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STATUS OF THE CARDIOVASCULAR SYSTEM OF THE FISH (*OREOCHROMIS MOSSAMBICUS*) AFTER DETERGENTS TREATMENTS

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The objective of this study was to note the effects of some commercial local detergents such as: chloride bleach, pine disinfectant, powdered soap and bar soap on the fish heart biochemical markers. Firstly, acclimatization fresh fish into seawater, then running different trials to estimate the lethal concentrations, (LD50) and tolerable limits of the fish,was done. This was followed by studying some of the biochemical parameters of these fish such as: total lipids, triglycerides, cholesterol and moisture contents. Then, the same parameters tested were compared to control ones. Fish behaviour were monitored and recorded. The result obtained showed remarkable changes in serum total lipid concentration, cholesterol concentration and triglycerides of fish exposed to different detergents.

Key words: Tilapia (*Oreochromis mossambicus*), Cardiovascular system (CVD), Total lipids, Triglycerides, Cholesterol, Moisture contents.

Introduction

The greatest single input from urban contributions to the Red Sea is of sewage. Sewage (treated and untreated) is usually discharged to, or just below, the inter tidal zone via pipelines, and is thus mostly a coastal problem. The volume (and thus area of effect) depends on the number of people involved and considerable inputs may occur around cities and large towns (e.g. Suez, Jeddah), but no figures are available.

Two related questions are frequently posed about biological monitoring of polluted areas. At what point does damage to marine systems become significant, and how long must monitoring continue? (There are no simple answers or magic numbers that can be applied at present. Where very little or no effect is found in studies of particular habitats over a period of years, it may not be unreasonable to expect that little significant damage will have occurred to the system as a whole).

Physiological adaptation in fishes is analogous to that of the higher vertebrates (Selye 1973; Peters 1979; Schreck 1981). It is characterized by changes in blood and tissue chemistry. These changes are a direct or indirect result of the physiological response to environmental stress and can be quantified and used as predictive indices (Wedemeyer *et al* 1984; Ribelles *et al* 1995; Hamilton *et al* 1996; Jaworska *et al* 1999).

A clear picture of the fish's overall health and degree of acclimatization can best be obtained from physiological and performance capacity profiles rather than from single tests (Buckley *et al* 1985). This report concentrate on studying the biochemical parameters of the cardiovascular system of the fish treated with different detergents. Information obtained will help in monitoring the effect and the degree of stress.

Materials and Methods

1. Experimental Fish. Tilapia (*Oreochromis mossambicus*) was chosen to be the experimental species, due to its importance as one of the most popular commercial fish. Fish was obtained from King Abdulaziz University hatchery.

2. Fish Maintenance. After the fish were brought from the fish farm they were kept in several tanks. They were kept under the same experimental conditions with continuous aeration.

3. Detergents. Four types of detergents were used in this study. They were: Chloride bleach (C.B) Pine disinfectant (P.D) Powdered soap (P.S) Bar soap (B.S)

4. Parameters. 96 h LD50. The acute toxicity of the suggested detergents to the fish was investigated using bioassays under continuous aeration over a period of 96 h. The LD50 was established for each detergent type. The concentration of the detergents was determined in part per million (ppm). The detergent bath soap lux was first made into chips and grinded in powdery form. All of the detergents were first mixed with freshwater before introducing to the water medium to assure homogenous mixing. Forty liters capacity circular fiberglass tanks were used with two replicates in each concentration. Forty pieces of about ten grams average weight of (*Oreochromis mossambicus*) were used as test organism. Each tank was provided with aeration system and the test organism were allowed to stabilize for two days prior to introduction of the respective concentration of the detergent.

The water parameters such as pH, salinity, D.O, and temperature were recorded before and after the introduction of the detergents until the duration of observations.

Table 1

L D 50 for different detergents tested

Detergents	LD 50 (ppm)
Bar soap	no effect
Chlorine bleach	0.01
Powdered soap	0.01
Pine disinfectant	0.015

Biochemical parameters. Total lipids were measured according to the method of Folch *et al* (1957), triglycerides according to the method of Steinmetz *et al* (1979), where cholesterol was measured according to the method of Allain *et al* (1974).

Behavioural responses. The behavioural changes were monitored, such as changes in movement, balance, feeding habits and respiration. The opercular ventilation rates per minute were determined. In this part, a video camera was used to monitor fish behaviour and to measure the opercular ventilation rates per minute.

Results and Discussion

Based on the finding of the different trials, the LD50 for detergents are shown in Table 1. However, no effect on fish biochemical parameters was seen with bar soap after 96 h.

Serum total lipids. Figure 1 shows the effects of different detergents and bleach on the total lipids of *Oreochromis mossambicus.* Chlorine bleach did not have many effects on the total lipids of the fish, whereas the pine disinfectant decreased the total lipids in the blood of the fish.

However, the powdered soap increased the total lipids of the fish to almost three times the concentration of the control fish, this might be due to solubilization of lipid membranes.

Serum cholesterol. Figure 2 shows the effects of different detergents and bleach on the serum cholesterol concentration of tilapia. Cholesterol concentration from the fish treated with either chlorine bleach or pine disinfectant shows a similar decrease in the concentration compared to control fish. However, cholesterol concentration in the fish treated with powdered soap showed an increase triple in size to the control.

Serum triglycerides. Figure 3 shows the effects of different detergents and bleach on the triglycerides of tilapia. Serum triglycerides from the fish treated with chlorine bleach showed a little increase whereas no effect with pine detergent. However, triglycerides in the fish treated with powdered soap showed an increase to almost triple the size of the control.

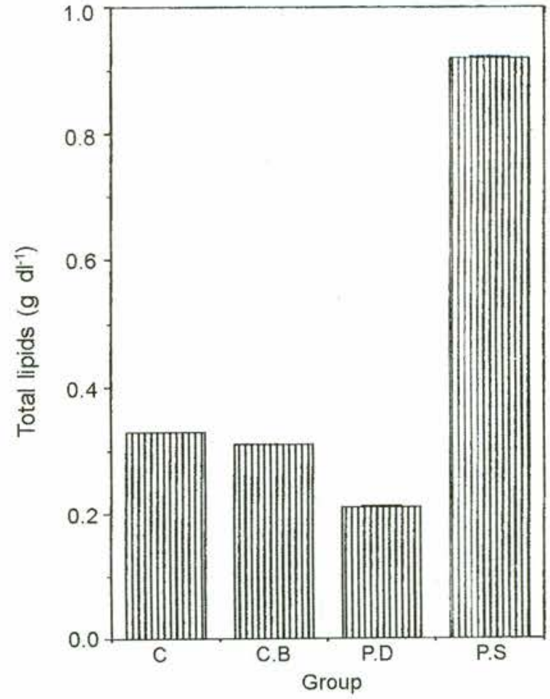

Fig 1. The effects of different detergents and bleach (C= control; C.B=chloride bleach; P.D=pine disinfectant and P.S= powdered soap) on the total lipids of *Oreochromis mossambicus.*

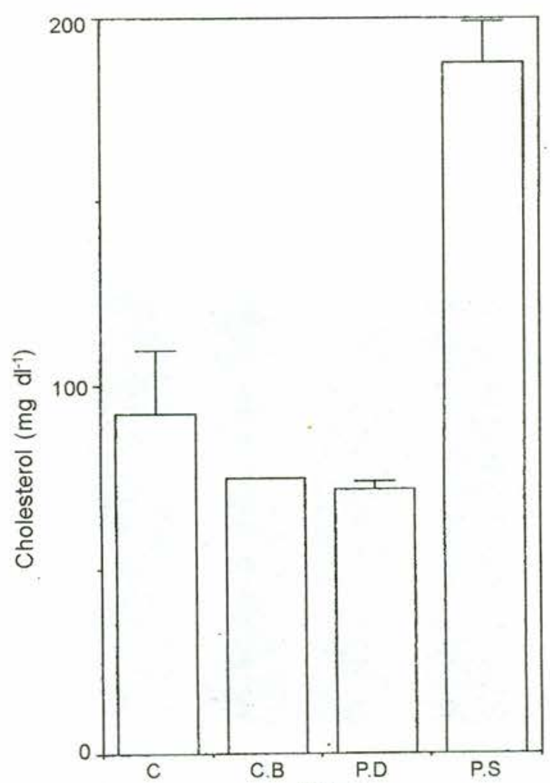

Fig 2. The effects of different detergents and bleach (C = control; C.B=chloride bleach; P.D = pine disinfectant and P.S = powdered soap) on the total cholesterol of *Oreochromis mossambicus.*

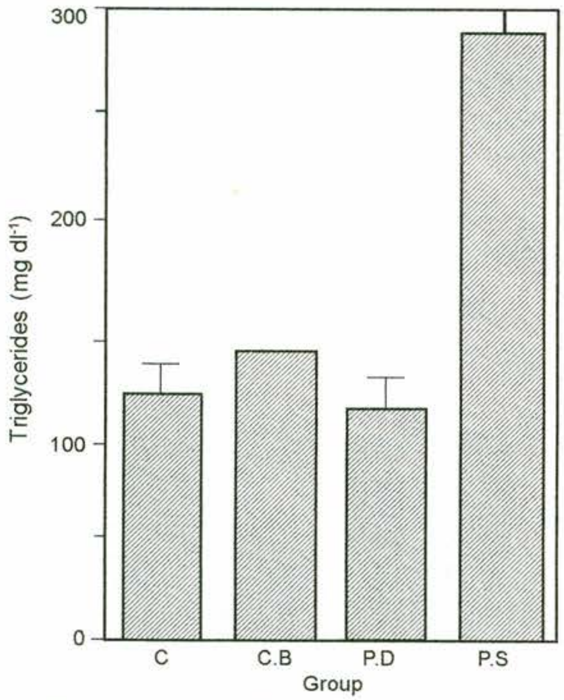

Fig 3. The effects of different detergents and bleach (C=control; C.B= chloride bleach; P.D= pine disinfectant and P.S=powdered soap) on the triglycerides of *Oreochromis mossambicus.*

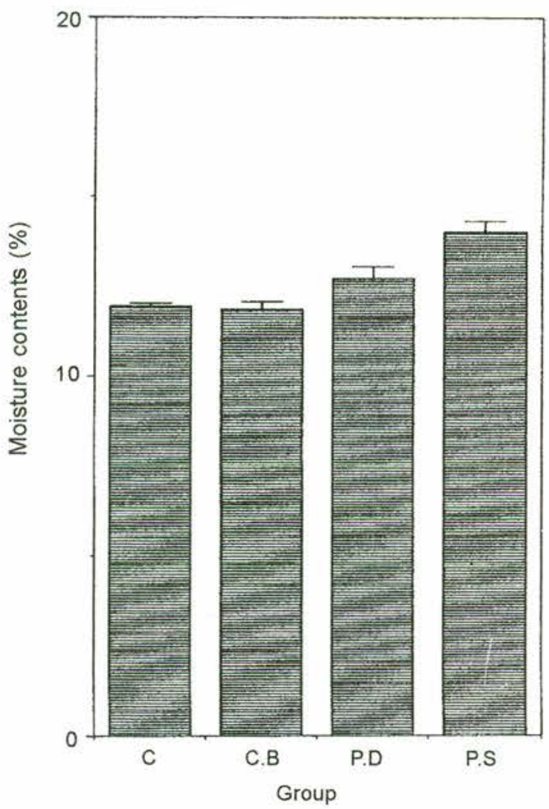

Fig 4. The effects of different detergents and bleach (C= control; C.B=chloride bleach; P.D= pine disinfectant and P.S= powdered soap) on the moisture contents of *Oreochromis mossambicus.*

Tissues moisture contents. Figure 4 shows the effects of different detergents and bleach on the moisture contents of *Oreochromis mossambicus.* Moisture contents in the fish treated with either pine disinfectant or powdered soap showed an increase in their moisture contents. However, no change was observed in the fish treated with chlorine bleach when compared with control ones.

Behavior. The control fish were swimming freely throughout the water column. Respiration (opercular movement) among the control fish was steady and regular movement of the operculum. The opercular ventilation rates (OVR) per minute ranged from 35-38 movements/minutes. Due to the fact that the treated fish had stopped feeding shortly after introducing the powdered soap, feeding was stopped for all the groups including the control till the end of the experiments.No changes in movement during the first 3 h of introducing the powdered soap. The fish then looked as if they were gasping for air. The opercular movement was sudden. Some fish had been seen swimming in circles while lying down. The fish started to swim towards the side of the tanks and rub the body to the side of the tanks. In general, most of the fish in this group gathered in the bottom of the tanks. The fish stopped feeding after the introduction of the powder soap. Opercular ventilation rates (OVR) per minute were ranging from 28-36 movement/minute.

There were some changes in movements among the chloride bleach treated fish. The fish showed no reaction after the introduction of the chloride bleach. However, they started to gather at the bottom of the tank with sudden movements for the operculum, by sudden opening and closing of the operculum, as if they were gasping for air. The respiratory movement was slower than that of the control. There was no change of balance among this group.

However, some mortality had occurred and the fish started to flip up side down and started to swim in circles before they finally died. The fish stopped feeding after the introduction of the chloride bleach. There was a drop in the opercular ventilation rates per minute; the range was 25-30 movements/minutes. The movement of the operculum among the treated fish was not steady nor could be described as regular. The pine disinfectant treated fish did not show any reaction at the beginning, but after one hour the fish started to move to the surface of the water and started to swim in circles. In about three hours they started to move erratically. The fish stopped feeding after the introduction of the pine disinfectant. Opercular ventilation rates (OVR) per minute were ranging from 31-35 movement/ minute.

Detergents differ in its toxicity level to fish. For example linear alkyl benzene sulfonate (LAS), was found to be more toxic than branched alkyl benzene sulfonate (BAS), to an estuarine fish, *Ambassis commersonii* (Shanmukhappa *et al* 1987), to the toothed carp, *Aphyosemion gairdneri* (Okwuosa and Omoregie 1995), on the respiratory functions of Tigerperch, *Terapon jarbua* (Huang and Wang 1994) and in the corneal damage in young Tigerperch, *Terapon jarbua* (Huang and Wang 1995).

Serum total lipid concentration, cholesterol concentration and triglycerides showed the same trend of effects with detergents and bleach tested. And this may be explaining the solubilization action of detergents and bleach on several cellular components of fish tissues.

Fish blood chemistry was found to be effected by detergents. Serum protein and serum albumin concentrations increased significantly after exposing rainbow trout, *Salmo gairdneri*, to a cationic detergent (Byrne *et al* 1989).

Detergents affect the tissue structure of fish. A detergent such as linear alkyl benzene sulfonate, (LAS) was found to cause morphological and electrophysiological damage to the corneal epithelium of the tiger perch, *Terapon jarbua*. It causes partial opacity of corneas and as a result a reduction in retinomotor responses (Huang and Wang 1995). LAS has been found to cause damage to the barbel taste buds of the catfish, *Ictalurus sp.*, which are exposed to sub lethal concentrations of this anionic detergent (Zeni *et al* 1995). Degenerative changes to the club cells in the epidermis of *Clarias batrrachus* were caused by the anionic detergent sodium dodecyl sulphate (SDS). The club cells released their contents (Mittal and Garg 1994). Moreover, SDS was found to cause intestine tissue destruction in juvenile gilthead sea bream intestine (Ribells *et al* 1995).

Acclimation may be possible if the compensatory stress response can reestablish a satisfactory relationship between the changed environment and the fish. However, the cumulative effects of even sub lethal stress factors may eventually lead to deaths even though the factors may not individually exceed physiological tolerance limits (Carmichael 1984; Barton *et al* 1986).

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