

Effects of dietary fructo-oligosaccharide supplementation on the growth performance, haemato-immunological parameters, gut microbiota and stress resistance of common carp (*Cyprinus carpio*) fry

Seyed Hossein Hoseinifar^{1*}, Narges Soleimani² and Einar Ringø³

¹Department of Fisheries, Faculty of Fisheries and Environmental Sciences, Gorgan University of Agricultural Sciences and Natural Resources, Gorgan, Iran

²Department of Aquatic Animal Health, Faculty of Veterinary Medicine, University of Tehran, Tehran, Iran

³Norwegian College of Fishery Science, Faculty of Biosciences, Fisheries and Economics, UiT The Arctic University of Norway, NO-9037 Breivika, Norway

(Submitted 22 October 2013 – Final revision received 23 April 2014 – Accepted 18 June 2014)

Abstract

The present study was conducted to investigate the effects of dietary fructo-oligosaccharide (FOS) (0, 1, 2 and 3%) supplementation on the growth performance, haemato-immunological parameters, cultivable autochthonous (non-adherent) intestinal microbiota and stress resistance of common carp (*Cyprinus carpio*) fry (3.23 (SEM 0.14) g). These parameters were measured after feeding the carp fry with the experimental diets for 7 weeks. Dietary FOS supplementation had no significant effects on the growth performance and food intake of carp fry compared with the control treatment. It also had no significant effects on the following haematological parameters: erythrocyte count; leucocyte counts (WBC); haematocrit; Hb; mean corpuscular volume; mean corpuscular Hb content; mean corpuscular Hb concentration. However, WBC and respiratory burst activity were significantly affected by dietary FOS supplementation. Evaluation of the cultivable autochthonous intestinal microbiota revealed a significant increase in the levels of total viable heterotrophic aerobic bacteria and lactic acid bacteria in fish fed diets supplemented with 2 and 3% FOS. Furthermore, dietary FOS supplementation significantly increased the survival rate and stress resistance of carp fry compared with the control treatment. These results encourage conducting further research on the administration of FOS and other prebiotics in carp fry studies.

Key words: *Cyprinus carpio*; Fructo-oligosaccharide; Growth performance; Haemato-immunological parameters; Gut microbiota; Stress resistance

Prebiotics are non-digestible food ingredients that beneficially affect the host by selectively stimulating the growth and/or activity of health-promoting bacteria in the intestinal tract⁽¹⁾. Fructo-oligosaccharide (FOS or oligofructose) is a fructan with a degree of polymerisation (2–20) that is obtained by enzymatic hydrolysis of inulin⁽²⁾. FOS is present in a number of common foods such as garlic, onion, artichoke and asparagus⁽³⁾, and dietary FOS has received great attention as a prebiotic for aquatic animals^(4,5). Despite some contradictory results^(5–7), beneficial effects of dietary FOS supplementation on growth performance and survival^(8–14), gut microbiota^(14,15), immune response^(12,16,17) and digestive enzyme activity^(12,13) have been reported in several fish species.

Common carp (*Cyprinus carpio*) is a widespread freshwater fish and is the main aquaculture species in many European

and Asian countries⁽¹⁸⁾. Considering the progress in culture methodologies, specifically elevation of the production by intensification of culture, which causes deterioration of water quality, stress to cultured organisms and outbreaks of infectious diseases, elevation of fish resistance and improvement of fish health status through dietary supplements are of importance in commercial carp aquaculture, especially in sensitive periods (i.e. larval and fry culture)⁽¹⁹⁾. However, despite the well-documented beneficial effects of prebiotics in finfish^(4,5), to our knowledge, there is no available information on the effects of dietary FOS supplementation in carp fry.

Therefore, the aim of the present study was to investigate the effects of dietary FOS supplementation on the growth performance, haemato-immunological parameters, culturable gut microbiota and stress resistance of common carp fry.

Abbreviations: FOS, fructo-oligosaccharide; Ht, haematocrit; LAB, lactic acid bacteria; WBC, leucocyte counts.

* **Corresponding author:** S. H. Hoseinifar, fax +98 2632227765, email hoseinifar@gau.ac.ir