Human health aspects of certain metals in tissue of the African sharptooth catfish, *Clarias gariepinus,* kept in treated sewage effluent and the Krugersdrift Dam: Chromium and mercury

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Abstract

Chromium and mercury concentrations in water, sediment and fish tissue were studied to assess the health risks concerned when such fish are consumed. Metal concentrations were studied in the liver, kidney and muscle tissues of the African sharptooth catfish, *Clarias gariepinus,* kept in treated sewage effluent from a biofilter treatment plant and in the Krugersdrift Dam, Bloemfontein, South Africa as well as in the water and sediment of the mentioned localities.

Chromium concentrations were noticeably higher in the livers and kidneys than in the muscle tissue. In contrast, Hg concentrations were higher in the muscle tissue than in the livers and kidneys. However, no set seasonal patterns could be established regarding the incidence of these elements in both habitats. The occurrence of Hg in the water of both habitats was very low and could therefore not be considered harmful or toxic to aquacullure. Chromium concentrations showed a fluctuating occurrence and exceeded international limit values during some months. The Hg and Cr concentrations found in the muscles of C. *gariepinus,* kept in treated domestic effluent can be a health hazard to consumers if fish is consumed in excess. Only gutted fish with the gills removed would be recommended for intake due to the Hg and Cr concentrations found in the kidney and liver tissue.

Introduction

Loading of aquatic habitats with non-degradable, non-nutritious, cumulative pollutants such as Hg, Pb and As can result in undeniably complex alterations of numerous trophic levels. These effects can last for centuries and studies spanning the globe, document the ubiquity of such contamination (Sorenson, 1991). Industrial and/ or sewage effluents are major sources of metal poisoning in fish in Africa (Greichus et al., 1978).

The utilisation of human and animal waste in fish dams has already been known for decades (Feachem et al., 1978). but little information regarding the human health aspects of fish living in treated domestic effluent is currently available. The prevalence and accumulation of a series of metals in the tissue of local fish fauna as well as the accompanying health risks for the consumer thereof, were investigated by Van den Heever and Frey (1994). The primary goal of the study was to determine whether treated sewage *effluent* could be suitable for the culture of fish for safe human consumption. These usually abundant and nutritious waters are normally discharged into natural water sources without further use. In South Africa especially, it must be endeavoured to improve the quality of available water and to make use of treated effluents. A secondary goal of the study was to compare the pollution status of the Krugersdrift Dam, as a natural water source, and treated sewage effluent discharged from a biofilter treatment plant.

This paper specifically deals with the occurrence of Cr and Hg in treated sewage effluent and natural dam water and the extent of bio-accumulation of these metals in the tissue of the African sharptooth catfish *(Clarias gariepinus).* This fish was chosen as experimental species, as research conducted by Prinsloo et al. (1989) on C. *gariepinus* in maturation ponds in Lebowa, indicated that this fish thrives on the high organic content of ponds.

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Materials and methods

Water sampling, preparation and analysis

Water samples were collected monthly from January to December 1991 according to the method of Watling (1981). Sampling bottles were washed and left to stand in a 5% Decon 75 non-metallic detergent solution for 48 h. After rinsing with distilled water, the bottles were soaked in 50% HC1 for 24 h. Finally, the items were washed with distilled water and stored in 1% $HN0_3$ prior to their use.

Pre-cleaned high density polyethylene bottles with a 2lcapacity were used for sampling. Samples were acidified on site with 10 *ml* concentrated nitric acid (SAARCHEM) (AR) per litre sample and the bottles sealed with high density polyethylene screw-tops. Samples were transported to the laboratory in a sample case at 15°C and stored in high density polyethylene bottles until they were analysed. The collected samples were divided into three subsamples and then filtered through a 0.45 um membrane filter into a 335 *ml* high density polyethylene bottle with a polyethylene top. The first 20 ml of the filtered samples were discarded. A separate subsample of the 0.45 um filtered water sample was collected in a test tube for analysis. The samples were analysed according to the method of Kempster(l986).

The Hg concentrations of water samples collected from each locality were determined by means of a Varian Spectra 30 atomic absorption spectrometer (Watling, 1981). Chromium concentrations were determined by means of an ARL inductively coupled plasma (1CP) emission spectrometer (Model 3410). Various physical properties of the water of the *two* habitats such *as* pH, hardness, conductivity, redox potential and temperature variations were also determined monthly with a HANNA water test meter in order to