Safety of Children from Lead in Packaged Snacks, Fruit Juices and Distilled Water Marketed in Manila, Philippines

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Abstract—**The safety of Filipino children from contaminants is of primary importance since they hold the future of the Philippines. They must be safeguarded from hazards that will affect their mental and physical health. Lead contamination can result to an array of adverse effects particularly neurologic dysfunction. This contaminant must be monitored and removed from its sources. In general, this study aimed to determine the presence or absence of heavy metal lead in packaged snacks, powdered fruit juices and distilled water. Specifically this study aimed to determine the actual concentration in parts per million (ppm) of lead in the consumer products analyzed. It was also aimed to compare the values with allowable safety standard limits set by United States Environmental Protection Agency (EPA) and Agency for Toxic Substances and Disease Registry (ATSDR) . Further, blood levels in children were aimed to be computed based on the obtained concentrations of lead in the samples tested. Results of this study showed the presence of heavy metal lead in packaged snacks, powdered fruit juices and distilled water. For snack goods all samples except PSG10 went above the allowed safety limit of lead in food at 0.5ppm and projected blood levels at 10ug/dL. For powdered fruit juices, none went above the allowed safety limit of lead in food at 0.5ppm. PFJ2,5 and 7 went a little beyond the safe projected blood level of 10ug/dL while the rest went below it. All distilled water samples analyzed went above the allowed safety limit for lead at 0.015ppm. All projected blood levels went above the safe limits except for BDW8.**

Index Terms—**Distilled water, Fruit juices, Lead, Packaged snacks.**

I. Introduction

A. Background of the Study

Lead is an important component of many processes. It is also used in so many products. Lead is used in primers and explosives as azides [1]. It was used as gasoline additive, tetraethyl and tetramethyl lead [2]. It was found in the United States in paint, soil, dust, food, water, cosmetics, toys, art materials and hobby material [3]. In the Philippines, lead was found in tap, deep well, Baywalk water[4]; street foods [5], vegetables, shell foods [6], candies [7], cosmetics [8], soil, air, plants and blood [9].

Heavy metal is hard to biodegrade and thus stays long in the environment. Lead attacks the bone marrows, and the peripheral and central nervous systems on chronic exposure. It causes neurologic deficit. .It is readily absorbed through inhalation. Organic lead compounds are also absorbed via the skin. Adults, absorb around 20-30% of the heavy metal on ingestion while children absorb up to 50% [10] Exposure then of children to lead may cause pronounced adverse effects.

In the Philippine Presidential Decree No. 603 of December 10, 1974 it was stated in the declaration of policy that the child is the most important asset of the nation. Every effort should be exerted to promote his welfare and enhance his opportunities for a useful and happy life. Further in Article 3 dubbed as the rights of a child, section 8 and 9 it states that every child has the right to protection against exploitation, improper influences, hazards and other conditions or circumstances prejudicial to his physical, mental, emotional, social and moral development. Every child has the right to live in a community and a society that can offer him an environment free from pernicious influences and conducive to the promotion of his health and the cultivation of his desirable traits and attributes [11]

Lead contaminations in packaged snacks, fruit juices and distilled water may seriously affect the Filipino children. These consumer products are a few of those that children frequently ingest. It is by determining the exact amount of lead in the mentioned goods can appropriate measures be taken to protect the rights of the young generation to good health.

B. Objectives of the Study

In general, this study aimed to determine the presence or absence of heavy metal lead in packaged snacks, powdered fruit juices and distilled water. Specifically this study aimed to determine the actual concentration in parts per million (ppm) of lead in the consumer products analyzed. It was also aimed to compare the values with allowable safety standard limits set by United States Environmental Protection Agency (EPA) and Agency for Toxic Substances and Disease Registry (ATSDR) . Further, blood levels in children were aimed to be computed based on the obtained concentrations of lead in the samples tested.

C. Scope and Limitation

This study dealt only with ten samples each of packaged snacks, powdered fruit juices and distilled water. Only the heavy metal lead was analyzed in the collected consumer products. Atomic Absorption Spectroscopy (AAS) was used as instrumental analysis. Blood levels where obtained only as projected from the concentrations determined from the samples analyzed.

D. Significance of the Study

The results of this study will inform the public of the state of the selected consumer products in the market with respect to lead as contaminant. With such knowledge, the public will be able to choose for their health more intelligently. The Presidential decree no. 603 will be validated on the

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accuracy of its implementation using the results of this research. Strengthening of the decree for the improvement of children's health is the move being foreseen on the part of the government.

II. Methodology

A. Research Design

This research used descriptive, exploratory design. The concentration of lead in packaged snacks, powdered fruit juices and distilled water were explored using quantitative analysis through AAS. The lead content of the consumer products were compared with allowable standard limits of food and water given by US EPA and ATSDR, respectively.

B. Locale of the Study

The collection of the samples were performed in different supermarkets and stores in Metro Manila, Philippines. The samples were prepared at the University of the Philippines, Manila. These were analyzed using AAS at Chemistry Instrumentation Laboratory, Dela Salle Univerity, Manila, Philippines.

C. Sample Collection

Purposive sampling was employed. Ten different popular brands of packaged snacks, powdered fruit juices and distilled water were bought from supermarkets and stores in Metro Manila, Philippines. The samples prior to preparation for analysis were stored in cool, dry place at the University of the Philippines, Manila.

D. Solid Sample Preparation

To 5 g of the each sample, 10 mL nitric acid was added. These were left overnight for pre-digestion. The samples were then heated using a water bath maintained at 80-100°C for 5 hours, cooled, filtered and filled with distilled water to volume in a 50 mL volumetric flask. The samples were transferred and stored in PET bottles prior to AAS [12].

E. Liquid Sample Preparation

One hundred mL of the filtrate was collected in a beaker. Five mL of concentrated fuming nitric acid was added to the filtrate and the resulting solution was immediatel y covered with a watch glass. Samples were heated in a hotplate and evaporated to 50 mL without boiling. When the volume was reduced to half, the sides of the beaker and the watch glass were washed with freshly distilled water and then 3 mL of nitric acid were added to the solution. The samples were heated again and evaporated to around 40 mL. When the samples have cooled down, they were filtered again using #2 Whatman filter paper. The filter paper was washed around the funnel three times and the washings were collected in 50 mL volumetric flask. Samples were diluted to volume using distilled water and transferred to a high density oly eth ylene container and was analyzed using Flameless Atomic Absorption Spectroscopy. [adapted from 12].

F. Instrumental Analysis

The lead content of the samples was analyzed using AAS-6300, Shimadzu, France) controlled by a personal computer using WizAArd software. Measurements were carried out at 217.0 nm with 0.7 nm low slit and 5 mA electric current. Prior to analysis, the spectrophotometer was calibrated with standard lead solutions (0.05, 0.1, 0.50, 1.00, and 5.00 ppm for the plant samples) using distilled water as blank. The standard solutions and distilled water were provided by the Chemistry Instrumentation Laboratory of the De La Salle University, Taft Avenue, Manila. Lead concentration levels were expressed in mg/kg unit.

G. Data Analysis

The data obtained were analyzed in comparison with the Allowable Standard Limits set by US EPA and ATSDR to water and food respectively. The blood lead levels were projected based on the 50% absorption capability of children for lead. The starting amounts were based on the determined actual lead concentration in the samples studied.

TABLE I: Mean Concentrations (ppm) of Lead in Ten Packaged Snack Goods

Packaged Snack Goods (PSG)	Mean concentration (ppm)	Projected Blood level (ug/dL)
PSG1	0.9572+/-0.0002	47.86
PSG2	0.9932+/-0.0008	49.66
PSG3	1.0113+/-0.0006	50.565
PSG4	1.0293+/-0.0001	51.465
PSG5	1.0293+/-0.0006	51.465
PSG6	1.0563+/-0.0005	52.815
PSG7	1.0653+/-0.0005	53.265
PSG8	0.8852+/-0.0006	44.2605
PSG9	0.9392+/-0.0024	46.96
PSG10	0.1289+/-0.0003	6.445

TABLE II: Mean Lead Concentration (PPM) in Powdered Fruit Juices

Powdered Fruit Juices (PFJ)	Mean Concentration (ppm)	Mean Concentration (ug/dL)
PFJ1	0.1266+/-0.0002	6.33
PFJ2	0.2025+/-0.0009	10.125
PFJ3	0.1316+/-0.0002	6.58
PFJ4	0.1721+/-0.0003	8.605
PFJ5	0.2075+/-0.0007	10.375
PFJ6	0.1772+/-0.0011	8.86
PFJ7	0.2075+/-0.0004	10.375
PFJ8	0.1063+/-0.0001	5.315
PFJ9	0.0911+/-0.0005	4.555
PFJ10	0.0759+/-0.0001	3.795

III. Results and Discussion

At 0.5ppm which is the allowable standard limit of lead in food [13],all packaged snack goods are considered unsafe except for PSG 10(Table I). The lowest amount of lead was obtained from sample labeled PSG10, while the highest from PSG7.Provided that the physiologic condition of a child is normal, at 50% absorption only PSG10 has a blood level below the unsafe 10ug/dL concentration, as disseminated by the Center for Disease Control.

For the powdered fruit juices, none went above the allowable set limit of 0.5ppm for lead. Samples PFJ 10 and PFJ 7 showed the lowest and the highest lead level in powdered fruit juices, respectively. Majority of the projected blood levels for children did not exceed the safe 10ug/dL as well. Only samples PFJ 2,PFJ 5 and PFJ 10 exceeded the safety level for projected blood concentration (Table II). Since powdered fruit juices must be dissolved in distilled water, lead contamination may increase. It is shown that all brands of distilled water tested went above the allowable set limit of 0.015ppm. As a result the projected blood lead levels in children also went above the safe limit set at 10ug/dL except for sample BDW 8 (Table III)

The projected amount of lead in the blood, when it exceeds 10ug/dL could bring about adverse effects to the body. Chelation therapy should start when the blood level of lead reaches 40 ug/dL [10]

TABLE III: MEAN LEAD CONCENTRATION (PPM) IN BRANDED DISTILLED WATER

Branded Distilled Water (BDW)	Mean Concentration (ppm)	Mean Concentration (ug/dL)
BDW1	0.2009+/-0.0006	10.045
BDW2	0.2549+/-0.0003	12.745
BDW3	0.2459+/-0.0005	12.295
BDW4	0.2009+/-0.0008	10.045
BDW5	0.2549+/-0.0003	12.745
BDW6	0.2639+/-0.0010	13.195
BDW7	0.3180+/-0.0005	15.9
BDW8	0.1919+/-0.0004	9.595
BDW9	0.2909+/-0.0007	14.545
BDW10	0.2819+/-0.0010	14.095

IV. CONCLUSIONS

Results of this study showed the presence of heavy metal lead in packaged snacks, powdered fruit juices and distilled water. For snack goods the lowest concentration in parts per million (ppm) of lead is at 0.1289+/-0.0003 while the highest is at 1.0653+/-0.0005ppm. All samples except PSG10 went above the allowed safety limit of lead in food at 0.5ppm and projected blood levels at 10ug/dL. For powdered fruit juices, the lowest and highest amounts were shown to be at 0.0759+/-0.0001ppm and 0.2075+/-0.0007ppm, respectively. None of these samples went above the allowed safety limit of lead in food at 0.5ppm. PFJ2,5 and 7 went a little beyond the safe projected blood level of 10ug/dL while the rest went below it. Distilledwater samples analyzed went above the allowed safe limit for lead at 0.015ppm. All went above the safety projected blood levels except for BDW8. The samples had values from 0.1919+/-0.0004ppm to 0.3180+/-0.0005 ppm.

V. RECOMMENDATIONS

An increased number of brands of snack goods, powdered fruit juices and branded distilled water should be studied for better monitoring of consumer good integrity. Actual blood samples of children must be withdrawn from volunteers and analyzed. Correlation between blood samples and actual amount of consumed products must be performed to validate the projection done in this study. Policies related to consumer good contaminants must be put in place and implemented to prevent endangering the health of Filipino children.

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