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Publication date:
2015

Document Version
Publisher's PDF, also known as Version of record

Citation (APA):

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Correlations between arsenolipids, organic and inorganic forms of arsenic, mercury and selenium in muscles and cephalothorax of Aristaemorpha foliacea shrimp.

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Introduction

A Mediterranean species of shrimps, Aristaemorpha foliacea (giant red shrimp) from the deep waters of the Ionian Sea, was studied in terms of its content of organic and inorganic arsenic (As), mercury (Hg) and selenium (Se) in the muscles and cephalothorax (head including hepatopancreas). Generally, total As concentration ranges from 1 to 100 mg/kg w.w. in marine organisms. As is found in marine organisms as inorganic (the most toxic form of As, typically found in low concentrations) and as organic (considered as less- or non-toxic, and typically found in high levels): Arsenolipids, a group of lipophilic of arsenic-containing compounds, has been reported in concentrations ranging from 1 to 50 mg/kg in marine oils [1]. Hg, a well-known toxic element, is typically determined in low levels in crustaceans. Se is believed to have an antagonistic protective effect against the toxicity of Hg and hence the ratio of these two elements is interesting to be studied in marine organisms.

Aim

The aim of the present study was to determine the levels of the total As and its forms (organic and inorganic As), as well as the levels of Hg and Se in order to evaluate the food safety of this type of shrimp.

Materials and Methods

• Total Arsenic and Selenium

Digestion in a microwave system by the use of acids (HNO3 and H2O).

Final determination by Inductively Coupled Plasma Mass Spectrometry (ICP-MS) 7700x, Agilent Technologies

Instrumental conditions: RF power: 1550 W; Plasma gas flow: 15 L/min; Carrier gas flow: 1.0 L/min.

Make-up gas flow: 4.2 L/min; Torch: 2.5 mm i.d.; Nebulizer: OpalJet; Integration time: 1000 ms

• Total Arsenic of fat oil

Extraction of the fat oil containing the arsenolipids by the Bligh and Dyer method [2]

Digestion in a microwave system by the use of acids (HNO3 and H2O)

Final determination by ICP-MS (ICP-MS 7500ce, Agilent Technologies)

Instrumental conditions: RF power: 1500 W; Plasma gas flow: 15 L/min; Carrier gas flow: 0.9 L/min.

Make-up gas flow: 0.16 L/min; Torch: 2.5 mm i.d.; Nebulizer: Babington; Integration time: 1000 ms

• Inorganic Arsenic

Extraction in water bath with 0.1M HNO3/3% H2O2.

Final determination by High Performance Liquid Chromatography coupled to ICP-MS (HPLC 1200 / ICP-MS 7500ce, both Agilent Technologies)

Instrumental conditions: Column: Anion Exchange (Trugenomic, 120 4.6mm); Method: Isocratic elution; Injection Vol.: 25 μL; Flow: 1 ml/min; Column Temperature: 30°C; Mobile phase: 50 mM (NH4)2CO3 in 3% MeOH (10 min.)

• Organic Arsenic

Was calculated by the subtraction of inorganic arsenic from total arsenic

• Arsenolipids

Extraction of the fat oil containing the arsenolipids by using the Bligh and Dyer method

1.0 g of oil was partitioned between n-heptane (7.5 mL) and MeOH/H2O (9:1 v/v; 2x3.75mL). The MeOH phases were evaporated to dryness and dissolved in 0.5 mL MeOH/H2O and filtered. The samples further diluted in MeOH/H2O prior to analysis.

Determination by HPLC-ICP-MS [3] (HPLC 1200 / ICP-MS 7500ce, both Agilent Technologies).

Instrumental conditions: i) HPLC column: Waters Acquity UPLC C18 (2.1x100 mm, 1.7 μm); Mobile phases: A) 0.1% formic acid in H2O; B) 0.1% formic acid in MeOH. Gradient Program: 0-2 min: 30:100% B; 2-3.2 min: 100% B; 3.3-40 min:30% B; Flow: 0.14 ml/min; Injection Vol.: 3 μL; Column Temperature: 30°C; ii) ICP-MS: RF power: 1500 W; Plasma gas flow: 15 L/min; Carrier gas flow: 0.22 L/min; Make-up gas flow: 0.46 L/min; Torch: 1.5 mm i.d.; Nebulizer: Micromist, 10-100 μL/min; Integration time: 100 ms

• Mercury

Digestion in a microwave system by the use of acids and final determination by Cold Vapour Atomic Fluorescence Spectrometry (CVAFS) purge and trap dual amalgamation thermal extraction manual system coupled with Tekran detector, according to the EPA method 1631

References