International journal of
adulteration

To Cite:
Okeke OR, Ebere CU. Heavy metal deposits in toilet tissues sold in markets within Enugu metropolis, Enugu State. *International journal of adulteration*, 2024; 8: e5ijad3049
doi: https://doi.org/10.54905/disssi.v8i9.e5ijad3049

Author Affiliation:
[1]Plastic production Unit, Scientific Equipment Development Institute, Akwuke – Enugu State, Nigeria
[2]Department of Microbiology, Federal University of Health Sciences, Ila-Orangun, Osun State, Nigeria

Peer-Review History
Received: 04 August 2024
Reviewed & Revised: 08/August/2024 to 11/November/2024
Accepted: 15 November 2024
Published: 19 November 2024

Peer-Review Model
External peer-review was done through double-blind method.

International journal of adulteration
eISSN (Online) 2456 – 0294

DISCOVERY
SCIENTIFIC SOCIETY

Heavy metal deposits in toilet tissues sold in markets within Enugu metropolis, Enugu State

Okeke OR[1], **Ebere CU**[2]

ABSTRACT

Studies were carried out to assess the deposits of selected heavy metals (Pb and Cd) in toilet tissues sold in markets within Enugu metropolis, Enugu State using standard analytical procedures and instrumentation. The samples underwent digestion and, were subsequently analyzed for heavy metals using atomic absorption spectrophotometer, Toilet tissue samples A, B, C and D had mean Pb values of 0.121±0.071, 0.258±0.040. 0.205±0.076 and 0.302±0.014 µg/g respectively. The mean Cd levels in the toilet tissue samples A, B, C and D were 0.062±0.022. 0.037±0.008, 0.097±0.005 and 0.012±0.002µg/g respectively. The mean values of the investigated heavy metals were statistically significant in the studied toilet tissue samples. The toilet tissue samples, whether of high quality or low quality, poorly packaged or well packaged, had mean values of the studied metals within the recommended threshold limits.

Keywords: Heavy metals, Toilet tissues and Heavy metal contamination

1. INTRODUCTION

Toilet tissue is a soft paper product, usually discarded after use and made for an individual's hygiene and sanitation purposes. According to Paulapuro, (2000) a toilet tissue is usually produced from recycled paper pulp using a paper machine. A mixture of hardwood and softwood from pines, oak, maple bamboo, birch and eucalyptus have been extensively used in making toilet tissue (NRDC, 2020). According to Masternak-Janus and Rybaczewska-Blazejowska, (2015), wood pulp paper has a soft texture that leaves the user with a calming, comfortable and splendid experience. To produce a quality tissue paper from wood pulp, certain chemicals such as wetting and bleaching agents are added in order to give the product a brilliantly white appearance (Outhman and Lamma, 2020). Paulapuro, (2000) stated that its key characteristics include good absorbency, light weight, good thickness, brightness, good stretch, great appearance and comfort.

After water and food, toilet tissue is probably the third most important product used by people of all ages and classes to improve their personal hygiene because of its availability, affordability and near zero licensing of its production,

especially in many developing economies like Nigeria. According to NRDC, (2020), an average family of four consumes approximately a tree and half worth of toilet tissue in a year, in order to maintain a healthy hygiene. However, woods from which toilet tissue are produced, grows in different environments with varying levels of anthropogenic activities. Trees that grow in an environment contaminated with heavy metals would not be immune to the absorption and accumulation of heavy metals in its body parts for as long as possible. According to Okeke et al., (2020a), Aniobi et al., (2021), Aniobi et al., (2023a), Aniobi et al., (2024), soils contaminated with heavy metals provide the greatest source of exposure of plants to heavy metals through their roots.

For as long as the sources of exposure of plants to heavy metals are not remediated or controlled, it continues to bioaccumulate these environmental pollutant into its body parts for many years. Because heavy metals cannot be sequestrated from any system and therefore non-biodegradable, bioaccumulates and biomagnifies in a given environment for as long as the source (s) of exposure is sustained (Okeke et al., 2018a; Ezeh et al., 2019; Okeke et al., 2020a; Ezeagwu et al., 2023). Since heavy metals belong to the group of environmental toxicants considered as persistent environmental pollutants, any source of its exposure to man, especially at a consistent level is usually a grave concern to environmentalists and health regulatory authorities. According to Tomasevic et al., (2004), Okeke et al., (2018a), Ezeh et al., (2018), Aniobi et al., (2023a), people can be exposed to heavy metals through dermal contact, food, air and water.

Toilet tissues obtained from trees contaminated with heavy metals, would invariably transfers some of it dermally to tissue users, thereby increasing unduly, the body's heavy metal load. Within Enugu metropolis, both high, moderate and low-quality toilet tissues are manufactured and sold without any regulation to the source(s) of the wood pulps and other chemical agents used in the production process. It was based on the above scenario and the unchecked anthropogenic activities that spew environmental contaminants into our environment and also, the health dangers associated with being exposed to heavy metals through daily used products such as toilet tissues that necessitated this research.

2. MATERIALS AND METHODS

Sample collection and preparation

The toilet tissue samples were purchased from supermarkets and open stores within the metropolis. The samples were purchased at different prices based on their quality and packaging make-up. For ease of identification, tissue samples purchased at #500, #400, #200 and #100 were denoted as samples A, B, C and D respectively.

Heavy metal analysis

As described by Aniobi et al., (2023b), Ezeagwu et al., (2023), 4g of each of the sample was weighed into a 250ml beaker containing about 5ml of Conc. HNO_3 and $HClO_4$ in the ratio of 3:2. The digestion temperature was raised up to 150oC and it lasted for 4hr. The digestion procedure was deemed complete at the evolution of white fumes. The sample digest was allowed to cool and subsequently diluted with de-ionized water and filtered into 50ml volumetric flask using Whatman filter paper. The filtrate was made up to mark with de-ionized water. Each of the samples was subjected to triplicate digestion procedure, together with reagent and were kept in the refrigerator until heavy metal analysis. The samples were analyzed for the presence of Pb and Cd using Hitachi Z- 5000 flame atomic absorption spectrophotometer (AAS). Quality control measures was adopted to reduce metal contamination and ensure the reliability of the results.

Statistical analysis

The data obtained were expressed in mean ± standard deviation and subjected to one way analysis of variance (ANOVA) at 5% confidence level using IBM SPSS 23.0.

3. RESULTS AND DISCUSSION

Lead

The result of Table 1 shows that the mean Pb values in the toilet tissue samples A, B, C and D were 0.121±0.071, 0.258±0.040, 0.205±0.076 and 0.302±0.014μg/g respectively. Recall that the samples A, B, C and D were purchased at #500, #400, #200 and #100 respectively, which resulted from the nature of their packaging and quality of the issue paper in terms of absorbency, thickness and stretch. Therefore, it was observed from the result of Table 1 that the cost of the purchase and overall quality of the tissue samples did not

significantly affect their Pb levels. The mean Pb levels decreased in the tissue samples in the following order; D > B > C >A as shown in (Figure 1). Further interpretation of the above statement can be found in Figure 1, in which sample D (sold at #100) had the tallest peak chart of mean Pb value, followed by tissue sample B (sold at #400), sample C (sold at #200) and the lowest Pb chart value was sample A (sold at #500).

Table 1 Mean heavy metal deposits in the toilet tissue samples sold in markets within Enugu metropolis.

Sample Metal(µg/g)	A	B	C	D	F test P value	WHO STD (WHO, 2014)
Pb	0.121± 0.071	0.258±0.040	0.205±0.076	0.302±0.014	0.01	0.5
Cd	0.062±0.022	0.037±0.008	0.097±0.005	0.012±0.002	0.01	0.5

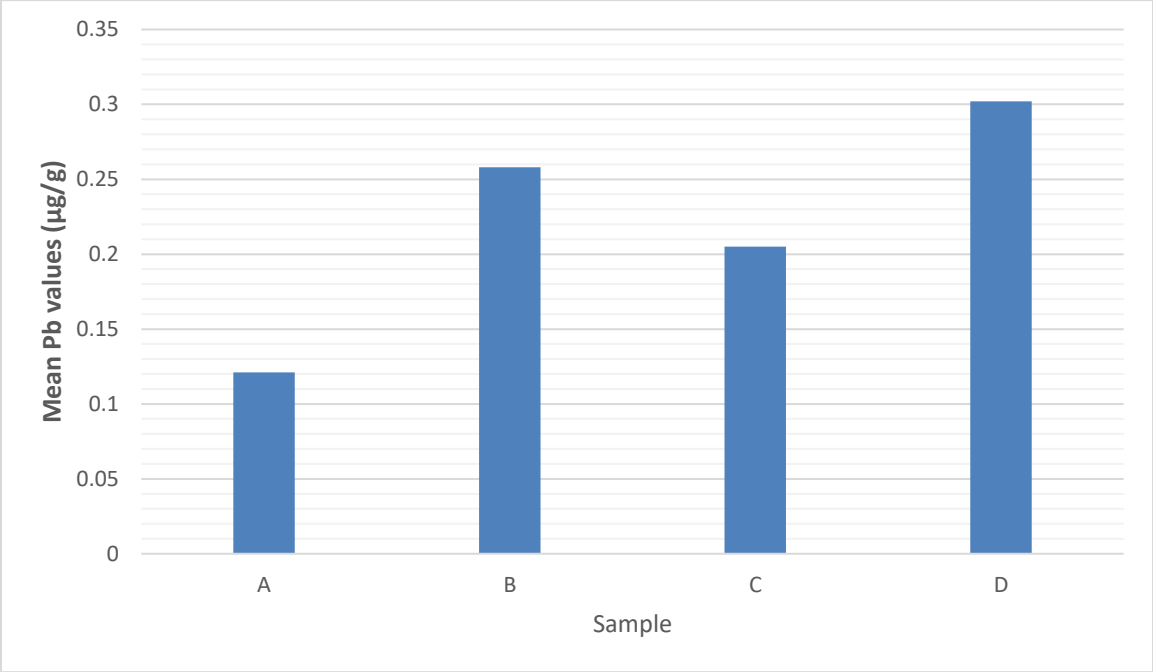

Figure 1 Bar chart representation of the mean Pb values in the studied toilet tissue samples.

The mean Pb levels in the studied samples were statistically significant but however, within the recommended threshold limits. Outhman and Lamma, (2020) obtained a mean value of 0.165µg/g in the toilet tissue samples sold in Algeria, which was significantly lower than what this study reported for toilet tissue samples B to D (Figure 1). The difference in Pb values in the samples from the two geographical environments could be attributed to the varying anthropogenic activities in the environments where the raw materials for the tissue samples were sourced. The health hazards associated with consistent exposure to lead by air, water or food has been well described by (Okeke et al., 2018b; Ezeh et al., 2018; Okeke et al., 2020b; Okeke et al., 2023a; Aniobi et al., 2023b; Aniobi et al., 2024).

Cadmium

The result of Table 1 shows that the mean Cd levels in the toilet tissue samples A, B, C and D were 0.062±0.022, 0.037±0.008, 0.097±0.005 and 0.012±0.002µg/g respectively. The mean Cd values decreased in the following order in the samples; toilet tissue C > toilet tissue A> toilet tissue B > toilet tissue D as shown in (Figure 2).

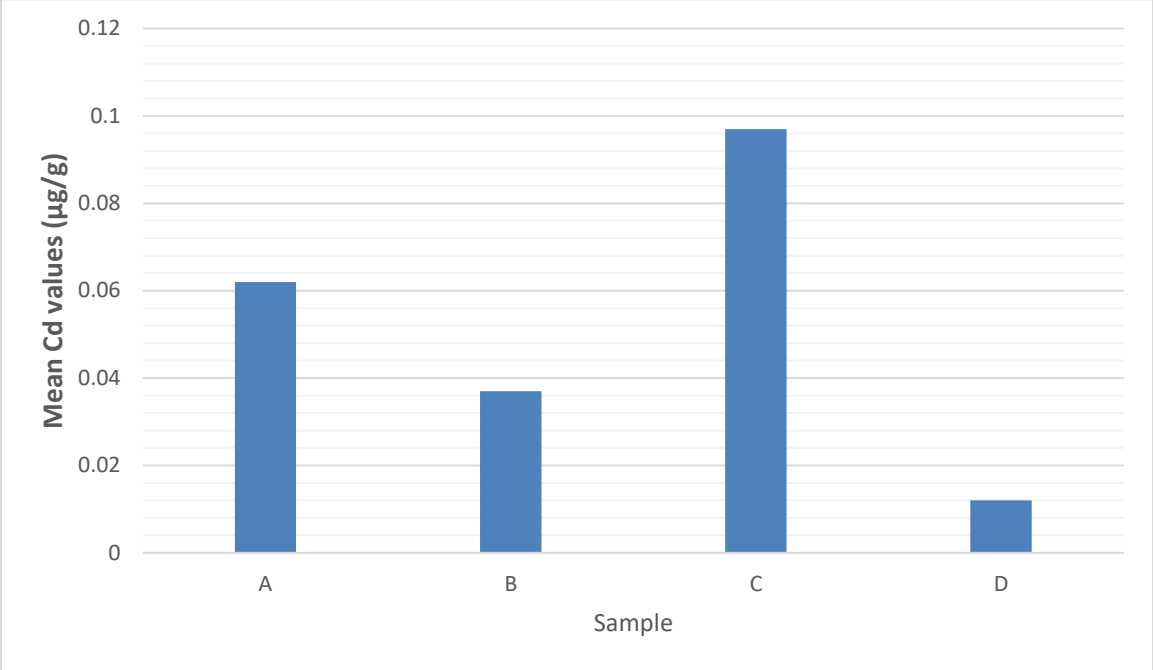

Figure 2 Bar chart representation of the mean Cd values in the studied toilet tissue samples.

The mean concentrations of Cd in the toilet tissue samples as shown in Table 1 showed a similar pattern of deposit (presence) as obtained for Pb values in the studied samples. This observation means that the quality and purchasing cost of toilet tissues does not affect the level of their heavy metal deposits. The mean Cd values in the studied samples were statistically significant but however, within the recommended threshold limits. Outhmann and Lamma, (2020) obtained a mean Cd value of 0.12µg/g in the toilet tissue samples consumed in Algeria, which was in agreement with the mean value of the metal in tissue sample D. Cadmium is a very toxic metal, even at low concentrations and have been known to exert toxicities to the human body as described by (Aniobi et al., 2021; Okeke et al., 2022; Ezeagwu et al., 2023; Okeke et al., 2023b; Aniobi et al., 2024; Okeke et al., 2024).

4. CONCLUSION

The studied heavy metals (Pb and Cd) were present in both the high- and low-quality tissue samples, although at non-toxic levels. The study revealed that the cost, packaging style and quality of toilet tissues does not insulate them from being contaminated with environmental contaminants such as heavy metals. The study indicated that people can be unduly exposed to heavy metals at consistent basis through unexpected sources such as toilet tissues. Therefore, consistent advocacy on the sourcing of raw materials for the production of toilet tissues from environments that witness very minimal anthropogenic activities is key to minimizing the heavy metal contamination of toilet tissues, that serve the everyday hygienic needs of people of all classes.

Informed consent

Not applicable.

Funding

This study has not received any external funding.

Ethical approval

In this article, the product ethical regulations are followed as per the ethical committee guidelines of Plastic production Unit, Scientific Equipment Development Institute, Akwuke – Enugu State, Nigeria; the authors observed the heavy metal deposits in toilet tissues sold in markets within Enugu metropolis, Enugu State. The "brand name" of the product is not mentioned in content and also the "brand

image" not displayed as image in the article. The product ethical guidelines are followed in the study for observation, identification & experimentation.

Conflict of Interest

The author declares that there are no conflicts of interests.

Data and materials availability

All data associated with this study are present in the paper.

REFERENCES

1. Aniobi CC, Ezeagwu PC, Okeke OR, Nwanya KO, Agbom C. Evaluation of the aerial deposits of heavy metals in fruits sold by the road sides within Enugu metropolis. Afr J Agric Food Sci 2024; 7(3):183–192.
2. Aniobi CC, Ndubuisi JO, Ezeagwu PC, Okeke OR, Igoche SA, Ejinnaka NO. Heavy metal determination in selected local and foreign food seasoning sold in markets within Enugu metropolis and their risk potentials. Discovery 2023a; 59(e98d 1302):1-7.
3. Aniobi CC, Okeke HC, Okeke O, Akagha IC, Osueze CN, Ezeagwu PC. Effect of topography on the heavy metal levels of Raphia palm tree and oil palm tree wine produced within Awka South and North Local Government Areas in Anambra State. Res Health Sci 2023b; 8(1):1-11.
4. Aniobi CC, Okeke O, Ezeh E, Okeke HC, Nwanya KO. Comparative assessment of the phytochemical and selected heavy metal levels in *Cucumis sativus* L. and *Solanum aethiopicum* L. fruit samples grown in South eastern and North Central regions of Nigeria respectively. Nat Resour 2021; 12:2 23–236.
5. Ezeagwu PC, Nwanya KO, Okeke OR, Igoche SA, Aniobi CC. Heavy metal burden in smoked and dried samples of meat and fish sold at Abakpa market, Enugu State and their health risk potentials. J Res Chem 2023; 4(2):30–34.
6. Ezeh E, Okeke O, Aniobi CC, Ikediniobi CS, Alieze AB. Analysis of heavy metals in different brands of lipsticks sold in Enugu metropolis, Nigeria and their potential health risks to users. J Chem Biol Phys Sci 2019; 9(4):402-411. doi: 10.24214 /jcbps.D.9.4.40211
7. Ezeh E, Okeke O, Ozuah AA, Nwoye B. Comparative assessment of the heavy and trac metal levels in honey produced within Nsukka and Enugu metropolis. Food and Public Health 2018; 8(2):42–46. doi: 10.5923/j.fph.20180802.02
8. Masternak- Janus A, Rybaczewska–Blazewskajowska M. Life cycle analysis of tissue paper manufacturing from virgin pulpor recycled waste paper. Manag Prod Eng Rev 2015; 6(3): 47–54. doi: 10.1515/mper-2015-0025
9. NRDC. The issue with tissue: How Americans are flushing forests down the toilet. National Resources Defense Council, NRDC annual Report, New York, 2020; 1-30.
10. Okeke MU, Okeke OR, Ezeh E, Aniobi CC, Ochuba CO, Offor CR. Effect of ash application on the heavy metal levels in the rice grains grown in paddy farmlands in Ishiagu, Ivo Local Government Area of Ebonyi State. J Environ Sci Comput Sci Eng Technol 2020a; 9(1):068–081. doi: 10.24214/jecet.A.9.1.068 81
11. Okeke MU, Chime CC, Okeke OR, Okeke HC, Aniobi CC, Offor EN. Effect of fertilizer amendment on the levels of heavy and essential metals in rice grains harvested from soils in Ishiagu, Ebonyi State. Int J Chem Sci 2023a; 7(1):37–42.
12. Okeke O, Aniobi CC, Akagha IC, Okoro MU, Nwosu D. Proximate, phytochemical and heavy metal levels of selected ripened fruits sold in market outlets within Enugu metropoli, Enugu State, Nigeria. Discovery 2022; 58(320):914-920.
13. Okeke O, Aniobi CC, Ezeh E, Ochuba CO, Ejiofor CC. Microbial and heavy metal evaluation of solutions of ash produced from unripe plantain peels and oil palm bunch sold in market outlets within Afikpo L.G.A. in Ebonyi State. Int J Sci Res 2018a; 9(4):1670–1676.
14. Okeke O, Ezeh E, Effiong I, Emeribe IE. Effect of agricultural practices on the heavy metal levels in cereals (maize and millet) grown within Ayamelu L.G.A. Anambra State. Int J Sci Eng Res 2018b; 9(4):825–835.
15. Okeke O, Ezeh E, Okeke HC, Aniobi CC, Akagha IC. Comparison of soil samples from selected anthropogenic sites within Enugu metropolis foe physicochemical parameters and heavy metal determination. J Environ Prot 2020b; 11:848 -861.
16. Okeke OR, Aniobi CC, Ezeagwu PC, Ndubuisi JO, Ndubuisi KC, Igoche SA. Microbial and heavy metal assessment of meat samples from ranched and non-ranched domestic animals

sold at Gariki market, Enugu State, Nigeria. Res Health Sci 2023b; 8(2):22–33.
17. Okeke OR, Nwanya KO, Ezeagwu PC, Aniobi CC, Ezejiofor CC. Effect of storage duration on the microbiological and heavy metal levels in selected sachet water samples consumed within Enugu metropolis. J Curr Res Food Sci 2024; 5(1):71–77.
18. Outhman AM, Lamma DV. Investigation of the contamination of tissue paper with heavy metals in the local markets. Int J Chem Stud 2020; 8(1):1264–1268.
19. Paulapuro H. Paper and board grades. Paper Making Science and Technology 2000; 18.
20. Tomasevic M, Rejsic S, Dordevic DS. Heavy metals accumulation in tree leaves from urban areas. Environ Chem Lett 2004; 2:151–154. doi: 10.1007/s10311-004-0081-8