



Effects of Fish Oil Replacement with Vegetable Oils in Rainbow Trout (*Oncorhynchus mykiss*) Fingerlings Diet on Growth Performance and Foregut Histology

Rasoul Shahrooz^{1,*}, Naser Agh², Nasim Jafari³, Ali Kalantari¹, Reza Jalili³, Ali Karimi¹

¹ Urmia University, Faculty of Veterinary Medicine, Department of Histology and Embryology, Urmia, Iran.

² Urmia University, Urmia Lake Research Institute, Department of Artemia and Aquaculture, Urmia, Iran.

³ Urmia University, Faculty of Natural Resources, Department of Fisheries, Urmia, Iran.

* Corresponding Author: Tel.: +98 9143482436 ;
E-mail: rasoul_shahrooz@yahoo.com

Received 20 June 2017
Accepted 09 October 2017

Abstract

The present study was performed to elucidate the effects of total replacement of fish oil with vegetable oils on growth performance and foregut histological indices of the rainbow trout. Fishes with average initial weight of 15.10 ± 0.20 g were transferred into 15 (300 L) tanks (50 fishes/tank) and reared for 60 consecutive days using different experimental diets. Kilka fish oil (FO) was fully replaced with different vegetable oil sources including canola oil (CO), safflower oil (SO), linseed oil (LO) and a mixture (CSLO) of CO (40%), SO (30%) and LO (30%) as dietary lipid sources. The samples were fixed at 10% neutral-buffered formalin and paraffin sections were prepared and stained with hematoxylin and eosin and periodic acid-Schiff methods. Growth performances in CO and CSLO groups were better than other groups. Moreover, in these groups, the number of goblet cells was decreased; however thickness and height of intestinal folds and thickness of tunica mucosa and tunica sub-mucosa were increased in comparison to FO group. Overall, performance and histological findings did not show any negative effect due to canola and mixed vegetable oils feeding compared to FO group.

Keywords: Fish oil, vegetable oil, histology, foregut, rainbow trout.

Introduction

Fish oil is the main material used in the formulation of fish feeds. Due to the expansion of aquaculture industry, fisheries will not be able to sustain the aquaculture needs for not too distant future. The global request of fishmeal for aqua feeds may exceed in the next decade. Aquaculture production is expected to extend as a source of fish products for consumption (Tidwell & Allan, 2001). Fish feed replacements in rainbow trout (*Oncorhynchus mykiss*) have been investigated for many years and more attention has been paid to this issue as fishmeal and aquaculture production costs are increasing (Gatlin *et al.*, 2007). In line with that, some alternatives should be introduced instead of marine materials in fish feeds. Several studies have investigated the replacement of fish oil by vegetable oils in fish feed. Partial replacement of fish oils by vegetable oils such as rapeseed, soya bean, linseed and palm oils in fish feeds did not show negative impacts on growth and survival of Atlantic salmon (Rosenlund, Obach, Sandberg, Standal, & Tveit, 2001), brook char (Guillou, Soucy, Khalil, & Adambounou, 1995), gilthead sea bream and European sea bass (Izquierdo *et al.*, 2003) and

rainbow trout (Greene & Selivonchick, 1990; Caballero *et al.*, 2002). Fatty acid (FA) composition of fish lipids generally reflects the FA profile of the diets (Watanabe, 1982). Vegetable oils contain higher levels of saturated and n-6 polyunsaturated fatty acids (PUFA) than fish oil which is richer in n-3 PUFA, mainly eicosapentaenoic and docosahexaenoic acids and long-chain monounsaturated fatty acids. Lipid deposition in fish tissues involves in several metabolic processes including lipogenesis, lipid transport by lipoproteins, tissue lipid uptake (mediated by lipoprotein lipase) and lipids storage (Sheridan, 1988; Tocher, 2003).

Changes in dietary FA composition have been reported to affect FA composition of fish lipids storage and cell membranes in hepatic (Kjaer *et al.*, 2008; Fountoulaki, Alexis, Nengas, & Venou, 2005; Castro *et al.*, 2015), intestinal (Caballero *et al.*, 2003; Ruyter, Moya-Falcón, Rosenlund, & Vegusdal, 2006) and digestive tract tissues (Olsen, Myklebust, Kaino, & Ringo, 1999; Moldal *et al.*, 2014).

Replacement of fish oil with vegetable oils in fish diets can cause histological changes in fish intestinal tissue affecting digestion and absorption processes. Accordingly, in Arctic char (*Salvelinus alpinus*), fed linseed oil (LO) containing high levels