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Variability of the Concentrations of Seventeen Trace Elements in the Muscle and Liver of a Single Striped Bass, *Morone saxatilis*

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The original aim of this study was to determine which of seventeen toxic or potentially toxic elements may be eliminated from analyses by our Laboratory in future investigations because of their occurrence in fish tissues at non-detectable or very low concentrations. These elements were chosen because the combustion of fossil fuels may be a significant source of anthropogenic releases of these elements in the environment (HEIT 1977).

To meet this aim, a striped bass was selected for examination because it is a relatively large carnivorous fish likely to concentrate pollutants, and because of its commercial importance. It was also felt that a gravid fish because of its enhanced metabolism during egg production would be likely to take up these elements at accelerated rates as compared to generally smaller males and non-gravid females. The selected fish was commercially caught in Chesapeake Bay, an area known to be affected by oil spillage, and industrial and domestic pollution (FRAIZER 1972).

During the course of the data analyses, however, it appeared that the distribution of trace elements in the dorsal muscle and both lobes of the liver was not homogeneous, but rather the elements varied significantly within different portions of these tissues. It is these data which are presented here.

MATERIALS AND METHODS

A 25 lb., 34 inch standard length, gravid female striped bass, commercially caught in Chesapeake Bay, was dissected under a laminar flow clean station. The incisions were made with a stainless steel scalpel and dissecting scissors. Five dorsal white muscle samples

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were dissected from the fish. From each of these five samples, triplicate one gram tissue plugs were extracted using a stainless steel scalpel. These samples were analyzed for Ag, As, Be, Cd, Cr, Cu, Ga, Hg, Ni, Pb, Sb. Se, Sn, Te, Tl, V and Zn. Three samples from the larger liver lobe and one sample from the smaller lobe were also taken. One gram plugs were also taken in triplicate from each of these liver samples and analysed for the same elements as the muscle. The excised frozen tissue samples were analyzed under contract by Dr. Herbert L. Windom of the Skidaway Institute of Oceanography, Savannah, Georgia, according to the methods described in WINDOM and CUTSHALL (1976). All of the elements except As, Hg, Sb and Se were measured by flame atomic absorption spectrophotometry. The elements As, Sb and Se were measured by DC-arc induced plasma emission spectrophotometry, and Hg by cold vapor atomic absorption spectrophotometry.

RESULTS AND DISCUSSION

The trace element concentrations of the muscle, large and small liver lobes, and both liver lobes combined are given in Table 1. Values are shown for the individual muscle and liver tissue samples, analyzed in triplicate, as well as the mean concentrations. All values are reported as μg/g wet weight.

The elements Be, Ga and Sb were not detected in either muscle or liver tissue. Thallium occurred at, or just above, the level of detectability, 0.005 μg/g. All of the other elements occurred in the tissues at concentrations higher than their levels of detectability.

Although all of the muscle samples were taken anterior to the dorsal fin, significant ($p \leq .05$) differences (NATRELLA 1963) in the concentrations of all of the detectable elements except Cr were found among individual samples. The Cr tissue concentrations measured in this fish were also higher than those reported elsewhere in the literature (Thompson *et al.* 1972). It is possible that this uniformly high level of Cr in the muscle may be due to contamination from the stainless steel blades used for dissection. Future dissections will be performed with titanium blades which should alleviate this possibility.

Variability was also found for some of the elements measured in samples taken from different portions of the large liver lobe. However, the inhomogeneity within the large liver lobe was less than that within the muscle. Only Ag, As, Cr, Cu, Hg, Ni, Pb and Zn were significantly ($p \leq .05$) different in concentration among large liver lobe tissue samples. Unfortunately, not enough tissue was available to make a similar comparison of the variability within the smaller liver lobe.

Mercury, generally regarded as the element of most concern in edible fish (HEIT 1977), was found to vary slightly although significantly ($p \leq .05$) in its distribution in both the muscle and liver tissue of this specimen. This is of interest in that Hg has been reported to decrease in concentration in fish muscle in samples taken from the anterior to the posterior in some fresh water species (BISHOP and NEARY 1977).

A comparison of the average element concentrations in the muscle with those found in both lobes of the liver indicated that the levels of Ag, As, Cd, Cu, Hg, Ni, Pb, Se, Te and Zn were significantly higher ($p \leq 0.10$) in the liver than in the muscle. Only Cd, Hg and Se were significantly higher ($p \leq 0.10$ in concentration in the larger liver lobe as compared to the smaller lobe).

These results are not unexpected in that a number of marine and freshwater species have been reported to have higher concentrations of trace elements in their liver than in their muscle tissue (BAUER 1974, WRIGHT 1976). Published results were not available for comparing variability in trace element content between the large and small lobes of fish liver.

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TABLE 1
Trace element concentrations in the muscle and liver of a striped bass (μg/g wet weight).

Sample number*		Ag	As	Be	Cd	Cr	Cu	Ga	Hg	Ni	Pb	Sb	Se	Sn	Te	Tl	V	Zn
1	Muscle	0.0010 ±0.0003	0.17 ±0.02	<0.001	0.015 ±0.005	3.5 ±0.3	0.30 ±0.03	<0.005	0.35 ±0.02	1.10 ±0.05	0.32 ±0.7	<0.01	0.12 ±0.01	0.32 ±0.02	0.085 ±0.005	≤0.005	<0.01	3.4 ±0.3
2	"	0.0010 ±0.0003	0.11 ±0.03	"	0.010 ±0.003	2.7 ±0.6	0.26 ±0.05	"	0.35 ±0.03	0.87 ±0.26	0.45 ±0.16	"	0.15 ±0.03	0.13 ±0.01	0.076 ±0.003	≤0.005	0.013 ±0.003	3.2 ±0.2
3	"	0.0010 ±0.0003	0.20 ±0.02	"	0.013 ±0.003	3.0 ±0.4	0.21 ±0.01	"	0.31 ±0.03	0.87 ±0.12	0.47 ±0.10	"	0.12 0.01	0.30 ±0.01	0.080 ±0.002	≤0.005	0.010 ±0.004	3.4 ±0.3
4	"	0.0040 ±0.0003	0.44 ±0.01	"	0.040 ±0.011	9.5 ±3.3	0.40 ±0.03	"	0.40 0.06	0.88 ±0.26	0.76 ±0.03	"	0.57 ±0.01	0.37 ±0.01	0.120 ±0.012	0.006	0.063 ±0.003	4.6 ±0.8
5	"	0.0080 ±0.0003	0.33 ±0.03	"	0.063 ±0.014	4.5 ±1.0	0.58 ±0.11	"	0.35 0.03	1.20 0.31	0.67 ±0.16	"	0.50 ±0.05	0.38 ±0.04	0.130 ±0.009	≤0.005	0.050 ±0.010	4.3 ±0.1
	Avg. conc.	0.003 ±0.003	0.25 ±0.13	<0.001	0.03 ±0.02	5 ±3	0.35 ±0.15	<0.005	0.35 ±0.03	1.0 ±0.2	0.5 ±0.2	<0.01	0.3 ±0.2	0.3 ±0.1	0.10 ±0.03	.006 ±.001	0.03 ±0.03	3.8 ±0.6
6	Liver-large lobe	0.016 ±0.001	0.85 ±0.21	<0.001	0.31 ±0.05	4.3 ±0.4	2.5 ±0.1	<0.005	0.59 ±0.02	0.91 ±0.02	1.20 ±0.10	<0.01	0.7 ±0.2	0.35 ±0.05	0.14 ±0.02	0.005 ±0.001	0.040 ±0.015	39 ±3
7	"	0.11 ±0.01	0.29 ±0.01	"	0.31 ±0.11	2.6 ±0.4	1.4 ±0.5	"	0.47 ±0.02	0.28 ±0.09	0.43 ±0.01	"	0.64 ±0.06	0.33 ±0.01	0.15 ±0.01	0.005 ±0.001	0.043 ±0.003	36 ±1
8	"	0.10 ±0.01	0.94 ±0.16	"	0.32 ±0.01	9.8 ±3.7	2.5 ±0.3	"	0.60 ±0.05	4.6 ±1.8	0.89 ±0.08	"	0.65 ±0.03	0.31 ±0.01	0.12 ±0.01	≤0.005	0.045 ±0.005	34 ±1
	Avg. conc.	0.08 ±0.05	0.7 ±0.4	<0.001	0.30 ±0.03	6 ±4	2.1 ±0.6	<0.005	0.55 ±0.07	2 ±2	0.8 ±0.4	<0.01	0.66 ±0.03	0.33 ±0.02	0.14 ±0.02	≤0.005	0.04 ±0.01	36 ±3
9	Liver-small lobe	0.11 ±0.02	0.71 ±0.10	<0.001	0.26 ±0.01	2.6 ±0.1	2.3 ±0.1	<0.005	0.40 ±0.02	0.26 ±0.03	1.4 ±0.10	<0.01	0.36 ±0.10	0.34 ±0.02	0.16 ±0.01	≤0.005	0.033 ±0.007	32 ±2
	Avg. conc.	0.08 ±0.05	0.7 ±0.3	<0.001	0.30 ±0.03	5 ±3	2.2 ±0.5	<0.005	0.52 ±0.10	2 ±2	1.0 ±0.4	<0.01	0.6 ±0.2	0.33 ±0.02	0.14 ±0.02	≤0.005	0.04 ±0.01	35 ±3

*Each tissue sample was analyzed in triplicate.

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