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Impact of nematode helminthes on metal concentrations in the muscles of Koshar fish, *Epinephelus summana*, in Jeddah, Saudi Arabia

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KEYWORDS

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Nematoda;
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Heavy metals

Abstract The aim of the present study was to determine the impact of nematode parasites on the metal balance of the Koshar fish *Epinephelus summana*. A total of 102 fish were randomly collected from the Red Sea, Jeddah coast, during the period of March to September 2014. The element concentrations in the infected and non-infected fish were analyzed using flame atomic absorption spectrometry. Nematodes were collected and described from fish liver, intestine, stomach and gonads. The results showed that intestinal and stomach nematodes caused significant decreases in both magnesium and lead and insignificant decreases in iron and calcium compared to non-infected fish. There were significant increases in potassium and sodium and insignificant increases in zinc and copper in fish infected with intestinal and stomach nematodes. Most elements significantly decreased in fish infected with gonadal nematodes, with the exception of magnesium and lead, which insignificantly decreased in comparison to healthy fish. Adult nematode infection in marine fish is considered to be a biological indicator for heavy metal pollution, and its presence can minimize the bioaccumulation of heavy metals in fish tissue and organs.

Introduction

Fish are said to be gold in water, as they play an important role in Saudi Arabia's economy. From a nutritional point of view, fish provide a high content of proteins to the daily growing population, which is currently facing malnutrition (Jawale et al., 2011). Fish are located at the end of the aquatic food chain and may accumulate metals and pass them to humans through food, causing chronic and acute diseases (Forstner and Wittmann, 1979; Khan and Weis, 1993; Jorgensen and Pedersen, 1994; Adeyeye et al., 1996).

The relationship between pollution and parasitism in aquatic organisms and the potential role of parasites as water quality indicators have received increasing attention during the past two decades. Until recently, little was known regarding the accumulation of toxins within parasites (Genc et al.,

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2008). It is necessary, from a public health viewpoint, to determine the heavy metal concentrations in fish captured for human consumption. However, chronic exposure to pollutants over a period of time causes physiological, behavioral and biochemical host changes that can ultimately influence the prevalence and intensity of parasitism (Khan and Thulin, 1991). The present study was designed to investigate the impact of nematodes inhabiting Koshar fish liver, intestine, stomach and gonads on some metals in fish muscles.

Materials and methods

Sample preparation

A total of 102 *Epinephelus summana* were randomly collected from fish markets, the Red Sea, Jeddah coast, Saudi Arabia, during the period from March to September 2014. Fish were transferred to the laboratory using small containers containing seawater with aeration. Fresh fish were dissected and examined microscopically for endoparasites using a dissecting microscope. The liver, intestine, stomach and gonads were investigated separately. Nematodes were fixed and relaxed by immersing them in 70% hot alcohol. They were cleared and mounted, either temporarily with lactophenol or permanently using Glycerin-gelatin.

Chemical analysis

One gram of fish muscles was placed in crucibles with fourfold its volume of distilled water. These crucibles were left in a furnace thermolyne at 80 °C overnight. Then, they were crushed using a mortar and pestle, weighed and transferred into 100-ml flasks. Approximately 10 ml of nitric acid was added to each flask and then boiled on a hot plate until nitric acid dryness. The final step was the addition of 25 ml of distilled water into the previous flasks, followed by the addition of 1 ml of HCL. The solution was analyzed by Flame Atomic Absorption Spectrometry (FAAS). FAAS was performed using a varian 5-AAS analytic Jena Spectrometer (Department of biology, Faculty of Science, King Abdul Aziz University, Jeddah, Saudi Arabia) to determine the Zn, Cu, Pb, Fe, K, Mg, Ca and Na concentrations. The flame wavelength and sample aspiration rate were optimized according to the manufacturer's recommendations. Four aqueous standards that had analytic concentrations within the linear response range of the instrument and contained the same concentration of nitric acid as the sample were used for calibration. Each sample, standard and blank were analyzed using three 10-s integrations. The reagent blank was prepared, and its value was subtracted to give the final concentration.

Data analysis was performed using a one-way ANOVA to compare the biochemical analysis between infected and non-infected fish. All the statistical analyses were performed using the SPSS software program (version 16). Microsoft Office Excel 2007 was used for to draw graphs.

Results

The percentage of a single infection of nematodes was 17.65%. Nematodes were identified according to their morphological features, depending on taxonomic keys. They were identified as: *Anisakis simplex* (Plate 1) from liver, intestine and stomach; *Procamallanus* sp1. and *P.* sp2 from intestine (Plates 2 and 3); and *Philometra* from gonads (Plate 4).

Table 1 shows that some minerals, such as zinc, copper and iron, significantly decreased in the case of infection by liver nematodes, while there were insignificant decreases in lead and sodium compared to healthy fish. On the contrary, some minerals, such as potassium, magnesium and calcium, significantly increased in nematode-infected fish liver. Most elements significantly decreased in fish infected with intestinal nematodes, such as zinc, copper, lead, potassium, magnesium and calcium, or insignificantly decreased, such as in iron. Sodium

Plate 1

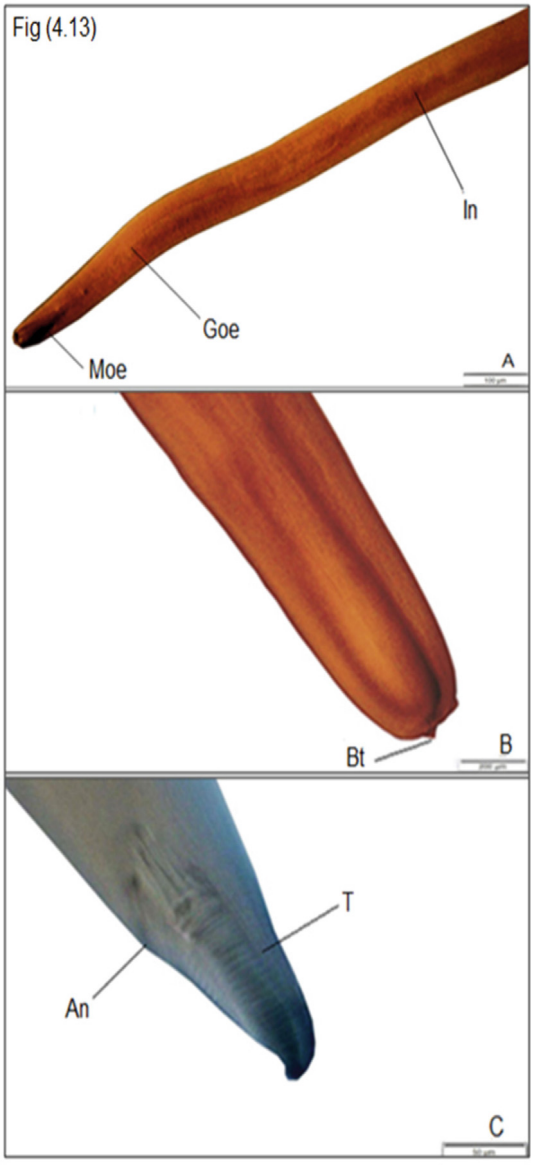

Plate 1 *Anisakis simplex* larva. A. The anterior end of *Anisakis simplex* showing the muscular esophagus (Moe), glandular esophagus (Goe) and intestine (In). B. Magnified parts of the anterior end of *Anisakis simplex* larvae showing the boring tooth (Bt). C. The posterior end of the body, anus (An) and tail (T).