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Potential Ability of Tea Bag Packaged Shells of *Perna Viridis, Helix Pomatia*, and *Crassostrea Gigas* as Table Water Decontaminating Agent

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Abstract. Water as a basic commodity must be free from harmful contaminants. Heavy metals are part of the chemicals that pollute water bodies and thus drinking water. Lead and cadmium are two metals found in Manila, Philippines' water and should then be eliminated from it. In general, this study aimed to determine the potential ability of tea bag packaged shells of *Perna viridis, Helix pomatia, and Crassostrea gigas* in decontaminating simulated contaminated drinking water. Specifically, it aimed to obtain the trend in removal of lead and cadmium from the simulated water that the said tea bag packaged shells will achieve. Further, this study aimed to determine if the kind of shells and concentration of heavy metals in the simulated water affect the removal potential of the waste materials. After pre-treatment of the varied shell wastes, these were added to the simulated contaminated water with different concentrations of lead and cadmium. The treated and untreated samples were acid digested and analyzed for heavy metal content using Atomic Absorption Spectrophotometry. This study showed that the varied shells have the ability to remove lead and cadmium from simulated contaminated water. There was a general declining trend of heavy metal percent removal by the different shell wastes used with increasing concentration of heavy metals in the simulated water samples. From the results of two way ANOVA, the percent removal of heavy metals from simulated water samples were shown to be affected by type of shells used, heavy metal concentration of the water sample and interaction between the two.

Keywords: Perna viridis, Helix pomatia, Crassostrea gigas, Water, Lead, Cadmium, AAS

1. Introduction

1.1. Background of the Study

Water is a basic need. It is needed by biologic systems to survive. Frequent use of contaminated water will definitely endanger the health of man and other living organisms. Manila, Philippines' water including tap, deepwell, Baywalk and restaurant drinking water were found to exceed the allowable limits set by EPA [1,2]. Shell wastes coming from *Perna viridis , Helix pomatia, and Crassostrea gigas* or tahong, kuhol, talaba respectively*,* in its crude form have been proven to remove heavy metals from simulated and actual community water [3,4]. The proposed mechanism for the interaction of lead with the shells is based on complexation reaction [5].

Heavy metals are hard to biodegrade and thus stays long in the environment. Lead attacks the bone marrows, the peripheral and central nervous systems on chronic exposure.It is readily absorbed through inhalation. Organic lead compounds are also absorbed dermally. Adults, absorb around 20-30% of the heavy metal on ingestion while children absorb up to 50% [6]. Cadmium was once an environmental toxicant in Japan that resulted to itai-itai (ouch-ouch), a disease characterized by severe arthralgia and osteomalacia in middle-aged, postmenopausal women with low calcium and vitamin D intake. Cadmium attacks the kidneys

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particularly chronic poisoning, lungs on acute inhalation and the gastrointestinal tract on acute ingestion [6,7].About 25% and 5% cadmium is absorbed by inhalation and ingestion, respectively. It is not well absorbed dermally (0.5%) [6,8,9]. Cadmium is classified as a human carcinogen by the National Institute for Occupational Safety and Health (NIOSH) [10].

1.2. Objectives

In general, this study aimed to determine the potential ability of tea bag packaged shells of *Perna viridis, Helix pomatia, and Crassostrea gigas* in decontaminating simulated contaminated drinking water.Specifically , it aimed to obtain the trend in removal of lead and cadmium from the simulated water that the said tea bag packaged shells will achieve. Further, this study aimed to determine if the kind of shells and concentration of heavy metals in the simulated water affects the removal potential of the waste materials.

1.3. Hypotheses

The following were the working null hypotheses employed in the study:

Ho1: There is no significant difference in the removal of lead and cadmium amongst varied shell wastes

Ho2: There is no significant difference in the removal of lead and cadmium relative to varied heavy metal concentrations of the simulated water

H03: There is no significant difference in the removal of lead and cadmium relative to interaction between shell type and heavy metal concentration in simulated water.

1.4. Scope and Limitation

This research determined the ability of shells of *Perna viridis, Helix pomatia, and Crassostrea gigas* to remove lead and cadmium from simulated contaminated water only. The concentrations of lead and cadmium were placed at 10%, 30% and 50% solutions only. The pH of the solution was maintained only at 4. The length of tea bag use in the contaminated water was limited to 30 minutes. Sterile gauze and thread were used to create the tea bags where 10g of pretreated shells were placed. These were used for every 100 ml of contaminated water.

1.5. Significance of the Study

Results of this study will hopefully aide in the quick decontamination even of table water particularly in the community. This will prove that wastes from shell foods have potential in cleaning polluted water. Its use will be beneficial not only to public health but also to the deteriorating environment. Researches on other potentials of other biodegradable waste products are envisioned to be catalyzed.

2. Methodology

2.1. Research Design

This study followed the experimental research design. Pre-tests and post-tests were conducted in order to determine the heavy metal removing ability of tea bag packaged shells of *Perna viridis, Helix pomatia, and Crassostrea gigas* in simulated contaminated water samples.

2.2. Locale of the Study

The shell samples were collected from Cavite, Philippines. These were prepared, stored and analyzed in Manila, Philippines.

2.3. Sample Collection and Preparation

The shell wastes were collected from Cavite, Philippines. These were washed with distilled water, dried with clean towel, pulverized and pre-treated with 10% sodium hydroxide, 10 % hydrochloric acid and 1% sodium hypochlorite. The shells were washed with distilled water until neutral [11].

2.4. Decontamination of Simulated Water

To 10%, 30% and 50% lead and cadmium solutions, 100mL were withdrawn from each concentration. Tea bag packaged shells of *Perna viridis, Helix pomatia, and Crassostrea gigas,* each containing 10g, were submerged in the simulated water for 30 minutes. This was the decontaminating treatment done to the simulated water.

2.5. Instrumental Analysis

Both the filtered treated and untreated simulated water were acid digested [12]. The resulting digested samples were subjected to Atomic Absorption Spectrophotometry.

2.6. Statistical Analysis

Both descriptive and inferential statistics were used. Two way ANOVA was utilized to determine the significant difference, if any, of the removal of heavy metals from the water samples among shells, concentration of heavy metals in the simulated contaminated water preparations or the interaction of shells and concentration.

3. Results and Discussion

The untreated simulated contaminated water samples prepared in the laboratory with 10%, 30% and 50% heavy metal concentrations showed near perfect correlation coefficients (Table1). For lead the value is at 0.9864 while for cadmium it is at 0.999. The same was used for standard calibration curve of AAS.

Kuhol, Talaba, Tahong showed the highest ability to remove lead from 10%, 30% and 50% simulated lead contaminated water respectively. Tahong showed the highest ability to remove cadmium at 10%, while at both 30% and 50% simulated cadmium contaminated water samples, kuhol showed the highest ability to remove cadmium. The differences between the amounts of the untreated and the treated simulated water samples were taken as the amount of heavy metals removed by the different shells using the proposed complexation reaction. There was a general declining trend of heavy metal removal by the different shell wastes used especially upon reaching the 50% concentration of heavy metals in the simulated water samples (Tables 4 and 5). It may be because the surface area of the pre-treated shells can only accommodate enough heavy metals in its system. The available interaction areas may become saturated with increasing metal concentration resulting in decreased efficiency of heavy metal removal by the shells.

Table 1: Concentration of lead and cadmium (ppm) in untreated simulated contaminated water

Untreated water	10%Heavy Metal	30% Heavy Metal	50% Heavy Metal	Correlation Coeffecient
Lead	8.073+/-0.0017	33.854+/-0.0013	48.073+/-0.0041	r= 0.9864
Cadmium	9.8578+/-0.0016	30.2845+/-0.0024	49.8578+/-0.0068	r=0.999

The amounts of lead and cadmium in the simulated contaminated water samples decreased with the use of tea bag packaged shells of *Perna viridis, Helix pomatia, and Crassostrea gigas* or tahong, kuhol, talaba, respectively (Tables 2 and 3).

Table 2: Concentration of Lead (ppm) in simulated water samples after treatment with shells

Treated water	10% Lead	30% Lead	50% Lead
Kuhol	0.0888+/-0.0022	26.9352+/-0.0017	43.9033+/-0.0012
Talaba	3.2242+/-0.0008	12.8699+/-0.0008	38.7734+/-0.0023
Tahong	0.3221+/-0.0010	22.8313+/-0.0026	27.4087+/-0.0041

Table 3: Concentration of cadmium (ppm) in simulater water samples after treatment with shells

Treated water	10% Cadmium	30% Cadmium	50% Cadmium
Kuhol	4.0135+/-0.0018	6.3442+/-0.0012	26.3442+/-0.0014
Talaba	4.2411+/-0.0016	16.9132+/-0.0036	39.2176+/-0.0034
Tahong	3.3345+/-0.0004	10.0996+/-0.0041	32.3898+/-0.0049

Table 4: Percent removal of lead from simulated water by shells

Percent removal	10% Lead	30% Lead	50% Lead
Kuhol	98.90%	20.44%	8.67%
Talaba	60.06%	61.98%%	19.34%
Tahong	96.01%	32.56%	42.98%

Table 5: Percent removal of cadmium from simulated water by shells

Percent removal	10% Cadmium	30% Cadmium	50% Cadmium
Kuhol	59.29%	79.05%	47.16%
Talaba	56.98%	44.15%	21.34%
Tahong	66.17%	66.65%	35.04

By using two way ANOVA, it showed that there is statistically significant difference among varied shell wastes and the removal of heavy metals from the simulated water samples. There is also significant difference in the removal of heavy metals by the shells using varied amounts of heavy metals in the simulated water. Further there is also significant difference in the removal of heavy metals with interaction among varied shell wastes and heavy metal concentrations in the water samples analyzed (Tables 6 and 7).The percent removal of heavy metals from simulated water samples were affected then by type of shells used, heavy metal concentration of the water sample and interaction between the two.

4. Conclusions and Recommendations

The results of the study showed that tea bag packaged shells of *Perna viridis, Helx pomatia, and Crassostrea giga* have the ability to remove lead and cadmium from simulated contaminated water. There was a general declining trend of heavy metal percent removal by the different shell wastes used with increasing concentration of heavy metals in the simulated water samples. There is statistically significant difference among varied shell wastes and the removal of heavy metals from the simulated water samples. There is also significant difference in the removal of heavy metals by the shells using varied amounts of heavy metals in the simulated water. Further there is also significant difference in the removal of heavy metals with interaction among varied shell wastes and heavy metal concentrations in the water samples analyzed. The percent removal of heavy metals from simulated water samples were affected then by type of shells used, heavy metal concentration of the water sample and interaction between the two.

Actual Manila, Philippines' water is recommended to be tested using the tea bag packaged shells to ascertain its applicability to actual scenario. Other biodegradable wastes must be studied for future collaborative use with the present shell wastes studied. Microbiological assay should be performed to assess the water safety after the proposed heavy metal removing treatment.

Table 6: Results of Two Way ANOVA for Lead

Source	SS	df	MS	F	P
Rows	231.33	2	115.67	1519.69	<0.0001
Columns	5687.67	2	2843.84	37364.26	<0.0001
r x c	536.68	4	134.17	1762.82	<0.0001
Error	1.37	18	0.08		
Total	6457.05	26			

Table 7: Results of Two Way ANOVA for Cadmium

Source	SS	df	MS	F	P
Rows	284.93	2	142.47	3827.42	<0.0001
Columns	4034.78	2	2017.39	54198.54	<0.0001
r x c	137.39	4	34.35	922.77	<0.0001
Error	0.67	18	0.04		
Total	4457.77	26			

5. References

[1] JN Solidum, VR Dahilig, A Omran. Lead Levels of Water Sources in Manila, Philippines. *International Journal of Engineering.* 2010, 8(2): 111-118.

[2] J. Solidum. Lead and cadmium levels in shell foods, raw vegetables, restaurant drinking water in Metro Manila, Philippines. *International Journal of Chemical and Environmental Engineering*. 2011, 2(4): 234-237.

[3] JN Solidum, Z Llarena. Ability of Tahnong (Perna viridis), Kuhol (Helix pomatia) and Talaba (Crassostrea gigas) to de-Lead Simualted Waste Water Preparation. *In Book of Proceedings IEEE Bioinformatics and Biomedical Engineering, Environmental Pollution and Public Health* Wuhan China, May 10-12, 2011.

[4] JN Solidum, G. Solidum. Assessment and Remediation of Heavy Metals in Community Tap Water from Manila, Philippines. *In Book of Proceedings IPCBEE International Conference on Environment Science and Engieering* Bangkok. Thailand. 2012, volume 32: 1-6..

[5] D. Zhou, L. Zhang, S. Guo. Mechanisms of lead absorption on cellulose/chitin beads. *Water Research*. 2005: 39(16);3755-3762.

[6] RC Dart,ed.*MedicalToxicology*,3rdedition.USA:Lippincott Williams and Wilkins, 1411-1414 , 2004.

[7] CG Elinder, Cadmium: uses, occurrence and intake. *In Cadmium and health: a toxicological and epidemiological appraisal. Vol. I, Exposure, dose, and metabolism.Effects and response*. Boca, Raton, FL:CRC Press pp23-64, 1985.

[8] R Guy,JJ Hostynek, RS Hinz and CR Lorence. *Metals and the skin: topical effects and systemic Absorption*. New York, New York.1999.

[9] T.Kjellstrom, K. Borg, B.Lind. Cadmium in feces as an estimate of daily cadmium intake in Sweden. *Environ Res* 1978, 15:242-251.

[10] www.http://hc-sc.gc.ca/cps- spc/legislation/.../metal- metauxconsult- eng.ph

[11] http://www.plasticstrends.net-Plastic Trends Net

[12] L.Prester. Decomposition of Fish Samples for Determination of Mercury. *Arh high rada toksikol*, 1998,49(4),343- 348.