The Effect of Dietary Organic Chromium on Specific Growth Rate, Tissue Chromium Concentrations, Enzyme Activities and Histology in Common Carp, Cyprinus carpio L.

Arafat R. Ahmed, Awadhesh N. Jha & Simon J. Davies

Editors

Peter Schramel

Yasushi Kodama

Alain Favier

Biological Trace Element Research

ISSN 0163-4984

Biol Trace Elem Res DOI 10.1007/s12011-012-9436-3

Volume 116 • No. 1 • April 2007 • ISSN 0163-4984 (Print) • ISSN 1559-0720 (Online) Biological Trace Biological Education </

Featured in this issue: Decreased Thiamine and Magnesium Levels in the Potentiation of the Neurotoxicity of Lead in Occupational Lead Exposure Effects of Rare Earth Elements on Telomerase Activity and Apoptosis of Human Peripheral Blood Mononuclear Cells Fluoride-Induced Oxidative Stress of Osteoblasts and Protective Effects of Baicalein Against Fluoride Toxicity Effects of Cadmium and Zinc on the Quality of Quail's Eggs

*** Humana Press**



Your article is protected by copyright and all rights are held exclusively by Springer Science+Business Media, LLC. This e-offprint is for personal use only and shall not be selfarchived in electronic repositories. If you wish to self-archive your work, please use the accepted author's version for posting to your own website or your institution's repository. You may further deposit the accepted author's version on a funder's repository at a funder's request, provided it is not made publicly available until 12 months after publication.



The Effect of Dietary Organic Chromium on Specific Growth Rate, Tissue Chromium Concentrations, Enzyme Activities and Histology in Common Carp, *Cyprinus carpio* L.

Arafat R. Ahmed · Awadhesh N. Jha · Simon J. Davies

Received: 10 February 2012 / Accepted: 18 April 2012 © Springer Science+Business Media, LLC 2012

Abstract A 63-day feeding trial was carried out to investigate the effect of three levels of Cr yeast (0.5, 1.0 and 2.0 mg Cr/kg) on the utilization of diets containing 38.5 % of maize starch or dextrin in common carp, Cyprinus carpio L. (initial mean body mass 14 ± 0.3 g) in an auto circulator system at 25 ± 0.5 °C. A two-way analysis of variance (ANOVA) showed that the final body mass (FBM), percentage mass gain (%MG), specific growth rate (SGR) and feed conversion ratio (FCR) were significantly (P < 0.05) affected by the two sources of variation (carbohydrate source and Cr level). In general, fish fed on a diet containing starch and fortified with 0.5 mg Cr/kg performed significantly higher FBM (47.23 g), %MG (225.11), SGR (1.91) and lower value of FCR (1.24) compared to fish fed on the other diets. Carp fed on 2.0 mg Cr/kg with maize starch and 1.0 mg Cr/kg with dextrin-based diet showed a significant reduction (P < 0.05) in whole body lipid content as confirmed by a two-way ANOVA. Fish fed on a maize starch-based diet supplemented with 0.5 and 1.0 mg Cr/kg recorded the highest activities for hexokinase enzyme. Glucose-6-phosphate dehydrogenase activity was neither affected by Cr concentration nor by dietary carbohydrate source. Fish fed on dextrinbased diets accumulated higher Cr in the whole tissue compared to fish fed on starch-based diets. Normal histological structures in the liver and gut tissues were observed in all groups. The present data clearly showed that dietary Cr yeast was safe in the fish diet at the levels tested.

A. R. Ahmed (⊠) · A. N. Jha · S. J. Davies School of Biomedical and Biological Sciences, University of Plymouth, Portland Square, Plymouth PL4 8AA Devon, UK e-mail: arafat.ahmed@plymouth.ac.uk

A. R. Ahmed e-mail: arafat.rajab@yahoo.com **Keywords** Chromium yeast · Carbohydrate · Growth · Cr accumulation · Histology · Common carp

Introduction

Regardless of species, fish do not have specific requirements for dietary carbohydrate per se, and they grow normally when fed on a diet free from carbohydrate [1]. The reason for this is due to their gluconeogenesis capacity whereby glucose is synthesized from non-glucose precursors such as amino acids [2]. However, from the economic and an environmental perspective, carbohydrate is considered to be a regular source of nutrients in fish diets with little negative impact on the ecosystem [3, 4]. Fish have a limited capacity for dietary carbohydrate digestion, and the efficiency of carbohydrate utilization by fish depends on the molecular complexity of carbohydrate [5, 6]. It has been reported that most fish species use complex carbohydrate (e.g. starch) for growth better than the more simple forms (e.g. glucose) [7–9]. On the other hand, other studies reported the opposite observation [10–12]. It seems that the variation in carbohydrate utilization by fish can be affected by different factors such as the differences in the digestive and physiology metabolic system of each species [13], carbohydrate source [9] and dietary carbohydrate level inclusion [14].

With the rapid expansion in aquaculture industries, carbohydrate utilization improvement in farmed fish is one of the major challenges. Hence, different studies have been carried out to enhance carbohydrate utilization in different fish species in order to reduce the cost of fish diets [15–18]. Creating transgenic fish is one of the possible strategies that can be used to achieve this goal [6]. As an attempt to improve the efficiency of carbohydrate metabolism in salmonid fish, human glucose transporter type 1 and rat