METALS AND ORGANOCHLORINE COMPOUNDS IN THE MUSCLE OF DUGONG FROM SULAWESI ISLAND

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ABSTRACT

The muscle of two dugongs from Sulawesi Island were analyzed of metals and organochlorine compounds. Total mercury in the adult female was 0.005 ppm and 0.002 ppm in the immature female. The ratio of total mercury to the selenium was higher in the older individual. Metal concentrations, except for arsenic, were higher in the adult female. PCB, DDT and BHC were not detected in both dugongs. Concentrations of mercury and organochlorine compounds in the dugong were compared with those of other marine mammals.

INTRODUCTION

In recent years the presence of significant concentration of metals and organochlorine compounds has been reported in seals and dolphins which are high-order carnivores. As the dugong, *Dugong dugon* (Müller), are hervivorous, comparison of metals and organochlorine residues in the dugong with those in other marine mammals appears to throw some light on concentrations through the food chain. On this problem very few study has been made chiefly due to difficulty of collecting the fresh samples. Present study was undertaken to investigate the accumulation of metals and organochlorine compounds in the muscle of dugong, and to compare the data with those of other marine mammals.

MATERIALS AND METHODS

The muscle samples analyzed here were obtained from two dugongs caught in 1975 in Laikang Bay, Sulawesi Island and preserved for the Okinawa Exposition. These animals were kept alive for about 20 days at the Exposition. The biological informations of two individuals are shown in Table 1 and age of them is cited from Kasuya and Nishiwaki (1978), who made age determination of dugongs basing

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on the dentinal growth layers in the larger tusk. Samples (about 2 kilogram per individual) were kept frozen to about −20°C after death until the analyses in 1979. In order to protect against dryness they were glazed twice during cold storage by Dr T. Kasuya. All substance data described here were expressed in wet weight basis.

Mercury: Total mercury was determined directly by a semiautomated flameless atomic absorption spectrophotometer (Itano *et al.*, 1977).

Methylmercury: Methylmercury was analyzed by the gas chromatographic method based on the procedure of Westöö (1967).

TABLE 1. LIST OF MATERIALS

Specimen No.	Captured Date	Captured Place	Death Date	Death Place	Sex	Body Length (cm)	Maturity	Age*
RRM001	25 July, '75	Sulawesi Is.	20 Oct. '75	Okinawa	Female	254	Adult	18
RRM002	26 Aug. '75	Sulawesi Is.	21 Oct. '75	Okinawa	Female	204	Immature	7

* cited from Kasuya and Nishiwaki (1978).

Arsenic, selenium and other metals: Arsenic, selenium and other metals were determined using silver diethyldithiocarbamate method, a fluorometric spectrophotometer (Itano *et al.*, 1977) and an atomic absorption spectrometer, respectively.

Organochlorine compounds: Muscle was ground with anhydrous sodium sulfate, and extracted by blending with n-hexane. The extracted fat was removed by florisil dry column method. Then the sample was cleaned up by silicagel column chromatography and determined by GC-ECD.

TABLE 2. CONCENTRATIONS OF TOTAL MERCURY, METHYLMERCURY AND SELENIUM IN THE MUSCLE OF DUGONGS

Specimen No.	Total mercury ppm	Methylmercury ppm	Selenium ppm	Total mercury / Selenium
RRM001	0.005	0.004	0.087	0.057
RRM002	0.002	ND	0.074	0.027

The tissue weights used for the determination of total mercury, methylmercury and selenium were 0.2 g, 10 g and 3 g, respectively.

RESULTS AND DISCUSSION

Concentrations of total mercury, methylmercury and selenium in the muscle of two dugongs are shown in Table 2. This Table indicates that total mercury concentrations in the adult female (RRM001) was 2.5 times as much as that in the immature female (RRM002). As the values of total mercury in dugongs were rather close to 0.001 ppm of the detectable limit of this method, these data might be not adequate for a strict analysis. However, it can be definitely said that contamination by mercury in the dugong is lower than that of grey, harbour, hood and harp seals (Sergeant and Armstrong 1973), harbour porpoise (Gaskin *et al.*, 1972), striped

dolphin, spotted dolphin, short-finned pilot whale, bottlenose dolphin and finless porpoise (Arima and Nagakura 1979). Concentration of methylmercury of the adult individual was 0.004 ppm and that of the immature was lower than 0.001 ppm of the detectable limit of this method. Ratio of total mercury to selenium in two dugongs was conspicuously lower than that in the ringed seal (Kari and Kauranen 1978), striped dolphin, spotted dolphin, short-finned pilot whale, bottlenose dolphin and finless porpoise (Arima and Nagakura 1979).

Concentrations of nine metals are shown in Table 3. Metal concentration, except for arsenic, were higher in the older individual. On the contrary arsenic showed higher concentration in the immature individual. Denton (personal communication) also obtained the similar result on the North Queensland dugong whose tissue concentrations of metals varied with the age.

TABLE 3. METAL CONCENTRATIONS IN THE MUSCLE OF DUGONGS IN PPM

Specimen No.	Fe	Mn	Zn	Cu	Pb	Ni	Co	Cd	As
RRM001	32.0	0.094	29.5	0.97	0.25	1.25	0.043	0.120	0.015
RRM002	18.0	0.031	14.8	0.74	0.20	0.55	0.040	0.031	0.050

The tissue weights used for the determination of arsenic and the other elements were 20 g and 10 g, respectively.

Fat contents in the muscle of the adult female and the immature were 0.084% and 0.065%, respectively. These were remarkably lower than those of harbour seal, ranging 0.45 to 5.80% (Gaskin *et al.*, 1973). Since the organochlorine compounds are expected to be most concentrated in the fat of animal tissues, fat was extracted from a large amount of muscle (240 g) for the analyses. However, PCB, DDT and BHC were not detected. The detectable limits of PCB, α-BHC, β-BHC, γ-BHC, *p*, *p*′-DDE, *p*, *p*′-DDD and *p*, *p*′-DDT were 0.001, 0.0005, 0.001, 0.001, 0.0001, 0.001 and 0.001 ppm, respectively. The concentration of organochlorine compounds in the dugong might be extremely lower than in harbour seal (Gaskin *et al.*, 1973). Heinsohn and Brich (1972) reported that stomach contents of dugongs were almost exclusively sea grasses and no animal matter was found. Marine mammals accumulate various pollutants from their environment mostly through food unlike fihes which concentrate pollutants through both food and water. Therefore it is concluded that the difference in contamination by mercury and organochlorine compounds between dugongs and other marine carnivorous mammals is mainly due to the difference of their food.

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