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Short Note

EFFECT OF HEXAVALENT CHROMIUM ON THE CARBOHYDRATE METABOLISM OF A FRESHWATER TROPICAL TELEOST *COLISA FASCIATUS*

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Kedar Nath and Nishith Kumar (1987) Effect of hexavalent chromium on the carbohydrate metabolism of a freshwater tropical teleost *Colisa fasciatus*. *Bull. Inst. Zool., Academia Sinica* **26**(3): 245-248. Toxic impact of hexavalent chromium at the sublethal dose of 48 ppm (0.8 of LC50 96 h) on the muscle glycogen and blood lactic acid levels of a freshwater tropical teleost, *Colisa fasciatus*, has been investigated from 3 to 96 h. Muscle glycogen contents of exposed fish registered significant decrease at 24 h onwards. Blood lactate levels registered significant elevation at 24, 48, 72 and 96 h only.

Extensive use of chromium in electroplating, polishing and paint pigment industries has aroused great concern over the toxicological potential of this metal. Doudoroff and Katz (1953) reported that hexavalent chromium is quite different in its toxicological behaviour from most of the other heavy metals. Horak and Sunderman (1975) and Ghafghazi *et al.* (1979) have reported that chromium induces hyperglycemia in mammals. However, the literature concerning chromium toxicity to fish is scanty. The present study, was, therefore, designed to investigate the effect of sublethal chromium exposure on the muscle glycogen reserves and blood lactate level of a freshwater teleost *C. fasciatus*.

MATERIALS AND METHODS

Colisa fasciatus, a freshwater teleost, (wt 5.23 ± 0.22 gm, length 5.41 ± 0.27 cm) were collected locally from Ramgarh lake (Gorakhpur) and acclimated to the laboratory conditions in tap water for a period of 15 days. Water was renewed daily and the fish were fed dried shrimp powder 2–3 times daily. Acclimated fish were placed into fourteen glass aquaria containing five fish in each of which seven aquaria were filled with 15 litres of water containing chromium trioxide (CrO_3) at the sublethal concentration of 48 ppm (0.8 of 96 h LC50). Remaining seven aquaria contained 15 litres of tap water only and served as controls. Physico-chemical characteristics of the test water were as follows-Temperature 24.75 ± 1.78°C; pH 7.63 ± 0.08; dissolved oxygen content 7.67 ± 0.09 mg/ℓ; hardness 170.33 ± 5.60 mg/ℓ as $CaCO_3$; conductance 324.17 ± 25.34 μmho/cm. For the determination of biochemical parameters fish were anaesthetized with MS 222 (1 g/2 ℓ) and were sacrificed at 3, 6, 12, 24, 48, 72 and

96 h. Blood samples were collected by sectioning caudal peduncle (in heparinized tubes) and blood lactic acid was measured by the technique of Barker and Summerson (1941). Muscle glycogen was precipitated by the method of Hassid and Abraham (1963) and measured by phenol-sulphuric acid technique of Dubois *et al.* (1956).

RESULTS

Fish subjected with hexavalent chromium, exhibit restlessness increased mucus secretion at the opercular region, as well as histopathological changes in the gills. Mean control value for muscle glycogen has been found to be 2.31 ± 0.07 mg/g. The muscle glycogen contents after Cr treatment register depletion at 3–96 h time periods. At 24 h significant decrease is observed which progresses till 96 h (Table 1). Blood lactic acid level exhibits a mean control value of 18.04 ± 0.90 mg/100 ml. Following subjection with Cr, fish become hyperlacticemic. Blood lactic acid levels exhibit elevation at all time periods from 3–96 h, however, from 24 h onwards, a progressive and well marked significant increase has been recorded which attains its peak at 96 h (Table 1).

DISCUSSION

Muscle glycogen levels have been reported to decrease following exposure to a variety of stressful environmental alterations (Black *et al.* 1961, 1962; Heath and Pritchard, 1965) and pollutants including heavy metals (McLeay and Brown, 1975; Shaffi, 1978, 1980; Larsson *et al.*, 1980). Contrary to the observations made in the present study, increased muscle glycogen contents have been observed in fish, *Channa punctatus* treated with chromium (Sastry and Tyagi, 1982).

It has been shown that catecholamines are secreted in increased amounts in fish under stressful conditions (Nakano and Tomlinson, 1967); and are said to be responsible for the depletion of glycogen energy reserves in fish (Nakano and Tomlinson, 1967; Larsson, 1973). The observed muscle glycogenolysis in fish *C. fasciatus* might be due to the increased secretion of catecholamines. Elevation in blood lactate levels hsa been recorded in fish exposed to a variety of stressors and exposure to pollutants including heavy metals (Heath and Pritchard, 1965; Caillouet, 1968; McLeay and Brown, 1975; Soivio and Oikari, 1976; Shaffi, 1979, 1980). Workers like Putte *et al.* (1982), Sastry and Tyagi (1982) and Sastry and Sunita (1984) have also reported elevation in blood lactate levels in rainbow trout (*Salmo gairdneri*) and *Channa punctatus*, respectively after Cr treatment.

The hyperlacticemic response observed in the present study may be attributed to muscle glycogenolysis. Fish intoxicated with Cr exhibit various histopathological changes in the gill tissues (Strik *et al.*, 1975; Putte *et*

TABLE 1

Carbohydrate metabolite values of fish *C. fasciatus* following intoxication with hexavalent chromium

Parameters	Control	Exposure period (h) 3	6	12	24	48	72	96
Muscle glycogen mg/g wet wt.	2.31 ±0.07	2.24 ±0.11	2.13 ±0.06	2.19 ±0.08	2.03* ±0.09	1.78*** ±0.09	1.82*** ±0.08	1.64*** ±0.06
Blood lactic acid mg/100 ml	18.04 ±0.90	20.03 ±1.28	22.49 ±1.86	20.99 ±1.84	26.71*** ±1.08	30.66*** ±1.25	29.38*** ±1.07	33.49*** ±1.03

Each value represents mean±S. E. of six determinations.

* and ***, indicate significant sesponses compared with control $p<0.05$ and $p<0.001$ respectively.

al., 1981). According to Putte *et al.* (1982), gill epithelial damage and increased level of plasma lactate suggest oxygen uptake blockage at gills and a shift to some anaerobic metabolism. They have suggested that increased ventilation frequency, hematocrit, plasma glucose and lactate levels in the fish (*Salmo gairdneri*) exposed to Cr (VI) may be due to tissue hypoxia. Such an effect has also been observed in fish exposed to severe hypoxic conditions (Heath and Pritchard, 1965; Holeton and Randall, 1967). According to Burton *et al.* (1972) increased lactic acid concentration in fish on exposure to Zn is indicative of severe tissue hypoxia. Hypoxia has also been shown to cause depletion in muscle glycogen levels and elevation in blood lactate levels (Heath and Pritchard, 1965; Shaffi, 1979, 1980; Larsson *et al.*, 1980).

The increase in mucus secretion and blood lactate levels alongwith gill damage in *C. fasciatus* (Nath, 1985) after Cr exposure supports to the assumption that hypoxia might also be an important contributory factor for observed glycogenolysis in muscle as well as hyperlacticemia in blood.

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六價鉻離子對淡水熱帶魚條紋鬪魚 (*Colisa fasciatus*) 碳水化合物代謝之影響

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本研究探討六價鉻離子，在低於致死劑量，48 ppm 情況下（0.8 of LC50 96 小時），對淡水熱帶魚，條紋鬪魚，肌醣及血中乳酸濃度之毒害影響。經鉻離子處理後，24 小時開始，肌醣含量顯著減少。血中肌酸濃度在處理後 24, 48, 72 及 96 小時顯著升高。