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Trace Metal and Electrolyte Levels in Organs of the Dogfish *Scyliorhinus canicula* L. Following Zinc Treatment

Zn has been shown to be toxic to the dogfish *Scyliorhinus canicula* L. (2, 3, 6) being the LC50 24 and 48 h 175 and 80 ppm respectively (3). The cause of fish kills following acute Zn treatment may be the disruption of respiratory or osmoregulatory processes due to desquamation of gill epithelium (5, 12). Regarding subacute or chronic treatment, results are still unclear and many hypothesis have been given to explain the cause of death (1, 9, 10). We must take into account that accumulation of a determined metal in tissues of contaminated individuals may cause an imbalance in trace or essential metal distribution (13) which might be responsible for the appearance of toxicity symptoms.

In order to study metal imbalance caused to the dogfish by Zn treatment, the aim of the present investigation was to measure trace metal levels (Cu, Zn, Mn) and electrolyte (Na, K) levels in some organs of the dogfish following Zn treatment.

Experiments were carried out on 25 dogfish of 150-300 g body weight. Only males were used as differences in Zn distribution (4) and Zn accumulation (2) due to sex were found. Specimens were contaminated by adding $ZnSO_4$ to seawater up to final concentrations of 10 and 80 ppm Zn. Nine fish were used as controls; 8 fish were treated with 10 ppm Zn for 3 weeks (subacute treatment); 8 fish were exposed to 80 ppm Zn for 24 h (acute treatment). Heavy metal levels were determined by atomic absorption spectrophotometry as detailed by CRESPO *et al.* (5). Na and K levels were determined by flame photometry after dilution of the samples. Analysis were carried out on gills, kidney, intestine, brain and muscle. Electrolyte levels were not measured in internal organs following acute treatment as variations, if any, were mainly expected to be apparent in the gill system.

Table I shows the concentrations of Zn, Cu, Mn, Na and K in organs of the dogfish following subacute and acute treatment. After subacute Zn contamination, a significant increase in Zn concentration was found in the gills, kidney and intestine ($P = 0.05$) and Cu concentration of the gills increased significantly ($P = 0.005$). After acute Zn treatment, Zn accumulated in the gills ($P = 0.05$) and Mn levels increased significantly in the kidney ($P = 0.05$). Na and K levels were not altered in dogfish tissues following Zn treatment. Data in the literature on heavy metals and osmoregulation are somewhat contradictory: SKIDMORE (11) does not find osmoregulation is impaired in the rainbow trout *Salmo gairdneri* following acute Zn treatment, whereas KATZ (7) reports a Na efflux through the gills of teleosts following acute heavy metal contamination (7). LOCK *et al.* (8), also in teleosts, describe an inhibition of Na^+-K^+ ATPase activity following both subacute and acute Hg treatment. No definite answer can be given on the effects of Zn on osmoregulatory mechanisms of the dogfish until Na^+-K^+ ATPase and carbonic anhydrase activities are recorded.

From our results on heavy metal dis-

Table 1. *Zn, Cu, Mn (μg/g dry weight) and Na, K (mg/g dry weight) concentrations in organs of the dogfish* Scyliorhinus canicula *following subacute (10 ppm-3 weeks) and acute (80 ppm-24 h) Zn treatment.*
Mean and standard deviation. Significant differences according to the Student's t-test: △, ●, ▲, ◇, ✻ ($P = 0.05$) and □ ($P = 0.005$).

		Gills	Kidney	Intestine	Brain	Muscle
Zn	control	74.5± 11.5 ●▲	72.1±16.4 ◇	128.3±80.2 ✻	84.9±58.3	49.7±30.9
	subacute	86.4± 6.4 ●	101.1±30.9 ◇	246.5±85.0 ✻	76.7±20.7	54.0±26.4
	acute	290.0±100.4 ▲	79.1±15.5	125.2±81.3	86.0±51.8	38.1±18.1
Cu	control	8.6± 1.9 □	9.1± 2.2	4.9± 3.5	12.0± 4.7	3.0± 1.7
	subacute	12.7± 2.0 □	10.0± 3.6	5.6± 2.0	17.1± 2.0	2.5± 1.6
	acute	8.9± 2.5	8.7± 1.9	3.9± 2.0	14.2± 4.9	1.7± 1.8
Mn	control	7.6± 3.4	9.4± 3.6 △	4.6± 0.6	6.6± 4.2	5.1± 0.1
	subacute	5.6± 1.4	9.7± 5.0	5.2± 1.3	3.6± 0.8	3.9± 1.4
	acute	7.6± 2.5	13.8± 2.7 △	5.6± 1.7	8.6± 5.3	3.2± 1.7
Na	control	17.7± 3.0	17.3± 1.2	12.4± 2.0	8.3± 2.7	17.7± 2.1
	subacute	16.5± 1.4	20.0± 1.4	8.7± 2.2	8.6± 2.2	16.5± 1.4
	acute	18.7± 2.9				
K	control	11.4± 2.1	7.9± 4.0	15.3± 2.0	16.2± 2.9	11.4± 2.1
	subacute	10.7± 1.3	9.1± 6.1	14.7± 1.3	18.5± 3.1	10.9± 1.0
	acute	10.9± 1.0				

tribution after Zn exposure we conclude that Zn contamination is followed by Zn accumulation in the tissues which causes a trace metal imbalance within the organism. Similar results have been reported by SUTHERLAND and MAJORS (13) in *Mytilus edulis* following $CuSO_4$ contamination and might be responsible for the appearance of toxicity symptoms.

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