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# ANALYSIS OF THE HEAVY METALS CONTENT OF LAGOS LAGOON LAGOS NIGERIA

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***Abstract:*** **This study investigated the heavy metals content of Lagos lagoon Lagos state for its suitability for industrial, agriculture and aquacultural utility. It was an ex-post facto research that answered 3 research questions and tested a hypothesis. The research area Lagos Lagoon was mapped into 5 research zones, water samples were collected from 5 sampling spots in each sampling zone, bulked, composites drawn and fixed with $HNO_3$ and taken to the laboratory for analysis. The analytical standard adopted was USEPA 61060 and the analytical instrument deployed for the determination of the heavy metals is Agilent ICP model 7900. The mean results obtained were: Cd; 0.01±0.12 mg/l, Cr, 0.02±0.14 mg/l, Pb, 0.02±0.03 mg/l, V 0.01±0.01 mg/l and Hg; 0.01±0.04 mg/l. The mean results obtained were subjected to test of significance with ANOVA deploying SPSS model 29 at 0.05 level of significance. The p-value was 0.06 thus accepting $H_{o,\ thus}$ . The study recommend that the environmental mentoring agencies responsible for monitoring the operation of Lagos lagoon should continue to keep surveillance on the industries operating of industries the lagoon so that the lagoon environment will continue to remain pristine man's continuous utility.**

***Keywords:*** **Industries, wastes discharge, heavy metals, Lagos-lagoon.**

## 1. INTRODUCTION

Water is one of the most essential compounds for human existence on planet earth. The earth is composed of 70 percent water, 97 percent of the water in the earth are held in ocean, seas and lagoon (Baraka, 2011, Ogwu *et al*., 2022a, Mansaura and Madani, 2016, Ogwu *et al*., 2022b) Water bodies provide over 50 percent of the oxygen required on earth through the planktons (Yaragbe *et al*., 2020, Sabhanardakani, 2018, Sobhanardakani *et al*., 2018, Matins & Griswold, 2018). The oceans and lagoon regulate the climate of the earth by absorbing heat from solar radiation (Ogwu *et al*., 2021, Chen *et al*., 2019, Onwuegbu *et al*., 2013, Chiroma *et al*., 2014). They account for 16 percent of animal protein supply globally (Flora *et al*., 2006, Ghane, 2011, Ayene, 2014). Macro and Micro nutrients elements viz Na, Ca, Mg, I amongst others are provided in abundance by the water bodies (Food and Agricultural Organization, 2020, Ogwu 2021, Shafluddin-Ahmed, 2019, Varol & Sen. 2012). The marine is the home for incredible amount of biodiversity, 91 percent of this biodiversity population remain unclassified (Ogwu *et al*., 2021, Luis *et al*., 2019, Ruiz *et al*., 2018), regulates drought and rainfall and acts as the major store of carbon as carbon sink and sequestration (Ogwu *et al*., 2020, Xiao *et al*., 2010, Duruibe *et al*., 2017, Affandi & Ishak, 2019,, Byrne *et al*., 2017). Oceans and lagoons are the original highways linking many economies of the world (Zang *et al*., 2015, Eggletin *et al*., 2004, Long & Luo, 2019). They are the greatest employer of labour engaging over 40 million through fisheries, tourism and maritime (Tirde & Yang, 2016, Bird, 2016), with over 3 billion out of the world

population of 7 billion depending on ocean and lagoons for their livelihood (Jung, 2008, Sarmento *et al*., 2008, Letcert et la., 2010). The oceans and lagoons water are utilized in cosmetic industries, industrial cooling and food products, (Hammarsstrom *et al*., 2002, Liu *et al*, 2013, Fu et la., 2007).

However, world oceans and lagoons are currently threatened by pollution with different countries having varying degrees of ocean and lagoon contamination emanating from natural and anthropologic sources (Ogwu, 2020). Marine pollution results from storm water discharges, industrial effluents discharges, poor waste water management and litters (Tang *et al*., 2016, Husintee, 2006; Mishra *et al*., 2021), herbicide, detergent, furams, dioxins, sewage and industrial chemicals through runoffs and direct discharges (Wu et la., 2020, Chen *et al*., 2015, Zhang *et al*., 2011). Pharmaceutical products wastes, bacteria, viruses radioactive rays also cause Marine contamination (Gao 2019, Tang 2021, Githaiga *et al*., 2021, Wang et la., 2017). Oil spillage marine dumping, and heavy metals in industries effluents, equally account for marine pollution (Wei *et al*., 2018, Huang *et al*., 2010, Mao et la., 2019, Zhang *et al*., 2015).

Heavy metals contamination in aquatic environment will result in bioaccumulation and biomagnification (Bellinger *et al*., 2015, Gao *et al*., 2020) causing health implications such as cancer, cardiovascular diseases, osteoporosis, lung diseases and so (Yuhu 2020).

The focus of this study is the assessment of the heavy metals content of Lagos lagoon for its suitability for agriculture, aquaculture and industrial purposes. The heavy metals investigated are Cd, Cr, Pb, V and Hg

The study was guided by research questions as

i. What are the concentration of Cd, Cr, Pb, V and Hg in Lagos lagoon?

ii. Are the concentrations of the heavy metals within maximum permissible concentrations as stipulated by World Health Organization, 2014?

iii. Can water in Lagos lagoon be utilized for domestic, agricultural and aqua cultural purposes?

The study was guided by a hypothesis as follows:

Ho: there is no significant difference in the concentration of heavy metals measured in Lagos lagoon and World Health Organisation (WHO) maximum allowable concentrations for the heavy metals in water.

**Study Area**

Lagos state is a state of "aquatic splendor". It is one of the 36 states in the Federal Republic of Nigeria and hosts the lagoon. It lies within geographical positioning system of latitude 6°.465422' and longitude 3°.506448' and coordinates of 6°.27' 55"N and 3° 24′ 23.2128″E with a land area of 3577km$^2$ The current population of Lagos is 28 million (Google estimate, 2022). Lagos is the economic hub of Nigeria with 3 major sea ports and 13 industrial estates. The Lagos lagoon is the recipient of industrial, municipal and household waste generated by these teaming population and industrial clusters.

## 2. MATERIALS AND METHODS

Lagos lagoon was mapped out into 5 sampling zones (Abdulwaheed, 2016). These are Lagos inland zone, Ebutta Meta zone, Iddo zones, CMS zone and Bonny Camp zone. From each of the sampling zones water samples were collected from 5 sampling spots with clean plastic sampling bottles tied to graduated string at 10cm and covered subsurface. The sampled water were bulked fixed with nitric acid to ward off oxidation and stored in ice-cooled boxes for analysis.

## 3. ANALYSIS

The analysis of the samples were carried out in the water pollution laboratory of Nigeria Institute for Oceanography and Marine Research (NIDMR) Victoria Island Lagos (NIOMR).

The samples were filtered with µm glass filter fibre membrane to remove suspended debris. Nitric acid was then added again to a pH of about 2 and kept at 4°C. The heavy metals in the sample were determined using Agilent inductively coupled plasma mass spectroscopy system (ICP-MS) model 7900. The accuracy of the determination were validated using a standard Agilent reference material, AFS 9620 and A1, OMR 6200. The recovery rate is 96 percent.

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## 4. RESULTS

The results of the analysis of the heavy metals content of Lagos lagoon are as in Table 1.

**Table 1: Heavy metals content of Lagos lagoon and WHO maximum permissible concentration in mg/l**

| | Lagos Victoria island | Ebutta Melta | Iddo | CMS | Bonny camp | Mean | SD | WHO MPC |
|---|---|---|---|---|---|---|---|---|
| Cd | 0.18 | 0.31 | 0.02 | 0.03 | 0.02 | 0.11 | 0.12 | 0.005 |
| Cr | 0.01 | 0.01 | 0.01 | 0.04 | 0.04 | 0.02 | 0.14 | 0.05 |
| Pb | 0.01 | 0.01 | 0.02 | 0.62 | 0.02 | 0.01 | 0.03 | 0.05 |
| V | 0.01 | 0.01 | 0.01 | 0.02 | 0.01 | 0.01 | 0.01 | 0.05 |
| Hg | 0.01 | 0.02 | 0.01 | 0.01 | 0.02 | 0.01 | 0.04 | 0.001 |

The heavy metals concentration in Lagos lagoon were presented in graph as in Figure 2.

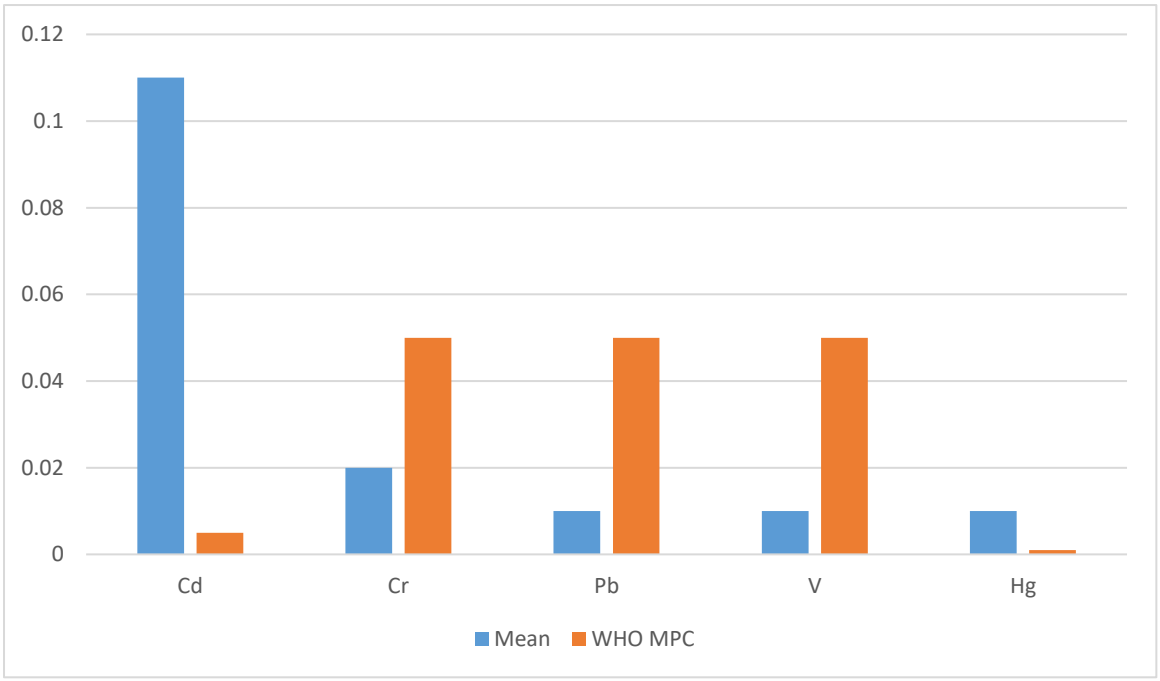


**Figure 2: heavy metals content of Lagos lagoon and WHO MPC in mg/l**

The mean result of the heavy metals content of Lagos lagoon were subjected to test of significance with analysis of variance (ANOVA) deploying Special Package for Social Science (SPSS) model 29 at 0.05 level of significance. The p-value is 0.06, thus accepting $H_o$.

## 5. DISCUSSION OF FINDINGS

The analysis of the water samples from Lagos lagoon at different sampling zones revealed varying concentrations of the heavy metals investigated. The concentrations of Cd ranged from 0.02 mg/l in Iddo and Bonny Camp to to 0.18 mg/l in Victoria Island area with mean concentration of 0.11 mg/l. The WHO maximum permissible concentration for Cd in water is 0.05 mg/l, thus the Cd concentration is higher than recommended. Prolonged exposure to Cd by humans results in kidney failure, decreased bone density and cardiovascular disease (Adjei-Keyereme *et al*., 2015, Amto-Out *et al*., 2012). Increased content of Cd in Lagoon have been reported in (Apau *et al*., 2014, Bhattachoryu *et al*, 2007).

The analysis of water from Lagos lagoon showed that the concentration of Cr is between 0.01 mg/l in Victoria Island, Ebutta Melta and Iddo to 0.04 mg/l in CMS and Bonny Camp with a mean concentration of 0.02 mg/l. the WHO MPC for Cr in water is 0.05 mg/l. The Cr in Lagos lagoon is within acceptable range. Low content of Cr in water was reported in

(Blakrishann & Ramu 2016, Baokery *et al*., 2015). Cr above recommended in water will result in lung problem, cancer of sinuses, and shortness of breath (Chuamsanthit *et al*., 2020).

Water analysis of Lagos Lagoon revealed that the concentrations of Pb is between 0.01 mg/l in Victoria Island, Ebutta Meta to 0.02 mg/l in Iddo, CMS and Bonny Camp with mean of 0.01 mg/l The WHO maximum acceptable concentration for Pb in water is 0.05 mg/l. Low concentration of Pb in water was reported (Dan *et al*., 2014, Durube *et al*., 2007). Human exposure to Pb give rise to neurological complications, high blood pressure, headache, and general weakness (Garg *et al*., 2008, Ayamfi et la., 2012).

Analysis of water in Lagos lagoon revealed that the content of Hg range between 0.01 mg/l in Victoria Island, Iddo and CMS to 0.02 mg/l in Ebutu Meta and Bonny Camp with a mean concentration of 0.01 mg/l. The WHO MPC for Hg is 0.001 mg/l the increase in Hg is the concomitant effect of poor industrial effluent management. Increase in Hg in the marine was in the reports of (He *et al*., 2005, Hsu and Leon, 2002). Health implications of Long exposure to Hg include tremor, insomnia, memory loss (Kim et la., 2002, Koffi *et al*., 2014).

The V content in Lagos lagoon the analysis revealed is between 0.01 mg/l in Victoria Island, Ebuta Meta Iddo and Bonny Camp to 0.02 mg/l in CMS with a mean concentration of 0.01 mg/l. WHO MPC for V in water is 0.05 mg/l. The report of low concentration of V in marine was reported in (Appiah-Opong *et al*., 2021, Muskovini et la., 2020). Human exposure to V results in cardiovascular disease, renal failure, kidney and liver problems (Shanbehzadeh, 2014, Prabu, 2009).

## 6. CONCLUSION

Industrialization most often than non-leaves the environment with severe degradation. Industrialization is highly desirable because it helps to improve the standards of living of the citizens, however, such should be carried out with utmost consideration for the environment of operation. The analysis of the water in Lagos lagoon showed that the industrial discharges into the lagoon is minimal, making water for useable in industries, agriculture and aquaculture. This shows that the industries are operating with the environmental standards template thus adopting best practices which is in tandem with United Nations sustainable development goals.

Against this backdrop, the industries and citizens of Lagos state are enjoined to continue to operate within the standard set by National Environmental Standards and Regulation Agency (NESREA) which is the monitoring agency in Nigeria so as to keep the environment pure and safe for the use of man his animals and crops.

The minoring agencies are also encouraged to continue with their surveillance to ensure that the industries do not deviate from standard practices spelt out.

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