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Determination of Bacteriological and some physicochemical properties of Hospital wastewater

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Abstract *The search to determine the level of bacteriological and other pollutants in Hospital wastewater is a major concern to the environmental health workers. The bacterial-ogical analysis were determined within the wastewater treatment Plant to ascertained quantitatively the total Coli-form count and E. Coli, which ranged between 2.5×10^3 to 2.8×10^3 MPN/100ml and 2.5×10^3 to 2.7×10^3 MPN/100ml respectively. Wastewater samples were collected from Ahmadu Bello University Teaching Hospital wastewater Treatment Plant. Samples were collected between the period of July 2010 to September 2010, and the mean values of the following parameters were determined: pH temperature, Chemical Oxygen Demand (COD), Biological Oxygen Demand (BOD5), Dissolved oxygen (DO), nitrate, sulphate, phosphate and conductivity. From the results obtained, the level of temperature is above the World Health Organization limit, while the level of Dissolved oxygen (DO) is below the tolerance limit for the survival of aquatic life in the wastewater. The Bacteriological load is highly contaminated in the wastewater and may pose a threat of infection to human health. The level of nitrate and sulphate did not exceed the WHO limits as recommended for hospital wastewater disposal, while the level of phosphate was found to be higher than the WHO limits. All other parameters determined in the wastewater and food sample were lower than the limits set by WHO and the maximum permissible levels*

Keywords: *E.coli*, Coli-form count bacteria, Hospital wastewater, and tolerance level

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1.0 Introduction.

Most waste are unwanted in the environment because of their environmental and subsequent health impacts (Okibe, 2014). The initial stage in every waste management policy is the identification, classification and characterization of the waste (Alau, 2015). Subsequent policy progress may afterward involve transportation, treatment, disposal, resource recovery and recycling (Wyasu, 2016). Most commonly monitored wastes are industrial and domestic wastes and yet wastes that create severe challenges to public health are hospital wastes. For example, several medical personnel have reportedly contacted several infections through their interaction with the hospital environmental wastes (Awodele *et al*., 2016). Hospitals are significant generators of various types of wastes (Jolibios and Guerbet, 2005). Report of study on waste generated by a hospital in Amol city in Iran, indicated that the physical composition of the waste included, glass (4.8%), metal (1.07%), plastic (up to 30.2%), textiles (13.4%), paper (17.9%), organic waste (17.8%) and other materials (14.7%). Characterization of the generated waste indicated that the hospital generated about 3.1 kg/bed-day and that 51% of the wastes were hazardous. Wastes generated by the National Taiwan University hospital was classified to consist of daily 4,600 kg/day, which consisted of 4,100 kg/day non-infectious refuse, 340 kg/day infectious waste, 70 kg/day kitchen waste, 50 kg/day pathological waste, and 40 kg/day plastic syringes (Li and Jeng, 1993).

Hospital consume a significant amount of water in a day, ranging from 400 to 1200 litres per day per bed (Deloffre-Bonamour, 1995) and generates significant amount of wastewater loaded with microorganisms, heavy metals and radioactive elements (Wyasu, 2016).

Wastewater generated in a health care institution may represent a serious health hazard and little is known about the health hazard of hospital waste in Zaria metropolis. Children, adults and animals all have the potentials to come into contact with those wastes through irrigation / agricultural activities which may pose severe health risk to them (Akter et al., 2000).

Food crops such as cocoyam, cassava and tomatoes constitute an important part of the human diet since they contain carbohydrates, protein as well as vitamins, minerals and trace elements (Dastane, 1987).

However, in recent years their consumption is increasing gradually particularly among the urban community. This is due to increased awareness on the exposure to other culture and acquiring proper education (Fisseha, 2002). Recently, pollution of general environment has increasingly gathered a global interest. In this respect contamination of agricultural soils with heavy metals has always been considered a critical challenge in set urban community (Faruk et al., 2006).

Hospital wastewaters are major components of water, contributing to oxygen demand and nutrient loading of water bodies, Promoting toxic algae blooms and leading to a destabilized aquatic ecosystem (Alau, 2015).

This article aimed at determined the level of *E.Coli*, Coliform count bacteria and other physico-chemical parameters which has been compared with standard set by WHO to ascertain whether they are detrimental to human health and the environment within the vicinity of the studied area.

2.0. Materials and methods

Wastewater samples were collected within four different components designated as A1, A2, A3 and A4.

2.1. Bacteriological analysis of wastewater

Wastewater samples for bacteriological analysis were collected in cleaned sterile containers. The samples were designated as A1, A2, A3, A4 and Control which is the source of water from the Teaching Hospital. The Coliform count and E.Coli were determined quantitatively using a special portable UV-Visible spectrometer within one hour after sampling. A portion, $10cm^3$ curvette was filled with wastewater samples and inserted into the machine. The Machine was switched on for few five minutes for stabilization before the reading were taken (APHA, 2000).

The physicochemical parameters analyzed were as follows; PH, temperature, DO, BOD, COD, nitrate, sulphate, phosphate and conductivity. Standard methods were followed in determining the above variables (Greenberg *et al.,* 2000).

3.0. Results and Discussion

The Table 3.1 and 3.2 below showed the results of the physicochemical parameters and bacteriological count of Ahmadu Bello University Teaching Hospital (ABUTH) wastewater.

Table 1: Physicochemical parameters of wastewater from ABUTH

Parameter	A1	A2	A3	A4
pH	6.53±0.12	6.53±0.13	6.86±0.11	7.10±0.13
Conductivity(μscm^{-1})	2071.33±1.18	950.00±1.54	801.00±1.54	781.00±1.78
DO (mg/1)	1.93±0.24	2.33±0.15	1.90±0.25	2.50±0.12
BOD5 (mg/1)	0.83± 0.09	1.60±0.15	0.76±0.12	0.93±0.11
COD (mg/1)	181.00±1.86	210.67±1.72	201.00±1.54	290.33±2.87
Nitrate (mg/1)	30.00±1.54	30.33±1.50	26.08±2.35	23.83±2.62
Sulphate (mg/1)	75.67±1.30	20.33±1.72	20.67±1.87	25.67±1.72
Phosphate (mg/1)	31.00±1.48	29.17±1.23	24.87±0.97	7.86±1.16
Temperature (^0C)	42.32±0.32	14.12±0.12	46.33±2.92	43.36±1.43

****Mean value ± standard deviation of triplicate samples .**

The level of pH varied between 6.530±.12 to 7.100± 0.13 for sampling point A1 to A4 in the hospital wastewater. The Mean pH values recorded for all the sampling point were within the WHO pH tolerance limit between 6.00-9.00 for wastewater to be discharged and channelled into stream.

Dissolved oxygen (DO) values for all the sampling points varied between 1.90 ±0.25 to 2.50 ±0.12 mg/l as shown in table 1. The DO is a measure of the degree of pollution by organic matter, the destruction of organic substance as well as the self-purification capacity of the water body. The standard for sustaining aquatic life is stipulated at 5mg/l. A concentration below this value adversely affects aquatic biological life, while concentration below 2mg/l may lead to death for most fishes (Chapman, 1997). The DO levels at point A1 and A3 were below 2mg/l, while DO at point A2 and A4 are greater than 5mg/l, which implies aquatic biological life will be adversely affected.

An indication of organic oxygen demand content of wastewater can be obtained by measuring the amount of oxygen required for its stabilized either as BOD5 and COD. Biological oxygen demand (BOD5) is the measure of the oxygen required by microorganisms whilst breaking down organic matter, while chemical oxygen demand (COD) is the measure of amount of oxygen required by both potassium dichromate and sulphuric acid to break down both organic and inorganic matters (Wyasu,

2011). BOD5 and COD concentration of the hospital wastewater obtained for point A1 to A4 ranged between 181± 1.86 to 291.33± 2.87mg/l.

The concentration of Nitrate, sulphate and phosphate in all sampling points varied between 23.83 ± 2.69 to 30.33 ±1.50 mg/l for Nitrate; 20.331±.72 to 75.671± .30 mg/l for sulphate and 7.86± 1 .16 to 31.00 ± 1.48mg/l for phosphate respectively (table I). Low concentrations of nitrate, sulphate and phosphate were observed in all the sampling points.

The levels of nitrate and sulphate did not exceed the WHO limits of 45 mg/l and 250 mg/l respectively as recommended for hospital wastewater.

The conductivity value were 2071.33±1.18 μScm^{-1} for A1, 950.00± 1.54 μScm^{-1} for A2, 801.00±1.54 μScm^{-1} for A3 and 781.33μScm^{-1} for A4 (Table3.1). Conductivity of water which is a useful indicator of its salinity or total salt water is high in the wastewater discharge from Ahmadu Bello University teaching hospital, Zaria. This result is not surprising, since wastewater from domestic sewage in which hospital wastewater is a subset, often contains high amount of dissolve salt. Conductivity values for sampling A1 is higher than WHO guideline value of 1000 µScm-1 for the discharge of hospital wastewater channel into streams while value for sampling point A2, A3 and A4 are lower than WHO guidelines and is safe for discharge into streams or river (Greenberg et al., 2000).

Temperature is basically important for its effect on other properties of wastewater. Average temperature of wastewater under investigation is 42.32±0.32^{0}C for A1 41.21±0.12^{0}C for A2, 46.33±2.92^{0}C for A3 and 43.36±1,43^{0}C for A4. The results indicate that some reactions could be speeded up by the discharge of this wastewater into the environment. It will also reduce solubility of oxygen and amplified odour due to anaerobic reaction (less oxygen). These values were higher than WHO standard of 40^{0}C for discharge hospital wastewater into stream (Greenberg et al., 2000).

Table 2: Bacteriological count im wastewater from ABUTH

Microorganism	A1	A2	A3	A4	Control
Coliform count MPN/100ml)	$2.6x10^3$	$2.8x10^3$	$2.7x10^3$	$2.5x10^3$	$3.4x10^2$
E. Coli (MPN/100ml)	$2.6x10^3$	$2.7x10^3$	$2.6x10^3$	$2.5x10^3$	1

From the results obtained in Table 2 above, the lowest value of Coliform count bacteria is 2.5×10^3 MPN/100ml in sampling point A4 due to minor treatment and is the exit point, while the highest value is 2.8×10^3 MPN/100ml in sampling point A2. The control is water from the tap in Ahmadu Bello University Teaching Hospital, Zaria, which has a total coliform count of 3.4×10^2MPN/100ml which is lower than values obtained within the sampling points. Moreover, the highest value of E.Coli is 2.7×10^3 MPN/100ml in sampling point A2. The least value is 2.5×10^3 MPN/100ml, which occur in sampling point A4. The control has a value of 1MPN/100ml which is far below the toxicity level set by the WHO standard (Greenberg et al., 2000).

4.0 Conclusion

The bacterial load suggests that the activities of Hospital wastes in the environment is a major health and environmental threat, which therefore call for a proper regulatory system on disposal of Hospital waste in Ahmadu Bello University, Zaria -Nigeria.

All other physico-chemical parameters determined were below the WHO standard limits with the exception of phosphate and temperature which were higher and DO is very low for the survival of aquatic life.

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