

Mercury Contamination of Terrestrial Vegetation near a Caustic Soda Factory in Thailand

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Elevated levels of mercury were recently measured in the Water Spinach, Ipomoea aquatica Forsk., growing near the Thai Asashi Caustic Soda Co. Ltd. (TACSCO) in the Samut Prakarn Province of Thailand. This plant had accumulated 0.75 - 1.3 ppm mercury (on dry weight basis) in leaves and 0.28 - 0.68 ppm mercury in the floating stems, while those from the control areas had only 0.01 - 0.17 ppm in the leaves and 0.01 - 0.06 ppm in the stems (SUCKCHAROEN 1978). The mercury in the leaves of this plant was later found to be mainly methylmercury (PAASIVIRTA et al. 1979). This plant is widely used as human food in Thailand, therefore the rather high levels of the neurotoxic methylmercury could be a threat to public health. In addition to Water Spinach, the shoot of a submerged plant, Ceratophyllum demersum L., collected from the same area had accumulated mercury ranging from 0.67 to 4.6 ppm (on dry weight basis), while samples from the control area had mercury levels ranging from 0.03 to 0.08 ppm (SUCKCHAROEN 1979).

Besides aquatic plants, terrestrial plants are known to be highly contaminated with mercury not only around the mercury mines or on cinnabar veins (BYRNE & KOSTA 1970, SHACKLETTE 1970), but also around chlor-alkali plants (WALLIN 1976, GRIFFIN 1976 ab, BULL et al. 1977, LODENIUS & LAAKSOVIRTA 1979).

The present study is concerned with the fall-out of mercury on some terrestrial plants and one species of aquatic plant growing in the vicinity of the TACSCO factory.

MATERIALS AND METHODS

During November, 1978, samples of plants were collected near the TACSCO factory. The collecting localities were near the Suksawad Road which lies in front of the factory. Six samples, consisting of about 10-30 g (fresh weight) of leaves, were taken from each of the following species:

Leucaena glauca Benth, Coccinia indica Wight and Arn., Psidium guajava L., Solanum melongena L., Morinda citrifolia L., Sesbania grandiflora Poir. The duckweed, Lemna minor L., was collected from the channel which lies between the TACSCO factory and Suksawad Road.

In addition, samples of Sporobolus virginicus Kunth were collected from the front concrete wall of the factory at distances of 5, 10, 20, and 45 m from the exit of the factory in southward direction. At each point, five samples were collected.

Control samples of similar plant species were collected from the unpolluted area of Donmuang in Bangkok District. The collecting area was about 200 m from a highway.

All unwashed samples were air dried for 5 days before being packed in polythene bags and mailed to Finland. Samples were then oven dried at 60° C for 3 days, ground in a mortar, digested by 10 mL of conc. H₂SO₄ and conc. HNO₃ (4:1, v/v), and shaken in a waterbath at 60° C for 5 h.³ The mercury content of the digest was measured with a Coleman Mercury Analyzer MAS-50.

RESULTS AND DISCUSSION

As shown in table 1, the mercury contents of samples from the TACSCO area varied from 0.33 to 7.4 ppm, while those from the control area varied from less than 0.01 up to 0.06 ppm. High amounts of mercury were observed only in plants growing near the factory. For instance the mercury content of Leucaena glauca was 1.1 ppm near the factory, but only 0.75 ppm at a distance of 500 m.

It must be noted that the highest mercury amount was found in Solanum melongena and the hairy leaves of this plant probably contributed to the accumulation of the mercury through fall-out.

The mercury contents of Sporobolus virginicus increased with increasing distances from the factory (Table 1). This phenomenon has also been observed in plants growing close to the chlor-alkali works in Finland (LODENIUS & LAAKSOVIRTA 1979). The observed mercury values in plants from Thailand were in the ranges of mercury observed in the carpet-forming moss (Hypnum cupressiforme) and the grass (Festuca rubra) as reported by WALLIN (1976) and BULL et al. (1977)

TABLE 1

Mercury content (on dry weight basis) in the leaves of plants from the TACSCO area and from the control area.

Species	TACSCO area mean \pm S.D.	Control area mean \pm S.D.
<u>Leucaena glauca</u>	1.1 \pm 0.1 (N=6)	0.02 \pm 0.005 (N=6)
<u>Leucaena glauca</u> (500 m from the factory)	0.75 \pm 0.07 (")	0.02 \pm 0.005 (")
<u>Coccinia indica</u>	1.5 \pm 0.2 (")	0.06 \pm 0.02 (")
<u>Psidium guajava</u>	2.5 \pm 0.2 (")	0.04 \pm 0.02 (")
<u>Solanum melongena</u>	7.4 \pm 0.7 (")	0.04 \pm 0.02 (")
<u>Morinda citrifolia</u>	1.3 \pm 0.2 (")	0.06 \pm 0.005 (")
<u>Sesbania grandifolia</u> (800 m from the factory)	0.33 \pm 0.05 (")	< 0.01 \pm 0.03 (")
<u>Lemna minor</u>	1.8 \pm 0.2 (")	0.04 \pm 0.03 (")
<u>Sporobolus virginicus</u>		
Distance from the factory		
5 m	0.63 \pm 0.11(N=5)	0.04 \pm 0.02 (N=20)
10 m	0.70 \pm 0.08 (")	
20 m	0.82 \pm 0.09 (")	
45 m	1.8 \pm 0.5 (")	

The mercury contents of the plants from the TACSCO area were about 16 - 190 times higher than those from the control area. The mercury contents of plants from the control area in Thailand were low when compared to the mercury concentrations in the leaves of a sugar maple from a natural forest in the U.S.A. (SMITH 1972).

With the exception of Lemna minor and Sporobolus virginicus, the increased mercury levels in the other plants species can be regarded as a risk to public health because in Thailand they are used as human food. Although the studied samples were unwashed, TEMPLE & LINZON (1977) have found that washing did not readily remove mercury contamination in or on the surface of the maple leaf. It should also be noted that the duckweed is commonly used for feeding domesticated ducks and geese meant for human consumption and therefore this represents an additional route for the bioaccumulation of mercury in man. In addition to this, fish from the TACSCO area are polluted with mercury (SUCKCHAROEN et al. 1978, SUCKCHAROEN & LODENIUS 1979), so the local inhabitants are likely to obtain mercury from several different sources.

It is known that TACSCO built a system for water purification in 1974, but nothing is known about the control of atmospheric-mercury-emission. This latter emission is of particular interest

because atmospheric emissions exceed the emission into water by about a factor of 15 (HARRISS & HOHENEMSER 1978). In Samut Prakarn Province there exists several industries where mercury cells have been used in the production processes, therefore a prompt research is urgently required in order to determine potential risks to public health from mercury contamination.

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