

Assessment of Bromine in Particulate Matter (PM₁₀) Obtained In an Urban City in Nigeria

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Abstract

Air contamination has been noteworthy stress all through the universe because of its consequences for lives and properties. There are different issues exuding from the impact of air contamination, which includes: untimely mortality, different infections (coronary, heart, type 2 diabetes, bosom disease, colon malignant growth) (Slezakova et al., 2018).

Halogen signifies "to create ocean salt (Science Clarified, 2019). Halogen (fluorine (F), chlorine (Cl), bromine (Br), iodine (I), and astatine (At) is lethal, non-metallic components which form Group 17 of the periodic table (Muthu and Li, 2014). Each has roles to play in the environment (eg stratospheric ozone (O₃). Most halogen light like Cl, Br, and I enter the earth through the common source - The ocean, while the wellsprings of Fare through volcanoes, fumaroles, woodland flames, and marine mist concentrates. Bromine has been utilized to deliver an assortment of natural items that have been utilized as pesticides, a model is methyl bromide utilized as a fumigant, which secures potatoes, tomatoes, and other farming harvests from irritation assaults. Bromine is fixing in the creation of halons which are utilized as fire retardants yet have restricted use due to the harm to Earth's ozone layer (Science Clarified, 2019).

Numerous works (Simpson et al., 2007; Yokota et al., 2017; Sherwen et al., 2017; Nayebare et al. 2018; Gautam et al., 2018;) have been carried out on halogens and its impacts on human and animal health, the results are unevenly distributed knowledge of its presence in particulate matter and little or no information is available on the particulate matter obtained in Akure, Ondo State This investigation will be valuable as it will give the essential data as a baseline on the quality and amount of bromine in this part of Nigeria

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I. METHODOLOGY

The sampling of PM₁₀ was performed, using "Gent" stacked filter unit sampler at the sampling points: Federal University of Technology, Akure (FUTA), Faculty of Science car park (N07 18 07.6 E005 08 06.5), National Museum (N07 15 11.6 E005 11 40.2), Akure, and Science and Education Development Institute compound, Oba Ile (N07 16 04.4 E005 14 29.1), monthly for ten months (January 2018 to October 2018). The sampling was carried out for 8 hours duration. The PM₁₀ were filtered through quartz fiber filters and kept in a desiccator at room temperature at 50% relative

humidity within 48 hours before and after the sampling. The sampling points were chosen due to the intensity of activities within the sites. Within Oba Ile, the possible sources of pollution are residential buildings, open biomass, waste burnings, and traffic (pedestrians and vehicles), whereas at FUTA, there are trees, buildings, and traffic, finally, the National Museum site is located around buildings, vehicular movements and commercial activities. Br analysis of samples was performed using an XRF instrument at the Center for Energy Research, Obafemi Awolowo University, Ile Ife, Nigeria. The manufacturer's specifications and procedures were duly followed.

Statistical analysis

The descriptive statistical analyses were done with Microsoft Office Excel 2007 and Minitab 16 version statistical software. The line chart was obtained with a Microsoft Office Excel 2007 version. The correlation coefficient, PCA, and cluster analyses were done with Minitab 16.

II. RESULTS AND DISCUSSION

Figure 1 portrayed the concentrations of the month to month samples in Akure to be 0.33 (0.01–0.90) $\mu\text{g m}^{-3}$ (mean (min-max)) with a huge coefficient of variation. The variation might be because of the various exercises that happened during sampling. The outcomes indicated high relationships (r^2) in the bromine substance of all the chosen locations (Table 1). The Br levels in Oba Ile were higher than those in other parts of the locations. The higher Br values were recorded during the consuming of biomass and waste, which exposure to the risk of human health. Figure 2 showed that the results at a 95% confidence interval, had a right-skewed distribution, the boxplot showed that the mean was higher than the median. Also, the tail of the distribution was positive because the right-hand side was longer than the left-hand side. In the box and whisker, a diagram, it was observed that the median was closer to the first quartile than the third quartile. Table 2 showed that despite the different climatic conditions, the results of this study compared with results of previous

studies (Merešová et al. 2008; Isildak, 2011; Ezeh et al. 2018), except in a few cases where above 1 $\mu\text{g m}^{-3}$ were recorded (Jemigan et al., 1971; Lammel et al., 2002; Takeda et al. 2011; Nayebare et al., 2018).

Table 1. Basic Statistical Description of the Bromine Results

Statistical Tools	Results
Mean ($\mu\text{g m}^{-3}$)	- 0.33
SE Mean	- 0.05
Std Dev	- 0.29
CoefVar	- 87.06
Minimum	- 0.01
Maximum	- 0.90
Q1	- 0.04
Q3	- 0.60
Skewness	- 0.37
Kurtosis	- -1.30
Correlation Coefficients	- $r = 0.871; 0.702; 0.824$

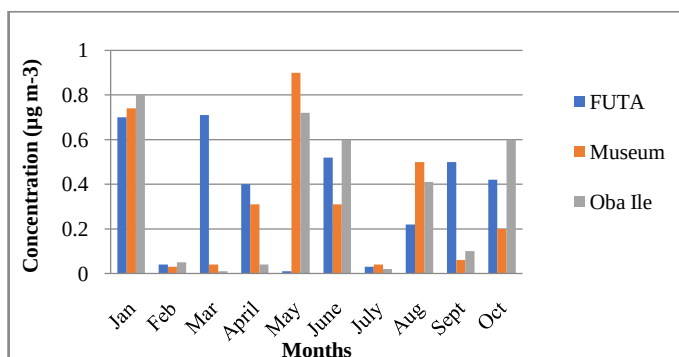


Figure 1. Bromine concentration for 10 months (Jan-Oct)

Fig 2. Summary of the Bromine Results

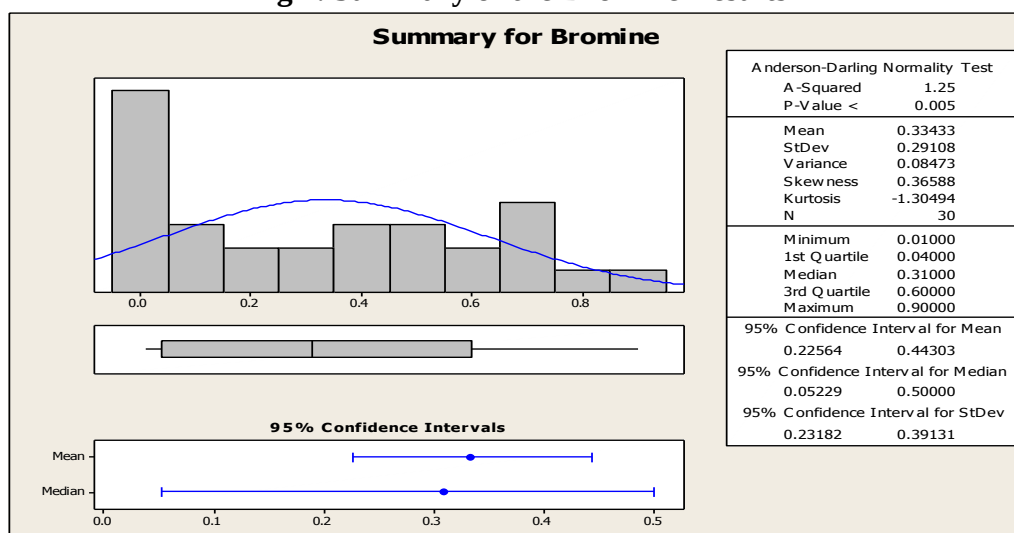


Table 2. Comparison of Values of Bromine with Previous Results

Site	Year	Type of sample	Value ($\mu\text{g}/\text{m}^3$)	References
Akure, Nigeria	2018	PM ₁₀	0.01 – 0.90	This study
Oahu, Hawaii	1971	PM	1.60	Jemigan et al., 1971
Samsun, Turkey	2004-2005	PM	0.18 – 0.48	Isildak, 2011
Makkah, Saudi Arabia.	2014-2015	PM _{2.5}	0.41 – 1.68	Nayebare et al., 2018
Lagos, Nigeria.	2010-2011	PM _{2.5}	0.02-0.54	Ezeh et al. 2018
Aomori Prefecture, Japan.	2011	Soil	0.03-1.63	Takeda et al. 2011
Switzerland	2008	PM _{2.5}	0.35	Merešová et al. 2008
Germany	1998-2000	TSP	0.02-1.27	Lammel et al., 2002

Table 3. Principal Component Analysis of the Results

Variable	PC 1	PC 2	PC 3
FUTA	0.071	0.983	0.168
Museum	0.701	-0.169	0.693
Oba Ile	0.710	0.068	-0.701
Eigen value	1.806	1.020	0.175
Proportion (%)	60.2	34.0	5.8
Cumulative (%)	60.2	94.2	1.000
Source	Traffic & Ammonium Nitrate	Crustal	Mixed Combination

PC1 (60% of all out combination) grow to be related to an anthropogenic supply and this changed into Br from Museum and Oba Ile zones (Table three). The Br content material fabric was associated with site visitors (tires, brakes and scratched spot) and compost, which factors have been of discretionary ammonium nitrate. PC 2 depicted 90 four% entire combined. The variable that was above 0.6 became FUTA. This deliver changed into associated with crustal cloth began from soil resuspension. At long final, PC 3 became observed to the Museum. The wellsprings of Br were related to the blended mixes of impact of street dust due to the asphalt put on and to the scraped spot going on on mechanical additives, soil resuspension, ingesting of biomass, and NH₄ + and SO₄ 2– are credited to gasoline-to molecule responses prompting the optionally to be had ammonium sulfate development (Tositti et al., 2013).

III. CONCLUSION

Contamination stays a significant issue on the earth, specifically particulate difficulty. Akure,

Nigeria is not forgotten about. The assure of Br within the particulate hassle isn't ordinary due to the fact that bromine has been associated to three healing issues. It is gratifying to take a look at that the trends were given inside the studies had been modestly low. Regardless of the way that there were no Br benchmarks to consider internal this work, the effects contrasted well and traits obtained from numerous worldwide locations. Head Component Analysis exposed that the wellsprings of Br were avenue dirt because of the asphalt put on and to the scraped spot going on on mechanical elements, soil resuspension, consuming of biomass, and NH₄ + and SO₄ 2– credited to gas-to molecule responses prompting the auxiliary ammonium sulfate development.

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