



Estimation of Mercury in Soil, Water and Plants Spectrophotometrically

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ABSTRACT

Trace levels of mercury in soil, environmental water (portable and polluted) and plant specimens (cucumber and pepper) at Koya area–Kurdistan region–Iraq was described by simple procedure, where, no further solvent purification or pre-concentration required steps. The method based on soxhelt extraction with oxalic acid and stannous chloride in acidic media for about 2.5 h, followed by spectrophotometric measurement at λ_{max} of 300 nm. The results show different mercury levels, water samples show (3-215) ppm, while soil samples (5 -150) ppm. Also, some agricultural products show (23 -80) ppm mercury level.

Keywords: Soxhlet, Mercury, Spectrophotometer.

INTRODUCTION

Mercury is one of the most toxic elements and is associated with many health problems, include, instantaneous neurological damages particularly irritability, paralysis, insanity, blindness, chromosome damage and birth defects¹.

It is found in different forms, as elemental mercury vapor in atmosphere, although, as organic and inorganic form. The main natural sources of mercury are volcanoes, forest fires and the weathering of mercury-bearing rocks². Anyhow, industry produces huge amounts of mercury³.

The most important common sources of

mercury in this field are , paper, cellulose and plastic industries, paint, pharmaceutical industries and pesticides^{4,5}.

Also, mercury assumes to be the most dangerous of all contaminants which may be consumed in our daily foods like fish, cereals and other foodstuffs have resulted in numerous poisoning⁶.

The most common methods for measuring total mercury include absorption spectrometry, neutron activation analysis, and cold vapor atomic absorption spectrometry^{7,8} and colorimetric solvent extractive method⁹.



The goal of this study was to evaluate the mercury content in soil, water and plant samples at Koya area–Kurdistan region–Iraq, by simple soxhlet extraction, and then, spectrophotometric measurement.

EXPERIMENTAL

Apparatus

A CECIL (CE7200) double beam UV-Visible spectrophotometer was used for measurements of absorbance.

Reagents and solutions

- A series of standard solutions (1, 5, 20, 25, 100, 180, and 200) ppm of Mercury (II) chloride (Romil, 99%) prepared to construct standard graph.
- 0.1 M HCl (Scharlau, 37%) solution.
- Oxalic acid (Fluka, 99.8%) 4% solution.
- Stannous chloride (Fluka, 95%) 2% solution.
- λ_{\max} was determined using stock solution and the results show of maximum absorbance at 300 nm.

Procedure

2 gram of tested sample weighed to the soxhlet extraction apparatus, 50 mL of oxalic acid solution, 50 mL stannous chloride solution and 10 mL of HCl solution added. The mixture refluxed for about 2.5 h (filter if need), after that the contents diluted to 250 mL distilled water. From the final solution, 5 mL diluted to 25 mL with distilled water.

Absorbance measured at 300 nm against a corresponding reagent blank and mercury content of unknown samples was determined using a concurrently prepared calibration graph.

RESULTS AND DISCUSSION

Mercury content in soil, agricultural products and water sample is convenient to geologist exploring and metals accumulation inspection¹⁰.

The optimize operation conditions to get an effective extraction and obtain maximum absorbance have been investigated.

Sample digestion

The pretreatment step in quantitative determination of total mercury is an exceptive

step, because of some mercury specifications. The accuracy of results depends on the efficiency of extraction and digestion processes^{11,12}. Where, the incomplete of ineffective extraction, loss of mercury vapor and faulty mercury oxidation–reduction reaction may influence in descend the accuracy of process. The optimum period for soxhlet extraction was 2.5 h, as shown in Figure 1.

Absorption spectra

For absorption measurements, a set of mercury standard solutions prepared, absorbance was measured at λ_{\max} of 300 nm. And then, calibration graph with absorbance versus concentration plotted¹³. The concentration of unknown samples was directly obtained from this graph, as shown in Figures 1 and 2.

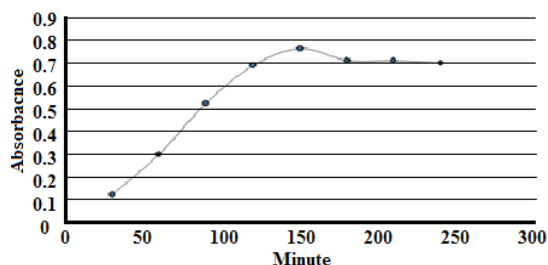


Fig. 1. Effect of time on absorbance

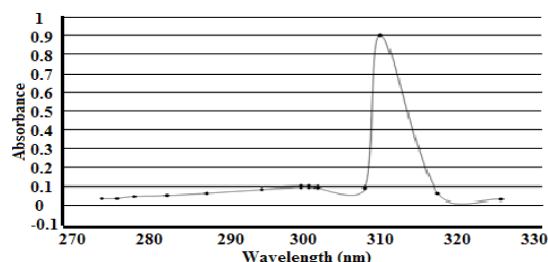


Fig. 2. Determination of λ_{\max}

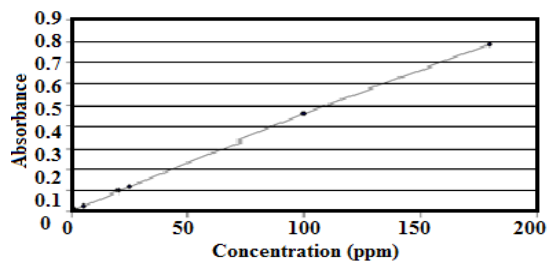


Fig. 3. Calibration graph.

Effect of acidity

Using of hydrochloric acid for digestion of samples was found to be the most suitable acidic media for determining of mercury in all samples under study.

The optimum acidity range for all consecutive measurements 10 mL of 0.1M HCl was used, as in Figure 4.

Effect of extraction environment

The oxidizing environment bring into existence by addition of oxalic acid at the time of extraction. Mercury exists as Hg (II) in the acid digestion solution was reduced to its elemental form with SnCl₂. Hence, SnCl₂ is a convenient mercury reductant¹⁴, according to the results, as in Figure 5.

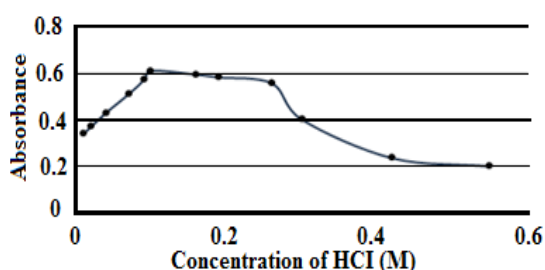


Fig. 4. Effect of acidity on absorbance

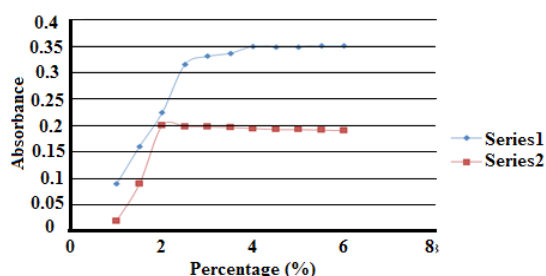


Fig. 4. Effect of extraction conditions

The optimized analytical parameters of all experiments are summarized in Table 1.

Table 1: Optimized analytical parameters

Parameter	Studied range	Selected range
λ_{max} (nm)	200 - 600	300
Acidity /HCl (M)	0.01 – 0.6	0.1
Time of extraction (min.)	30 - 240	150
Temperature (°C)	80	80
Oxalic acid (%)	1 - 6	4
Stannous Chloride (%)	1 - 6	2

CONCLUSION

Mercury is a ubiquitous, environmentally toxic chemical element. The normal range of mercury at rural area is (0.07-1.22 ppm) and urban area is (0.07-1.53ppm). In this research appeared that the

Table 2: Mercury content in some soil samples

No.	Soil Samples	Hg (ppm)
1	Direct waste	150
2	Direct surface (0 m distance)	147
3	Surface Fossa Soil (1-2 m distance)	143
4	South west (1Km distance)	124
5	Ground {Kelaspi} (3Km distance)	78
6	Auto industry	78
7	West (1Km distance)	68
8	East (1Km distance)	28
9	South (1Km distance)	25
10	North (1Km distance)	24
11	Well Soil (3Km distance)	20
12	Farming place at Tobzawa	5
13	Oxidizer	53

Table 3: Mercury content in some water samples

No.	Water Samples	Hg (ppm)
1	Fossa's water	215
2	Lake (1Km distance)	200
3	Tobzawa	25
4	Chicken poultry (2Km East distance)	21
5	Chicken poultry (2Km South distance)	19
6	Kelaspy Well (3Km distance)	3

Table 4: Mercury content of some agricultural products

No.	Plant Sample	Hg (ppm)
1	Cucumber	80
2	Pepper	23

environment (soil, water and plants) the area near the semi factory of recycle engine oil was polluted by this toxic element because the bi-product of their work is through away behind of the factory, so, the distance between Koya city and the semi factory is only 7Km. Day by day, mercury will be transferred to Koya by air because of mercury is volatile chemical element. Therefore, the factory must be treated with their bi-product scientifically to save the human health environment.

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Conflicts of Interest

The authors declare no conflict of interest.

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