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# Adsorption of Lead (Pb) from Aqueous Solution using Powdered *Psidium Guajava* (Guava) Leaves as an Adsorbent

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**Abstract***: Guava leaves are economically cheaper. The contamination of water sources with heavy metals, such as lead, poses a significant threat to human health and the environment. The present investigation was carried out with the aim to assess the potential of powdered guava leaves as an effective adsorbent for the removal of lead from aqueous solution. Various factors affecting the adsorption process including concentration of Psidium guajavaleaves and contact time of adsorption process were examined. The result shows that concentration of guava leaves that has good adsorbent was set-up no. 2 with adsorbent dose of 4g. The higher the adsorbent dose, the higher the percentages of lead remove. A contact time of 15 min gas a greater adsorption of lead. Shorter the contact time, the higher the percentage of removal. Thus, there is a significant relationship between contact time and adsorption doses of guava leaves, the greater the absorption doses the higher the percentage remove at a shorter contact time. This revealed that Psidium guajava leaves are promising and eco-friendly and could be an economically method for lead removal in aqueous solutions*

**Keywords:** Adsorption, lead, aqueous solution, *Psidium gaujava*

## I. INTRODUCTION

"Lead (Pb) is a toxic heavy metal known to have severe health implications, even at low concentrations in drinking water. Exposure to lead can result in developmental and neurological disorders, as noted by the study conducted by Senthil Kumar and Gayathri [1]. Such exposure has been associated with conditions like anemia, encephalopathy, hepatitis, and nephritic syndrome, making it a significant concern for public health. In recent years, the prevalence of lead contamination has increased exponentially, reaching alarming levels in its impact on living organisms [2]. The presence of heavy metals in the environment has become a matter of grave concern due to their rising discharge and detrimental effects on aquatic ecosystems. Consequently, the removal of toxic heavy metals, including lead, from aqueous environments has gained considerable attention. These metals are known for their toxicity and carcinogenicity, which can adversely affect various systems within the human body [3].

In recent years, the utilization of natural adsorbents derived from plant materials has gained attention due to their abundant availability and low cost. *Psidium guajava*, commonly known as guava, is a tropical plant known for its rich phytochemical content. The leaves of this plant have been reported to contain compounds with adsorption potential for heavy metals. In this study, powdered Psidium guajava leaves are investigated as potential adsorbent for lead removal from aqueous solutions.

## II. METHODOLOGY

### 2.1 Preparation of Psidium guajava

Guava *Psidium guajava* leaves were collected in Gamuton, Lanuza, Surigao del Sur. Leaves were washed with distilled water, sun dried for three days and oven dried for four minutes at 30°C. Leaves were then ground using mortar and pestle until desired size [4].

**2.2 Preparation of solution (contaminated with PbO)**

Five grams of lead oxide (PbO) was dissolved in eight hundred (800 ml) of water. There were eight 100 ml samples of aqueous solution (contaminated with PbO), four of which were used for set-up A (same amount of *Psidium guajava*) and four were used for set-up B (same contact time).

Prepared adsorbent was added into the aqueous solution while constant stirring. The solution was filtered using filter paper while pouring it gently into empty beaker. Residue was left in the filter. Treated samples were then transferred into empty bottles and send it for laboratory analysis to Davao Analytical Laboratories, Inc.

**2.3 Preparation of Test Solution**

Concentration and percent remove of lead oxide was determined using atomic absorption spectrophotometry. For lead stock solution, 100 ppm was dissolved in 0.1598-g lead nitrate $(PbNO_3)_2$ in a minimum amount of 1 + 1 $HNO_3$ and 10 ml conc $HNO_3$ and was diluted to 1000 ml water.

For lead QC solution, 100 ppm was dissolved in 0.1289-g $PbCO_3$ in 10 ml conc $HNO_3$ and dilute to 1L with 15% $HNO_3$.

One-gram of test sample was dissolved in 10 ml conc. HCl in 150 ml beaker. Solution was then boiled and evaporates nearly to dryness on hot plate without baking the residue. Residue was dissolved again in 20 ml 2M HCl while boiling gently. It was then filtered through a fast paper into 100 ml volumetric flask, washing paper and residue thoroughly with $H_2O$ and was diluted to mark with 0.5M HCl. Solution was then diluted with 0.5M HCl to obtain solutions with ranges of the instrument and directly measure its absorption.

**2.4 Calculations**

Lead (mg/kg) = {[concentration reading × DF × VF] WF} × 10.4

where VF – total volume of the sample diluted (in ml)
DF – dilution factor
WF – weight of sample used (in g)

Lead Oxide (mg/kg) = lead concentration × 1.08

Note: Official methods of analysis of AOAC International. 2000. $17^{th}$ Edition. Vol. I. Ch 2. Pp. 25-26.

For percentage of lead removed, this study used the method provided by Payne et. al (2004) and Meena Soni et. al. (2012)

$$\%\text{ of lead remove} = \left|\frac{initial\ conc - final\ conc}{initial\ conc}\right| \times 100\%$$

## III. RESULTS AND DISCUSSION

Concentration and percentage remove of lead oxide for the same amount *Psidium guajava* with varying time is given in Table 1 below.

Table 1. Percentages of lead remove at constant adsorption doses.

| **No. of Samples** | **Amount of Guava Leaves (g)** | **Contact Time (min)** | **Lead Oxide (PbO)** | |
|---|---|---|---|---|
| | | | Concentration (ppm) | Percentage remove (%) |
| **Control (untreated)** | | | 5812.5 | |
| **1** | 1 | 15 | 44.6 | 99.23 |
| **2** | 1 | 30 | 85.8 | 98.52 |
| **3** | 1 | 60 | 82.7 | 98.57 |
| **4** | 1 | 90 | 163.0 | 97.19 |

The concentration of the untreated (controlled) solution is 5812.5 ppm. First treatment shows to be the most effective removing 99.23% of lead which is numerically higher than the other treatment.

A sudden decrease of percent remove is observed in Table 1. According to Soni et al (2012), a rapid removal is observed at the initial stages and it then proceeds slowly until reached in equilibrium. This is due to the availability of number of vacant adsorption sites at initial stage.

Concentration and percentage remove of lead oxide with varying amount of *Psidium guajava* but time was held constant is given in Table 2 below.

Table 2. Percentages of lead remove at constant time.

| **No. of Samples** | **Contact Time (min)** | **Amount of guava leaves (g)** | **Lead Oxide (PbO)** | |
|---|---|---|---|---|
| | | | Concentration (ppm) | Percentage remove (%) |
| **Control (untreated)** | | | 5812.50 | |
| **1** | 60 | 4 | 37.90 | 99.34 |
| **2** | 60 | 3 | 102.00 | 98.24 |
| **3** | 60 | 2 | 69.90 | 98.79 |
| **4** | 60 | 1 | 81.50 | 98.59 |

First treatment showed to be the most effective removing 99.34% of lead which is numerically higher than the other treatments. In Table 2, sudden decrease of percent remove also at an increasing amount of adsorbent was observed. According to Soni et al (2012), many factors can attribute to this adsorbent concentration effects. One important factor is that adsorption site remains unsaturated during the adsorption reaction. This decrease in the adsorption capacity with increase in adsorbent dose is mainly attributed on saturation of the adsorption site during the adsorption process.

## IV. CONCLUSION

The adsorption of lead (Pb) from aqueous solutions using powdered*Psidium guajava* leaves as an adsorbent has demonstrated its potential as an effective and eco-friendly method for mitigating lead contamination. This study has highlighted the remarkable adsorption capacity of guava leaves, showcasing their ability to efficiently remove lead ions from water sources. The utilization of guava leaves as a natural adsorbent offers a sustainable and cost-effective solution to the pressing issue of heavy metal pollution. Further research and optimization of this method are essential to unlock its full potential and address environmental concerns associated with lead contamination contributing to a cleaner and safer environment.

## V. ACKNOWLEDGMENT

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## REFERENCES

**[1].** P. S. Kumar and R. Gayathri (2009). "Adsorption of Pb2+ Ions from Aqueous Solutions onto Bael Tree Leaf Powder: Isotherms, Kinetics and Thermodynamics Study". Journal of Engineering Science and Technology. Vol. 4 No. 4 p. 381-399

**[2].** V. C. Renge, S. V. Khedkar and S. V. Pande (2012). "Removal of Heavy Metals from Wastewater Using Low-Cost Adsorbents: A Review". Scientific Reviews and Chemical Communications2(4) p. 580-584

**[3].** M. Jaishankar, T. Tseten, N. Anbalagan, B. B. Mathew and K. N. Beeregowda (2014). "Toxicity, Mechanism and Health Effects of Some Heavy Metals". Interdisciplinary Toxicology Vol. 7 (2) p. 60-72

**[4].** S. V. Ashtikar and A. D. Parkhi (2014). "Adsorption of Copper from Aqueous Solution Using Mango Seed Powder". International Journal of Engineering Research and Applications. Vol. 4 (4) p. 75-77

**[5].** N. Azouaoua, M. Belmedanib, H. Mokaddema, and Z. Sadaoui(2013). "Adsorption of Lead from

**[6].** Aqueous Solution onto Untreated Orange Barks". Chemical Engineering Transaction. Vol. 32 p. 55-60

**[7].** Ponnusami, V., Vikram, S. and Srivastava, S. (2007). "Guava *Psidium guajava*Leaf Powder: Novel

**[8].** Adsorbent for Removal of Methylene Blue from Aqueous Solutions". Journal of Hazardous

**[9].** Materials. Vol. 152 No. 1 pp 276-286

**[10].** Soni, M., Sharma, A., Srivastava, J. and Yadav, J. (2012). "Adsorptive Removal of Methylene Blue from an
**[11].** Aqueous Solution using Water Hyacinth Root Powder as a Low-CostAdsorbent". International Journal of Chemical Sciences and Applications, Vol. 3 No. 3 p. 338-345