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

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Abstract

Health risks associated with the utilisation of waste water for fish production were studied by investigating the possible bioaccumulation of iron and manganese in the muscle tissue, kidneys and liver of the African sharptooth *catfish,Clariasgariepinus*, kept in treated sewage effluent and in the Krugersdrift Darn, Bloemfontein, South Africa. Metal concentrations were also determined in the water and sediment of the mentioned localities. The water of natural water sources, such as the Krugersdrift Dam. was found to be more subject to changes in chemo-physical factors, e.g. pH and hardness, compared to that of treated sewage effluent. This finding correlates with the higher concentrations of Fe measured in the former-mentioned habitat during certain months of the year. The average wet mass concentrations of Fc and Mil in the muscle tissue for fish in treated sewage effluent (0.804 and 0.024 mg g^{-1} respectively) and for fish in natural dam water (0.880 and 0.017 mg g^{-1} respectively) were well below the recommended values set by health authorities for domestic water supplies. In contrast, the concentrations of these metals were noticeably higher in the liver and kidneys of catfish. As the latter concentrations approached the maximum permissible levels in the liver and kidneys of catfish, especially in the Krugersdrift Dam, these organs are not recommended for human consumption.

Introduction

Periodic water shortages in South Africa, which lies in a semi-arid region in which rainfall and water bodies are unevenly distributed, have made an investigation into the use of treated sewage water for the purpose of aquaeullure, imperative. This water, which is unsuitable for domestic use, has an abundant supply of nutrients (Duffer. 1982) and is usually discharged into rivers without further ado. In general the effluent of most well-planned maturation ponds of sewage purification plants in South Africa is of such a good quality that many species of fish could survive in it.

According to the Council for Population Development (1990), the SA population at present increases at a rate of 2.3% per year which, if maintained, will result in an alarming 138 m. people by the year 2025. However, it is estimated that only a maximum of 80 m. people could be supplied with adequate water due to the country's limited natural water sources. Fourie (1989) also warns that more food will have to be produced per unit area in South Africa in order to satisfy future domestic needs. Bearing these facts in mind it is clear that the development and utilisation of alternative water sources in the RSA for domestic purposes as well as for food production is of the utmost importance.

Published records pertaining to the use of domestic effluent for the production of fish in South Africa, date back to the beginning of the second half of the 20th century. In the 1950s Hey (1955) had already reported on the use of sewage for the production of fish. However, various authors (Guelin, 1962; Janssen, 1970; Reichenback-Klinke, 1973; Feachem et al., 1978; Lawton and Morse, 1980) are of the opinion that, although treated sewage effluent is a good source of nutrients, it may be a potential health hazard to handlers and consumers of fish inhabiting it. According to Simpson and Stone (1988) effluent from cities during rainy conditions could cause dangerous and toxic substances to accumulate in rivers and dams. However, stringent control may ensure that the same does not happen in maturation ponds of biological filter purification plants.

The idea of fish production in maturation ponds still has several drawbacks such as public disapproval of sewage-related products and conditions resulting in stress to the fish (Wrigley et al., 1988). According to Sandbank and Nupen(1984), the biggest disadvantage regarding aquaculture in effluent, is the accumulation of heavy metals, pathogens and pesticides in the tissues of fish and, as a result, the possible transmission of diseases to man. However, Hejkal et al. (1983) stated that the health risk related to the consumption of fish kept under the controlled conditions of maturation ponds cannot be greater than in (he case of fish kept under uncontrolled conditions anii that the latter may be contaminated by pollutants at any time. The various discrepancies regarding health hazards related to human consumption of fish living in treated sewage therefore still have to be clarified. As a result, such waters have not yet been approved for the purpose of aquaculture by health authorities in South Africa.

To investigate the health risks regarding the concentrations of heavy metals in fish kept in treated sewage effluent produced by a biological filter purification plant, it was decided to compare the occurrence of selected heavy metals and related trace elements in the water, sediment and tissue of fish kept in the first maturation pond of the Blocmspruit Sewage Purification Plant with that of the water, sediment and tissue of fish kept in the Krugersdrift Dam. Due to their possible synergistic relationship in the same habitat (WHO, 1984), Fe and Mn were selected for one of a series of papers covering this topic. The previous paper (Van den Heever and Frey, 1994) dealt with the occurrence of Zn and Cu in the respective habitats as well as in the tissues of catfish inhabiting these habitats.

The Bloemspruit Purification Plant (Fig. 1) is situated just

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