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Short Communication

Estimation of mercury content in water, soil, fodder and animal tissues

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Abstract

Water samples from the Cooum river in the coastal area and the soil, fodder and pig's tissues from Kattupakkam were analysed for their mercury content. The average values of mercury were 4.07 ng/l, 1.25 μg/g, 0.009 μg/g and 0.015 μg g respectively for water, soil liver and kidney. Mercury in fodder was below detectable limit.

Key words: Mercury, water, soil, fodder, tissues.

1. Introduction

Environmental pollution is caused by trace metal ions and poses many health hazards to living beings. Mercury being one such well-known toxic element, it is appropriate that it has attracted the attention of many researchers in this field from diverse angles. Precise quantitative estimation of mercury poses innumerable problems. Since it is present in traces in water in dissolved form, soil, fodder and animal tissues are affected. Accurate results can be obtained using atomic absorption spectrophotometer [1–3]. In order to estimate total mercury content in water it is necessary to convert organic mercury to inorganic form by treating it with either potassium permanganate[4], persulphate[5] or ultraviolet irradiation[6].

In this investigation water was collected from 23 points in river Cooum flowing through Madras City from September, 1983 to August, 1984. Soil and fodder samples were collected from Kattupakkam Sheep Farm near Madras City. Animal tissues were collected from pigs reared in the same farm. Analysis was done using Mercury Analyser MA 5800 (ECIL) which works on the principle of cold vapour absorption technique, which provides more analytical sensitivity for mercury.

2. Experimental

2.1. Reagents

$KMnO_4$ (1 and 5% W/V), NaOH (20% W/V), $SnCl_2$ (20% W/V in 10% HCl), Hg solution (100 ppm in 2% HNO_3), H_2SO_4 (0.5·N and 1:1 V/V), HNO_3 (conc. and 10% V/V), Aquaregia, $K_2S_2O_8$ (5% W/V) and NaCl-NH_2OH.HCl solution (1:1) were prepared appropriately following standard procedures[4].

2.2. Pretreatment and concentration of natural water

Fresh water was filtered through 0.45 μm millipore filter paper just after the collection of the sample. Since mercury reacts with polythene[7] or glassware due to its high absorptivity[8], water samples containing mercury were preserved in polythene and glassware containers at pH less than 2.0. The samples were pretreated[4] and concentrated[9] as per standard methods.

2.3. Preconcentration of soil

Dried soil was powdered with pestle and mortar and preserved in bottles. Preconcentration and estimation were done as per standard methods[4].

2.4. Digestion of fodder and animal tissues

Digestion of fodder and animal tissues was carried out following the methods described elsewhere[10,11].

2.5 A suitable aliquot of the blank, standard or sample solution was taken in the reaction vessel. Eight ml of 10% nitric acid and 2 ml of stannous chloride were added and the stopper was replaced immediately. Magnetic stirrer was switched on and the contents stirred vigorously for about five minutes. The pump was started to allow the air to purge through the reaction vessel. Absorbance was noted as quickly as possible. Measurements were prepared twice/thrice in each case.

3. Results and discussion

The absorbance values (at λ 253.7 nm) obtained for varying concentrations of the standard Hg solutions gave a good linear plot. The unknown Hg concentrations in the test samples were obtained from this standard plot. Selected readings for triplicate analysis of three sets of blank solution for the different procedures applicable to soil, fodder and animal tissues are given in Table I. In Table II are given the weight of liver, kidney and fodder used, mercury present, mercury spiked, mercury found before and after spiking and the percentage recovery. The recovery is well above 95% showing that the results are reliable and the method adopted for digestion is justifiable. Mercury concentration in soil, fodder and pig's liver and kidney are given in Table III. Mercury was present in low levels in soil as well as tissues taken from pigs and was non-detectable in fodder. The

Table I
Replicate analysis of blank with mean and standard deviations of Hg concentrations

		Replicate analysis of mercury (ng/4 ml)			Mean	Standard deviation
Soil Blank	1	5.3	5.6	5.4	5.43	0.15
Fodder Blank	2	6.3	6.7	6.9	6.63	0.31
Tissue Blank	3	7.3	7.5	7.0	7.27	0.25

Table II
Percentage recovery

Sample	Weight of the sample (g)	Mercury found (ng/4 ml)	Mercury present (μg/g)	Mercury spiked in 5 g of the sample (ng)	Mercury found in 4 ml aliquot after spiking (ng)	Recovery of mercury (ng)	Recovery %
Liver	5	7.2	0.009	250	47.20	40.00	100
Kidney	5	12.0	0.015	250	50.96	38.96	98
Fodder grass	5	ND	ND	250	40.00	40.00	100

ND = Not detectable.

Table III
Mercury concentration in soil, fodder and pig's tissues

	Number of samples analysed	Mercury concentration (μg/g)
Soil	5	1.25 ± 0.60 (dry weight)
Fodder	5	ND
Liver	20	0.0091 ± 0.0025 (wet weight)
Kidney	20	0.0150 ± 0.0031 (wet weight)

ND = Not detectable.

average mercury concentration in pig's liver in US and Sweden are reported to be 0.04 and 0.06 μg/g respectively [12,13]. Compared to these values, the concentration of mercury in pig's liver from the Kattupakkam Sheep Farm is low.

Table IV
Mercury concentration in Cooum water in coastal zone

Location	Mercury concentration (ng/l)
Cooum House	5.25
T.V. Station	3.31
Navy Officers' Quarters	3.39
Army Officers' Quarters	3.18
Behind General Hospital	5.25
Mean	4.07 ± 0.44

Mercury concentration in water from river Cooum in the coastal zone alone is given in Table IV even though the study has been extended to 23 points. The data show that Cooum is not polluted with mercury.

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