Human health aspects of the metals zinc and copper in tissue of the African sharptooth catfish, *Clarias gariepinus*, kept in treated sewage effluent and in the Krugersdrift Dam

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Abstract

Bioaccumulation and health risks of the metals zinc and copper were studied in the liver, kidney and muscle tissues of the African sharptooth catfish, *Clarias gariepinus*, kept in treated sewage effluent and in the Krugersdrift Dam, Bloemfontein, South Africa. Metal concentrations were also studied in the water and sediment of the mentioned localities. Marked differences in the bioconcentrations of Zn and Cu were measured in the different types of tissue. Concentrations of the selected trace elements were noticeably higher in the livers and kidneys than in the muscle tissue. However, no set seasonal patterns could be established regarding the incidence of these elements in both localities. The occurrence of Zn and Cu in the water of both localities was very low and therefore it would not be considered harmful or toxic to aquaculture. The Cu and Zn concentrations found in the muscles of *C. gariepinus*, kept in domestic effluent from abiofilter plant, are not considered to be a health hazard to consumers. Gutted fish only would be recommended for intake due to the Cu and Zn concentrations found in the kidney and liver tissue. A diet containing fish would contribute to the daily requirement of 4 to 10 mg for Zn and approximately 3 mg for Cu.

Introduction

The alarming growth rate of 2.3% per year for the South African population, will result in a total population of approximately 138 m. in less than 35 years (Council for Population Development, 1990). The Council estimated the natural water sources of the country to be adequate for a maximum of 80 m. people. It is clear, therefore, that the development and utilisation of water sources in the Republic of South Africa is of the utmost importance. Fourie (1989) furthermore warns that more food will have to be produced per unit area in South Africa in order to satisfy future domestic needs. General water shortages areas suitable for aquaculture in South Africa necessitate investigations into the use of effluent, such as treated sewage effluent from municipal purification plants for food production. These usually abundant and nutritious waters (Duffer, 1982), are normally discharged into natural water sources. Especially in South Africa, it must be endeavored to improve the quality of available water and to make use of effluent as much as possible.

The utilisation of human and animal waste in fish dams has been known for decades (Feacham et al., 1978), but little information regarding the human health aspects of fish living in treated domestic effluent is currently available. These waters may pose a potential healih risk to handlers and consumers of such fish (Guelin, l962;Janssen, 1970;Reichenback-Klinke,l973;Feachem et al., 1978; Lawton and Morse, 1980). For this reason the use of domestic effluent for aquaculture has not yet been approved by health authorities in South Africa. Additional drawbacks of fish production in maturation ponds are public disapproval of sewage-related products as well as conditions resulting in stress to the fish (Wrigleyetal., 1988). According to Sandbank and Nupen (1984), the most important problem regarding aquaculture in domestic effluent, is the accumulation of metals, pathogens and pesticides in the fish and, as a result, the possible transmission of diseases to man. The potential of fish being contaminated is very high where cultivation has taken place in effluent because of the possibility of contamination by bacteria, viruses and toxic chemicals (Hejkal etal., 1983). However, the health risks related to the consumption of fish kept under the controlled conditions of maturation ponds cannot be greater than in the case of fish kept under uncontrolled conditions (Hejkal et al., 1983). The authors suggest further that a sewage treatment system employed for aquacultural may be a potentially useful alternative to conventional sewage purification installations. Uncontrolled water sources on the contrary can be contaminated by pollutants at any time. The various discrepancies regarding health hazards to man consuming fish living in treated sewage effluent still have to be clarified.

Very little information is available on the effects of metals on local fish fauna (Bezuidenhout et al., 1990; Du Preez and Steyn, 1992; DuPreez et al., 1993; Van der Merwe et al., 1993; Wepener et al., 1992) as well as accompanying health risks for the consumer thereof. For this reason the primary goal of this study was to determine whether treated sewage effluent could be suitable for the culture of fish for table purposes. Generally known for its hardiness, the African sharptooth catfish *{Clarias gariepinus)* was chosen as experimental species, as research conducted by Prinsloo et al. (1989) on *C. gariepinus* in maturation ponds in Lebowa, had indicated that this species of fish thrived on the high organic content of the ponds. A secondary goal of this study was to compare the pollution status of the Krugersdrift Dam, as a natural water source, and treated sewage effluent.

Additive and synergistic relationships among pairs of metals are concentration-dependent as is the case with Cu and Zn (Doudoroff and Katz, 1953; Lloyd, 1961; Sprague and Ramsay, l965;BirgeandBlack, 1979). This was demonstrated by Sorensen (1991) with studies on the hatchability of catfish, goldfish and bass embryos with a 1:1 Cu:Zn solution. Due to their elemental interactions in the same habitat, Zn and Cu were selected for a first paper in a series on metals and related trace elements in treated effluent, sediment and tissue of catfish kept at the Bloemspruit Sewage Works and the Krugersdrift Dam near Bloemfontein, South Africa.

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