

## RESEARCH ARTICLE

# Cadmium and arsenic levels in edible fishes, *Oreochromis niloticus* (Nile tilapia) and *Ompok bimaculatus* (butter catfish) from Padaviya Reservoir, Sri Lanka and human health risk assessment associated with their dietary exposure

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Submitted: 09 December 2019; Revised: 22 June 2020; Accepted: 07 July 2020


**Abstract:** Consumption of fish contaminated with toxic heavy metals is a threat to human health. Cadmium and arsenic are suspected as potential risk factors for chronic kidney disease of unknown aetiology (CKDu), which is highly prevalent in agricultural settlements in dry zone districts of Sri Lanka causing a severe public health crisis. Objectives of this study were (i) to determine cadmium and arsenic levels in muscle, liver and kidney of two edible fishes (Nile tilapia and butter catfish) from the Padaviya reservoir located in the North Central Province, Sri Lanka where CKDu is highly prevalent and (ii) to assess the potential human health risks associated with the dietary exposure through edible muscle of these fishes. Cadmium and arsenic levels of the tissues in the two fish species were determined using inductively coupled plasma mass spectrometry. In both fish species, highest cadmium levels were found in kidney ( $p < 0.05$ ) whereas no significant tissue specific differences ( $p > 0.05$ ) were evident for arsenic. In the edible muscle, the maximum detected cadmium level in Nile tilapia was 0.1 mg/kg in wet weight. However, cadmium levels in the muscle of all Butter catfish were  $< 0.05$  mg/kg. Arsenic levels in the muscle of all Nile tilapia and Butter catfish were  $< 0.05$  mg/kg. Cadmium contents in muscle of most fishes and arsenic contents in all fishes ( $n = 60$ ) were within the maximum permissible limits set by the international food standards regulatory authorities. Based on the estimated daily intake and target hazard quotients ( $< 1$ ) for lifetime exposure, it is highly unlikely that cadmium and arsenic contents of the muscle meat of these fishes would pose human health risks to moderate level consumers.

**Keywords:** Chronic kidney disease, heavy metal, ICP-MS, North Central Province, Padaviya reservoir fish, risk assessment.

## INTRODUCTION

Consumption of fish provides an important source of protein, polyunsaturated fatty acids and essential minerals which are associated with health benefits and normal growth. However, contamination of fish with toxic heavy metals can affect the nutritional and other beneficial effects of fish on human health (Castro-González & Méndez-Armenta, 2008). Due to the high degree of toxic effects, some heavy metals and metalloids such as cadmium and arsenic have been ranked as priority metals that are of public health significance. Cadmium and arsenic are systemic toxicants that could induce multiple organ damage, even at lower levels of exposure (Tchounwou *et al.*, 2012; Karri *et al.*, 2016; Wise *et al.*, 2017). Inorganic forms of arsenic in food appears to be more toxic than the organic arsenic forms (USEPA, 2000; Castro-González & Méndez-Armenta, 2008; Varol & Sünbül, 2018).

Chronic kidney disease of unknown aetiology (CKDu) is an emerging health problem in some low-

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