

MERCURY CONTAMINATION IN FISH IN WEST BENGAL

SUMMARY OF THE FINDINGS

Mercury is one of the most dangerous environmental pollutants, both in its elemental form and in chemical combination. When mercury is released into the environment it gets transformed into methyl mercury through microbial action. The methylation of mercury is a key step in the entrance of mercury into food chains. This methyl mercury is mercury in its most pernicious form. Methyl mercury bioaccumulates in fish and enters the human body when the fish is eaten.”

Study Objectives

- A. To quantify and assess the level of mercury in fish and crustaceans collected from –
 1. Waterbodies in selected areas from different parts of West Bengal
 2. Five prominent markets in Kolkata
- B. To try and arrive at a reasonable conclusion regarding the nature and extent of mercury contamination of fish, on the basis of analysing the results from the Laboratory.
- C. To make a risk assessment of mercury contaminated fish intake on the basis of detected contamination levels.
- D. To suggest recommendations on the basis of the above results and analysis thereof.

Sampling Locations

1. THE KOLKATA MARKETS

The samples were collected from the following markets:

SL. No.	MARKET	LOCATION IN KOLKATA
1	Gariahat	South
2	Sahababur Bazaar	Central
3	Manicktala	North
4	Sealdah	Central
5	Behala	West

The total sample number was 60.

2. COLLECTION FROM WATERBODIES IN DIFFERENT PARTS OF WEST BENGAL

The following table gives a list of areas and waterbodies from which the samples were collected. This is followed by a brief discussion of the nature, mode and constraints of sample collection.

SL. No.	AREA	WATER BODY
1	FARAKKA (THERMAL POWER PLANT)	RIVER –GANGA AND FEEDER CANAL
2	DURGAPUR – ASANSOL (INDUSTRIAL BELT)	RIVER, DAMODAR
3	KOLKATA (METROPOLIS) AND NEARBY AREA	POND – EAST KOLKATA WETLAND AND MUDIALI; RIVER – GANGA AT DOWNSTREAM FROM KOLKATA
4	HALDIA (INDUSTRIAL BELT)	AT THE ESTUARINE CONFLUENCE OF HALDI AND

		HOOGHLY
5	KOLAGHAT (THERMAL POWER PLANT)	PONDS
7	DIGHA (TOURIST SPOT)	SEA – BAY OF BENGAL
8	JHARKHALI, SUNDERBAN BIOSPHERE RESERVE	RIVER – MATLA, VIDYADHARI, HEROBHANGA
8	HUGLI (AGRICULTURAL BELT)	PONDS
9	NORTH BENGAL MAHANANDA BARRAGE	CONFLUENCE OF MAHANANDA, TEESTA CANAL AND BALASHON RIVER
10	NORTH BENGAL, DARJEELING DISTRICT, PLAIN, NEAR TEA GARDEN	RUIDASA, POND
11	NORTH BENGAL, AGRICULTURAL BELT	POND AT DOLUA, JALPAIGURI
12	NORTH BENGAL, AGRICULTURAL BELT	POND AT KANCHANSIRI, IN JALPAIGURI DISTRICT
13	NORTH BENGAL	RIVER KOROLA, JALPAIGURI DISTRICT
14	NORTH BENGAL	POND RANIJOT, DARJEELING DISTRICT, PLAIN

The total number collected was 204.

The total number of samples submitted to the Laboratory for mercury testing is 264. And the total number of fish and crustacean varieties collected is 56.

Lab Methodology

The Laboratory to which the samples were delivered for digestion is the *SGS India Private Limited* Kolkata Laboratory located at Behala Kolkata, an NABL accredited laboratory. AOAC, 977.15 was followed for determining total mercury concentration.

Standards

The main standard used in this work is that proposed by the Joint FAO/ WHO Expert Committee on Food Additives in 2004 and reconfirmed by the said body in 2006. This is the *methylmercury in fish* standard and is given in terms of Provisional Tolerable Weekly Intake (PTWI) for an individual. The standard is 1.6 µg / kg of body weight for an individual. It works out to be around 0.228571 µg / kg of body weight / day.

The **JOINT FAO/ WHO EXPERT COMMITTEE** clearly tells us that although its PTWI may be exceeded somewhat in case of adults (to about twice the tolerable intake per week), this is not recommended in the case of pregnant mothers (where the health of the foetus is in question) or in the case of children or young adolescents; in all such cases the PTWI should be followed.

The other local reference taken into consideration is the Prevention of Food Adulteration Act and Rules, 1954. This gives the limit of mercury in fish as 0.5 ppm by weight and that of methylmercury (calculated as the element) in the case of all foods (obviously including fish) as 0.25 ppm by weight. For exposition purposes it might be mentioned that ppm in our context is mg / kg or, what is the same thing, µg / gm.

The fact that the aforesaid Act and Rules mentions methylmercury has tremendous import, for it is the mercury in the methylated form that is of the greatest toxic significance.

Our survey among 43 families in Kolkata and outlying areas and with incomes as diverse as Rs. 8,000 per month (4 family members), Rs. 10,000 per month (9 family members) and 90,000 per month (4 family members) came up with the following results:

- Only 2 families exhibited average per head intake of less than 300 gm per week.
- 12 families were consuming at the average per head rate of 300 gm to 500 gm per week.
- 29 families were consuming at the average per head rate of more than 500 gm per week.
- 24 families were consuming at the average per head rate of more than 650 gm per week.

Using a conversion factor of 0.75 to estimate the amount of flesh in the fish purchased, a conversion factor based on actual weighing of parts in different fish samples, the investigators concluded that typical fish flesh consumption among residents of West Bengal, particularly in the middle income groups, easily ranges between 300 to 400 gm, and large numbers consume over 500 gm of fish flesh per week. The combination of this high level of fish consumption with the comparatively high mercury levels detected in fish from Kolkata markets and many locations in West Bengal raises substantial health concerns.

Another important thing is that children of 5 years and above, if they don't have a particular dislike for fish, consume fish at adult rates; indeed this is encouraged for fish intake is supposed to provide essential nutrients for body and brain development.

Therefore per head weekly consumption of 400 gm of fish would tend to indicate overall consumption of not less than 300 gm of fish flesh. However, the fish head is also eaten, at least more often than not. Therefore, actual consumption of fish would tend to be more than indicated by consumption of fish flesh. And methylmercury is also found in fish brains, but that aspect has been left out of the domain of this study as brains were not tested for mercury contamination in this study.

Although several experts tend to take the total mercury detected in fish flesh as methylmercury, investigators in this study have been more conservative. On the basis of research findings we have we have taken 80% of the total mercury as the average level of methyl mercury in the case of all fish and the few crab samples, while for shrimps we have taken a general level of 40%.

RESULTS

For Samples from Kolkata Markets

Total number of samples is 60.

- 7 out of 60 samples have mercury levels above PFA stipulations.
- 24 out of 60 samples have methylmercury levels above PFA stipulations.

- In 5 out of 7 cases of excess Hg, Hg levels have exceeded by more than 50% over PFA stipulations and in 2 such cases it has exceeded by more than 100% above PFA stipulations.

- In the 24 cases of methylmercury excess, 18 cases show MeHg excess of more than 50% above PFA stipulations.

- 7 cases show MeHg excess of more than 100% above PFA stipulations.

For samples from fishing locations from different parts of West Bengal

The total number of samples is 204.

- In 45 cases Hg levels have been exceeded and in 105 cases MeHg levels have been exceeded.

- Of the 45 cases where Hg levels have been exceeded 35 cases exhibit excess by more than 50% of PFA stipulations and 19 cases show excess by more than 100% of PFA stipulations.

- Of the 105 cases where MeHg levels have been exceeded 70 cases exhibit excess by more than 50% of PFA stipulations and 45 cases show excess by more than 100% of PFA stipulations.

- Moreover 18 cases show excess of more than 200% over PFA stipulations for MeHg levels.

APPLYING THE WHO/FAO CRITERION

For applying the WHO/FAO criterion one needs to consider body weight and intake.

Two hypothetical instances have been considered, showing rather moderate consumption levels.

- (i) that of a child of 25 Kg body weight and weekly fish flesh consumption of 250 gm and
- (ii) that of an adolescent/adult of body weight 50 Kg and weekly fish flesh consumption of 500 gm.

The results show that in the two scenarios:

The PTWI is exceeded in 181 samples in scenario (i).

- Of these 181 samples, the PTWI is exceeded by more than 100% in the case of 105 samples, and by more than 200% in the case of 54 samples.

The PTWI is exceeded in 155 samples in scenario (ii).

- Among these 155 samples the PTWI is exceeded by more than 100% in the case of 80 samples, and by more than 200% in the case of 37.

The Kolkata Markets

		A child of 25 Kg/ PTWI 40	An adult of 60 Kg/ PTWI 96	A child of 25 Kg/ PTWI 40		An adult of 60 Kg/ PTWI 96	
Market	Average MeHg in $\mu\text{g}/\text{Kg}$	0.25Kg intake	0.50 Kg intake	Whether exceeded	By how much?	Whether exceeded	By how much?
Gariahat	479	119.75	239.50	Yes	199.38	Yes	149.48
Sahababu	119	29.75	59.50	No	Does not arise	No	Does not arise
Sealdah	298	74.50	149.00	Yes	86.25	Yes	55.21
Manicktala	248	62.00	124.00	Yes	55.00	Yes	29.17
Behala	240	60.00	120.00	Yes	50.00	Yes	25.00
The average for 5 Markets	277	69.25	138.50	Yes	73.13	Yes	44.27

The Localities

		A child of 25 Kg/ PTWI 40	An adult of 60 Kg/ PTWI 96	A child of 25 Kg/ PTWI 40		An adult of 60 Kg/ PTWI 96	
Locality	Average MeHg in $\mu\text{g}/\text{kg}$	0.25Kg intake	0.50 Kg intake	Whether exceeded	By how much?	Whether exceeded	By how much?
Hugli	309	77.25	154.50	Yes	93.13	Yes	60.94
Budge Budge	451	112.75	225.50	Yes	181.88	Yes	134.90
Jharkhali	1023	255.75	511.50	Yes	539.38	Yes	432.81
Haldia	261	65.25	130.50	Yes	63.13	Yes	35.94
Digha	382	95.50	191.00	Yes	138.75	Yes	98.96
East Kolkata Wetlands	345	86.25	172.50	Yes	115.63	Yes	79.69
Kakdwip	569	142.25	284.50	Yes	255.63	Yes	196.35
Mudiali	161	40.25	80.50	Yes	0.63	Yes	-16.15
Farakka	364	91.00	182.00	Yes	127.50	Yes	89.58
North Bengal	52	13.00	26.00	No	Does not arise	No	Does not arise
Kolaghat	127	31.75	63.50	No	Does not	No	Does not arise
Durgapur	103	25.75	51.50	No	Does not arise	No	Does not arise
Average	328	82.00	164.00	1.00	105.00	1.00	70.83

Statistical and PTWI summary of all the results

		A child of 25 Kg/ PTWI 40	An adult of 60 Kg/ PTWI 96	A child of 25 Kg/ PTWI 40		An adult of 60 Kg/ PTWI 96	
Market	Average MeHg in $\mu\text{g}/\text{kg}$	0.25Kg intake	0.50 Kg intake	Whether exceeded	By how much?	Whether exceeded	By how much?
Average for the Whole	317	79.25	158.50	Yes	98.13	Yes	65.10

What happens when we look at the species average and apply them to our two scenarios?

In the case of (i) 44 of the 56 species tested show PTWI to have been exceeded, i.e. 79% of the species tested.

In the case of (ii) 39 of the 56 species tested show PTWI to have been exceeded, i.e. 70% of the species tested.

Moreover in the case of (i), 27 of the species tested show PTWI to have been exceeded by more than 100% and 14 species show PTWI to have been exceeded by more than 200%.

In the case of (ii), 23 of the species tested show PTWI to have been exceeded by more than 100% and 10 species show PTWI to have been exceeded by more than 200%.

The implications are obvious. We need to act and ACT NOW.

THE NEED OF THE HOUR

The need of the hour is to launch a full-scale investigation. And on the basis of the results it is necessary for governments to try and formulate fish advisories, which highlight the most contaminated species and advise quantities of intake, particularly for the most susceptible population, pregnant women and children.

What is also required is that the Indian medical community wake up to the need of including environmental medicine into their discourse of diagnostics and therapy. For example, the neurological and psychological symptoms of methylmercury poisoning may often be similar to disorders due to other reasons. It is important that doctors should be awake to the possibility of methylmercury toxicity as a possible source of disorder and investigate accordingly. This applies not only to mercury but to the entire range of environmental pollutants. So far, the Indian medical community, barring few exceptions, tends to approach disease diagnostics and therapy in the usual conventional terms. It is important that pollutant induced pathology become a key item in medical practice.

We may spell out the various items most required at this hour:

- That fish in West Bengal have significant, and often alarming, levels of mercury contamination is evident from this study. Both the government and civil society should wake up to this problem.
- The concerned governmental departments, e.g. the Health and Environment Departments, should undertake a thorough investigation of the scale, intensity and sources of mercury pollution.
- The scientific community should independently and in collaboration with the government, undertake such investigation.
- Once the sources are identified efforts must be made to cut down on pollution so as to bring mercury pollution down to safe levels.
- Pending this long term solution, and drawing upon thoroughgoing studies of mercury contamination in fish, fish advisories should be prepared by the concerned authorities instructing citizens about relatively safe and unsafe species and fish sources.
- Mercury and other pollutants of similar severity should become an important item in civil society initiatives.
- Medical practitioners should include the subject of pollutant induced pathology as a key item in their practice.

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