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To what extent will contaminated water affect physical, haematological and lipid properties of *Clarias gariepinus*?

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ABSTRACT

Some haematological and physical properties of *Clarias gariepinus* cultivated in water contaminated with phthalate, benzene and cyclohexane over a period of 56 days were examined. The haemoglobin (Hb) and packed cell volume (PCV) concentrations of test animals were found to be significantly lower than those of control ($p < 0.05$). The gain in body weight of male *C. gariepinus* cultivated in uncontaminated water (control), water contaminated with phthalate, benzene and cyclohexane was found to be 11.88 ± 0.55, 13.5 ± 0.62, 21.60 ± 1.03 and 27.54 ± 1.22 g, respectively. Serum cholesterol concentrations of fish cultivated in contaminated water were found to be significantly higher than those of control ($p < 0.05$). The experimental results suggested that the pollutants may cause anaemia in the fish as evident in the Hb and PCV results. It could also be inferred that the gain in body weight may be due to impaired fat metabolism which might have led to elevated levels of serum cholesterol and triglycerides in the fish. It is our view that consumption of such fish may cause hypercholesterolemia.

1. Introduction

Clarias gariepinus, which is generally considered to be one of the most important tropical catfish species for aquaculture, has an almost Pan-African distribution, ranging from the Nile to West Africa and from Algeria to Southern Africa. They also occur in Asia Minor (Israel, Syria and South of Turkey) (Adamek and Sukop, 1995). The African catfish, *C. gariepinus*, from a biological perspective, is one of the most ideal aquaculture species in the world. It is widely distributed (70° of latitude), thrives in diverse environments (temperate to tropical), is hardy, adaptable and an ecological pioneer species – principally as a consequence of its air-breathing ability. It feeds on a wide array of natural prey and can adapt its feeding habits depending on food availability (Buttle et al., 1995). It is able to withstand adverse environmental conditions, is highly fecund and easily spawned under captive conditions. It is generally recognized as an altricial species, yet displays a remarkable degree of phenotypic plasticity. It has a wide tolerance of relatively poor water quality conditions in which other freshwater fishes would find it difficult to survive. The "hardiness" of the fish makes it an ideal candidate for highly intensive culture, without pre-requisite pond aeration or high water exchange rates (Adeyemo et al., 1994).

C. gariepinus is a source of food to Nigerians; it's cultivated by many for sale and subsistence. Most of the ponds where *C. gariepinus* is cultivated serve as recipients to runoffs from open dumps where domestic and industrial wastes are discarded (Alegbeleye et al., 1991) while a few others, watered by boreholes, are contaminated by landfill leachate (Adeyemi et al., 2007a). Components of runoffs and leachate of serious health concern are phthalate, benzene and cyclohexane (Johnson et al., 2000). Early studies focused on phthalates ability to cause testicular atrophy (Ema et al., 1998) but phthalates are now known to cause a broad range of birth defects and lifelong reproductive impairment in laboratory animals exposed in uterus and shortly after birth (Gray et al., 1999; Blount et al., 2000; Swan et al., 2005). Eating or drinking foods containing high levels of benzene can cause vomiting, irritation of the stomach, dizziness, sleepiness, convulsions, rapid heart rate and death. The major effects of benzene are chronic (long-term) exposure through the blood (ATSDR, 2007).

Cyclohexane is used as a nonpolar solvent for the chemical industry, and also as a raw material for the industrial production

Abbreviations: Hb, haemoglobin; PCV, packed cell volume; RBC, red blood cell; WBC, white blood cell; MCV, mean corpuscular volume; MCH, mean corpuscular haemoglobin; MCHC, mean corpuscular haemoglobin concentration

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of adipic acid and caprolactam, both of which are intermediates used in the production of nylon. Toxicity of cyclohexane in animals includes severe diarrhea, vascular damage and collapse, hepatocellular degeneration and toxic glomerulonephritis (OSHA, 1993).

Paucity of information on the effect of theses water contaminants on *C. gariepinus* prompted this study. The present study delved into the examination of the effect of phthalate, benzene and cyclohexane on the physical properties, such as weight and height, and haematological properties of *C. gariepinus* with a view to elucidating the potential effect on public health.

2. Materials and methods

Chemicals used are of analytical grade and most are products of Sigma-Aldrich Inc., St. Louis, USA, while others are products of British Drug House, Poole, England.

Table 1
Gain in body weight (g) of *C. gariepinus* cultivated in water contaminated with phthalate, benzene and cyclohexane over a period of 56 days.

Fish group	Male	Female
Control	11.88 ± 0.55^{a}	9.90 ± 0.50^{a}
Phthalate	13.50 ± 0.62^{b}	11.25 ± 0.55^{b}
Benzene	21.60 ± 1.03^{c}	18.00 ± 1.12^{c}
Cyclohexane	27.54 ± 1.22^{d}	22.95 ± 1.50^{d}

Results are means of 5 determinations ± SEM. Values on the same column carrying different superscripts are significantly different ($p < 0.05$).

The experimental water for the study was collected from the supply of Adekunle Ajasin University, Akungba-Akoko, Ondo State, Nigeria. The physicochemical properties of the water were analysed using the method described by APHA (1992) and compared favourably with that reported earlier (Adeyemi et al., 2007a). The experimental water samples were contaminated with 10 μg/mL of phthalate, benzene and cyclohexane, respectively, and designated as follows:

A: water as collected from the University Supply
B: water contaminated with phthalate (10 μg/mL)
C: water contaminated with benzene (10 μg/mL)
D: water contaminated with cyclohexane (10 μg/mL)

The concentration of each pollutant is about ten times the recommended permissible limit (ACGIH, 1994) and a representation of the concentration found in a typical runoff from open dumps and leachate from landfills.

Eighty African catfish (*C. gariepinus*) of weight 68.56 ± 6.92 g were obtained from the Department of Environmental Biology and Fishery, Adekunle Ajasin University, Akungba-Akoko, Ondo State, Nigeria. The experimental fish were managed in accordance with the guidelines for handling experimental animals. They were fed (3% w/w) with commercial feeds obtained from Livinco feeds, Jubilee road, Ikare Akoko, Ondo State, Nigeria. The experimental animals were kept inside a transparent plastic container assigned into eight groups of ten animals each. The first two groups of fish were cultivated in uncontaminated water from the University Supply and water contaminated with 10 μg/mL phthalate. The third and fourth groups were placed on water samples contaminated with 10 μg/mL benzene and 10 μg/mL

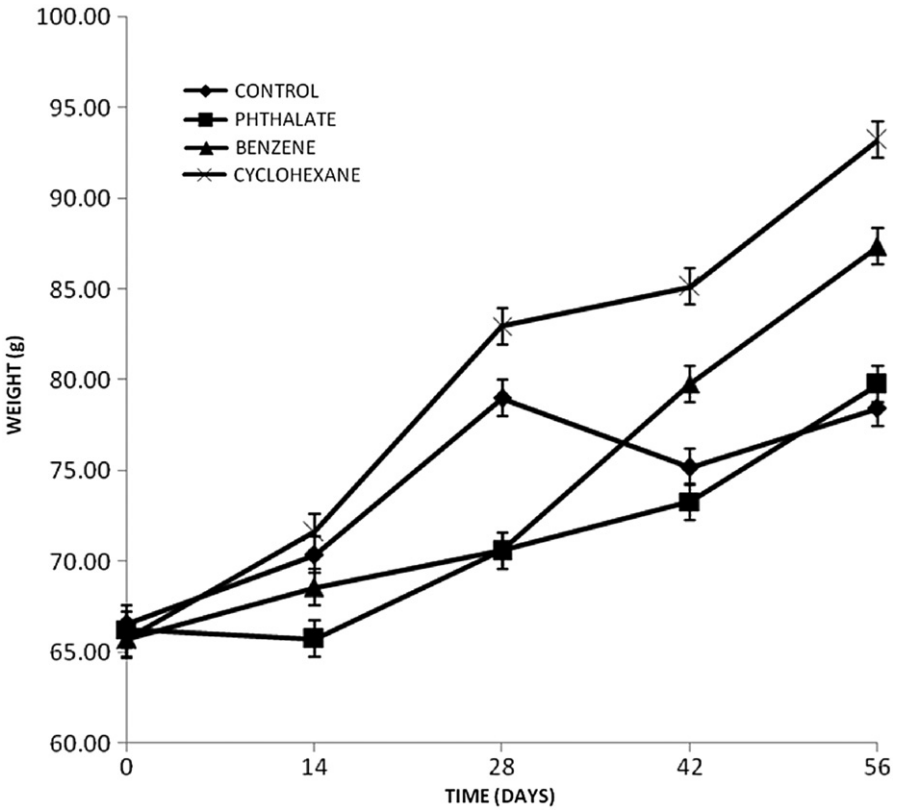

Fig. 1. Growth response of male *C. gariepinus* cultivated in water contaminated with phthalate, benzene and cyclohexane over a period of 56 days. Results are means of 5 determinations ± SEM.