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Magnitude and Distribution Pattern of Zinc in Oysters

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A good portion of the world's diet consists of fish in one form or another. Many of the world's great gastronomic masterpieces are based on preparations of fish from both saltwater and freshwater. Our forefathers depended heavily on the bounty of fish. Nutrition is a part of human biology. Nutrition cannot be divorced from health. The recent discovery of relatively high levels of trace elements in fish has now focussed intense concern on numerous of other potentially toxic trace elements such as mercury, copper, zinc, arsenic, selenium and others which may be ubiquitous in ecosystem.

Trace elements from anthropogenic activities and natural processes enter the marine environment. Such discharges are known to contain organic and inorganic micropollutants including toxic trace elements (Grimanis et al 1978). Many potentially dangerous chemicals which contain trace elements ultimately find their way into waters which are natural habitats for fish.

South Carolina is a coastal country which has many rivers, lakes, ponds, ditches, marshy places, estuaries, bays, lagoons and long seacoast on the Atlantic Ocean. More than enough fish is caught inland and offshore of South Carolina coast to meet the needs of South Carolinians. The increasing pollution of our waters poses a great threat to living organisms, to commercial and recreational fisheries and ultimately a potential health hazard to man himself. Marine lagoon and estuary organisms can concentrate trace elements many times above ambient levels.

For centuries, the waters of the world have been a receptacle for man's effluent waste. Effluent waste, including toxic trace elements, from anthropogenic activities and natural processes enter the aquatic environment and pollute it, and threaten to alter quantitatively and qualitatively the natural biochemical cycle.

Many potentially toxic chemicals ultimately find their way into waters which are natural habitats for fish. Fish which live in polluted water may accumulate pollutants from water via their food chain. Fish feeding on small marine organisms, algae, and bottom sediments, readily accumulate toxic trace elements. The presence of toxic trace elements in fish could create problems if ingested over a long period of time. Trace elements some of which are toxic, enter human body through the algae-fish-human food chain (Donald 1972).

This study was an attempt to assess the magnitude and distribution pattern of trace element zinc in oysters to see if the problem of the magnitude of zinc contamination was evident in the South Carolina Fishery. It would identify potentially hazardous situations and persons affected would be made aware of the problem. Where high zinc concentration are found in oysters, it would then attempt to identify the source of pollution.

MATERIALS AND METHODS

Oyster samples from the Atlantic Coast of South Carolina were collected during the Summer of 1983 and 1984 for analysis. The species composition of the collection generally reflects the oyster population of the water sampled. Oysters were collected from three different selected sites namely Charleston, Mount Pleasant and Beaufort, South Carolina. The oysters were placed on ice in an ice-chest and brought to the laboratory from the sample site. Oysters were labeled with an identification number, the date of collection, the place of collection and weight. Oysters were placed in plastic bags and frozen in a freezer.

Oyster samples were thawed and dissected. The muscle tissue, about 5 g, were weighed and placed in a clean dry erlenmeyer flask which was closed with a polyethylene stopper. Sample flasks were digested in a reagent grade nitric acid using a constant temperature shaking-water bath at 58°C until a clear solution was obtained (50-60 min). Sample flasks were removed from the bath and allowed to cool. The digests were diluted to 100 ml total volume with deionized water (Bohn and McElroy 1976).

Zinc content levels of the digests were determined by atomic absorption spectrophotometer, Perkin-Elmer Model 5000 (Uthe et al 1970) and (Hatch and Ott 1968). Zinc content levels were determined by comparing with standard solution. The experimental parameters used for the determination of zinc were the same for all sample determinations. At present, atomic absorption is the most commonly used method for the determination of the zinc. The sensitivity is high and concentrations less than 0.001 ppm can be determined. The specificity of zinc determination with atomic absorption is thus dependent on the amount of NaCl and other compounds in the sample. If interfering substances are not present, the accuracy is very high about 99.9%. Repeatability was 2% when duplicate analyses of zinc was done.

RESULTS AND DISCUSSION

This study was an attempt to assess the zinc content of shellfish oyster eaten by the people of South Carolina. Determination of background zinc levels in marine fauna, oyster, was part of a wider environmental baseline investigation carried out at selected sites of South Carolina fishery. Surprisingly, few extensive surveys of zinc pollution in shellfish oysters have been conducted. Since, nutritionally, oysters constitute an important segment of our food, high levels of zinc in oysters are obviously a great concern.

Trace element zinc was determined by flame atomic absorption analysis of oysters. Magnitude and distribution pattern of zinc is different in different sizes of oysters (Table 1,2 and 3). Table one shows zinc levels in oysters averaged 1.27 mg/kg and ranged between 1.562 mg/kg and 0.49 mg/kg. Table two shows zinc levels in oysters averaged 0.905 mg/kg and ranged between 1.573 mg/kg and 0.315 mg/kg. Table three shows zinc levels in oysters averaged 0.618 mg/kg and ranged between 1.386 mg/kg and 0.128 mg/kg. It seems that oysters from Mount Pleasant contain more zinc levels than oysters from Charleston and Beaufort (Table 1,2 and 3). It is also found that shellfish oysters contain more zinc levels than other shellfish species, shrimp, crab, clam, scallop and squid. The zinc content levels found in these oysters were not high enough to render them dangerous for human consumption. Oysters have remarkably high activity in accumulating zinc and the element interacts with protein molecules of oyster muscle tissue (Cross et al 1973).

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Table 1. Zinc Levels of Oysters*

Species	Whole body weight in grams	Zn mg/kg
Oyster	2.1	0.490
Oyster	3.6	0.816
Oyster	4.0	0.678
Oyster	4.2	0.908
Oyster	4.4	0.898
Oyster	4.7	0.952
Oyster	4.8	0.789
Oyster	5.0	0.943
Oyster	5.1	0.996
Oyster	5.2	1.562
Oyster	5.5	1.539
Oyster	5.8	0.987
Oyster	6.7	1.399
Oyster	6.9	1.321
Oyster	7.7	1.296
Oyster	7.8	1.442
Oyster	9.1	1.311
Oyster	10.5	1.479
Oyster	11.1	1.359
Oyster	11.2	1.440

*Oysters collected from Mount Pleasant, South Carolina

Table 2. Zinc Levels of Oysters*

Species	Whole body weight in grams	Zn mg/kg
Oyster	1.2	0.315
Oyster	1.6	0.316
Oyster	2.2	0.992
Oyster	2.4	0.596
Oyster	3.0	0.989
Oyster	3.3	0.607
Oyster	3.7	1.401
Oyster	3.8	0.974
Oyster	3.9	0.680
Oyster	4.2	0.721
Oyster	4.3	0.611
Oyster	4.6	0.624
Oyster	4.9	1.236
Oyster	5.4	1.251
Oyster	6.3	0.608
Oyster	8.0	1.445
Oyster	8.5	1.348
Oyster	9.5	1.573

*Oysters collected from Charleston, South Carolina

Table 3. Zinc Levels of Oysters*

Species	Whole body weight in grams	Zn mg/kg
Oyster	0.7	0.172
Oyster	1.1	0.128
Oyster	1.2	0.506
Oyster	1.2	0.554
Oyster	1.3	0.429
Oyster	1.4	0.511
Oyster	1.5	0.262
Oyster	1.7	0.612
Oyster	2.5	0.561
Oyster	2.6	0.527
Oyster	3.5	0.518
Oyster	4.0	0.255
Oyster	4.6	1.117
Oyster	5.5	1.205
Oyster	6.0	0.678
Oyster	6.1	1.004
Oyster	7.0	1.310
Oyster	7.4	1.199
Oyster	7.9	1.386

*Oysters Collected from Beaufort, South Carolina

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