# MERCURY CONTENT OF FISH FROM THE RIVER MOUTH OF SUNGEI KELANG 1979

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### RINGKASAN

Sampel-sampel ikan telah ditangkap dari Kuala Sungei Kelang dan diuji untuk kandungan mercury dengan menggunakan teknik 'stationary cold vapour atomic absorption spectrometry'. Kebanyakan dari sampel-sampel yang diuji mengandungi mercury kurang dari 0.1 ppm. Kandungan mercury yang tertinggi sekali ialah 0.241 ppm yang terdapat di dalam Ikan Ketuka (Trygonidae family).

#### **INTRODUCTION**

Mercury, as one of the most toxic elements, which contributes to environmental pollution is released into the ecological system in industrial and domestic wastes or as agrochemical residues from pesticides and herbicides. It was indicated in early 1950's that the cause of death of 43 people in Minamata Bay, Japan was due to the consumption of fish contaminated with high level of mercury discharged by a chemical manufacturing plant (IRUKAYAMA et al., 1961). Mercury, like most heavy metals, is available to aquatic animals by its uptake directly from contaminated surroundings and through the ingestion of contaminated living organisms in the water. It is now known that some aquatic organisms have the ability to accumulate and concentrate mercury compounds (GRIDDING, 1973) and convert them into more toxic forms of organomercurials in their tissues.

As a result of public awareness of mercury pollution and mercury poisoning, various recommendations on the levels in fish are being proposed by different international organizations. The maximum permissible level set by United States Food & Drug Administration is 0.5 ppm. A similar level is set by the Department of Health, Australia. The Japanese, who generally consume larger amounts of fish, adopt an upper limit of 0.4 ppm. The choice of a proper limit requires careful and thorough studies of the various possible sources of pollution and the data pertaining to the specific food available on the market. To date, the permissible maximum level has not been finalised in Malaysia and the proposed level is 0.5 ppm.

Due to the rapid growth in industralization, the amount of toxic substances including mercury released into the aquatic biota also increased. In Petaling Jaya and Shah Alam, the two most developed areas in the state of Selangor, alarming amounts of domestic and industrial wastes are discharged into the drains which eventually flow into Sungei Kelang. Studies on the extent of pollution of the Sungei Kelang and its tributaries have been reported (ABU BAKAR & ABDUL AZIZ, 1976; Persatuan Perlindungan Alam Sekitar, 1975). However, little is known about the extent and the rate of mercury compounds discharged from the industry in relation to the food chain, with particular reference to fish caught in this area.

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The aim of this paper is to determine the content of mercury in fish caught from the river mouth of Sungei Kelang. In this fishes from ten different experiment. families caught near the river mouth were analysed. The most widely adopted method for trace mercury determination is based on the cold vapour atomic absorption spectrodeveloped technique bv metric POLEUKTOV et al., (1964) and HATCH and (1968). Many modification and OTT improvements on this technique have been published (ZOOK et al., 1975) and a detail account is given in an excellent review by URE (1975). A new stationary cold vapour method developed by TONG (1978) which offers certain advantages over the conventional transient methods. in terms of greater simplicity and higher sensitivity, has been employed in the present work.

### Experimental

# a. Materials and Sample Preparation

Fish samples were caught from the mouth of Sungei Kelang near the Jambatan

North Klang Straits by using 'Pukat Tunda'. Fishes from ten different families were obtained, their common names are: Pesia, Bawal, Selangat, Kasai, Ketuka, Duri, Semilang, Gelama, Katang and Buntal and the scientific name listed in *Table 1*. The size of these fishes ranged from 5-40 cm and the weight range from 2.4-343.6 g (*Table 1*).

The fish was properly cleaned and only the edible portion, including the skin was taken for analysis. Fish of the same species was taken as one sample and duplicate analysis were carried out. The edible portion of the fish was homogenised in a Waring blender with the addition of equal weight of water to ease the blending process. Samples were frozen in the freezer if not analysed immediately.

### b. Digestion

Four grams of the blended sample with standard addition of 0, 0.1, 0.2  $\mu$ g of mercuric chloride was digested with 20 ml of concentrated sulfuric acid in a 100-ml

Common Name	Scientific Name	Length in cm	Weight in g	Number of fish
Bawal	Pampus argenteus	9.6 – 14.2	25.7 – 85.7	2
Buntal	Lagocephalidae	10.0 - 12.0	30.0 - 52.0	4
Duri	Tachysurus caelatus	28.7	336.5	1
Gelama	Sciaenidae	27.5 - 29.0	13.90 - 192.0	2
Kasai	Engraulidae	14.0 - 25.0	19.1 – 129.7	4
Ketang	Scatophagus argus	13.0 - 13.7	59.2 - 75.2	4
Ketuka	Trygonidae	14.0 - 25.7	83.0 - 235.9	2
Pesia	*(1)	6.2 - 11.7	2.4 – 17.6	10
Selangat	Anodontosoma chacunda	5.0 - 5.9	4.3 - 18.0	13
Semilang*(2)	Plotosus canius	40.0	343.6	1
Semilang*(3)	Plotosus canius	26.0	80.2	1

TABLE 1:	SIZE	AND	WEIGHT	OF	FISH
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Note: \*(1) Unidentified

\*(2) Sample code Semilang I

\*(3) Sample code Semilang II

Erlenmeyer flask (RAMIREZ, 1971). The flask was shielded with aluminium foil and the mouth covered with a watch glass. It was heated on a steam bath for two hours with occasional swirling. The solution was cooled in an ice-bath while 20 ml of 6% (w/ v) aqueous potassium permanganate was added slowly with gentle stirring. The solution was allowed to stand at room temperature for 30 minutes and was further heated on a steam bath for another 30 minutes with occasional swirling. Five millilitre of potassium permanganate was again added and the solution was heated till boiling began. The mixture was allowed to cool and was transfered to a 50-ml volumetric flask quantitatively. Five millilitre of 10% hydroxylamine chloride was added to the mixture (prior to reading was taken) and made up to volume with distilled water. The solution was filtered through Whatman No. 1 filter paper just before determination of the mercury content by the stationary cold vapour technique.

### c. Instrument

An Instrumentation Laboratory IL-251 double beam atomic absorption spectrophotometer equipped with an automatic background corrector was used. The burner in the atomisation compartment was replaced by a specially designed holder for the 4-cm UV-cell (Spectrosil, dimensions 10 x 32 x 40 mm, Thermal Syndicate Limited, England) which allowed for proper alignment with the atomic light beam. A Varian mercury hollow cathode lamp and a hydrogen continum lamp for background correction were used. The wavelength was set at 253.7 nm and a slit width of 320 µm (bandpass of 1nm) was used for all measurements.

## d. Reagents

1. Mercury stock solution

A stock solution of  $1000 \ \mu g \ Hg/ml$  was prepared by dissolving 1.354 g of mercuric chloride in 50 ml conc. hydrochloric acid and diluted to one litre with distilled water.

2. Working solution

Working solution of 0.4  $\mu$ g Hg/ml was prepared freshly by appropriate dilution of the stock solution with 5% nitric acid and 0.01% potassium dichromate solution.

 The reducing agent contained 10% (w/v) stannous chloride, 5% (w/v) sodium chloride, 10% conc. sulfuric acid and 5% (w/v) hydroxylamine sulfate.

### e. Method

Four millilitre of 1N sulfuric acid was pipetted into the 4-cm UV-cell followed by the addition of 0.02-0.20 ml of the 0.4 ppm working standard solution and 0.5 ml of the reducing agent. The cell was tightly stoppered and shaken for two minutes to allow the reduced mercury to equilibrate between the vapour and liquid phases. It was then inserted into the cell holder fixed to the atomic absorption spectrophotometer which has been aligned to allow the atomic light beam to pass through the upper gas phase of the cell with maximum intensity.

In the case of the sample solution, 4 ml of the digest was pipetted into the 4-cm UV-cell followed by the addition of standard mercury corresponding to  $0-0.05 \mu g$  in cases where standard additions were carried out. 0.5 ml of the reducing agent was added and the solution was shaken for two minutes before the absorbance was read.

## **RESULTS AND DISCUSSION**

Calibration graph with a linear range of 0-30 ppb for mercury determination by the stationary cold vapour method was obtained. The sensitivity achieved in terms of the slope of the calibration graph was 0.025 ppb<sup>-1</sup> which is adequate for the present purpose. There are several precautions which have to be observed in

Sample	Standard added prior digestion	Standard added after digestion	Concentration in ppm (w/w)	S.D.	x
Bawal			0.047	0.0021	0.047
	_	0.02	0.046		
	_	0.05	0.049		
	0.2		0.044		
Buntal	_		0.011		
			0.013	0.0014	0.012
		-	0.114		
Duri		0.02	0.110	0.0028	0.112
			0.037		
Gelama Kasai Ketang		_	0.023	0.0099	0.030
			0.025		
		0.01	0.022	0.0021	0.024
	-	0.01	0.011		
			0.023	0.0085	0.017
	_		0.025		
Ketuka		-	0.025	0.0170	0.241
	-	0.02	0.254	010111	
	_	0.02	0.217		
	01		0.235		
	0.1	0.01	0.229		
			0.063		
Pesia		0.02	0.061	0.0126	0.072
		0.05	0.088		
	0.2	_	0.076		
Selangat	_		0.045		
	_	0.02	0.050	0.0081	0.042
	0.1	_	0.043		
	0.2		0.031		
Semilang (I) Semilang (II)		-	0.008	0.0078	0.014
		0.02	0.019		
		_	0.007		
		_	0.003	0.0028	0.005

TABLE 2: MERCURY CONTENT IN SAMPLES

order to obtain reliable and reproducible results in employing the present method. During the two hour digestion of the blended sample with conc. sulfuric acid, care was taken to ensure complete digestion by occasional swirling. Incomplete digestion can cause foaming problems during the determination stage. Addition of oxidising the agent. potassium permanganate, was carried out with gentle stirring and cooling in ice-bath to avoid too vigorous reaction resulting in loss of the mercury. The excess permanganate was removed from the reaction mixture by the addition of hydroxylamine chloride, just prior to the final measurement. Loss of mercury was observed if the hydroxylamine chloride treated digests were allowed to stand overnight. This could possibly be due to the absorption of mercury on the wall of the containers.

The recovery of the digestion process was examined by adding known amounts of mercury to several samples (Selangat, Bawal, Pesia and Ketuka) before digestion. As can be seen in *Table 2*, no significant loss was observed. Most of the digested solution were analysed by means of standard addition and the results are presented in *Table 2*. The consistency among each set of results indicates the reliability of the method of determination.

The results in *Table 2* showed that most of the samples analysed contained mercury of less than 0.1 ppm, except for Ikan Ketuka and Ikan Duri which were found to contain 0.241 ppm and 0.112 ppm respectively. These levels showed no apparent elevation compared with those reported in literature. (DIX and MARTIN, 1975; PIRATI *et al.*, 1972; RATKOWSKY *et al.*, 1975) and they were well below the maximum permissible level generally considered safe for human consumption which is 0.5 ppm.

It was noted that samples caught were mostly under the maturity size indicating a very unfavourable environment for normal fish growth in the river concerned. A correlation between the mercury concentration and the weight and size of the fish was reported by DIX and MARTIN (1975) in Tasmanian waters, if the site where the fish was obtained was taken into consideration. Even a small sized fish in a mercury polluted environment could have a high mercury concentration, whereas a large fish in an unpolluted environment could have a low mercury concentration. On examining the results further, there appeared to be a certain correlation between the mercury content and the body weight of the samples. However, more analysis needs to be carried out to verify this.

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### SUMMARY

Fish samples were caught from the river mouth of Sungei Kelang and analysed for their mercury content by the stationary cold vapour atomic absorption spectrometric techniques. Most of the samples analysed contained mercury of less than 0.1 ppm. The highest level detected was 0.241 ppm in Ikan Ketuka (Trygonidae family).

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