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Effect Different Level of Fructo-Oligosaccharide (FOS) on Growth Parameters and Feed Utilization in Common Carp (*Cyprinus carpio L.*)

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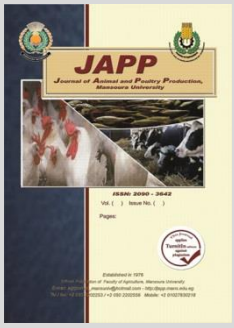

ABSTRACT

The recent research was managed to make an inquiry about influencing dietary fructo-oligosaccharide (FOS) on providing food supplements and growing procedure of common carp *Cyprinus carpio* fingerlings. The fingerlings were adapted for 3 weeks and then reared in triplicate groups in 15 tanks (n = 4 fish per tank with average initial weights of (40 ± 3.00 gm). The fish fed on experimental diets containing different levels of fructo-oligosaccharide (FOS); (0, 2.5, 5, 7.5, 10 gm FOS /kg diet) for apparent satiation twice a day for 10 weeks. Results showed that final weight, weight gain, daily growth rate, relative growth rate, and specific growth rate were significantly (P<0.05) increased with 10 gm FOS /kg diet compared to the other groups. While, food efficiency ratio and protein efficiency ratio were significantly higher (P<0.05) especially in group fed 10 gm FOS /kg diet (1.13 and 295.16) respectively compared to the other treated and control group. However, food conversion ratio in 0 gm FOS /kg diet (control) group was higher significantly (P<0.05) among other groups (1.63).

***Keywords*:** FOS prebiotic, feed utilization, growth performance, *Cyprinus carpio* fingerlings.

INTRODUCTION

Producing is an industrial section that has the highest growing rate in comparison to other animal sections. In the past years from 1970 to 2010 the growing ratio was 2.9%. Meanwhile other meat productions were 2.7% (Tacon and Metian, 2013). In 2012 survey for the world fishing industrial and aquaculture production were 65 million tonnes in which fishery product was a great deal of it by 91.3 million tonnes, other aquaculture industry production took 66.6 million on the scale. Although provided amount held by capture fishery is higher than from aquaculture production, aquaculture production is still on the rise every year. Furthermore, the establishment of capture fishery products has been established during last 2 decades (FAO, 2014).

C. carpio is the largest number crucial aquatic industrial types generally in Asian countries. On the record scale it took the third position among all freshwater industrial species (3 043 712 t) in 2005 survey, the export rate from Asian countries is more than 90% of that type (FAO, 2014). Prebiotics is dyspepsia supplement components that has beneficial impact on the host by particularly invigorating the development and energizing metabolism of health by increasing bacteria in the gastrointestinal (GI) tract (Manning and Gibson, 2004).

FOS is a unit of oligosaccharide which is made up of glucose molecule connected to 2-4 fructose molecule, this formulation takes place spontaneously in some plants for instance; onion, garlic, banana, asparagus and chicory. Some researchers have implied that FOS could enhance the growth performances and feeding utility of heterogeneous types of fish species through abdominal mucosa of ultra-structure and it results in enlarging absorptive area (Soleimani *et al*., 2012; Zhang *et al*., 2016), and activating health promotion bacteria in the abdominal (Zhou *et al*., 2007). Abdulrahman and Ahmed, (2016) found impacts of FOS on the blood indicators which affected significantly the red blood cell, white blood cell and haemoglobin. Improvements in the intestinal morphology and activities of digestive enzymes caused by prebiotics are increasingly important, which contribute to improved growth and feed efficiency.

MATERIALS AND METHODS

The experiment was done on 60 fingerlings for 70 days. The fish were distributed among experimental tank with initial average body weight of (40 ± 3.00 gm). During the acclimation period (14 days), fish were fed a control diet twice a day. All of the tanks were supplied with appropriate continuous oxygenate and stocked with 4 fish. In T1, fish were fed a diet with 0 gm/kg FOS, while in T2, fish were fed a diet with 2.5 gm/kg FOS, also fish were fed a diet with 5 gm/kg FOS in T3, then in T4, fish were fed a diet with 7.5 gm/kg FOS, the last treatment was T5 in which fish were fed a diet 10 gm/kg FOS.

Diet formulation: the diets that were prepared for this experimental with fishmeal, wheat bran, soybean, broken rice, vitamins, and date seed, and the composition of the different diet shown in table (1). The ingredients were mixed with water to obtain dough, then the dough was passed through an electrical mincer for pelleting by using Kenwood Multi-processors. The pellets were dried at room temperature for a few days and crushed to yield fine particles. The fish were fed twice a day, once was at 9:00 am and another time at 2:00 pm. Feeding rate started with 4% of biomass then the accurate feeding rate was determined to be

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3% by third week depending on satiation level. Fish were individually weighed bimonthly. The feeding amount was then recalculated according to new weights.

Table 1. Ingredients and proximate composition of diet:

Ingredients	%
Animal concentrate	10
Soya meal	40
Yellow corn	15
Wheat bran	18
Barely	15
Premix	2
Total	100
Proximate composition, gm/kg diets	
Protein %	27.35
Lipid %	2.58
Fibre %	6.16
Energy kcal/kg	2235.2
Ash %	87.61

Growth parameters: The individual body weight (gm) and total body length (cm) for all fish per treatment were measured weekly. The feed consumption of each treatment was recorded and readjusted according to the obtained biomass at every treatment weekly. The fish weight gains as (gm/fish) was estimated according to the following equation:

Weight gain (gm/fish) = mean of weight (gm) at the end of the experimental period – weight (gm) at the beginning of the experimental period.

Daily weight gain (DWG)= weight gain/experimental period (Schmalhusen, 1926).

Relative growth rate (RGR) = (in W2- W1) / (t2- t1)

t1= time one (in days) t2 = time two (in days)

W1 = Dry weight of plant at time one (in grams)

W2= Dry weight of plant at time two (in grams)

Specific growth rate (SGR) = (Log W1 – Log W0) / T) x 100 (Uten, 1978)

W1: final weight W0: initial weight T: time between W1 and W0

Feed conversion ratio (FCR) =Total feed fed (g/fish) / total weight gain (g/fish) (Uten, 1978)

Feed efficiency ratio (FER) = Total weight gain (gm) / Total feed fed (gm)

Protein efficiency ratio (PER) = Total wet weight gain (gm/fish) / amount of protein fed (gm/fish) (Uten, 1978)

Statistical analysis: The experiment was conducted using the completely randomized design (CRD) and the general linear models (GLM) procedure of XLSTAT. Pro. 7.5 one way (ANOVA). Duncan tests were used for comparison of the means values of the treatments.

RESULTS AND DISCUSSION

Table 2 summarizes the growth performance results for the date variety used in this study. The data indicate that FOS affects significantly final weight, weight gain daily growth rate, relative growth rate, and specific growth of fish during the 70 days of rearing in T5 with 10 gm/kg FOS except the initial weight.

Fish in T5 with 10 gm/kg FOS has consumed diet, FER, consumed protein, and PER more than fish in other treatments significantly. In opposite, the FCR in T5 were more than other treatments due to has less feed conversion ratio as shown in table 3.

Table 2. Growth performance of the *C. carpio* fed diets containing different rates of FOS:

Treatments	Initial wt.	Wt. gain	DGR	RGR	SGR
T1 Control	$43.26^{a} \pm 0.30$	$15.50^{e} \pm 0.88$	$0.22^{e} \pm 0.004$	$0.19^{e} \pm 0.006$	$34.86^{e} \pm 1.40$
T2 2.5 g/kg FOS	$41.54^{b} \pm 0.22$	$18.68^{d} \pm 0.83$	$0.28^{d} \pm 0.004$	$21.88^{e} \pm 0.02$	$48.56^{d} \pm 1.29$
T3 5 g/kg FOS	$40.00^{bc} \pm 0.03$	$21.78^{c} \pm 0.92$	$0.31^{c} \pm 0.02$	$24.91^{c} \pm 0.02$	$51.65^{c} \pm 1.11$
T4 7.5g/kg FOS	$39.95^{bc} \pm 0.13$	$24.89^{b} \pm 0.87$	$0.35^{b} \pm 0.007$	$0.30^{b} \pm 0.007$	$62.36^{b} \pm 1.31$
T5 10 g/kg FOS	$38.20^{c} \pm 0.02$	$31.04^{a} \pm 0.93$	$0.44^{a} \pm 0.02$	$0.36^{a} \pm 0.01$	$81.44^{a} \pm 1.04$

Table 3. Nutrition utilization of the *C. carpio* fed diets with different rates of the FOS:

Treatments	Consumed Diet	FER	FCR	Consumed protein	PER
T1 Control	$25.27^{c} \pm 0.23$	$0.62^{d} \pm 0.02$	$1.63^{a} \pm 0.06$	$9.60^{c} \pm 0.23$	$161.78^{d} \pm 0.26$
T2 2.5 g/kg FOS	$25.89^{bc} \pm 0.28$	$0.72^{c} \pm 0.20$	$1.38^{ab} \pm 0.06$	$9.22^{bc} \pm 0.19$	$195.00^{c} \pm 0.01$
T3 5 g/kg FOS	$26.20^{b} \pm 0.33$	$0.83^{bc} \pm 0.02$	$1.10^{b} \pm 0.04$	$10.00^{ab} \pm 0.21$	$203.81^{bc} \pm 0.13$
T4 7.5g/kg FOS	$26.80^{ab} \pm 0.40$	$0.93^{b} \pm 0.02$	$1.08^{b} \pm 0.03$	$10.20^{ab} \pm 0.19$	$244.10^{b} \pm 0.20$
T5 10 g/kg FOS	$27.57^{a} \pm 0.33$	$1.13^{a} \pm 0.02$	$0.81^{c} \pm 0.40$	$10.52^{a} \pm 0.20$	$295.16^{a} \pm 0.12$

The using of FOS have different stimulation in the results of Abdulrahman & Ahmed (2015), granulocyte ratio obtained for T3 (5 gm/kg FOS) were higher significantly than other treatments (P<0.05). The consequences of Soleimani, *et al.*, (2012) demonstrated that adding of FOS could enhance the innate immune responses of Caspian roach. The immunostimulatory effect of prebiotics may be attributed to energizing of the growth of beneficial microbes such as *Lactobacillus* and *Bacillus*. (Zhang *et al*., 2011), that possess cell wall components such as lipopolysaccharides which have immunostimulatory nature (Van Hai and Fotedar, 2009).

FOS induces profound metabolic changes by modulating the composition and the activity of the intestinal macrobiotic, possibly through the involvement of leptin (Respondek *et al*., 2013). Řehulka, *et al*., (2011) have found that adding of FOS to salmon displayed some improvement of feed efficiency ratio and this agree to the present results. Yilmaz *et al*. (2007) examined the dietary MOS and found an increased in rainbow trout growth performance at 1.5% dietary MOS supplementation.

Growth performance is brought by elevated digestive enzyme activities, possible improvements of intestine morphology or via prebiotic fermentation by endogenous gut normal flora to produce SCFAs as stated by Dimitroglou *et al*., (2010). The results of Sweetman and Davies, (2007) demonstrate the association of improved growth and performance, gut health, immune status, and resistance to disease in fish fed Bio-Mos.

The influence of FOS supplements on growing performance may need estimation again under diverse culture situation. Specifically, in eutrophic waters (Li *et al*., 2007), the addition of FOS as a source of periodic expanding growing ratios.

The progressed FCR of *C. carpio* noticed in late research is in accord to with similar findings by Ahmad (2013) with carp fingerlings. The research has implied that FOS fed salmon indicated improvements of feed proficiency rate that has accorded to present outcome. The study of Mahious *et al*., (2006) agree with our results in that Sturgeon growth was enhanced after feeding with inulin and oligofructose with better FCR. The results of Al-Asha'ab *et al*., (2014) illustrated meaningful dissimilarity P<0.05 in growth parameter and food conversion and efficiency rate FCR and FER of common carp.

REFERENCES

Al-Asha'ab, M. H., Mohammad, S. D., Al-fathly, and Neamah, Y. J. (2014). Effect of using probiotics with prebiotics in growth indicia and some physiological characters for fingerlings common carp *Cyprinus carpio L.* Journal of Biotechnology Research Center, special issue, 8(2), 44-50.

Abdulrahman, N.M. and Ahmed, V.M. (2015). Comparative effect of probiotic (*saccharomyces cerevisiae*), prebiotic (fructooligosaccharide fos) and their combination on some differential white blood cells in young common carp (*Cyprinus carpio L.*). Asian Journal of Science and Technology, 6(02), 1136-1140.

Abdulrahman, N.M. and Ahmed, V.M. (2016). Comparative effect of probiotic (Saccharomyces cerevisiae), prebiotic (Fructooligosaccharide) and their combination on some blood indices in young common carp (*Cyprinus carpio L.*). The Iraqi Journal of Veterinary Medicine, 40(1), 9-15.

Ahmed, V.M. (2014). Comparative effects of probiotic (saccharomyces cereviciae), prebiotic (fructooligosaccharide fos) and their combination on growth performance and some blood indices in young common carp (*Cyprinus carpio L.*). MSc thesis, College of Agricultural Sciences, University of Sulaimani, 97pp.

Akrami, R., Iri, Y., Rostami, H.K., and Mansour, M.R. (2013). Effect of dietary supplementation of fructooligosaccharide (FOS) on growth performance, survival, Lactobacillus bacterial population and hemato-immunological parameters of stellate sturgeon (Acipenser stellatus) juvenile. Fish & Shellfish Immunology, 35, 1235-1239.

Dimitroglou, A., Merrifield, D.L., Spring, P., Moate, J., Sweetman, R., and Davies, S.J. (2010). Effects of mannan oligosaccharide (MOS) supplementation on growth performance, feed utilization, intestinal histology and gut microbiota of gilthead sea bream (Sparus aurata), Aquaculture, 300,182e8.

FAO. (2014). The state of the world fisheries and aquaculture: opportunities and challenges. Food and agricultural organization of the united nations. http://www.fao.org/3/a-i3720e.pdf.

Fuller, R. (1992) "History and development of probiotics", in Probiotics", the Scientific Basis, edited by Fuller, R, 232: 1–18.

Li, P., Burr, G.S., Gatlin, D.M., Hume, M. E., Patnaik, S., Frank L. Astille, and Lawrence, A. L. (2007). Dietary supplementation of short-chain fructooligosaccharide influences gastrointestinal microbiota composition and immunity characteristics of pacific white Shrimp, litopenaeus annamei, cultured in a recirculating system. The Journal of Nutrition Nutritional Immunology, 2763-2768.

Mathious, A.S., Gatesoupe, F. J., Hervi, M., Metailler, Ollevier, R. F. (2006). Effect of dietary inulin and oligosaccharides as prebiotics for weaning turbot, Psetta maxima (Linnaeus, 1758). Aquaculture International, 14, 219–229.

Manning, T.S. and Gibson, G.R. (2004). Prebiotics. Best Pract. Res. Clin. Gastroenterol., 18, 287–298.

Řehulka, J., Minařik, B., Cink, D., Žalak, J. (2011). Prebiotic effect of fructo–oligosaccharides on growth and physiological state of rainbow trout, Oncorhynchus mykiss (Walbaum). Acta univ. agric. et silvic. Mendel. Brun., 5, 227–236.

Respondek, F., Gerard, P., Bossis, M., Boschat, L., and Bruneau, A. (2013). Short-chain fructo-oligosaccharides modulate intestinal microbiota and metabolic parameters of humanized gnotobiotic diet induced obesity mice. PLoSONE, 8(8), e71026. doi:10.1371/journal.pone. 0071026.

Soleimani, N., Hoseinifar, S. H., Merrifield, D.L., Barati, M., and Abadi, Z.H. (2012). Dietary supplementation of fructooligo-Saccharide (FOS) improves the innate immune response, stress resistance, digestive enzyme activities and growth performance of Caspian roach (Rutilus rutilus) fry. Fish Shellfish Immunol., 32(2), 316-321.

Sweetman, J., and Davies, S. (2007). Improving growth performance and health status of aquaculture stocks in Europe through the use of Bio-Mos®. In: Nutritional Biotechnology in the Feed and Food Industries. (Eds. T.P. Lyons and K. Jackues). Nottingham University Press, Nottingham, UK. pp 445-452.

Tacon, A. and Metian, M. (2013). Fish matters: importance of aquatic foods in human nutrition and global food supply. Reviews in Fisheries Science 21(1), DOI: 10.1080/10641262.2012.753405

Van Hai, N., and Fotedar, R. (2009). Comparison of the effects of the prebiotics (Bio- Mos_ and [beta]-1, 3-D-glucan) and the customized probiotics (Pseudomonas synxantha and P. aeruginosa) on the culture of juvenile western king prawns (Penaeus latisulcatus Kishinouye, 1896). Aquacul., 6, 289-310.

Yilmaz, E., Genc, M.A., and Genc, E. (2007). Effects of dietary mannan oligosaccharides on growth, body composition, and intestine and liver histology of rainbow trout, Oncorhynchus mykiss. Israeli Journal of Aquaculture–Bamidgeh, 59, 182–188.

Zhang, Q., Tan, B., Mai, K., Zhang, M., Ma, H., and Ai, Q. (2011). Dietary administration of Bacillus (B. licheniformis and B. subtilis) and isomaltooligosaccharide influences the intestinal microflora, immunological parameters and resistance against Vibrio alginolyticus in shrimp, Penaeus japonicus (Decapoda: Penaeidae), Aquaculture Research, 42, 943e52.

Zhang, M., Sun, Y., Liu, Y., Qiao, F., Chen, L., and Liu, W. (2016), Response of gut microbiota to salinity change in two euryha-line aquatic animals with reverse salinity preference. Aquaculture, 454, 72 –80.

Zhou, Z., Ding, Z., and Huiyuan, L.V. (2007). Effects of dietary short-chain fructooligosaccharide on intestinal microflora, survival and growth performance of juvenile white shrimp Litopenaeus vannamei, Journal World Aquaculture Society, 38, 296–301.

تأثير تراكيز مختلفة من السكر المتعدد الفركتوز (FOS) في أداء نمو إستهلاك العلف لصغار أسماك الكارب الشائع (*Cyprinus carpio L.*)

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أجريت الدراسة الحالية لتقييم تأثير السكر المتعدد الفركتوز (FOS) في أداء نمو وكفاءة استهلاك العلف لأصبعيات الكارب الشائع. تم أقلمة الأصبعيات لمدة ثلاث أسابيع ثم تمت تربيتها بثلاث مكررات في 15 حوض (أربعة أسماك لكل حوض وبمعدل وزن أولي 40 ± 3 غم). تم تغذية الأسماك بعلائق التجربة والتي إحتوت على تراكيز مختلفة من السكر المتعدد الفركتوز (FOS) (0، 2.5، 5، 7.5، 10) غم السكر المتعدد الفركتوز (FOS)/ كغم علف لحد الإشباع مرتين باليوم ولمدة 10 أسابيع. أوضحت النتائج إن كل من الوزن النهائي و الزيادة الوزنية و الزيادة الوزنية اليومية و معدل النمو النوعي والنسبي إزدادت زيادة معنوية ($P < 0.05$) بتركيز (10 gm FOS /kg) بالمقارنة مع المجاميع الأخرى. بينما إزدادت معنويا ($P < 0.05$) نسبة كفاءة العلف والبروتين بالمعاملة (10 gm FOS / kg) بنسبة 1.126 و 295.163 على التوالي بالمقارنة مع المجاميع الاخرى ومعاملة السيطرة. ولكن كان معامل التحويل الغذائي أعلى معنويا ($P < 0.05$) بمعاملة 0 gm FOS /kg بالمقارنة مع بقية المجاميع بنسبة 1.632.