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Trace and Heavy Metals in the Oyster *Crassostrea virginica*, San Andres Lagoon, Tamaulipas, Mexico

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Trace and heavy metals in the marine ecosystem may have indirect or direct effects in marine organisms, and in seawater they can be removed by adsortion processes, chemical changes and bioaccumulation (Mance, 1987). The concentration of metals in aquatic organisms depends upon several factors: physiological conditions (growth, age, sex), salinity, temperature, pH and the concentration of metals (Phillips, 1980; Croatto, 1985; Mance, 1987). The marine environment is becoming increasingly polluted by products of human activities (Croatto, 1985). Bivalve molluscs have been studied in marine pollution in order on understand the ability of these organisms to transmit trace and heavy metals to higher trophic levels, the ability to accumulate high body residues of metals without displaying any apparent deleterious effects to the individual and in identifying the metabolic processes wich may facilitate this resistance of metal intoxication (Cunningham, 1979).

The present study describes the seasonal variations of the concentrations of seven trace metals (Cd, Cu, Co, Fe, Mn, Ni, Pb and Zn) in the American oyster <u>Crassostrea virginica</u> in order to establish the levels of metal pollution in Mexican oysters.

MATERIALS AND METHODS

The samples were collected every two months at 11 stations located in San Andres lagoon, Tamaulipas, Mexico from August, 1984 to June 1985 (Fig. 1). The oysters were collected manually, stored in platic bags and frozen at -20°C. The complete animals (without shell) were freeze-dried, the sample size usually being 1g.

The reagents utilized were of a high purity, appropiate

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for metal trace analysis (Kremling, 1983).Extraction of metals was performed by using acid digestestion bombs (with a teflon cup) with HNO_3 and HCl, 3N (Hamilton, 1980). The standards solutions were prepared dissolving the metal in minimum volume of 1:1 nitric or hydrochloric acid.
Analyses were performed on a Perkin Elmer Model 2380 with graphite furnace Model HGA-400.

RESULTS AND DISCUSSION

Concentrations of nickel and cadmium were homogeneous in this work. Average values of Ni and Cd for each season are given in Table 1. The values of Cd were more uniform than the values of Ni. Cadmium in C. virginica ranged from 1.5 to 7.5 ppm (dry weight basis) and Ni ranged 1.5 to 12 ppm.

Concentrations of cadmium were lower than the value reported of LC_{50} (7.5 ppm) for C. virginica (Nelson et al. 1976). None the less, average values of Cd are comparable to those previously reported by Botello et al. (0.9 ppm; 1974), Frazier (3.0 ppm; 1975), and Goldberg et al. (2.5 ppm; 1978).

Concentrations of nickel fall within the standard level for seafood (10 ppm; Mance, 1987). Average values of Ni are in agreement with those reported by Goldberg et al. (3.2 ppm; 1978), but are much lower than the values reported for Ostion lagoon by Villanueva et al. (84 ppm; 1988); such a difference may be attributed to geomorphology of Ostion lagoon wich is a shallow water body situated 18 km from the industrial Coatzacoalcos City, Veracruz (Paez et al. 1986). While San Andres lagoon does not have the direct effect of industrial city.

Average values of Fe and Mn concentrations in C. virginica are shown in Table 1. Iron ranged from 40.5 to 101.3 ppm and manganese ranged from 13.5 to 49.5 ppm. Average iron concentrations were lower than the values reported by Frazier (1975), Goldberg et al. (1978) and Villanueva et al. (1988). Average manganese concentrations are comparable to those reported by Goldberg et al. (1978). However, Villanueva et al (1988) did not detect Mn in oysters.

Iron is not usually a significant contaminant of the sea (Clark, 1986). Fe and Mn at pH and pE values generally found in seawater, predominantly form oxides practically insoluble or hydrous oxides (Ahrland, 1985). High concentrations of iron oxides have certain effects in several marine organisms (Clark, 1986).

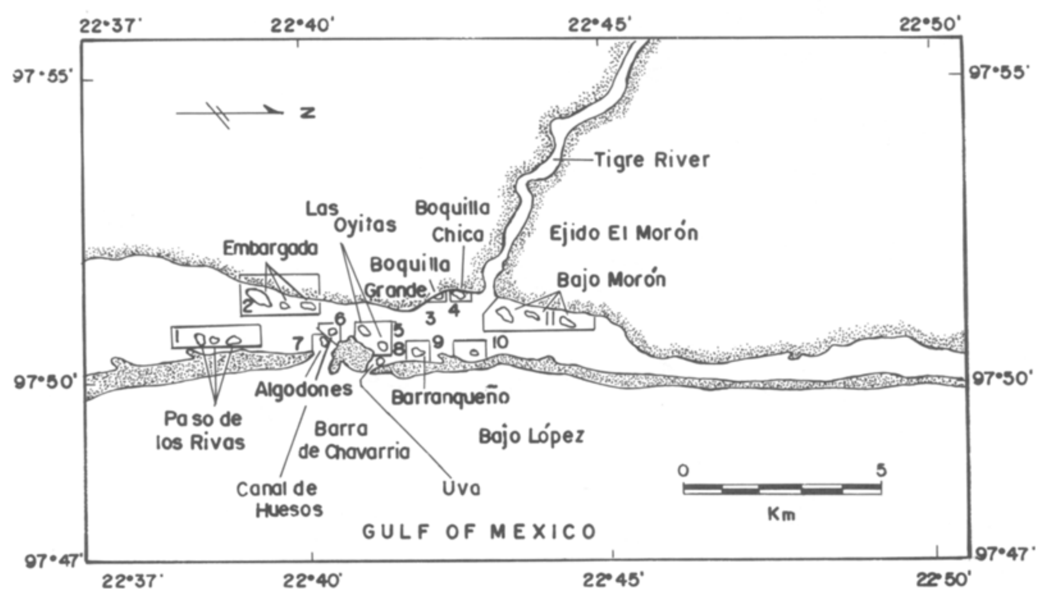

Fig. 1 San Andres Lagoon, Tamaulipas, Mexico, Sampling stations.

Table 1. Trace metals concentrations in several seasons in *Crassotrea virginica*, San Andres Lagoon, Tamaulipas, Mexico.

Season	Mean	Min.	Max.	Season	Mean	Min.	Max.
		CADMIUM				COPPER	
I	2.5	1.5	4.0	I	54.3	22.4	115.5
II	2.1	1.5	2.1	II	82.6	30.6	135.7
III	2.8	1.5	7.5	III	37.0	25.1	53.1
IV	2.8	1.5	4.5	IV	19.2	3.5	34.4
		IRON				MANGANESE	
I	55.0	40.5	78.6	I	33.7	18.0	49.5
II	77.9	59.2	101.3	II	34.6	24.8	45.0
III	60.6	50.1	80.0	III	23.5	13.5	40.5
IV	62.9	39.8	82.7	IV	18.0	13.5	27.0
		NICKEL				LEAD	
I	4.5	1.5	12.0	I	6.6	4.7	8.8
II	3	1.5	4.5	II	7.6	5.3	10.4
III	2.0	1.5	3.0	III	4.4	3.3	6.3
IV	4.1	3.0	7.5	IV	4.8	3.3	66.6
		ZINC					
I	3457.7	269.4	6371.4				
II	3489.7	2495.8	4369.7				
III	3064.5	2201.4	5022.9				
IV	2726.0	1550.3	3364.1				

I: rain (84); II: north; III: dry; IV: rain (85).

The toxicity of copper in the marine environment is well documented (Mance, 1987). Dissolved copper in the sea is in the form of $CuCO_3$, Cu^{2+} and $CuOH^+$ (Ahrland, 1985; Clark, 1986). Average copper concentrations are given in Table 1. These values are comparable to those reported by previous workers. Our values are in agreement with those reported for Terminos lagoon (Botello et al. 1976), for Ostion lagoon (Villanueva et al. 1988) and by Chesapeake Bay (Freitas and Boehm, 1989) (Fig. 2) but were lower than the values reported by Goldberg et al. (1978).

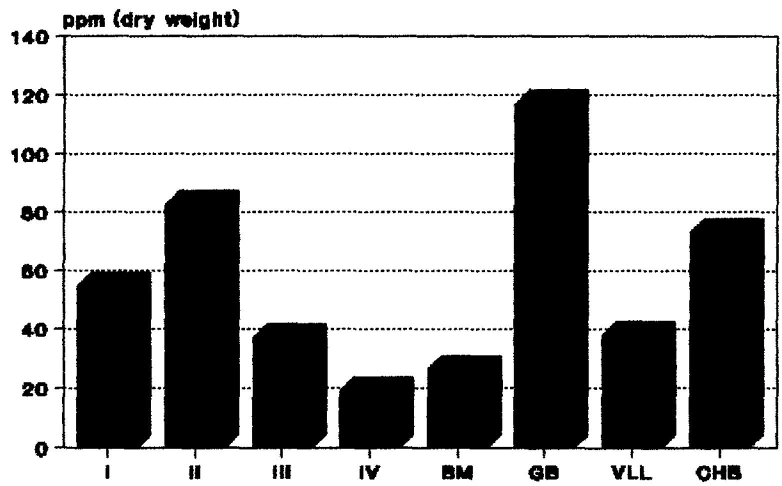

Figura 2. Comparison of copper concentration in <u>Crassostrea virginica</u>, San Andres lagoon. (BM = Botello et al. 1976; GB = Goldberg et al. 1978; VLL = Villanueva et al. 1989; CHB = Freitas y Boehm, 1989).

The total lead concentration in seawater is 10^{-10} M and the free Pb^{2+} concentration is even lower (Ahrland, 1985). Lead causes serious damage to health on land, but in the sea and for marine products it does not appear to be a matter for concern (Clark, 1986). Average lead concentrations (Table 1) are more higher than the values reported by Botello et al. (0.26 ppm; 1974), Goldberg et al. (1.8 ppm; 1978) and Freitas y Boehm (<0.9 ppm; 1989). Lead in <u>C</u>. <u>virginica</u> ranged from 3.3 to 10.4 ppm (Table 1; Fig. 3B). Larvae of molluscs are sensitive to concentrations more higher

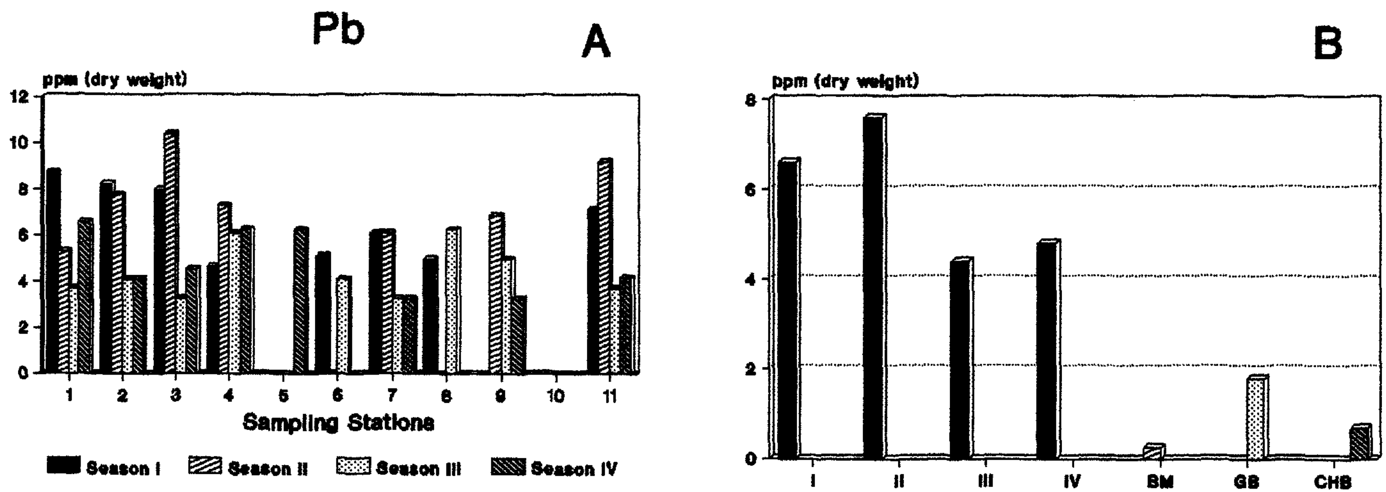

Figure 3. (A) Seasonal accumulation of lead by *C. virginica*; (B) Comparison of lead concentrations with values of Botello *et al.* (BM), Goldberg *et al.* (GB), Freitas and Boehm (CHB).

than 0.45 ppm (Martin et al. 1981), above which abnormal development occur. However, in San Andres lagoon C. virginica did not show abnormal development. This may be explained by the possibility that these organisms have been able to develop detoxifying mechanisms for lead similar to those described for Mytilus (Clark, 1986). However further studies are neccesary to substantiate this matter.

Zinc ranged from 269.4 to 6371.4 ppm (Table 1). Average zinc concentrations are comparable to those reported by previous workers . Our values are in agreement with those reported by Frazier (1975) and Goldberg et al. (1978), but were lower than those reported by Botello and Mandelli (101.3 ppm; 1974) and Villanueva et al. (144 ppm; 1988).

Changes in metal concentrations for each season and sampling station were not regular (Fig. 3A). Cobalt was not detected in C. virginica throughout this study.

According to copper, cadmium, nickel, iron, manganese and zinc concentrations the distribution of these metals in C. virginica is comparable to those works previously reported. However lead concentrations were higher with respect the values previously reported. These values suggest further studies to explain if this bivalve mollusc have been develop detoxifying mechanims.

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