

[Home](#) > [Journal](#) > [Earth & Environmental Sciences](#) > [JEP](#)
[Indexing](#) | [View Papers](#) | [Aims & Scope](#) | [Editorial Board](#) | [Guideline](#) | [Article Processing Charges](#)
[JEP](#) > Vol.3 No.8, August 2012



An Evaluation of Edible Plant Extracts for the Phytoremediation of Lead Contaminated Water

PDF (Size: 643KB) PP. 722-730 DOI : 10.4236/jep.2012.38086

Author(s)

Lovell Agwaramgbo, Charne Thomas, Chardai GrayS, Jessica Small, Tajeve Young

ABSTRACT

There is a growing global concern for the environmental and health hazards posed by heavy metal contaminants, especially lead in the soil and ground water. The potential for plant and animal uptake, metabolism, and propagation into food-chain poses great health risks. World communities face a common need to a cheap, efficient, and effective technology to mitigate the growing problem of heavy metal contaminations. The present investigation was undertaken to evaluate the potential of using aqueous extracts of edible vegetables and fruits for the in-situ remediation of lead contaminated water (1300 PPM). The plants used in this study include Mustard Green (*Brassica juncea*), Spinach (*Spinacea oleracea*), Collard Green (*Brassica Oleracea*), Bitter leaf (*Vernonia Amygdalina*), Carrot (*Daucus Carota Sativus*), Red, Green, and Yellow Bell Pepper (*Capsicum Annuum*), tomatoes (*Lycopersicon esculentum*), red and white grape (*Vitis vinifera*), and lime (*Citrus aurantifolia*). After shaking triplicate reaction mixtures lead contaminated water with each substrate for 22 hours at room temperature, lead removal by the substrates were analyzed by EPA Method 6010, using Inductively Coupled Plasma-Atomic Emission Spectrometry (ICP-AES). Results suggest that the order of lead removal is Collard Green (99.8%) > Spinach (98.7%) > Mustard Green (98.2%) > Green Bell Pepper (97.8%) > Yellow Bell Pepper (97.75%) > White Grape (96.7%) > Carrot (95.5%) > Red Bell Pepper (94.28%) > Red Grape > 93.5% > Tomatoes (84%) > Bitter Leaf (61%). The study concludes that liquid substrates such as the supernatants from pureed edible tuberous, leafy, and fruity vegetables can effectively remove lead from contaminated water.

KEYWORDS

Heavy Metals; Bioremediation; Lead Remediation; Water Contamination; Phytoremediation

Cite this paper

 L. Agwaramgbo, C. Thomas, C. GrayS, J. Small and T. Young, "An Evaluation of Edible Plant Extracts for the Phytoremediation of Lead Contaminated Water," *Journal of Environmental Protection*, Vol. 3 No. 8, 2012, pp. 722-730. doi: 10.4236/jep.2012.38086.

References

- [1] P. Gottesfeld and C. R. Cherry, "Lead Emissions from Solar Photovoltaic Energy Systems in China and India," *Energy Policy*, Vol. 39, No. 9, 2011, pp. 4939-4946. doi:10.1016/j.enpol.2011.06.021
- [2] P. A. Meyer, M. J. Brown and H. Falk, "Global Approach to Reducing Lead Exposure and Poisoning," *Mutation Research*, Vol. 659, No. 1-2, 2008, pp. 166-175. doi:10.1016/j.mrrev.2008.03.003
- [3] L. J. Fewtrell, A. Pruss-Ustun, P. Landrigan and J. L. Ayuso-Mateos, "Estimating the Global Burden of Disease of Mild Mental Retardation and Cardiovascular Diseases from Environmental Lead Exposure," *Environmental Research*, Vol. 94, No. 2, 2004, pp. 120-133. doi:10.1016/S0013-9351(03)00132-4
- [4] U. Forstner, "Land Contamination by Metals: Global scope and magnitude of problem," In: H. E. Allen, C. P. Huang, G. W. Bailey and A. R. Bowers, Eds., *Metal Speciation and Contamination of Soil*, CRC Press, Boca Raton, 1995, p. 133.
- [5] D. A. Peel, "Environment Research: Is Lead Pollution of the Atmosphere a Global Problem?" *Nature*, Vol. 323, No. 6085, 1986, p. 200. doi:10.1038/323200a0

- [Open Special Issues](#)
- [Published Special Issues](#)
- [Special Issues Guideline](#)

[JEP Subscription](#)
[Most popular papers in JEP](#)
[About JEP News](#)
[Frequently Asked Questions](#)
[Recommend to Peers](#)
[Recommend to Library](#)
[Contact Us](#)

Downloads:	301,550
------------	---------

Visits:	549,951
---------	---------

Sponsors, Associates, and Links >>

- [The International Conference on Pollution and Treatment Technology \(PTT 2013\)](#)

- [6] M. Weitzman, A. Aschengrau, D. Bellinger and R. Jones, "Lead Contaminated Soil Abatement and Urban Children's Blood Lead Levels," *The Journal of the American Medical Association*, Vol. 269, No. 13, 1993, pp. 1647-1654. doi:10.1001/jama.1993.03500130061033
- [7] H. W. Mielke, J. L. Adams, P. L. Reagan and P. W. Mielke Jr., "Soil-Dust Lead and Childhood Lead Exposure as a Function of City Size and Community Traffic Flow: The Case for Lead Contaminated Soil Abatement in Minnesota," In: B. E. Davies and B. G. Wixson, Eds., *Lead in Soil: Issues and Guidelines*, (Suppl 9), *Environmental Geochemistry and Health*, 1989, pp. 253-271.
- [8] T. Sardis, M. K. Chettri, A. Papaioannou, G. Zachariadis, and J. Stratis, "A Study of Metal Distribution from Fuels, using trees as Biological Monitors," *Ecotoxicology and Environmental Safety*, Vol. 48, No. 1, 2001, pp. 27-35. doi:10.1006/eesa.2000.2001
- [9] D. W. Blowes, E. J. Readon, J. L. Jambor and J. A. Cherry, "The Formation and Potential Importance of Cemented Layers in Inactive Sulfide Mine Tailings," *Geochimica Cosmochimica Acta*, Vol. 55, No. 4, 1991, pp. 965-978. doi:10.1016/0016-7037(91)90155-X
- [10] J. Cotter-Howells and I. Thornton, "Sources and Pathways of Environmental Lead to Children in a Derbyshire Mining Village," *Environmental Geochemistry and Health*, Vol. 13, No. 2, 1991, pp. 127-135.
- [11] T. J. Logan and R. L. Chaney, "Utilization of Municipal Wastewater and Sludge on Land: Metals," In: A. L. Page, T. L. Gleason III., J. E. Smith Jr., I. K. Islander and L. E. Sommers, *Proceeding Sponsored by US Environmental Protection Agency, US Army Corps of Engineers, USDA of 1983 Workshop on Utilization of Municipal Wastewater and Sludge on Land*, 1983.
- [12] Q. Y. Ma, T. J. Logan and S. J. Traina, "Lead Immobilization from Aqueous Solutions and Contaminated Soils Using Phosphate Rocks," *Environmental Science and Technology*, Vol. 29, 1995, pp. 1118-1126.
- [13] V. Gounaris, P. R. Anderson and T. M. Holsen, "Characteristics and Environmental Significance of Colloids in Landfill Leachate," *Environmental Science and Technology*, Vol. 27, No. 7, 1993, pp. 1381-1387. doi:10.1021/es00044a013
- [14] R. Chaney and H. Mielke, "Standard for Soil Lead Limitations in the United States, Trace Substance," *Environmental Health*, Vol. 20, 1986, p. 358.
- [15] Alison L Clune¹, Henry Falk¹, MPH, Anne M Riederer¹, "Mapping Global Environmental Lead Poisoning in Children," *Journal of Health Pollution*, Vol. 1, No. 2, 2011, pp. 16-25.
- [16] H. Falk, "International Environmental Health for the Pediatrician: Case Study of Lead Poisoning," *Pediatrics*, Vol. 112, No. 1, 2003, pp. 259-264.
- [17] P. A. Meyer, M. J. Brown and H. Falk, "Global Approach to Reducing Lead Exposure and Poisoning," *Mutation Research*, Vol. 659, No. 1-2, 2008, pp. 166-175. doi:10.1016/j.mrrev.2008.03.003
- [18] L. J. Fewtrell, A. Pruss-Ustun, P. Landrigan and J. L. Ayuso-Mateos, "Estimating the Global Burden of Disease of Mild Mental Retardation and Cardiovascular Diseases from Environmental Lead Exposure," *Environmental Research*, Vol. 94, No. 2, 2004, pp. 120-133. doi:10.1016/S0013-9351(03)00132-4
- [19] M. A. Smith, "Lead in History," In: R. Lansdown and W. Yule, Eds., *The Lead debate: The Environmental Toxicology and Child Health*, Taylor & Francis, London, 1984, pp. 7-24.
- [20] G. W. Goldstein, "Neurological Concepts of Lead Poisoning in Children," *Pediatric Annals*, Vol. 21, No. 6, 1992, pp. 384-388.
- [21] S. Tong, "Lead Exposure and Cognitive Development: Persistence and a Dynamic Pattern," *Journal of Pediatrics and Child Health*, Vol. 34, No. 2, 1998, pp. 114-118.
- [22] M. L. Miranda, K. Dohyeong, M. A. Galeano, C. J. Paul, A. P. Hull and S. P. Morgan, "The Relationship between Early Child Hood Blood Lead Levels and Performance on End-of-Grade Tests," *Environmental Health Perspectives*, Vol. 115, No. 8, 2007, pp. 1242-1247.
- [23] R. L. Canfield, C. R. Henderson Jr., D. A. Cory-Slechta, C. Cox, T. A. Jusko and B. P. Lanphear, "Intellectual Impairment in Children with Blood Lead Concentrations below 10 µg Per Deciliter," *The New England Journal of Medicine*, Vol. 348, 2003, pp. 1517-1526. doi:10.1056/NEJMoa022848
- [24] H. Needleman, C. McFarland, R. Ness, S. Fienberg and M. Tobin, "Bone Lead Levels in Adjudicated

Delinquents: A Case Control Study," *Neurotoxicology and Teratology*, Vol. 24, No. 6, 2003, pp. 711-717.

- [25] R. A. Shih, H. Hu, M. G. Weisskopf and B. S. Schwartz, " Cumulative Lead Dose and Cognitive Function in Adults: A Review of Studies That Measured Both Blood Lead and Bone Lead," *Environmental Health Perspectives*, Vol. 115, No. 3, 2007, pp. 483-492.
- [26] J. L. Lin, D. T. Lin-Tan, K. H. Hsu and C. C. Yu, " Environmental Lead Exposure and Progression of Chronic renal Diseases in Patients without Diabetes," *The New England Journal of Medicine*, Vol. 348, 2003, pp. 277-286.
- [27] V. Medina, S. L. Larson, L. Agwarambo, W. Perez, and L. Escalon, " Treatment of Trinitrotoluene by Crude Plant Extracts," *Chemosphere*, Vol. 55, No. 5, 2004, pp. 725- 732. doi:10.1016/j.chemosphere.200312.014
- [28] L. Agwarambo, " Evaluation of the Fate of RDX in Soils and Plants: Uptake, Transport, Accumulation, Degradation, and Release by Plants" US Army Research Office, Contract # DAAD19-02-D-0001, Battelle, Scientific Services TCN 03-123, 2003.
- [29] V. F. Medina, S. Larson, L. Agwarambo, W. Perez and L. Escaon, " Treatment of Trinitrotoluene by Crude Plant extracts," *Chemosphere*, Vol. 55, No. 5, 2004, pp. 725- 732. doi:10.1016/j.chemosphere.2003.12.014
- [30] N. Merkl, R. Schutze-Kraft and C. Infante, " Assessment of Tropical Grasses and Legumes for the Phytoremediation of Petroleum Contaminated Soils," *Water, Air, and Soil Pollution*, Vol. 165, No. 1-4, 2005, pp. 195-209. doi:10.1007/s11270-005-4979-y
- [31] A. S. Moffat, " Plants Proving Their Worth in Toxic Metal Cleanup," *Science*, Vol. 269, 1995, pp. 302-303. doi:10.1126/science.269.5222.302
- [32] M. M. Lasat, " Phytoextraction of Toxic Metals: A Review of Biological Mechanisms," *Journal of Environmental Quality*, Vol. 31, 2002, pp. 109-120.
- [33] R. D. Armstrong, M. Todd, J. W. Atkinson and K. Scott, " Selective Electrodeposition of Metals from Simulated Waste Solutions," *Journal of Applied Electrochemistry*, Vol. 26, No. 4, 1996, pp. 379-384. doi:10.1007/BF00251322