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MULTIPLE USE OF SURFACE WATER RESOURCES AND BACTERIA COLONIZATION OF WATER BODIES - CASE (I) NKISI RIVER, ANAMBRA STATE, NIGERIA.

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Abstract

Water samples collected along the Nkisi River course within Nkpor were analyzed for bacterial species inventory and Total viable Count (TVC) using the multiple test tube technique and colony counters. Nine species of bacteria including E-coli, staphylococcus aureus, salmonella, and fecal streptococci among others were identified. Total viable counts gave alarming growth levels when compared to the standards as set by the World Health Organization (WHO). The microbial population explosion in the river is attributable to the multiple activities within and around the river also the uses including wash off from abattoirs carrying abattoir wastes directly into the river, domestic wastes dumped along the recharge path, others include in stream fermentation of food stuff and general laundry point for any for clothes, automobiles. All these make sufficiently available to enhance microbial growth. Surface water use should be monitored to ensure sustainability and proper management of watershed will control this trend of colonization of public water supply sources and in turn control the trends in water borne infections.

Key words: Bacteria, species inventory, surface water, multiple use, watershed management

Introduction

According to Ayoade, (1988); the biological characteristics of water refers to the bacteriological content, coli form counts, as well as algal counts, Biochemical Oxygen demand (BOD) and Dissolved Oxygen (DO). The facts remains that there is no pure water in nature, water quality is naturally influenced by rock weathering, animal wastes, and vegetable matter. While rock weathering influences the inorganic chemistry of the water, animal wastes and vegetable matter apart from influencing the organic content also affects the BOD and DO as they set the stage for nutrient fixing microorganisms to breed in the water. By implication, the colonization of water by organisms depends on the physical and chemical state of the water (Okechukwu, 1983). Man-made interferences that can lead to water quality problems include: such uses as (i) receiving stream for sewage discharge from adjourning municipality (ii) abattoir wastes (iii) hospital wastes (iv) in-stream general laundry and fermentation of food stuffs. This sort of use is incompatible with uses such as (i) recreation and navigation (ii) drinking purposes (iii) supporting other aquatic lives (iv) general ecosystem functions. From past studies, such nutrients from such sources contain nitrates, phosphates and even sulfates in large amounts, in fact beyond the carrying capacity of the affected water body. The result is that undergoes deterioration in quality giving room to algal blooms, growth of other aquatic plants, eutrophication, Oxygen depletion, acidification of the water body and consequent death of aquatic organism. Bacteria enter water bodies from range of land uses across the catchments and unsustainable water uses Disease causing organisms enter water supplies via human wastes and sewage (Wagner et al., 1959). One of the major challenges facing environmental managers, hydrologists, water resource analysts and the allied professionals in Nigeria today is the problem of surface water pollution. Rapid urbanization, domestic and industrial activities constitute the sources of pollutants to urban and rural rivers. Surface water supplies vary in quality relative to the seasons, climatic conditions and uses (Onwuekwe, 2004; Watts, 1953; Nwachukwu et al., 1998). Nkisi River is subjected to multiple uses without monitoring, as though they constitute a center for all human activities in the community; from what may be termed as general laundry (for motor bikes, fermented starches, clothes etc), through agricultural food processing, domestic uses, recreational for children, gravel and sand mining, navigation, fishing and it plays host to waste dumps including wash offs from abattoirs and agricultural lands within the its catchment. This wide range of unmonitored uses places the quality of the surface water in doubthence,this work tried to estimate the bacteria load in the Nkisi River as downstream at the Onitsha end, it serves an intake source for the Greater Onitsha water supply scheme with the intent as to advice on management options. The presented study is limited to bacteria species inventory and the determination of the total viable counts for the species of bacteria identified in the course of the analysis of the water samples. It is further restricted to upstream area from which samples were taken.

Procedure for Data Collection

In accord with the standard procedure for water and wastewater sampling of (APHA –AWWA-WPCF, 1995), grab samples were collected from eight (8) locations across the Nkisi River water course from Nkpor axis and on the upstream part. Bacterial load in the water samples was obtained by a range of procedures from plating-incubating-culturing-filming to counting on microscope for species inventory. The individual count was done to ascertain the actual load or population of the individual species identified.

Incubation

It is doneto test for species inventory, the water samples were incubated in Mac Conkey broth medium at 37^{o}C and 45^{o}C for 48hours using the multi test-tube technique. The test revealed the presence of nine species of bacteria including E-coli, staphylococcus aureus, salmonella and shigella, yeast and mould,proteus mirabilis, Klebsiella pneumonia, pseudomonas aeuriginosa and fecal streptococci. Bacteria was presumed present with gas bubbles on inverted tubes indicating the presence of E-coli, thermo tolerant coli-form spp on Petri dishes, acid pH change confirms the presence of Streptococcus Bacilli and translucent agar plates for Salmonella Typhi. Aerobic incubation in Salmonella Agar at 35^{o}C for 18-24hours showed colourless and translucent appearance that did ferment lactose nor produce H_2S which is indicative of Shigella and some Salmonella species colonies. Translucent with a black center and producing H_2S indicates the presence of Proteus Mirabilis and most Salmonella spp. Incubation in Cled Agar: yellow opaque colonies indicates presence of E-coli; extremely mucoid colonies varying in colour from yellow to whitish blue indicates Klebsiellaspp; yellow to green colonies indicates Pseudomonas Aeuriginosa; yellow colonies indicates the presence of streptococci faecalis whereas deep yellow colonies presents staphylococcus aureus spp.

Biomass Estimation

The heterotrophic plate count was used to determine the total viable count of the individual bacterial species identified. On serial dilution, 2ml of water sample was adapted in 10ml of molten yeast agar extract on flat dish at 45^{o}C. The culture was allowed to cool down and the plates inoculated at different temperature and time ranges (one at 22^{o}Cfor 72hours and the other at 37^{o}C for 24 hours). The colonies that appeared were counted on the microscope and the counts reflect the Total Viable Counts for the individual water borne bacteria present.

Membrane Filtration

Further step was taken as to confirm the presence of thermo- tolerant species of coli-form bacteria, so that the water sample was passed through the membrane filtration equipment and the filter incubated in Lauryl Sulphate Agar plates aerobically for 24 hours at 22^{o}C and then for 14hours at 44^{o}C, a yellow colony confirms coli-form present. Positive methyl red reaction (indicative of a mixed acid fermentation) and negative reaction/non citrate utilization in appropriate media can aid confirmatory tests for coli-form.

Findings

The table below shows that about nine (9) different species of bacteria were present in varying number of counts in all the samples which were collected from different locations along the water course. Table 1 below reflects the result of the species inventory and the total viable counts (TVC) for the individual species identified.

Table 1: **The result of bacteria Species inventory and the total viable counts (TVC)**

Serial number	Bacteria spp	Mean	minimum	maximum
1	Escherichia coli	7.4 x10^2	3.0 x 10^5	7.7 x 10^5
2	Clostridium perfringes	2.3 x10^2	1.4 x 10^5	5.4 x 10^5
3	Salmonella and shigella	4.6 x10^2	2.9 x 10^5	7.2 x 10^5
4	Yeast and mould	3.6 x10^2	1.7 x 10^5	5.2 x 10^5
5	Proteus mirabilis	4.4 x10^2	2.9 x 10^5	6.3 x 10^5
6	Staphylococcus aureus	5.1 x10^2	4.2 x 10^5	6.5 x 10^5
7	Klebsiellapneumonaiae	5.1 x10^2	3.3 x 10^5	7.2 x 10^5
8	Pseudomonas aeuriginosa	5.4 x10^2	3.8 x 10^5	7.2 x 10^5
9	Streptococcus fecalis	6.9 x10^2	4.8 x 10^5	9.1 x 10^5

The result of the analysis as presented in the table which tries to compare TVC within and across samples. Observation shows that there are variations in TVC between species and across samples and from location to location. The variation from place to place may be attributed to the proximity to the various point sources of these organisms, as regards the points of entrance into the water bodies from human activities in those places. The figures below tend to reflect the relationships in graphical form.

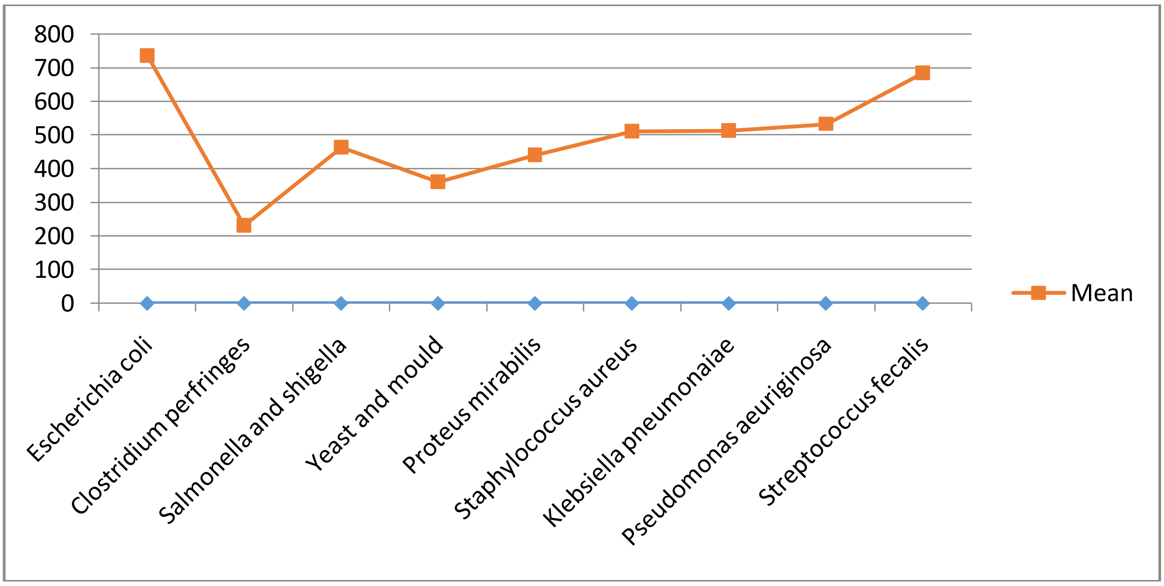

Figure 1.Graphical representation comparing mean TVCacross the Nkisi River water course

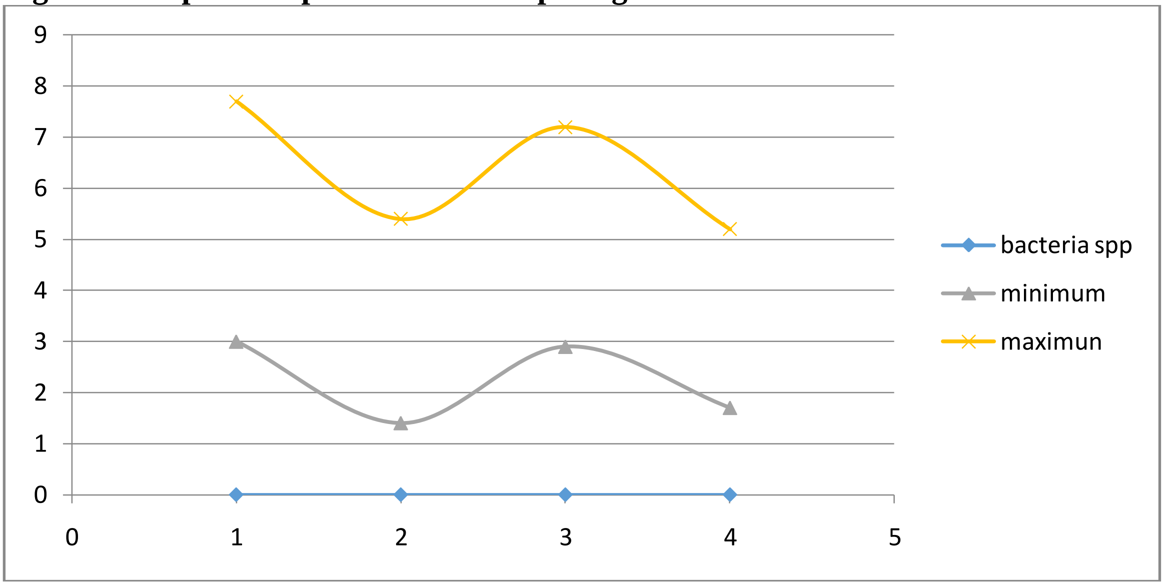

Figure 2.Graphical representations comparing the minimum and the maximum TVC

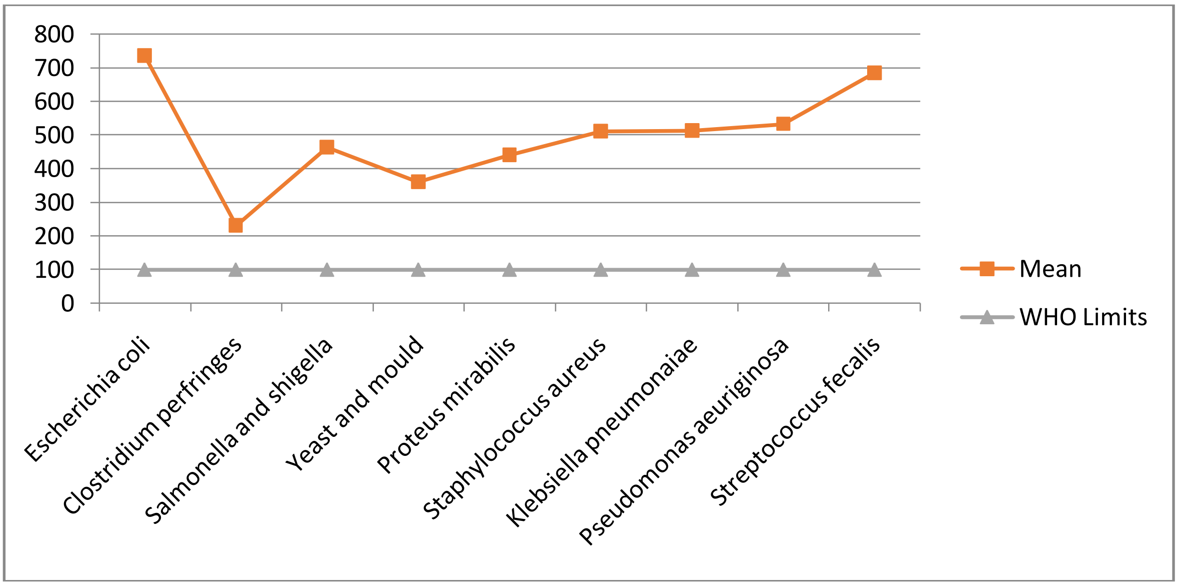

Figure 3.Graphical representations comparing the mean TVC in samples with WHO limits

Discussion of Findings

The extent of colonization in terms of spread and the numerical strength of the organisms show that the water supply source in the study area is unfit for drinking and most domestic uses.It is also evident that using such water in washing of food stuff; and for bathing predisposes the very user to infection. The water use pattern designate in the study area serve as a recycling process to these organisms concerning the severity of routine uses which the water body serves from drinking, through other domestic uses to playing host to human wastes (directly discharged by persons into the water or indirectly through runoff) and wastes (domestic, industrial and agricultural). Common around the river catchment is a big abattoir supplying meat to the metropolis and the said abattoir relies on this water body for (i) water supply for processing and dressing of various cow meant parts including washing bowels and emptying cow dung straight into the river(ii) receiving stream for the wastes from the abattoir that include blood and other wastes that are washed away from the working surface and channeled direct into the river. The fact also remains that these activities are within the catchment area of the said river. It is a general trend in Anambra State that abattoirs are located near water bodies for two obvious reasons (i) for a handy source of water supply (ii) and for discharging the effluent as there is sewer system for effluent discharge. Below are plates showing some of the activities that are a common place in some Nigerian river systems especially in the eastern Nigeria.


Plates 1 and 2 showing a portion of Nkisi River during sampling


Plates 3 and 4 showing portions of the river


Plates 5 and 6 showing different uses of the River


Plates 7 and 8 showing activities around the catchment area of the River

Plate 9 still showing the River in a different color

Why would abattoirs not be located at appropriate places and why are there no sewer systems instead of recycling microorganisms through their activities? This question if it can be given a candid and a sustainable answer; the surface water bodies in the affected areas of the state would wear a sustainable look.The plates showed other activities in and around Nkisi River.

Summary

The surface water sources of water supply in the study area require massive disinfection along the length and breadth of the water bodies. The direct use of such water sources in washing fermented starches and other biodegradables as well as direct discharge of wastes by persons of human wastes into the surface water bodies or on the recharge area should be discouraged by community leaders. Dislodging industrial wastes into the surface water sources should be disallowed while protecting the recharge paths from agricultural land wash offs and the water bodies from any harmful activity. The surface water sources can be kept from direct use especially the upstream side and water can be pumped out and piped away from source to various locations and as the need arises. Even canals/impoundment pits can be used to extract water from the main rivers/streams to provide for other uses.

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