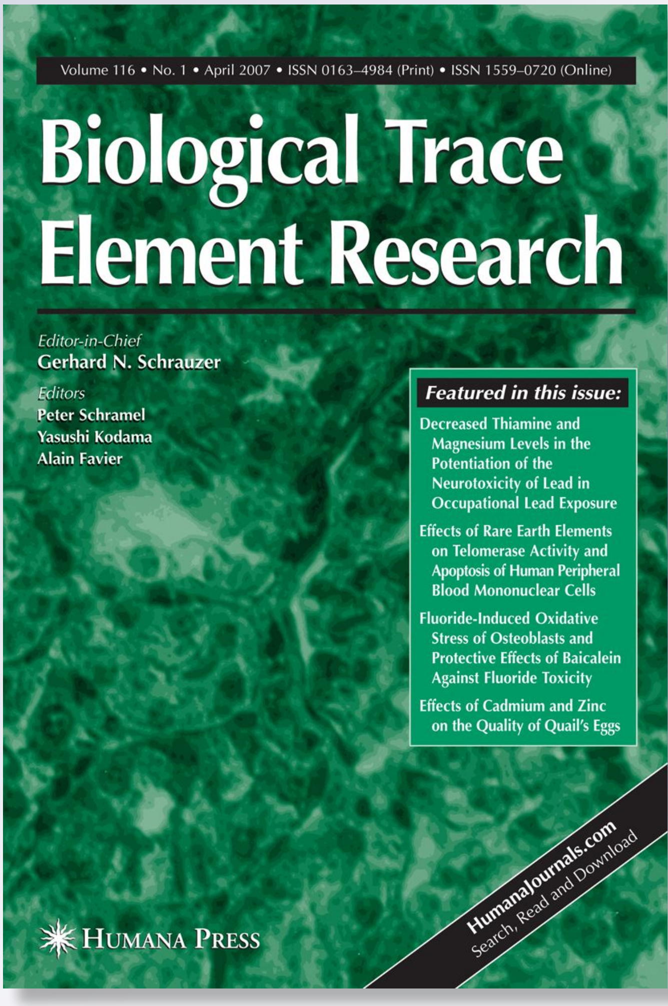
The Effect of Dietary Organic Chromium on Specific Growth Rate, Tissue Chromium Concentrations, Enzyme Activities and Histology in Common Carp, Cyprinus carpio *L.*

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

Biological Trace Element Research

ISSN 0163-4984

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



Springer

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

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

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 dextrin-based 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

Published online: 09 May 2012