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HEAVY METAL DEPOSITS IN TOILET TISSUES SOLD IN MARKETS WITHIN ENUGU METROPOLIS, ENUGU STATE.

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ABSTRACT: *Studies were carried out to assess the deposits of selected heavy metals (Pb and Cd) in toilet tissues sold in markets within the Enugu metropolis, Enugu State using standard analytical procedures and instrumentation. The samples underwent digestion and were subsequently analyzed for heavy metals using an 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.

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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), 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 quality tissue paper from wood pulp, certain chemicals such as wetting and bleaching agents are added to give the product a brilliantly white appearance (Outhman and Lamma, 2020). Paulapuro (2000) stated that its key characteristics include good absorbency, lightweight, 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 three trees and a half worth of toilet tissue in a year, to maintain healthy hygiene. However, woods from which toilet tissue is produced, grow 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 their body parts for as long as possible. According to Okeke *et al*. (2020); Aniobi *et al*. (2021); Aniobi *et al*. (2023) ; 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 the exposure of plants to heavy metals are not remediated or controlled, they continue to bioaccumulate this environmental pollutant into their 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*., 2018; Ezeh *et al*., 2019; Okeke *et al*., 2020; 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*. (2018); Ezeh *et al*. (2018); Aniobi *et al*. (2023), 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 transfer some of it dermally to tissue users, thereby increasing unduly, the body's heavy metal load. Within Enugu metropolis, 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.

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

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packaging makeup. 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*. (2023); Ezeagwu *et al*. (2023), 4g of each of the samples 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 to 150^oC 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 a 50ml volumetric flask using Whatmann filter paper. The filtrate was made up to mark with de-ionised water. Each of the samples was subjected to a triplicate digestion procedure, together with reagent and was kept in the refrigerator until heavy metal analysis. The samples were analyzed for the presence of Pb and Cd using a Hitachi Z-5000 flame atomic absorption spectrophotometer (AAS). Quality control measures were 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 a 5% confidence level using IBM SPSS 23.0.

RESULTS AND DISCUSSION

Table 1: Mean heavy metal deposits in the toilet tissue samples sold in markets within the 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

Lead (Pb)

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±0.014 µg/g respectively. Recall that

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samples A, B, C and D were purchased at #500, #400, #200 and #100 respectively, which resulted from the nature of their packaging and the quality of the tissue 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 Fig.1. Further interpretation of the above statement can be found in Fig. 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).

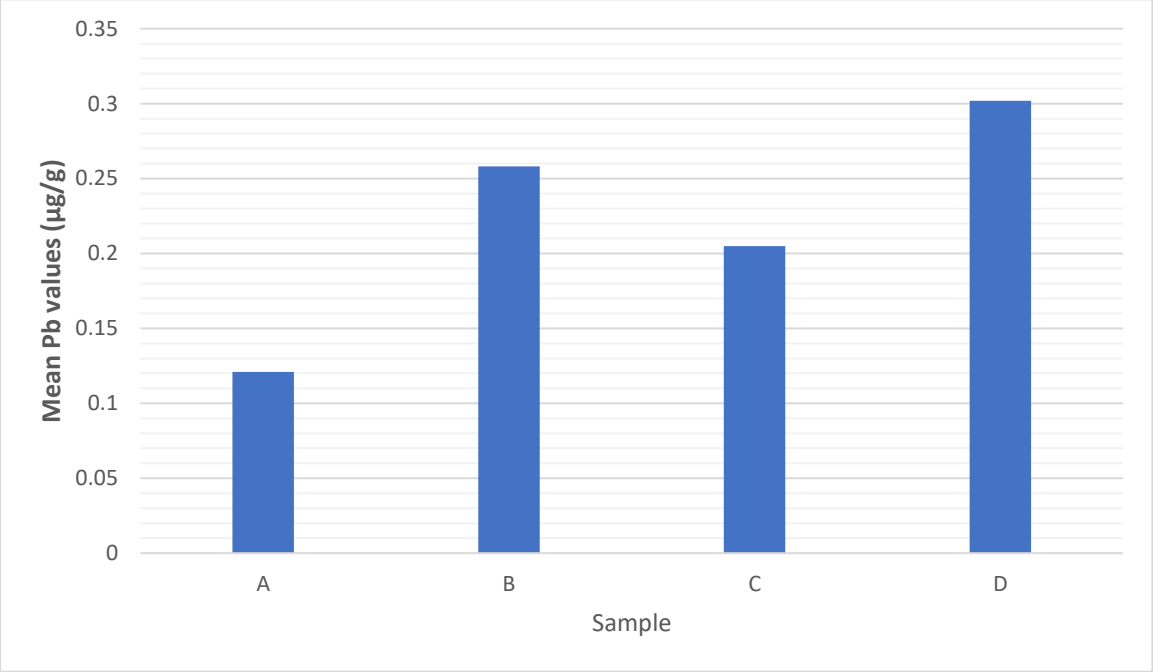

Figure 1: Bar chart representation of the mean Pb values in the studied toilet tissue samples.

The mean Pb levels in the studied samples were statistically significant but within the recommended threshold limits. Outhman and Lamma (2010) obtained a mean value of 0.165 µg/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. 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 have been well described by Okeke *et al*. (2018); Ezeh *et al*. (2018); Okeke *et al*., (2020); Okeke *et al.* (2023); Aniobi *et al*. (2023); 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 Fig. 2.

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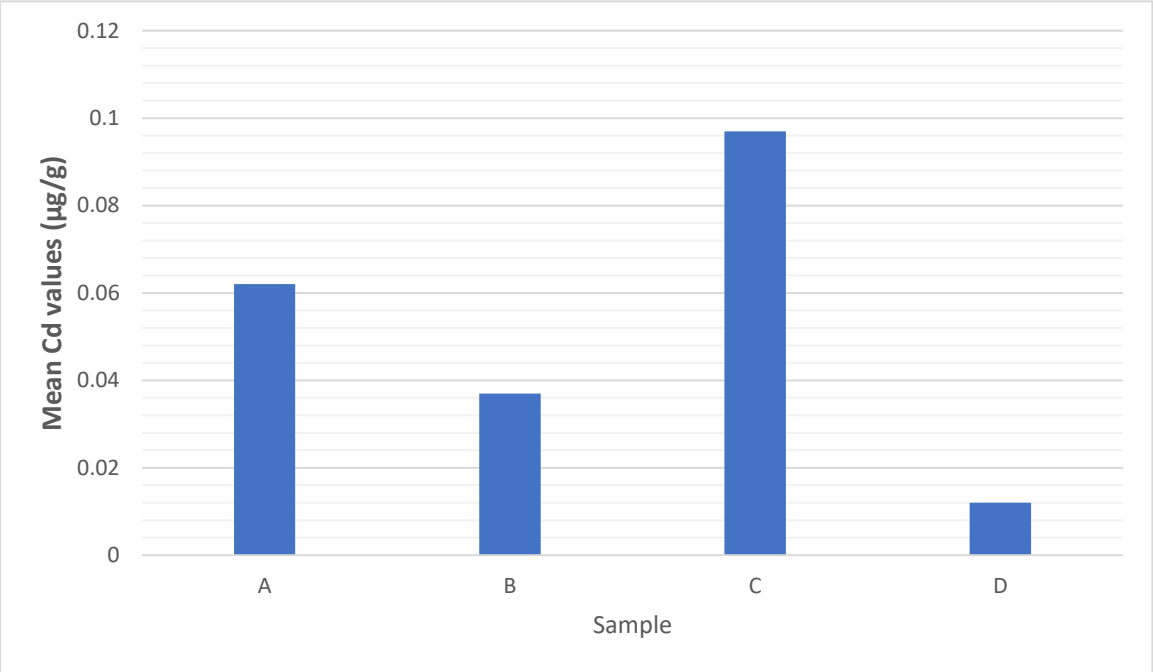

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The mean concentrations of Cd in the toilet tissue samples as shown in Table 1 showed a similar pattern of deposit (presence) as obtained for Pb values in the studied samples. This observation means that the quality and purchasing cost of toilet tissues do not affect the level of their heavy metal deposits. The mean Cd values in the studied samples were statistically significant. However, within the recommended threshold limits. Outhmann and Lamma (2020) obtained a mean Cd value of 0.12 µg/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*. (2023); Aniobi *et al*. (2024); Okeke *et al*. (2024).

CONCLUSION

The studied heavy metals (Pb and Cd) were present in both high and low-quality tissue samples, although at non-toxic levels. The study revealed that the cost, packaging style and quality of toilet tissues do not prevent them from being contaminated with environmental contaminants such as heavy metals. The study indicated that people can be unduly exposed to heavy metals consistently 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.

CONFLICT OF INTERESTS

The authors of this research paper bear no conflict of interest in carrying out the research and its eventual publication.

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