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The effect of bentonite and yeast cell wall along with cinnamon oil on aflatoxicosis in rainbow trout (*Oncorhynchus mykiss*): Digestive enzymes, growth indices, nutritional performance and proximate body composition

Ahmad Imani[a,*], Moslem Salimi Bani[a], Farzaneh Noori[b], Mohsen Farzaneh[c], Kourosh Sarvi Moghanlou[a]

[a] Department of Fisheries, Faculty of Natural Resources, Urmia University, Urmia, Iran
[b] Department of Artemia and Aquaculture, Urmia Lake Research Institute, Urmia University, Urmia, Iran
[c] Department of Agriculture, Medicinal Plants and Drugs Research Institute, Shahid Beheshti University, G.C. Evin, Tehran, Iran

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ABSTRACT

Feed safety is amongst the main factors affecting animal performance and economic viability of an aquaculture enterprise. The present research was to study the protective effects of mycotoxin binding agent along with cinnamon oil on the toxicity of various dietary aflatoxin levels in rainbow trout fingerlings. A three way factorial experiment was carried out for 60 days. Aflatoxin B1 (0, 25 and 50 ng/kg), mycotoxin binder (0 and 5%,) and cinnamon oil (0 and 1%) were deliberately included in the diet. Fish were fed three times a day. Dietary Aflatoxin B1 contamination resulted in better PPV ($p < 0.05$), while those fish fed aflatoxin contaminated diet supplemented with mycotoxin binder showed the highest weight gain ($p < 0.05$). Dietary inclusion of cinnamon oil resulted in significantly inferior growth and nutritional indices. Body lipid, energy and ash contents were mainly affected by cinnamon oil to the extent that fish received diet containing the oil had significantly lower lipid and energy content. Meanwhile, feeding oil containing diet resulted in higher ash content ($p < 0.05$). Markedly increased activity of digestive enzymes including alkaline protease, lipase and amylase were observed in fish fed aflatoxin B1 contaminated diet. However, the presence of mycotoxin binding agent rehabilitated lipase activity of aflatoxin received groups. Trout fed diet supplemented with cinnamon oil tended to have lower digestive enzymes activity. In conclusion, aflatoxin B1 resulted in pathologically elevated digestive enzymes activity in trout and mycotoxin binding agent and/or cinnamon oil could correct the enzymes activity of the species.

1. Introduction

Coined in 1962, mycotoxins are difficult to define, however, they are low molecular weight natural metabolites produced by filamentous fungi mainly *Aspergillus* species and some *Penicillium* species (Kabak et al., 2006). Presence of variety of chemically diverse mycotoxins in food and feed commodities, with subsequent safety issues and economic loss in terrestrial and aquatic animal farming, are now becoming issues of worldwide concern. Many of these toxins are frequently reported in feedstuffs at toxicologically relevant concentrations (Kosicki et al., 2016; Zhu et al., 2016). Amongst different types of aflatoxin, aflatoxin B1 (AFB1) is considered the most toxic natural carcinogenic compound by Food and Drug Administration of the United States (FDA) (Santacroce et al., 2008). The AFB1 and its residues could be transferred to human being via food chain and their accumulation in edible animal tissues or products (Boonyaratpalin et al., 2001; El-Sayed and Khalil, 2009). With no doubt, aflatoxin contamination would be a potential threat to aquatic animal health (Deng et al., 2010), especially when fish meal and marine ingredients are replaced by plant based materials in aquafeeds, it is internationally gaining specific attention (El-Sayed and Khalil, 2009). The FDA has set action levels for maximum allowable concentrations of 20 ng/kg total aflatoxin and maximum permitted levels of aflatoxin in animal feed and foods by European Union are 5 and 12 ng/kg, respectively (Streit et al., 2012).

The probable effects of aflatoxin have been investigated in different fish species including rainbow trout, salmon, channel catfish, common carp, Nile tilapia, gibel carp and rohu (Jantrarotai et al., 1990; Ellis et al., 2000; Sahoo and Mukherjee, 2001; Sahoo and Mukherjee, 2002; Williams et al., 2009; Deng et al., 2010; Han et al., 2010). Rainbow trout were found to be the most sensitive finfish to AFB1 as confirmed

* Corresponding author at: Department of Fisheries, Faculty of Natural Resources, Urmia University, Nazlou Campus, 11th km of Serow Road, Urmia, Iran.
E-mail address: a.imani@urmia.ac.ir (A. Imani).

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