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Zinc in the Gills of the Dogfish: Differences Due to Sex and Body Weight

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Zn content of gill arches and gill filaments of the dogfish *Scyliorhinus canicula* L. was analyzed. Differences in Zn content due to sex were found in gill arches but not in gill filaments, having the females lower Zn concentrations than the males. Correlations between body weight and Zn concentrations were found in both gill filaments and arches in the female group, but not in the male group.

Previous work carried out at our laboratory showed differences in Zn content due to sex in the dogfish *Scyliorhinus canicula* L. exposed to Zn contamination (2). Differences were found in gill arches but not in gill filaments or organs (2, 7). Since sex and weight of the animals are rarely taken into account when dealing with aquatic heavy metal pollution, our purpose is to evaluate the influence of sex and weight on the Zn content of the gills of the dogfish. Filaments and arches were analyzed separately as having different physiological meaning.

Materials and Methods

Experiments were carried out on 25 dogfish, *Scyliorhinus canicula* L. (50 % males, 50 % females) of 150-300 g body weight. The fish were collected off the Barcelona coast in a 80-120 m deep zone. 13 were collected and analyzed in January 1978 and 12 in January 1979 to check fluctuations of Zn content, if any. Gills were taken out and gill filaments were separated from each cartilaginous arch. Levels of Zn were determined by atomic absorption spectrophotometry (10, 12) after NO_3H digestion of the samples (2, 9). Gill filaments and gill arches were analyzed separately in all specimens.

Results

No differences in Zn content were found between samples collected in 1978 and 1979.

Table I shows the concentrations of Zn (μg/g dry weight) in the gill system of

Table I. *Zn concentration (μg/g dry weight) in the gills of the dogfish.* 25 animals; 50 % each sex.

Sex	Gill filaments	Gill arches
Males + Females	76.70 ± 20.57	66.29 ± 18.99
Males	74.27 ± 17.72	55.56 ± 13.62 Δ
Females	78.95 ± 23.39	77.01 ± 17.82 Δ

According to the Student t-test $\Delta t = 3.31 > 2.28$ $p = 0.01$.

Table II. *Zn concentration (μg/g dry weight) in the gill arches of the dogfish.*

Gill arches				
1	2	3	4	5
		Females		
56.32 ± 16.33	61.22 ± 18.93	49.68 ± 21.56 Δ	43.31 ± 31.14 ★	48.97 ± 35.20 ▲
		Males		
65.94 ± 11.58	76.66 ± 35.05	81.76 ± 32.43 Δ	92.35 ± 37.42 ★	100.00 ± 77.41 ▲

Significant differ.: $\Delta t = 2.41 > 2.09$ $p = 0.05$; $\star t = 3.28 > 2.83$ $p = 0.01$; $\blacktriangle t = 2.10 > 2.09$ $p = 0.05$.

Table III. *Zn concentration (μg/g dry weight) in the five pairs of gill filaments of the dogfish, males and females.*

Gill filaments				
1	2	3	4	5
58.25 ± 31.38	77.83 ± 19.49	78.18 ± 20.06	75.37 ± 34.61	81.58 ± 31.95

According to the Student t-test, gill 1 differs significantly from the others: 1 to 2: $t = 2.86 > 2.80$ $p = 0.01$; 1 to 3: $t = 3.37 > 2.80$ $p = 0.01$; 1 to 4: $t = 3.07 > 2.80$ $p = 0.01$; 1 to 5: $t = 3.92 > 3.79$ $p = 0.001$.

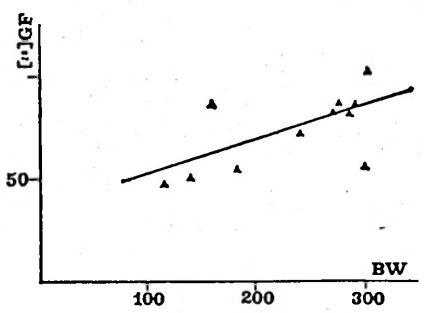

Fig. 1. *Correlation between body weight of the dogfish (female group) in g, and Zn concentration in gill filaments in μg/g dry weight.* BW = body weight; GF = gill filaments.

the 25 dogfish analyzed: there are no significant differences in Zn content between males and females: significant differences appear in gill arches.

Table II shows the concentration of Zn (μg/g dry weight) in each of the five gill arches. Arches 3, 4 and 5 differ significantly between males and females, Zn concentrations in males being much higher than in females.

Table III shows the concentration of Zn in each pair of filaments in the whole sample. Gill filament 1 is significantly different from the other four.

No correlations are found between body weight and Zn concentration in the gill filaments when male group and male plus female group are considered. There is a positive correlation in females ($r = 0.6434 > 0.5760$; $P = 0.05$), being the regression line: $y = 0.1509\ x + 37.6541$ (fig. 1).

Regarding correlation between body weight and Zn concentration in gill arches, there is again a positive correlation in the female group ($r = 0.7151 > 0.7079$; $P = 0.01$), being the regression line $y = 0.1320\ x + 23.8308$.

Discussion

Our previous results (2) are here confirmed with a larger sample. There are no

significant differences in Zn content between males and females in gill filaments but significant differences appear in gill arches. Arches 3, 4 and 5 differ significantly between both sexes. Since differences appeared only at the level of the 4th and 5th arches in previous experiments with 13 animals (2), it is not unlikely that, in a larger sample, differences between males and females should appear in all gill arches.

Regarding the heterogeneity among gill filaments, only the first one behaves in a different way. It must be noted that it is an hemigill transition form, complete in inferior species, but already lost in teleosts.

The 2nd and 3rd gills are the most uniform and were those which accumulated the highest amount of Zn following subacute treatment (2). They are the most developed gills and perhaps the most efficient in ventilation.

Differences due to sex are also found when the correlation body weight-Zn concentration is calculated. Correlations appear only in females. Unpublished data from our laboratory (1) show correlations body weight-Zn concentration related to sex in organs. As other authors have also found differences in metal content due to sex, age and body length in other aquatic organisms (3-6,11) we conclude that, when working with Zn in fishes, and generally when working with heavy metals, it is necessary to take into account the sex and the weight of the animal. We also suggest that it is not convenient to consider «gill» as a unic entity, as filaments and arches behave in a different way.

Variations were found among the different pairs of gill filaments. Heterogeneity in the gill system is also described by other authors (8, 9).

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Resumen

Se analiza el contenido de zinc en los arcos y en los filamentos branquiales del pez lija (*Scyliorhinus canicula* L.). Se hallan diferencias debidas al sexo en contenido de zinc de los arcos branquiales teniendo las hembras concentraciones más bajas que los machos. Se encuentra correlación entre el peso corporal y la concentración de zinc tanto en los arcos como en los filamentos branquiales en el grupo de las hembras y no en el de los machos.

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