

Microbiological quality of the catfish (*Clarias gariepinus*) kept in treated waste water and natural dam water

DJ van den Heever* and BJ Frey

Department of Environmental Sciences, Technikon OFS, P/Bag X20539, Bloemfontein 9300, South Africa

Abstract

A study was made of health aspects when utilising treated sewage effluent for fish production and this was compared to fish production in natural dam water. The presence of occasional pathogenic micro-organisms in the fillets of the catfish, *Clarias gariepinus*, was investigated. Fish were kept in cages in the first maturation pond of the Bloemspruit Sewage Works, and in the Krugersdrift Dam. Analyses of water and fish included total and faecal coliforms, species of the genus *Salmonella* and coliphages. Relatively high counts of faecal coliforms (6.3×10^3 /100 ml) and coliphages (7.2×10^3 /100 ml) were found in the maturation pond water. The corresponding counts for the natural dam water were 1.3×10^2 /100 ml and 2.6×10^3 /100 ml respectively. *Salmonellae* were in most cases isolated in the water of both habitats, but not found in the fish fillets. Fillets and muscle tissue of *C. gariepinus* grown in maturation pond water and natural dam water were declared safe for human consumption and no significant differences ($P < 0.05$) existed between the counts of pathogenic organisms in fish originating from the 2 different localities. It must, however, be emphasised that fillets be hygienically handled and prepared to prevent contamination. It is further recommended that the maturation pond water must be of domestic origin.

Introduction

Due to the alarming growth rate of 2.3% per year for the South African population, Fourie (1989) warns that more food will have to be produced per unit area in South Africa in order to satisfy future domestic needs. Periodic water shortages for aquaculture in large areas of 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, and it must be endeavoured to make use of effluent as much as possible, especially in South Africa.

The utilisation of human and animal waste in fish dams has been known for decades (Feacham et al., 1978), but little information regarding fish living in treated domestic effluent is currently available. These waters may pose a potential health risk to handlers and consumers of such fish (Guelin, 1962; Janssen, 1970; Reichenback-Klinke, 1973; Feachem et al., 1978; Lawton and Morse, 1980) and for this reason the use of 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 (Wrigley et al., 1988). According to Sandbank and Nupen (1984), the largest problem regarding aquaculture in effluent, is the accumulation of heavy metals, pathogens and pesticides in the fish and, as a result, the possible transmission of diseases to man. According to Hejkal et al. (1983) the infestation potential of fish being cultivated in effluent is very high because of the possibility of pollution by bacteria, viruses and toxic chemicals. However, Hejkal et al. (1983) also stated that the health risks associated with 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. The authors suggested further that an aquaculture sewage treatment

system may be a potentially useful alternative to conventional sewage purification installations. Uncontrolled water sources, on the other hand, can be contaminated by pollutants at any time. There are many discrepancies regarding health hazards to man consuming fish living in treated sewage effluent which still have to be clarified.

Previous studies in South Africa have demonstrated that wastewater aquaculture has a high potential for optimal utilisation of limited water resources and associated food production (Gaigher and Krause, 1983; Bok and Jongbloed, 1984; Gaigher and Toerien, 1985). The use of domestic and animal wastes for the enrichment of fish ponds in Eastern countries is, however, not a new concept (Edwards, 1980). Published records pertaining to the use 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. Records concerning the practical commercial application of animal waste and treated sewage were also published in the 1960s (Hepher and Schroeder, 1975).

Numerous studies have been undertaken to evaluate the health aspects of fish culture in waste water (Nupen, 1983; Turner et al., 1986; Slabbert et al., 1989), but to date, no study has been carried out on *C. gariepinus*. The present study was undertaken to evaluate the associated health risks in relation to microbiological quality between fish fillets of the catfish *C. gariepinus* kept in treated sewage water and natural dam water. In this way allegations that *C. gariepinus* kept in treated sewage effluent could perhaps pose a health hazard to humans, if such fish were consumed, could either be verified or declared void.

Materials and methods

Healthy adult catfish of approximately 30 cm in length, were collected in the Brandfort district near Bloemfontein, South Africa in December 1990. The fish were kept in a polyethylene pond with a capacity of 2 150 l for 2 weeks to obtain a homogeneous microbiological quality. During this phase of the study the fish were fed commercial breakfast food (WEET-BIX) every second day.

* To whom all correspondence should be addressed.

Received 30 March 1993; accepted in revised form 28 February 1994.