RESEARCH ON THE CHANGES OF SOME PHYSIOLOGICAL PARAMETERS IN PRUSSIAN CARP (*Carassius auratus gibelio* BLOCH 1782) UNDER THE ACTION OF PHENOL

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Abstract. Phenol and its compounds are ubiquitous water pollutants, which come to the natural water resources from the effluents of a variety of chemical industries and industries of resin, paint, textile, leather, petrochemical, causing ecological unbalance. In this paper we study the action of phenol, under different concentrations 1.2 mg phenol / l water, 2.4 mg phenol / l water on some physiological parameters on Prussian carp (*Carassius auratus gibelio* BLOCH 1782). Phenol had an increasing effect on oxygen consumption for the Prussian carp. In all concentrations, phenol modified the values of breathing frequency (the phenol effect is stimulating at first and then inhibits breathing frequency).

Keywords: phenol, Prussian carp, oxygen consumption, breathing frequency, number of erythrocytes.

Rezumat. Cercetări privind modificările unor parametri fiziologici la caras (*Carassius auratus gibelio* BLOCH 1782) sub acţiunea fenolului. Fenolul şi compuşii fenolici sunt poluanţi omniprezenţi în apă, care ajung în resursele naturale de apă din efluenţii evacuaţi din industriile chimice şi industriile de răşină, vopsea, textile, piele, petrochimie, cauzând un dezechilibru ecologic. În această lucrare am studiat acţiunea fenolului în diferite concentraţii (1,2 mg fenol / l apă, 2,4 mg fenol / l apă) asupra unor parametri fiziologici la caras (*Carassius auratus gibelio* BLOCH 1782). Fenolul a avut un efect inhibitiv asupra consumului de oxigen al carasului. În toate concentraţiile studiate fenolul a modificat valorile ritmului respirator (efectul fenolului este stimulator la început, după care frecvenţa mişcărilor respiratorii scade).

Cuvinte cheie: fenol, caras, consum de oxigen, frecvenţa mişcărilor respiratorii, număr eritrocite.

INTRODUCTION

Phenols and phenolic substances are aromatic hydroxyl compounds classified as monohydric or polyhydric, depending on the number of hydroxyl groups attached to the aromatic benzene ring (MCNEELY *et al.,* 1979). The chemical formula for phenol is C_6H_5OH. Phenols are a major by-product of the pulp and paper, mineral, chemical, steel and metal, and petroleum industries. Phenols are used as disinfectants, biocides, dyes, pesticides, medical and industrial organic chemicals. Phenols may occur naturally in aquatic environments from the decomposition of aquatic vegetation (DOBBINS *et al*., 1987). The major anthropogenic sources are industrial effluents and domestic sewage. Phenolic wastes may contain cyanide, aldehydes, ketones, alcohols, organic acids, and gases (ALABASTER & LLOYD, 1982).

Fish toxicity studies comparing the various phenols report differential toxicity (DEVI & SASTRY, 1987). Acute toxicities for *Daphnia magna* (MÜLLER 1785) include a 96-h LC50 of 2.12 mg*L-1 2.4-dimethylphenol and a 96-h LC50 of 4 mg*L-1 phenol (EWELL *et al*., 1986). Other 48-h values for phenol include a LOEL of 0.19 mg*L-1 for the rotifer *Brachinous calyciflorus* (PALLAS 1766) (SNELL & MOFFAT, 1992) and an LC50 of 3.1 mg*L-1 for *Ceriodaphnia dubia* (RICHARD 1894) (ORIS *et al.*, 1991). BRADBURY (1989) reported the occurrence of severe seizures, mediated by the central nervous system, in *Salmo gairdneri* (WALBAUM 1792) after exposure to sublethal phenol concentrations**.**

Phenols are pollutants in aquatic environments. KOBAYASHI & AKITAKE (1975) reported that fish are able to excrete phenol rapidly. Kinetic studies are of interest because there are two different phases of elimination of phenols from goldfish. According to FORSTER & GOLDSTEIN (1969), gills of fishes ostensibly do not provide an efficient way of elimination even for readily diffusible foreign substances. Dogfish excrete foreign compounds to a limited degree through gills (ADAMSON & SIEBER, 1974).

Phenols penetrate into surface waters with industrial effluents, especially the waste waters from the thermal processing of coal, from petroleum refineries, from the production of synthetic fabrics and other industrial segments.

This study was carried out to analyze the effects of sublethal and lethal concentrations of phenol on some physiological parameters of the Prussian carp (*Carassius auratus gibelio*).

MATERIAL AND METHODS

In all the variants, Prussian carp (*Carassius auratus gibelio*) was captured from the surrounding lakes of Piteşti. After 10 days of adaptation in the lab, where they were fed ad libitum once a day, the fish were separated in lots. The phenol concentrations that were used had been established by preliminary survival tests. The fish were immersed in these solutions, which had been well stirred and aired for five minutes. The water temperature was between 18ºC and 20ºC, the immersion solution was changed every 24 hours and the water was continuously aired. The energetic metabolism, expressed by the oxygen consumption, was determined by using the closed respiratory chamber method (the oxygen dose in the water was established by using the Winkler chemical method) (PICOŞ & NĂSTĂSESCU, 1988). These determinations were made at intervals of 24, 48, 72, 96, 168 and respectively 336 hours. In some cases the determinations were made at intervals shorter

than 24 hours from immersion. The breathing frequency was determined at the same intervals as in the case of the energetic metabolism. The number of erythrocytes was microscopically determined with a Thoma cells numbering chamber, by using a small amount of blood collected from the caudal artery (PICOŞ & NĂSTĂSESCU, 1988). The measurements were carried out only for the 14 day treatments with Prussian carp individuals subjected to concentrations of 1.2 mg phenol / l water and 2.4 mg phenol / l water.

RESULTS

For a better comparison between the toxic effects of phenol in the concentrations investigated, the average frequency of respiratory movements and oxygen consumption were represented graphically in figure 1 and figure 2.

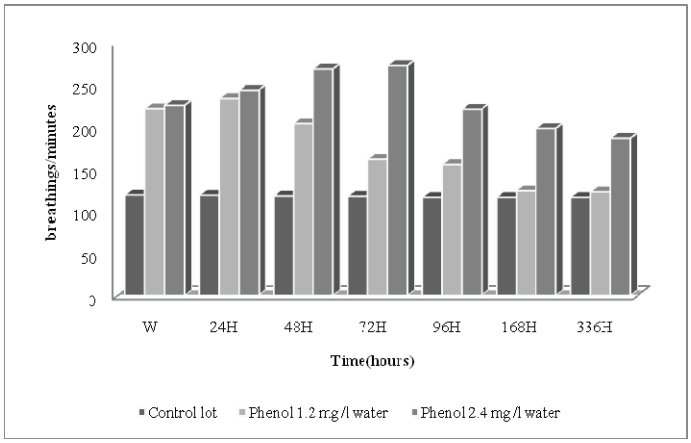

Figure 1. The influence of phenol upon breathing frequency on Prussian carp (*Carassius auratus gibelio*).
Figura 1. Influenţa fenolului asupra frecvenţei respiratorii la caras (*C. auratus gibelio*).

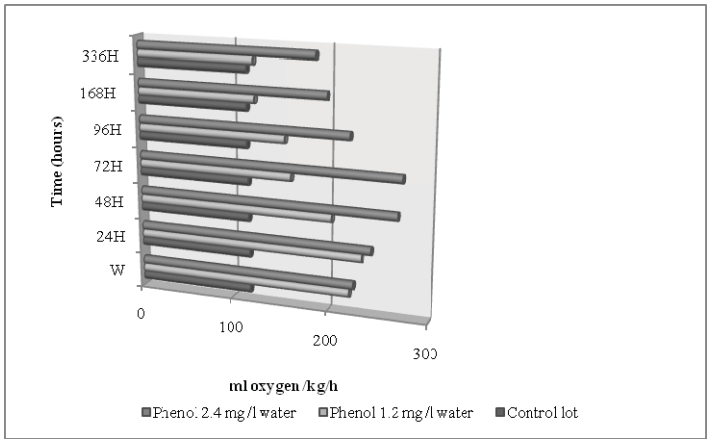

Figure 2. The influence of phenol upon oxygen consumption on Prussian carp (*Carassius auratus gibelio*).
Figura 2. Influenţa fenolului asupra consumului de oxigen la caras (*C. auratus gibelio*).

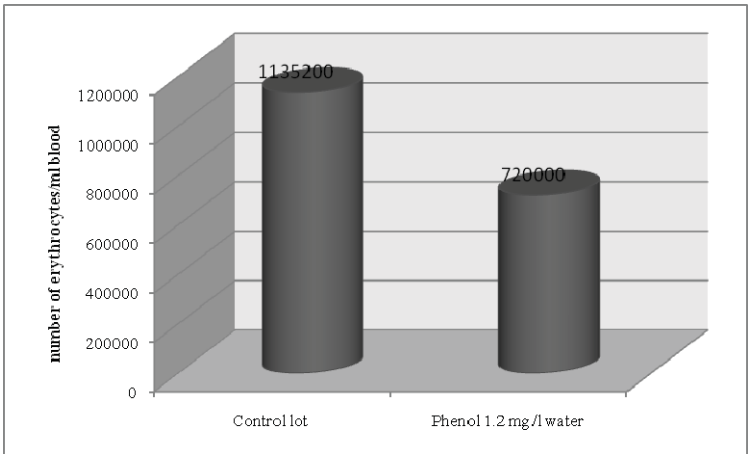

Figure 3. Number of erythrocytes of Prussian carp (*Carassius auratus gibelio*) after 14 days of exposure to phenol.
Figura 3. Numărul eritrocitelor la caras (*C. auratus gibelio* B) după 14 zile de expunere.

DISCUSSIONS

The most important sublethal acute effects observed in freshwater species after phenol exposure were a reduced heart rate and damage to the epithelium of gills, liver, kidneys, intestines and blood vessels. Direct contact between the aquatic environment and the gill epithelium may cause these surfaces to become sensitive to environmental alteration in the presence of toxic materials or other irritants.

Phenol changed the respiratory rhythm of Prussian carp in all investigated concentrations. For all concentrations tested, the effect of phenol was initially stimulating and then inhibitory as regards the frequency of respiratory movements.

The stimulating effect of respiration was maintained for 24 hours after exposure to two concentrations, the strongest stimulation being recorded after 48 hours of exposure to the concentration of 2.4 mg/l water.

Figure 2 shows the average oxygen consumption at Prussian carps (*Carassius auratus gibelio*) exposed to phenol in different concentration for 14 days. At the concentration of 2.4 mg/l water, stimulatory effect was found in the first 72 hours, at first concentration, with 17.44% as compared to the control lot, after which oxygen consumption decreased steadily to a value of 20.98% as compared to the control lot.

Haematological studies in fishes have assumed greater significance because these were to be used as an effective and sensitive index to monitor physiological and pathological changes induced by natural or anthropometric factors. Haematological analysis can provide important information about the internal environment of the organism (MASOPUST, 2000).

After two weeks of exposure to the phenol concentrations of 1.2 mg/l water, the number of erythrocytes in Prussian carp decreased to 63.43% as compared to the control groups (Fig. 3). It can say that these concentrations produce haemolysis, is impaired erythropoiesis.

CONCLUSIONS

Phenol in concentrations of 1.2 mg/l water and 2.4 mg/l water had an overall stimulating effect on oxygen consumption of Prussian carps (*Carassius auratus gibelio*) in the first phase followed by restoration of energy metabolism after 14 days of exposure to toxic.

In all concentrations studied, phenol significantly changed the values of the respiratory rhythm at Prussian carp (*Carassius auratus gibelio*) during the acute test (96 hours), the toxic effects being initially stimulating, followed by reducing the physiological parameter values after 14 days of exposure to phenol were in most cases very close to control.

The phenol, in a concentration of 1.2 mg/l water, has produced a significant decrease in the number of erythrocytes.

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