Physico-Chemical Properties of Pharmaceutical Effluents Samples in Lagos, Nigeria

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Abstract: **In most developing countries, pharmaceutical effluents generated during drugs production are often times discharged into the environment with little or no treatment, which poses potential toxic effects on the ecosystem. This study investigated the physico-chemical properties of pharmaceutical effluents of three pharmaceutical origins in Lagos, Nigeria to ascertaining their levels of compliance with FEPA and WHO as regards effluents discharge. The operational parameters include: Temperature, pH, Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total Solids (TS), Chloride (Cl^-), Nitrate (NO^-_3). The mean values of pH of the effluents were 5.57±0.20, 7.34±0.38 and 6.71±0.58 for sites the PC1,PC2 and PC3 respectively. Concentrations of heavy metals, such as Copper, Zinc, Chromium and Iron were also determined using the Atomic Absorption Spectrophotometer (AAS). The mean concentrations (mg/L) of the heavy metals range from 0.06 to 0.61 for copper,0.00 to 0.32 for chromium and 0.68 to 8.90 for Iron. The results obtained for the heavy metal concentrations were observed to fall within WHO/FEPA stipulated limits, while few of the water quality parameters were found to be higher, which indicate their extents of toxicity to man and his environment.**

***Keywords*: Pharmaceutical effluents, physico-chemical, potential toxic, ecosystem.**

I. INTRODUCTION

Pharmaceuticals are wide and different types of chemical compounds made to prevent, cure, treat and improve health [1,2]. Lots of fortunes were brought about by pharmaceuticals; yet, their adverse effects on our environment cannot be overemphasized, as a result of their structural stability and non biodegradability [3]. During pharmaceutical processes, a large amount of poisonous drugs is produced, which most times mix with plenty water, resulting in waste water, of which are highly poisonous to man and his environment [4]. Pharmaceutical industries produce a large amount of drugs, including anti-biotics, which consist of organic starting materials, solvents and other additives (inorganic). As a result of this, large quantities of effluents are produced, with very high contents of organics and solids, with the presence of active pharmaceutical ingredients [5]. Antibiotics are given more attention amongst pharmaceuticals because of their contamination of our environment could support the growth and the spread of antibiotic resistant amongst bacteria [6].

Reports have shown that different laboratories discharge pharmaceutical wastes' water streams, which contain the heavy metals. Some chemical tests and processes produce some quantities of waste water which also certain contain heavy metals. These metals cause different severe health issues, such as organ damage, cancer, nervous system damage and the death in some cases [7]. Pharmaceutical waste water posses the following properties: a high BOD and COD value, with a large difference of value in waste water, an intense concentration of organic pollutants, which make it difficult for water a treatment plant to treat [8].

The major routes of pharmaceuticals in our environment are through the direct discharge from the sewage treatment plants the metabolic excretion, and manufacturing processes, and an improper disposal of human and the vet nary drugs. [9]. Hence, there is the need for a thorough research in this field. In order to have the knowledge of the exposure routes, and the effects pharmaceutical pollutants have on a man and his immediate environments, physico chemical parameters of effluents samples from three pharmaceutical industries located in an industrial area of Lagos, Nigeria were collected and analyzed.

II. MATERIALS AND METHODS

Study Area

This novel study was carried out by collecting effluents samples with different compositions from three pharmaceutical companies, PC1, PC2 and PC3 located at three distinct industrial areas of Lagos - State, Nigeria. The effluent samples from their drains were randomly collected using sterile sampling bottles for twelve weeks at two weeks interval .After the collection,the effluent samples were immediately taken to the research laboratory for analysis . Physicochemical parameters: pH, temperature, Color, Total Solids, Dissolved Oxygen (DO), the Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Chloride and the Nitrate were assessed. The concentrations of Copper,

Zinc, Chromium and Iron were also analyzed, using the standard methods [10].

III. RESULT AND DISCUSSION

Table 1.0 : Physico- Chemicals Parameter of three Pharmaceeutical Effluents

Effluent	pH	Temp. (^oC)	TS (mg/L)	NO_3^-(mg/L)	Cl^- (mg/L)	DO (mg/L)	BOD (mg/L)	COD (mg/L)	Colour
PC1	5.57±0.20	30.17±1.09	1030.83±316.17	3.03±0.59	12.50±7.148	2.26±0.77	116.68 ±71.48	571.16±295.78	Light Yellow
PC2	7.34±0.38	29.50± 1.12	1408.67±919.08	5.56±2.97	70.00± 39.02	0.309 ±0.07	76.67± 28.80	323.83±114.32	Cloudy
PC3	6.74 ±0.54	28.67 ±0.51	629.83±572.19	2.73 ± 0.250	28.83±14.17	1.38±0.79	110.78±78.38	502.33± 330.62	Cloudy
WHO	N.S	30.00	50.00	250.00	N.S	15.00	N.S	N.S	0.01
FEPA	6-9.00	N.S	30.00	20.00	600.00	N.S	50.00	N.S	N.S

N.S : NOT Stated

Table 2.0 : Heavy Metals Concentrations

Effluent	Zn (mg/L)	Cu (mg/L)	Cr (mg/L)	Fe (mg/L)
PC1	0.28±0.23	0.60±0.36	0.17±0.11	8.13±0.44
PC2	0.13±0.04	0.061±0.018	0.04±0.03	1.71±0.50
PC3	0.14±0.03	0.18±0.09	0.016±0.016	1.19±0.50
WHO	<1	N.S	N.S	N.S
FEPA	<1	1.3	20	20

N.S: Not Stated

(Federal Environmental Protection Agency (1999). Permissible limits for effluents discharged into surface water, National recommended water quality criteria-correction; world Health Organization (2002).Guidelines for drinking water recommendation.

The pH of the sample PC1 appeared to be acidic (5.57), while that of the sample PC2 and PC3 were slightly neutral, with the values 7.34 and 6.74 respectively. The acidic nature of the sample PC1 could threaten the metabolic activities of aquatic lives, and as a stem the pH of other receiving water bodies. Thereby, reducing other parameters, such as: the alkalinity, hardness and metal solubility. At a low pH, there is high solubility and availability of metals, which in turn are dangerous to living organisms. At a high pH, the metal ions become insoluble and tend to store up in slugs and sediments [11,12]

Bad smell and taste often times occur as a result of low level of solubility of oxygen, which could have resulted from high temperature of the effluents, which increases the rate of chemical reactions in the water. The temperature of the samples PC1 (30.17) and PC2 (29.50)were noticed to be higher compared to that of PC3 (28.67°C).The Dissolved Oxygen in sample PC1is quite low (2.26 mg/L) while that of PC2 and PC3 were extremely low , 0.30mg/L and 1.389mg/L respectively. This indicates that aquatic lives can barely survive in them, because, these values did not fall within the WHO permissible limit of 15 mg/L. The Total Solids in the samples PC1, PC2 and PC3 are 1030.83mg/L 1408.67 mg/L and 629.83 mg/L respectively. These values as well did not fall within the WHO/FEPA permissible limit. Hence, lower concentration of Total Solids have been reported by Olaitan et al [11], in which values obtained were below the WHO permissible limits.

The Biochemical Oxygen Demand (BOD) of the effluent sample PC2 (76.67 mg/L) was high and much higher in sample PC1 (116.68 mg/L) and that of PC3 (110.78 mg/L) in which similar case was also reported by Siyanbola et al [13]. They stated that the low Dissolved Oxygen (DO) values led to high BOD and COD values, which in turn indicate low survival of living organisms in these systems .The Chemical Oxygen Demand (COD) of the sample PC1 (571 mg/L) and that of the sample PC3 (502.33 mg/L) were extremely high , PC2 was moderately high (323.83 mg/L). The concentration of copper in the sample PC1 (0.60 mg/L) was a bit higher, compared to that of PC2 and PC3 which were 0.06 and 0.19 mg/L respectively. The sample PC1 has the concentration of Zinc to be 0.28 mg/L, which is quite higher than that of PC2 and PC3 , which were 0.13 mg/L and 0.18 mg/L respectively. All these fell within the WHO/FEPA permissible limits The chromium concentrations in sample PC2 and PC3 were very low, 0.04 mg/L and 0.01 mg/L respectively, but that of PC1, 0.17 mg/L was extremely high. More so, the sample PC1 has a higher value of an iron concentration, 8.13 mg/L than that of PC2 and PC3 was 1.71 and 1.19 mg/L respectively. The

chloride ion in sample PC2, 70.00 mg/L was also high, while that of PC1 and PC3 were also observed to be 12.50 and 28.83 mg/L respectively. The Maximum value was recorded for nitrate ion concentration in sample PC2 was 5.56 mg/L, followed by that of PC1, 3.03 mg/L and PC3, 2.73 mg/L, all of which fell within the WHO/FEPA permissible limit.

IV. CONCLUSION

Pharmaceutical industries in Lagos often times discharge larger volumes of their raw or poorly treated effluents into the ecosystem at the detriment of the lives around. This research has established the fact that the investigated pharmaceutical effluents were highly acidic and discharged at high temperatures into the ecosystem, which has led to the rise in the Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD) and the metal insolubility of the effluents, and as a result poses threats to the lives of living organisms, and this makes Lagos a polluted city among others.

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CONFLICT OF INTEREST

There was no conflict of interest among the authors.

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