duncan's multiple range test; N: Number of fishes

Table 5: General protein efficacy rates for the fish fries subject to test according to stipulated periods

	Trial groups for carp fries			
Groups periods	Control	A	B	C
n	3	3	3	3
PER	1.45±0.00c	1.63±0.06ab	1.52±0.04bc	1.70±0.03a

The difference between the averages denominated in small letters within the same column is important ($p<0.05$)

Protein efficacy rate: When the protein efficacy rate is examined in general terms as of the date of completion of the tests, the highest protein efficacy was observed in group C 1.70±0.03, where MOS and vitamin B_{12} are used together. This is group was followed by group A (which includes MOS), group B (which contains vitamin B_{12}) and control group with respective values as, 63±0.06, 1.52±0.04 and 1.45±0.00 (Table 5).

Feed conversion rate: When the rates of feed assessment calculated through the amount of feed consumed and live weight, the best feed assessment rates are observed in

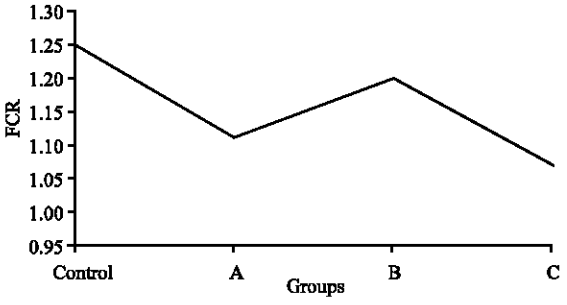

Fig. 1: Curve for general feed assessment rates for the carp fries subjected to test

group C, where MOS and vitamin B_{12} are used together (Fig. 1). This group was followed by group A (with MOS), group B (with vitamin B_{12}) and control groups.

DISCUSSION

In this study, the carp fries were fed for a period of 90 days with the introduction of commercial feed Mannanoligosaccharide (MOS) and vitamin B_{12}. Feeding through feeds with different rates of MOS and vitamin B_{12} was evaluated by examining the parameters such as live weights of the carp fries and total growth of length, condition factor, feed assessment and survival rate.

Out of the groups of the carp fries, whose live weight was observed to be 1.11±0.05 g at the initial stage, the best live weight average was observed in group C (4.51±0.13 g), where MOS and vitamin B_{12} were used together. This group was followed by group A (the group, which includes MOS) and group B (the group, which includes vitamin B_{12}). The best lengthwise growth of the carp fries whose average length was 4.04±0.05 cm at the initial stage was observed in group A (6.68±0.08 cm), which was followed by group C where MOS and vitamin B_{12} were used together and group B (the group, which includes vitamin B_{12}).

The results obtained in the present study with regard to live weight and total length shows that the control group had a 44% mortality compared to fishes that intook MOS with 17% weight increase and an increase of total biomass with emphasis on the fact that all such reported findings are similar with the values, we have already attained in agreement with Staykov *et al*. (2005) for the effects of the nutritional MOS on immune function and growth of the salmon and carp fries.

The study conducted for the effects of the MOS added pellet feed on the growth of the rainbow trout (*Salmo gairdneri irideus* G.) (Zegarra *et al*., 2005) implies parallel findings regarding the parameters of unit weight and rate of growth. It is recommended that MOS may be included in the feeds for bullhead fish (*Ictalurus punctatus*) without negative impacts on growth or feed assessment rates (Peterson *et al*., 2007).

It has been reported that MOS addition leads to substantial development in weight and feed assessment rates and decrease in the mortality rates of carp fries as well (Culjak *et al*., 2006). They conducted a study to focus on the effects of MOS on growth and feed assessment for juvenile sea basses (*Dicentrachus labrax*). When compared with the control groups upon completion of the experiment, it was concluded that growth and specific growth is about 10% higher (Torrecillas *et al*., 2006).

It has been observed that MOS increases the body weights, feed transformation ratio and survival rate for the fowls (Hooge, 2004). In addition, referring to the rainbow trouts (*Oncorhynchus mykiss*) and carp fries (*Cyprinus carpio*) fed through a product sold under commercial name of Bio-Mass, which include 100% MOS, for a period of 60 days, it was concluded that the growth performance increases significantly (Staykov *et al*., 2005). When 3.0 g kg^{-1} MOS was added to the diets of the shrimps (*Penaeus semisulcatus*), affirmative results were obtained depending on the increase in growth and survival rates (Genc *et al*., 2007).

CONCLUSION

The majority of the studies focus on the resistance of the fishes fed through the diets, which include prebiotic, against growth, feed productivity and pathogenic bacteria. Feeding through mannanoligosaccharide is proven to have encouraging impact on the growth of the fishes. A small number of surveys mentioned about the effects on the growth of the fishes. As a consequence, it has been observed that use of Mannanoligosaccharide (MOS) and vitamin B_{12} has positive impact on the growth of the carp fries and also no negative effect traced on vital and physiological functions of the carp fries in this study. Affirmative effect is provided on the live weight, total length, condition factor, protein efficacy rate, feed assessment rate and survival rate. It is recommended that the use of natural feed additives should be extended for improved performance of carp fries.

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