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Bacteriological and Physicochemical Analysis of Selected Domestic Drain Water in the University of Ibadan, Nigeria

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Abstract

Bacteriological and physicochemical analysis were carried out on selected domestic waste water from a drainage system in the University of Ibadan. Twenty-four water samples were collected from the three locations at the ratio of eight samples per drainage A, B and C sources. Physicochemical parameters were determined using standard methods, there are variations in the alkalinity and acidity of the water sampled which ranged from 6 – 7, slight turbidity and suspended dissolved particles that could be responsible for different colorations of the samples were also noticed. The Biochemical Oxygen Demand(a measure of biological degradable organic matter) of the samples varies from 7.0mg/L to 7.4mg/L which has exceeded the standardized breakpoint of 4mg/L index of clean water. The total bacteria count was determined by pour plate technique and four genera of bacteria namely; *Staphylococcus aureus, Klebsiella sp.,Micrococcus sp* and *Proteus sp* were isolated from water samples. The total viable bacteria count of $2.4x10^7$cfu/ml, $1.0x10^5$cfu/ml and C $1.1x10^6$cfu/ml were recorded for the sample A, B and C respectively. Results of the biochemical and microbial analysis obtained from this study serves an indication of bacterio-physicochemical pollution of these domestic drain which could serves as a potential source of infection transmission when not regularly treated.

Key words: Domestic drains water, Bacteria, B.O.D., University of Ibadan.

1.Introduction

Domestic drain water are water that had been used for a profitable domestic purposes which are liberated through a drainage channel to the immediate environment and if such wastewater are untreated, they are a potential reservoir for pathogenic bacteria, parasites, helminthes and insect vectors. n tropical and subtropical regions there is a close link between the presence of excess water (due to lack of adequate drainage) and the transmission of water related vector-borne diseases. Malaria, schistosomiasis (bilharziasis) and lymphatic filariasis are important water related vector-borne diseases. Despite control programmes, health services and available treatments, these diseases today represent a growing health problem. Water related vector-borne diseases are caused by bacteria, viruses and parasites (protozoa and helminths) transmitted by water related disease transmitting agents, also called vectors or intermediate hosts. A vector is an animal, often an insect, that transmits an infection from one person to another person or from infected animals to humans (Cairncross and Feachem, 1983). Most infections can only be transmitted by a particular, disease-specific vector, e.g., malaria by *Anopheles* mosquitoes. An intermediate host has a similar role to a vector. However, such an organism does not actively transmit a pathogen, like freshwater snails in the case of schistosomiasis. Vectors and intermediate hosts represent critical elements in various disease transmission cycles of parasitic water related diseases. In general, they live in or near aquatic environments. High level of fecal indicator bacterial can be indicated by presence of pathogenic micro organisms present in water body. The waste that flow into the drains, mixing with common water, subsequently pose a serious threat to the water ecology, animals

and human: Faecal polluted water may cause health hazard due to the presence of several bacterials, fungi, viruses and protozoa (Mohammed et al, 2008). Misuse and lack of maintenance are the two main reasons why drainage structures (road drainage ditches, culverts, dam site drainage or drainage canals in irrigation schemes, and also drainage water treatment and disposal facilities) are often associated with environmental health problems. Farmers, associations or national agencies generally conduct regular maintenance on irrigation canals. Water quality and flow velocity are relatively high. However, in drainage facilities the opposite conditions are frequent. Silting, uncontrolled aquatic weed growth, slow water flow or stagnant pools associated with the resulting wetlands offer ideal breeding conditions for mosquitoes and aquatic snails. Farmers seem to concentrate on irrigation water management rather than on drainage management. Moreover, there is often a lack of adequate domestic water supplies and sanitation facilities. Thus, drainage canals or drainage water treatment and disposal facilities are often misused for washing, drinking and uncontrolled disposal of human excreta or other waste by the poorest and, thus, most vulnerable social groups. In this way, drainage water contributes to disease transmission. Although health risks arising from chemical pollution are accepted as a major environmental concern, data on medical implications are difficult to obtain and often unavailable for developing countries. Due to the lack of environmental protection and regulation standards as well as the lack of environmental monitoring data, governmental services often neglect the issue of pollution control

The objectives of this study are to determine the physicochemical and bacteriological parameters of the domestic drains water from selected locations in university of Ibadan.

Materials and Methods

Study Area

The University of Ibadan (UI) is the oldest and one of the most prestigious Nigerian universities, and is located five miles (8 kilometres) from the centre of the major city Akinyele local government area of Oyo state.

Collection of Water samples

Twenty four water samples(eight samples per location) were aseptically collected from three designated locations using sterile sampling bottles. They were analyzed immediately at the Department of microbiology of the University

Physicochemical parameters

The pH, Color and Turbidity.

The Ph readings of the water samples were taken using an hand held Hanna WT 3020. The pH meter was standardized with buffer 4,7 and 9 before been used. Both colour and turbidity of each of the samples were determined using Wag WT 3020 turbidimeter.

Alkalinity Determination

Three drops of phenolphthalein indicator and 2ml of sodium thiosulphate solution was added to The solution was titrated with hydrogentetraoxosulphate (vi) to match the color equivalence point of pH 8.3 and phenolphthalein alkalinity im mg/ltr per ppm of $CaCO_3$ were determined.

Hardness

Two milliliter of 1N sodium hydroxide and 1g of murexide indicator were added to 50ml of water sample, the solution was shaken until the pink color were observed and was titrated against ethylenediamine tetraacetic acid. The titre value in mg/L were determined.

Chloride Ion Determination

Two milliliter of potasium dichromate was added to 100ml of water sample, the mixture was shaken and titrated against silver nitrate. Color changes from bright yellow to brown were noticed and the values obtained was multiply by 5 to express the value in mg/mL

Iron Content Determination

Ten gram of alum was dissolved in 100mL of warm water. The dissolved solution was filtered and 10mL of Hcl was added and the preparation was bring to a boil, stannous chloride was added until it became colorless from greenish yellow color. After cooling, 60mL of distilled water, mercury chloride, 30ml of 20% phosphoric acid and 1g of barium diphenyl sulphate were added to the sample. The solution was titrated with 0.10N potassium dichromate.

Filterable solid

Fifty milliliters of the water sample was pippetted and filtered through a conical flask, the filtrate was heated to dryness in a crucible of a known weight. The dried residue weight was deducted from the weight of the crucible.

Biochemical Oxygen Demand

A dilutions of 1/100, 1/50 and 1/33 in a duplicate sets of were prepared by adding 3ml,6ml and 9ml aliquots of the sample to the labeled bottles. The bottles were incubated at 20^{o}C FOR 5 days. 2 mls of mnO_4, 2ml of alkali iodide azide and concentrated tetraoxosulphate VI were added by placing the tip of the pipette below the surface of the liquid n the 300ml bottles. The bottles were allowed to stands for 45 mins and concentration of 20.5ml of the sample was titrated against 0.025N ($Na_2S_2O_3$). Color changes from yellow to colorless was observed at the endpoint when freshly prepared starch was introduced as an indicator.

Bacteriological Quality Determination

The total bacterial count was determined by filtering each sample of the drain water through a millipore membrane and pads. The pads were placed aseptically containing 1.8ml of endobroth agar . The preparation were incubated at 37^{o}C for 24 hrs. The sub-culture were made into nutrient media for the enumeration of total bacteria count using standard technique. Conventional biochemical characterization for the determination of catalase, urease, citrate, coagulase and indole were carried out on the isolates.

Results

The table 1,2 and 3 below elicited the physicochemical analysis of the drain water from site A, B and C . The varied physicochemical parameter values could be traced to different sources and activities associated with the drainage samples. The total viable bacterial count as shown in table 4.0 range within the ratio 2.4×10^{7}, 1.0×10^{5} and 1.1×10^{6} respectively. The isolates obtained from the drain samples elicited varied biochemical properties as shown in table 5, 6 and 7 respectively.

Table 1.0 The Physicochemical Parameters of Site A Drain Water Sample

Sample A Parameters	Values Obtained
Appearance	Blackish with particles
Color	>70
pH	7.0
Total Alkalinity	72
Total Hardness	158
Chloride	95.5
Iron	>0.2
Calcium	36
Silica	<1.0
Oxygen Demand	7.2
BOD	
3ml	7.1
6ml	6.1
9ml	5.4
Total Dissolved Solids	1688
Suspended Solids	318
Filterable Solids	1370

Table 2.0 The Physicochemical Parameters of Site B Drain Water Sample

Parameters	Values Obtained
Appearance	Clearer with particles
Colour	40
pH	7.2
Total Alkalinity	72
Total Hardness	76
Chloride	68
Iron	0.2
Calcium	20
Silica	10
Oxygen Demand	7.4
BOD	
3ml	7.0
6ml	6.8
9ml	6.9
Total Dissolved Solids	258
Suspended Solids	24
Filterable Solids	234

Table 3.0 The Physicochemical Parameters of Site C Drain Water Sample

Parameters	Values Obtained
Appearance	Blackish with particles
Colour	60
Ph	6.6
Total Alkalinity	94
Total Hardness	102
Chloride	51
Iron	0.2
Calcium	36.2
Silica	14
Oxygen Demand	7.2
BOD	
3ml	7.0
6ml	6.7
9ml	6.7
Total Dissolved Solids	5262
Suspended Solids	5062
Filterable Solids	200

Table 4.0 Microbial Load in Waste Water from site A, B and C along the drain

Source	Total viable count (cfu/ml)
Site A	2.4×10^7
Site B	1.0×10^5
Site C	1.1×10^6

Table 5.0 Biochemical Characterization of isolated microorganism from Site A

Sample A	Shape	Gram reaction	Glucose	Mannitol	Lactose	Catalase	Indole	Citrate	Urease	Coagulase	Motility	H_2S	Suspected Microrganism
Sample 1	C	+	AG	AG	AG	+	+	-	+	+	-	+	*Staphylococcus aureus*
Sample 2	C	+	AG	AG	AG	+	+	-	+	+	-	+	*Staphylococcus aureus*
Sample 3	C	+	AG	AG	AG	+	-	-	+		-	+	*Micrococcus sp*
Sample 4	C	+	AG	AG	AG	+	-	-	+		-	+	*Micrococcus sp*
Sample 5	C	-			-		AG	V	-		+	+	*Proteus sp*
Sample 6	C	-	AG	AG	AG	+	-	+	+		-	+	*Klebsiella sp*
Sample 7	C	-	AG	AG	AG	+	-	+	+		-	+	*Klebsiella sp*
Sample 8	C	+	AG	AG	AG	+	+	-	+	+	-	+	*Staphylococcus aureus*

KEY: Sample A

C = Cocci +=Positive - = Negative
AG =Acid and Gas Production V= Variable R =Rod

Table 6.0 Biochemical Identification of the Bacterial Isolates from Site B

Sample B	Shape	Gram reaction	Glucose	Mannitol	Lactose	Catalase	Indole	Citrate	Urease	Coagulate	Motility	H_2S	Suspected Microrganism
Sample 1	*C*	+	*AG*	*AG*	*AG*	+	+	-	+	+	-	+	*Staphylococcus aureus*
Sample 2	*C*	+	*AG*	*AG*	*AG*	+	+	-	+	+	-	+	*Staphylococcus aureus*
Sample 3	*C*	+	*AG*	*AG*	*AG*	+	+	-	+	+	-	+	*Staphylococcus aureus*
Sample 4	*R*	-	*AG*	*AG*	*AG*	+	-	+	+		-	+	*Klebsiella*
Sample 5	*C*	+	*AG*	*AG*	*AG*	+	+	-	+	+	-	+	*Staphylococcus aureus*
Sample 6	*C*	+	*AG*	*AG*	*AG*	+	+	-	+	+	-	+	*Staphylococcus aureus*
Sample 7	*C*	+	*AG*	*AG*	*AG*	+	+	-	+	+	-	+	*Staphylococcus aureus*
Sample 8	*C*	+	*AG*	*AG*	*AG*	+	+	-	+	+	-	+	*Staphylococcus aureus*

KEY: Sample B

C = Cocci +=Positive - = Negative
AG =Acid and Gas Production V= Variable R =Rod

Table 7.0 Biochemical Identification of the Bacterial Isolates from Site C

Sample C	Shape	Gram reaction	Glucose	Mannitol	Lactose	Catalase	Indole	Citrate	Urease	Coagulate	Motility	H_2S	Suspected Microrganism
Sample 1	R	-	AG	AG	AG	+	-	+	+		-	+	*Klebsiella sp*
Sample 2	R	-	AG	AG	AG	+	-	+	+		-	+	*Klebsiella sp*
Sample 3	R	-	AG	AG	AG	+	-	+	+		-	+	*Klebsiella sp*
Sample 4	C	+	AG	AG	AG	+	+	-	+	+	-	+	*Staphylococcus aureus*
Sample 5	C	+	AG	AG	AG	+	+	-	+	+	-	+	*Staphylococcus aureus*
Sample 6	C	+	AG	AG	AG	+	+	-	+	+	-	+	*Staphylococcus aureus*
Sample 7	C	+	AG	AG	AG	+	-	-	+		-	+	*Micrococcus sp*
Sample 8	C	+	AG	AG	AG	+	-	-	+		-	+	*Micrococcus sp*

KEY: Sample C

C = Cocci +=Positive - = Negative
AG =Acid and Gas Production V= Variable R =Rod

DISCUSSION AND CONCLUSION

The appearance of the drain water samples collected varied from brackish to clearer water with particles. The pH of the water samples ranged from 6.6 to 7.2 while the alkalinity were within the ratio of 72mg/L to 94mg/L which could be due to the activities associated with the water usage. The hardness and chloride contents of the water were equally examined, and it was recorded within the variations of 76 to 158 and 51 to 95.5mg/L respectively.

Color is an important physical quality of water which determine the composition of the water sample, the TCU values ratios of 40, 60 and 72 were obtained for the samples examined. The variation in color could be due to mineral composition of the water coupled with the activities related to the water usage.

The iron content of ≥ 0.2 were obtained for the three samples while calcium contents recorded ranged between 20 and 32.6 but a sharp variation were obtained in silica contents determination. The values obtained ranged between ≤1.0 to 10mg/L. The Biochemical Oxygen Demand for sample C

7.0, 6.7 and 7.2 . The filterable solids were found to be the lowest in sample C compared 200mg/L to 1370mg/L in sample A. The amount of suspended solid was very high in sample C 5062mg/L followed by site A 318mg/L and 24mg/L was recorded for sample B.
The platecount of the samples on endobroth elicited site A 2.4×10^7 cfu/ml, 1.0×10^5 cfu/ml for the sample B and site C had a 1.1×10^6 cfu/ml as elicited in Table4.0 above. Both Gram positive and Gram negative bacteria were isolated from these studies. *Staphylococcus aureus* and *Micrococcus sp.*were prevalent in the samples followed by *Klebsiella sp* which could be due to the nutritional components available for the survival and multiplication of the microbes in the water samples. The conventional biochemical identification tests for the isolates includes; Gram staining, glucose, lactose, mannitol, indole, catalase, urease, coagulase, motility and Hydrogen sulphide reaction tests. The isolates reacted differently to biochemical sugars and salts available. These types of pathogenic microbes obtained from the samples portrayed the danger associated with the untreated domestic drains which could serves a precursor pool or reservoir for the evolution of life threatening infections. Also, a regulatory authority should be made functional by providing adequate facilities for those agency to carry out their duties and environmental enforcement monitoring should be put in place to oversee the compliance and maintenance of domestic and industrial drains and stagnant pools and estuaries to minimize or curtailed the risk of contacting infections in epidemiologic proportions.

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