

Total Mercury Contents in Marine Fishes Caught in the South-East Region of the South China Sea

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Keyword : Total mercury, Marine fish, South China Sea

Abstract

Total mercury contents were measured on the samples of 10 species of fish caught in the south-east region of the South China Sea.

The higher mercury content was found in the samples of *Uranoscopus japonicus*.

Mean value of the total mercury contents of these 10 species was 0.036 ppm; highest in *U. japonicus* (0.082 ppm) and lowest in *Psenopsis annala* (0.010 ppm).

The mean values of the total mercury contents in marine fishes in the south-east region of the South China Sea were compared to the data obtained in Japanese coastal waters and the East China Sea.

The mercury contents were slightly lower in the former region than in the latter two.

In this study accumulations of mercury in various fish species related to their feeding habits and growth were discussed.

Oceanographic and trawl fishing surveys by the training ship Kagoshima Maru (1,295 tons) were carried out in the south-east region of the South China Sea (Fig. 1), in cooperation with the

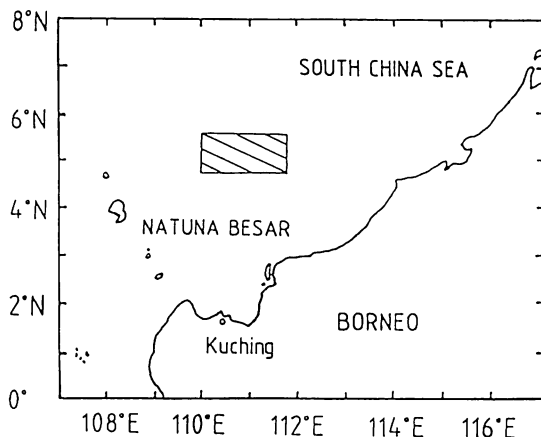


Fig. 1. Map showing the area studied by trawl fishing.

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Faculty of Fisheries and Marine Science, Universiti Pertanian Malaysia (UPM). In this connection we measured the total mercury contents in fishes caught by the experimental trawl fishing.

Total mercury contents in marine fishes from Japanese coastal waters been reported by Fujii *et al.*¹⁾ We also made such an investigation in the region of the East China Sea in 1985²⁾.

The total mercury contents in fishes changed depending on the localities and the effluents of mercurial substances from the land. Since no reports were available on the total mercury contents in marine fishes in the south-east region of the South China Sea.

We investigated the range of mercury pollution in various species of fish in this region.

Materials and Methods

Samples were collected from fishes caught by 8 operations on the 16th and 21st of June, 1987, in the south-east region of the South China Sea by the training ship Kagoshima Maru of the Faculty of Fisheries, Kagoshima University.

Ten species collected for the study include: Okihiragi (*Leiognathus rivulatus*), Kisujihimeji (*Upeneus moluccensis*), Kintokidai (*Priacanthus macracanthus*), Sarasahagi (*Thamnaconus tessellatus*), Ibodai (*Psenopsis anomala*), Sokoitoyori (*Nemipterus bathybius*), Igodakahoderi (*Lepidotrigla alata*), Kaiwari (*Caranx equula*), Mishimaokoze (*Uranoscopus japonicus*) and Tokageeso (*Saurida elongata*). About ten individuals with varied fresh weights were chosen from each species. After measurements of the total or fork length and fresh weight of each individual, a part of the fish meat was taken, reduced to ashes by a wet process and checked for the total mercury contents by a reducing vaporization method using an AMD-F2 analyzer (Nippon Jarrell Ash Co.).

Results and Discussion

Total mercury contents in fish

Table 1 shows the total mercury contents in fish with some biological characteristics. The mercury content was highest (0.082 ppm) in Mishimaokoze (*Uranoscopus japonicus*), but lowest (0.010 ppm) in Ibodai (*Psenopsis anomala*). The higher level was also noted in Kisujihimeji (*Upeneus moluccensis*).

These results were compared with the published data in different regions. Fujii *et al.*¹⁾ have rearranged the data on the total mercury contents in marine fishes from Japanese coastal waters.

These fishes were classified into three groups: Group A (fish and shellfishes with higher total mercury contents) which was divided further into three subgroups, *i.e.*, the first subgroup (mercury contents, 0.150~0.350 ppm) with Suzuki (*Lateolabrax japonicus*), Kasako (*Sebastes marmoratus*) and Akaamada (*Branchiostegus japonicus*), the second (0.100~0.250 ppm) with Madai (*Chrysophrys major*), Kanagashira (*Lepidotrigla microptera*), Fugu (family Tetraodontidae), Kochi (*Platycephalus indicus*), Nibe (*Nibea mitsukurii*) and Isaki (*Parapristipoma trilineatum*), and the third (0.080~0.015 ppm) with Ishidai (*Opelgnathus fasciatus*), Maeso (*Saurida undosquamis*), Tachiuo (*Trichiurus lepturus*), Mebaru (*Sebastes inermis*), and Kidai (*Taius tumifrons*); Group B (fish and shellfishes) divided into two subgroups, *i.e.*, the first subgroup (generally 0.040~0.100 ppm) with Makogarei (*Limanda yokohamae*), Shitabirame (*Paraplagusia japonica*), Masaba

Table 1. Total mercury contents of the muscles in 10 species of fish in the south-east region of the South China Sea

Scientific name	Common name	N	Body length (cm)	Body weight (g)	Total-Hg in muscle (ppm)
<i>Leiognathus rivulatus</i>	Okahiragi	10	5.7~ 8.5 a	5.7~ 11.7(8.2)	0.011~0.046(0.024)
<i>Upeneus moluccensis</i>	Kisujihimeji	10	11.5~15.5 a	20.0~ 56.0(36.8)	0.024~0.142(0.077)
<i>Priacanthus macracanthus</i>	Kintokidai	10	12.0~21.5	28.0~122.0(67.6)	0.014~0.033(0.021)
<i>Thamnaconus tessellatus</i>	Sarasahagi	10	10.3~16.3	10.0~ 48.0(20.6)	0.013~0.021(0.017)
<i>Psenopsis anomala</i>	Ibodai	9	15.5~17.5 a	86.0~126.0(101.8)	0.007~0.013(0.010)
<i>Nemipterus bathybius</i>	Sokoitoyori	10	13.0~20.5 a	42.0~160.0(84.4)	0.013~0.049(0.032)
<i>Lepidotrigla alata</i>	Igodakahoderi	10	7.0~18.0	4.5~ 78.0(43.7)	0.017~0.055(0.031)
<i>Caranx equula</i>	Kaiwari	10	11.5~18.0 a	34.0~130.0(56.8)	0.030~0.068(0.038)
<i>Uranoscopus japonicus</i>	Mishimaokoze	10	12.0~17.5	24.0~ 88.0(65.4)	0.013~0.168(0.082)
<i>Saurida elongata</i>	Tokageeso	9	12.0~26.3 a	14.0~184.0(74.4)	0.014~0.052(0.024)

a; fork length.

N; Number of fish.

Figures in parentheses indicate the averaged values.

(*Pneumatophorus japonicus*), Konoshiro (*Konosirus punctatus*), Kawahagi (family Aluteridae), Aji (family Carangidae), Madako (*Octopus vulgaris*), and Surumeika (*Todarodes pacificus*), and the second subgroup (0.030~0.060 ppm) with Tobiuo (*Prognichthys agoo*), Iwashii (family Dussumeriidae), Sakuraebi (*Sergestes lucens*), Kumaebi (*Penacus semisulcatus*), Asari (*Tapes japonica*), and Ika (family Decembrachiata); and Group C (fish and shellfishes, N.D. ~0.030 ppm) with shellfishes (Class Pelecypoda), Shirasu (*Engraulis japonica*), and Manamako (*Strichopus japonicus*). This classification has received a universal validity.

Ariam *et al.*²⁾, analyzed mercury contents in 19 species of fish from the East China Sea. The following is a list of the averaged total mercury contents in fishes which are related to the 10 species of fish caught in the south-east region of the South China Sea in this study: Maeso (*Saurida undosquamis*), 0.048 ppm; Kaiwari (*Caranx equula*), 0.070 ppm; Ibodai (*Psenopsis anomala*), 0.023 ppm; Mishimaokoze (*Uranoscopus japonicus*), 0.140 ppm; Kanagashira (*Lepidotrigla microptera*), 0.071 ppm; and Umazurahagi (*Narodon modestus*), 0.017 ppm. The same and sibling species among the fishes from the south-east region of the South China Sea, which are common to those from the other two regions, were as follows: Ibodai (*Psenopsis anomala*), Mishimaokoze (*Uranoscopus japonicus*), Kaiwari (*Caranx equula*), Sarasahagi (*Thamnaconus tessellatus*), Igodakahoderi (*Lepidotrigla alata*), and Tokageeso (*Saurida elongata*). Data on these 6 species show in Table 1 were slightly lower than those of their counterparts in the other two regions. Such low values of the total mercury contents seemed to be explained by the less mercurial pollution from the river water. On the other hand, some species of fish were biased toward young adults.

Total mercury contents and feeding habit

From the viewpoint of feeding habits, fish could be classified into plankton feeders, herbivores,

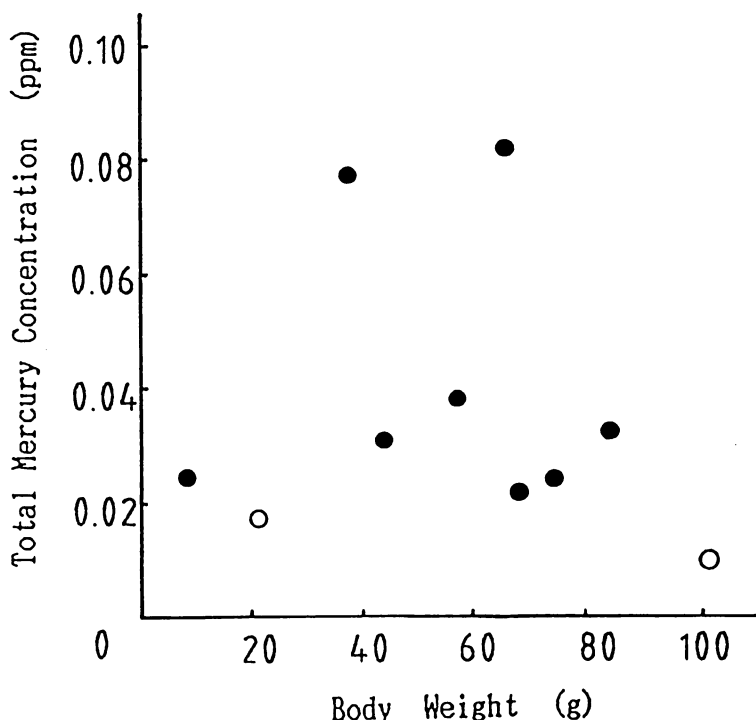


Fig. 2. Relationship between average weight and average total mercury concentration of ten fish species.

○: plankton feeders and jellyfish feeders, ●: carnivorous fish.

carnivores, piscivores and omnivores³⁾. The total mercury contents with fresh weights of individuals of each species are shown in Fig. 2. Species with less than 0.020 ppm of mercury (open circles in the figure) were Sarasahagi (*Thamnaconus tessellatus*), and Ibodai (*Psenopsis anomala*). As to the feeding habits of these species, Kawahagi fishes⁴⁾ (family Aluteridae) were plankton feeders, but they preyed upon various periphytons and benthonic animals. They fed mostly on Copepoda, especially *Calanus finmarchicus*, *Rhincalanus* sp., *Candacia* sp. and hydrozoa. They also fed on Amphipoda, Euphausiacea, shellfish larvae, diatoms, purple and brown algae by tearing them off with the incisor.

Ibodai (*Psenopsis anomala*), on the other hand, depended mainly on Kurage (jellyfish), though it was classified as a carnivor. The total mercury contents of these two species were found to be 0.014 ppm. Their trophic levels were low as in plankton- and Kurage-feeders. On the contrary, the other 8 species were all carnivores who preyed upon Crustacea, Mollusca, and other benthonic animals, showing that they might locate in higher trophic levels than the former two species. The mean total mercury content of these 8 species was 0.041 ppm. The mean contents between the two groups (kawahagi and Ibodai) differed about 3 times. Such a difference might be caused by the accumulation of mercury through the marine food chain.

Fresh weight and total mercury contents

Higher mercury contents were observed in species which did not grow so large, as compared with almost the same weight of individuals. This result indicated that, in addition to the feeding habit, the growth stage also affected the total mercury contents.

The mercury pollution in marine fishes in the south-east region of the South China Sea might be regarded as a minor although the mercury levels in fishes varied depending on the size, feeding habit and growth.

Acknowledgements

We wish to express our sincere gratitude to instructors and students of the Faculty of Fisheries and Marine Science, Universiti Pertanian Malaysia, Dr. S. Hayase (JICA) and Capt. Seiji Higashikawa and his crew of Kagoshima Maru, the Faculty of Fisheries, Kagoshima University. Cordial thanks are also due to Dr. Satoshi Arima, a researcher at Nansei Regional Fisheries Research Laboratory, for his continuous guidance and advice.

References

- 1) S. Kitamura, M. Kondou, Y. Takizawa, M. Fujii. and M. Fujiki (1976): Suigin. Koodan-Sha Tokyo., pp. 161~170. (in Japanese)
- 2) S. Arima, and S. Arima (1985): Total Mercury Level of Fish Caught in East *China Sea*. *Mem. Fac. Fish. Kagoshima Univ.* Vol. 34, No. 1, pp. 1~6. (in Japanese)
- 3) T. Yuwai, A. Otiai, and K. Matubara (1965): Gyoruigaku First Vol. Koseish-Koseikaku Tokyo., pp. 144~153. (in Japanese)
- 4) A. Otiai, and K. tanaka (1986): New edition Gyoruigaku Last Vol. Koseisha-Koseikaku Tokyo., pp. 1014~1017. (in Japanese)