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# Literature Review on Determination and Estimation of Lead in Vegetable Food Stuff Grown With Industrial Wastewater by Spectrochemical Techniques

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**ABSTRACT:** Vegetables are commonly cultivated with untreated wastewater and consumed by human beings who often ignore their harmful impacts on health. The industrialization and urbanization in developing countries have led to the release of increasing amounts of heavy metals (HM) into the environment. Regular monitoring of metal concentration levels in contaminated soils and edible plants is essential to prevent their excessive build-up in the diet and food chains. The use of agrochemicals, as well as industrial effluent and untreated sewage poisoning soil, can be considered a major source of the contamination of lead in food. Lead has the ability to accumulate rapidly in the human body if it enters the food chain and this results in acute poisoning.

**KEYWORDS:** lead, wastewater, food, vegetables, spectrochemical, estimation

## I. INTRODUCTION

Application of the spectrographic method to the detection and estimation of common impurities, of metals, and lead has been investigated in vegetables growing in wastewater coming from industries. The method employed requires conversion of the dried vegetable sample to lead nitrate, which is applied as a solution to treated graphite electrodes and dried. Spectra of samples are excited by a 4400 v alternating current arc of 5 amp, and photographed on Eastman Spectrum Analysis' No. 1 Plates (ultra violet sensitized for Cd and Zinc) by use of a stigmatic grating spectrograph of 8.34 Å/mm reciprocal dispersion. Provision is made for quantitative measurements by photometric comparison of line intensities 3118.92 and 2218.08 employed as internal standard, and for semiquantitative determinations by visual comparison of sample spectra with spectra of suitable standards. The minimum detectable proportions of impurities, in parts per million by weight, of different metals in the effluent.[1,2] Concentration procedures which provide at least ten-fold increase in sensitivity are described.

A spectrochemical series is a list of ligands ordered by ligand "strength", and a list of metal ions based on oxidation number, group and element. For a metal ion, the ligands modify the difference in energy  $\Delta$  between the d orbitals, called the ligand-field splitting parameter in ligand field theory, or the crystal-field splitting parameter in crystal field theory. The splitting parameter is reflected in the ion's electronic and magnetic properties such as its spin state, and optical properties such as its color and absorption spectrum. Ligands arranged on the left end of this spectrochemical series are generally regarded as weaker ligands and cannot cause forcible pairing of electrons within the 3d level, and thus form outer orbital octahedral complexes that are high spin. On the other hand, ligands lying at the right end are stronger ligands and form inner orbital octahedral complexes after forcible pairing of electrons within 3d level and hence are called low spin ligands.

However, it is known that "the spectrochemical series is essentially backwards from what it should be for a reasonable prediction based on the assumptions of crystal field theory."<sup>[3]</sup> This deviation from crystal field theory highlights the weakness of crystal field theory's assumption of purely ionic bonds between metal and ligand.

The order of the spectrochemical series can be derived from the understanding that ligands are frequently classified by their donor or acceptor abilities. Some, like  $\text{NH}_3$ , are  $\sigma$  bond donors only, with no orbitals of appropriate symmetry for  $\pi$  bonding interactions. Bonding by these ligands to metals is relatively simple, using only the  $\sigma$  bonds to create relatively weak interactions. Another example of a  $\sigma$  bonding ligand would be ethylenediamine; however, ethylenediamine has a stronger effect than ammonia, generating a larger ligand field split

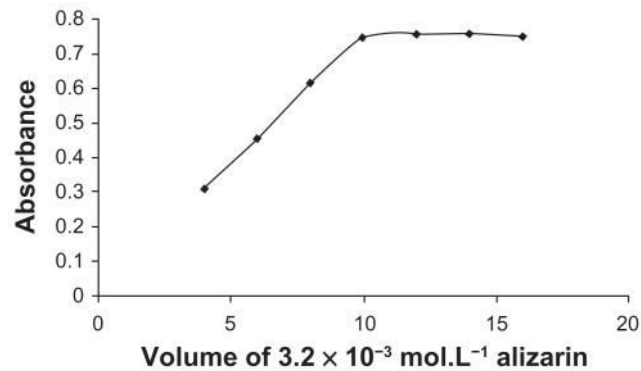
The method, though not of high precision, represents an improvement in sensitivity and in accuracy, within the range covered, over other known methods for the analysis of lead in vegetables growing in effluent coming out from industries. Spectrographic methods for accurate and rapid determination of both high and low antimony contents in solders have been discussed. Porous cup technique was adopted for estimation of high amount of antimony upto 10percent and oxide arc technique was adopted for antimony upto a lower limit of 0'001 percent. Analytical accuracy varied from 3 to 6 percent of the amount present when the concentration of the element to be determined is low. At higher concentration, however, lower values were obtained for both precision and accuracy.[3,4]

Lead occurs naturally in small amounts in all plants . The concentration of lead in vegetation varies not only with the individual species, but also as a complex function of climatic variations, parts of the plant, composition of the soil in which the plant grows and of the rock from which this soil is derived, and finally the effects of artificial contamination of both the water that nourishes the plant and the air that surrounds it. Anomalously high concentrations of lead in plants may reflect natural contamination from lead deposits or artificial contamination of the plant's environment by man.[5,6] Extensive analyses of plants from primitive areas, unaffected by either of these sources of contamination, are required to establish normal background values for lead in natural vegetation. Median concentrations of lead in the ash of uncontaminated natural vegetation are highest for lichens (1 ,000 ppm), an order of magnitude lower in mosses (100 ppm), about 30-50 ppm in evergreen trees, and about 15-30 ppm in deciduous trees, shrubs and grasses; however, all of these types of vegetation exhibit a wide range in lead content (commonly an order of magnitude) on both sides of the median. The ash of uncontaminated domestic fruit and vegetable samples from the United States has a median lead content close to 10 ppm, which is the lower limit of the analytical method. The observed range for lead in the ash of these foods is from vegetables and grasses grown in proximity to major highways, in crops grown on soil with a long history of treatment with lead-bearing insecticides, and in crops exposed to fallout from smelter smoke.[7,8]

## II. DISCUSSION

Lead may be determined in water, soil, and rock, and in the ash of plants and organic fuels by a wide variety of methods. The analytical methods employed for both water and solids in the laboratories of the U.S. Geological Survey include optical emission spectrography and atomic absorption spectrophotometry. In addition, X-ray, spectrographic, and colorimetric methods are employed for the analysis of rock, mineral, and soil samples; electron microprobe analysis of polished ore samples is used for the nondestructive determination of lead in high concentrations in small mineral grains. Water samples are filtered to remove solid particles and are then acidified. In the atomic absorption method a lead-scavenging organic compound is first added to the water and then extracted with an insoluble organic fluid (methyl isobutyl ketone); this fluid is then introduced into the flame of the atomic absorption spectrophotometer. In the emission spectrographic method, lead and other metals are first precipitated by adding a suitable reagent to the water sample. The precipitate is filtered, dried, and introduced into the arc of the emission spectrograph for the simultaneous determination of the metals present. The optical emission spectrograph is the most widely used laboratory tool for chemical analysis of solid samples that do not contain large amounts of organic carbon, because this method provides a simultaneous analysis for a large number of elements on a very small quantity of sample material. In routine operation it will normally determine lead in concentrations as low as 5 ppm. Specific analyses for small traces of lead in such materials are made by the atomic absorption method, which, in routine operation, will give good results for lead in amounts as small as 1 ppm, and, with special sample preparation, this method can be used to detect even smaller amounts. Colorimetric methods with a sensitivity to about 20 ppm of lead are used for rapid field tests in reconnaissance geochemical exploration.[9,10]

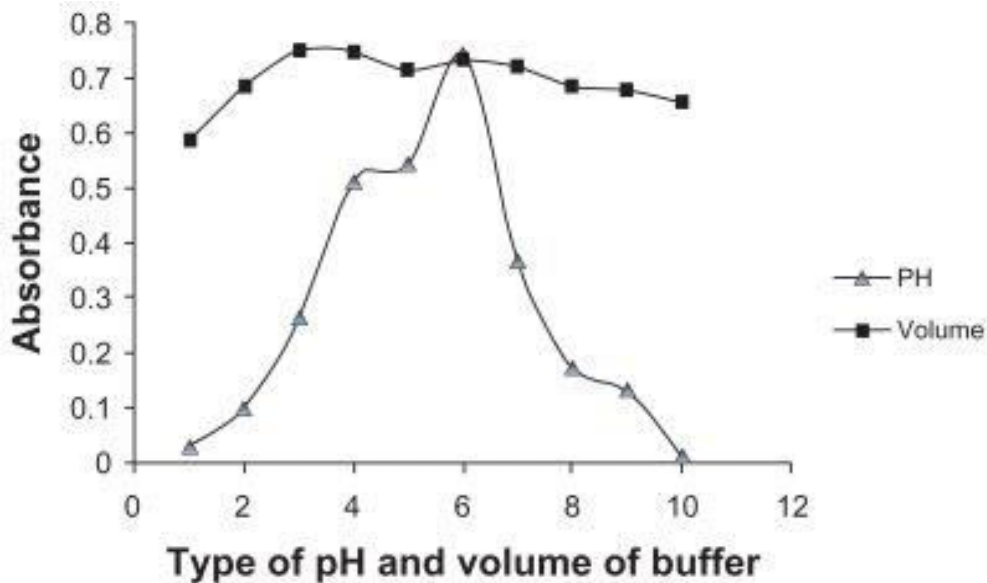
A simple and highly selective method for separation, preconcentration and spectrophotometric determination of extremely low concentrations of lead. It is based on flotation of a complex of Pb(2+) ions and Alizarin yellow between aqueous and n-hexane interface at pH = 6. The proposed procedure is also applied for determination of lead in vegetables growing in industrial wastewater samples. Beer's Law was obeyed over the concentration range of  $3.86 \times 10^{-8}$  To  $8.20 \times 10^{-7}$  molL(-1) ( $8-170$  ngmL(-1)) with an apparent molar absorptivity of  $1.33 \times 10^{(6)}$  molL(-1) cm(-1) for a 100 mL aliquot of these vegetables dried in oven. The detection limit ( $n = 10$ ) was  $8.7 \times 10^{-9}$  molL(-1) ( $1.0$  ngmL(-1)) and the Relative standard deviation (R.S.D), ( $n = 10$ ) for  $7.2 \times 10^{-7}$  molL(-1) ( $150$  ngmL(-1)) of Pb (II) was 4.36%. A notable advantage of the method is that the determination of Pb (II) is free from the interference of almost all cations and ions found in the vegetable and waste water samples. The determination of Pb (II) in these vegetable samples was also carried out by the present method. The results were satisfactorily comparable so that the applicability of the proposed method was confirmed to the real samples.[11]



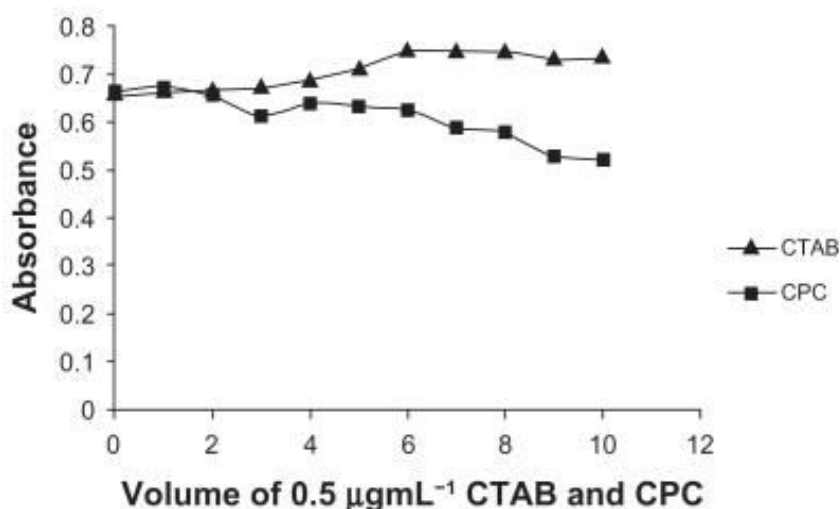
### III. RESULTS

The present study describes a simple and highly selective method for separation, preconcentration and spectrophotometric determination of extremely low concentrations of lead. It is based on flotation of a complex of  $\text{Pb}^{2+}$  ions and Alizarin yellow between aqueous and n-hexane interface at  $\text{pH} = 6$ .

A rapid flotation methodology for zinc(II) separation and enrichment from human biofluids is established. [18,19] At  $\text{pH} 6.0$  and ambient temperature, using oleic acid (HOL) as a foaming reagent, zinc(II) was separated with phenanthraquinone monophenyl thiosemicarbazone (PPT) as a new flotation collector for Zn(II). [12]







A simple and rapid graphite furnace atomic absorption spectrometric (GF-AAS) technique was developed for the determination of lead in these vegetable samples taken from industrial wastewater area.[16,17] The method was evaluated by measuring some of the samples by inductively coupled plasma atomic emission spectrometry. Water and nitric acid extraction were used to determine the easily soluble lead and the total lead in order to evaluate the mobility of lead in the ground. The precision (RSD) of the GF-AAS analysis ranged from 1.1% to 3.2%. The method was tested with determining the lead in the reference materials CANMETC-Pb, PACS-2, and CRM 320. The results obtained were in good agreement with the recommended values. [13]

#### IV. CONCLUSION

Lead has been with mankind almost from the beginning of civilization. Throughout this long journey to the present, this metal has been both angel and demon: in the words of John Emsley (The Elements of Murder, Oxford University Press, Oxford, 2005), "lead is useful, surprising, unpredictable, dangerous - and deadly". The technical, economic and social importance of this metal is, at the present time, beyond all doubt. [14,15] Nevertheless, over the last few decades surprisingly little attention has been pay in specialist literature to its behaviour (the properties and applications of its compounds, the environmental distribution of these derivatives, and their impacts on living creatures). We hope that the present book will bring about a change in this situation. The book covers both "traditional" and recent advances in the field. It is not, strictly speaking, a comprehensive treatise dealing exhaustively with all the topics covered; however, it offers sufficient bibliographic guidance to allow exploration of most of these topics in depth. It includes coverage of historical aspects, lead mining and production, metal properties, common lead compounds, uses of lead and its derivatives, coordination chemistry, organometallic chemistry, etc.[12,13]

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