



## Full length article

# Dietary fermentable fiber upregulated immune related genes expression, increased innate immune response and resistance of rainbow trout (*Oncorhynchus mykiss*) against *Aeromonas hydrophila*



Peyman Yarahmadi<sup>a</sup>, Hamed Kolangi Miandare<sup>b,\*</sup>, Hamid Farahmand<sup>a</sup>,  
Alireza Mirvaghefi<sup>a</sup>, Seyed Hossein Hoseinifar<sup>b,\*</sup>

<sup>a</sup> Department of Fisheries and Environmental Sciences, Faculty of Natural Resources, University of Tehran, Karaj, Iran

<sup>b</sup> Department of Fisheries, Faculty of Fisheries and Environmental Sciences, Gorgan University of Agricultural Sciences and Natural Resources, Gorgan, Iran

## ARTICLE INFO

## Article history:

Received 20 June 2014

Received in revised form

14 August 2014

Accepted 2 September 2014

Available online 10 September 2014

## Keywords:

Fermentable fiber

Rainbow trout

Immune genes expression

Immune response

Disease resistance

## ABSTRACT

This trial was carried out to investigate the effects of dietary administration of Vitacel<sup>®</sup>, a commercial fermentable fiber, on immune related genes (*Lysozyme*, *TNFα* and *HSP70*) expression, innate immune response and resistance of rainbow trout against *Aeromonas hydrophila*. 120 healthy rainbow trout (81.65 ± 1.49 g) were distributed in six fiberglass tanks assigned to two treatments. The treatments were feeding rainbow trout with diets supplemented with 0 (control) or 10 g kg<sup>-1</sup> Vitacel<sup>®</sup> for 45 days. The results revealed that administration of fermentable fiber significantly ( $P < 0.05$ ) upregulated *lysozyme* and *TNFα* gene expression. *HSP70* gene expression was significantly lower in Vitacel<sup>®</sup> fed fish at the end of trial ( $P < 0.05$ ). Furthermore dietary administrations of Vitacel<sup>®</sup> remarkably elevated rainbow trout innate immune parameters include serum lysozyme, ACH50, bactericidal activity and agglutination antibody titer ( $P < 0.05$ ). Administration of 10 g kg<sup>-1</sup> Vitacel<sup>®</sup> significantly increased rainbow trout resistance against *A. hydrophila* ( $P < 0.05$ ). The results of present study revealed that dietary Vitacel<sup>®</sup> can upregulates immune related genes expression and elevates innate immune response and disease resistance of rainbow trout.

© 2014 Elsevier Ltd. All rights reserved.

## 1. Introduction

Immune system in fish includes both inborn and acquired systems like other vertebrates. In aquatic animals, innate immune response plays a key role in protection of an organism against pathogens [47]. Innate immune system includes the variety of components such as scales and mucosa as physical barrier, phagocytic and macrophages cells [23]. This system in fish is more important compared to higher vertebrates as precedes and determines the nature adaptive response [23,35,36]. It is well-documented that several factors such as environmental conditions, pollution, nutrition and feed additives affect immune response in fish [5,6,21,37,46]. Regards feed additive, previous studies demonstrated that probiotics and prebiotics effectively

stimulate immune response through modulation of gastrointestinal microbiota [27,31]. Furthermore, some non-digestible components such as dietary fiber have the potential to modulate intestinal microbiota, particularly in non-ruminant animals (Reviewed by Refs. [19,26]. Vitacel<sup>®</sup> is a pure raw fiber and mainly consists of cellulose and hemicellulose. In the past decades fibers (non-starch polysaccharides; NSP) have been used in the diet of terrestrial and recently in aquatics animals [19,42]. Heidarieh M [14] reported that dietary Vitacel<sup>®</sup> stimulated innate immune response and enhanced growth performance in beluga sturgeon (*Huso huso*). In addition, prebiotic fibers such as inulin and oligofructose acts as immunostimulants and improved health status in vast range of aquatic animals [31].

Despite several reports on the effects of dietary fermentable fibers on growth and metabolism in terrestrial animals (reviewed by Refs. [40]), there is limited information about their effects on regulation of immune related genes and innate immune response of fish. Therefore, the aim of the present study was to investigate the effects of Vitacel<sup>®</sup> as a fermentable fiber source on immune related genes expression (*lysozyme*, *TNFα* and *HSP70*), innate immune response and resistance of rainbow trout against *Aeromonas hydrophila*.

\* Corresponding authors. Department of Fisheries, Faculty of Fisheries and Environmental Sciences, Gorgan University of Agricultural Sciences and Natural Resources, Gorgan, P.O.BOX: 45165-386, Iran. Tel.: +98 1714427040; fax: +98 1712245886.

E-mail addresses: [kolangi@gau.ac.ir](mailto:kolangi@gau.ac.ir) (H. Kolangi Miandare), [hoseinifar@gau.ac.ir](mailto:hoseinifar@gau.ac.ir) (S.H. Hoseinifar).