

Physico-Chemical and Microbiological Qualities of Abattoir Wastewater in Egbu, Imo State, Nigeria.

ABSTRACT

Abattoir waste water is of a complex composition. When discharged without being treated, poses a threat to human health and the environment. This is the practice common in Nigeria, and is worrisome.

Objective:The aim of this study was to assess the physico-chemical and microbiological qualities of waste water from Egbu abattoir discharged into 'Otamiri' river in Owerri North local government area, Imo State, Nigeria.

Methods:

The microbial quality of abattoir wastewater was studied. Samples were collected from the Egbu abattoir and from the point of entry(POE) of the effluent into Otamiri river, in Owerri North L.G.A, Imo State, Nigeria. Standard methods were employed to assess the microbiological and physiochemical quality of the effluent. The microorganisms isolated from the samples included *Escherichia coli*, *Salmonella*, *Staphylococcus*, *Aspergillus*, *Mucor*, *Listeria*, *Micrococcus* and *Candida* species. The Total Heterotrophic Count (THC) of effluent samples, at source and POE were $8.51\log_{10}$ cfu/ml and $6.15\log_{10}$ cfu/ml respectively, Total Coliform Count (TCC) for same samples were $6.77\log_{10}$ cfu/ml and $4.56\log_{10}$ cfu/ml respectively. The Total Fungal Count (TFC) of the effluent samples at source and at POE were $5.19\log_{10}$ cfu/ml and $4.18\log_{10}$ cfu/ml respectively. Results further revealed that the pH of the effluent at source was 6.58 while that at Point of Entry into the river was 7.30. The temperature of both samples was 25°C . The Total Dissolved Solid values of the effluent collected at source was higher, having a value of 1400mg/L against 1000mg/L at Point of Entry. Also the Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) values of the effluent at source were 5.10mg/L and 8.58mg/L respectively, while the BOD and COD of the water at the POE were 4.3mg/L and 7.9mg/L respectively.

Conclusion:

Abattoir wastes are becoming a major environmental health challenge and being discharged into the Otamiri River indiscriminately is of public health concern.The potential public health implications associated with discharging untreated abattoir wastewater into the environment and thus, the need for adequate treatment to ensure decontamination as well as providing wastewater treatment facility is imperative.

Keywords:Effluent, Physico-chemical, microbiological qualities, Biochemical Oxygen Demand, Chemical Oxygen Demand, Heterotrophic Count and decontamination

1. INTRODUCTION

Abattoir wastewater is the water obtained after washing the remains of slaughtered animals and the slaughter house floor [1]. In developing countries like Nigeria, wastewater discharged from abattoirs is usually not treated before release into water bodies. Abattoir wastewater usually has a complex composition and is very harmful to the environment [1]. The animal blood is most often released untreated into the flowing stream while the consumable parts of the slaughtered animal are washed directly into the flowing water [2,3]. The release of this wastewater into water bodies is of public health concern because the water bodies into which these effluents are discharged serve various purposes to the residents in that area including being a source of potable water, domestic water and for irrigation of farm lands [1]. The water bodies also serve as tourist attraction centers and can also be used for swimming.

In Nigeria, the abattoir industry is an important component of the livestock industry, as it provides domestic meat supply to over 150 million people and employment opportunities for a good number of the population [4]. However, this industry is less developed and facilities for the treatment of abattoir effluents are lacking, unlike in advanced countries where these facilities are adequately provided [5]. Large amounts of solid waste and effluent such as rumen contents, blood and wastewater are generated from abattoirs and they pollute surface and ground water with pathogens and undesirable chemical compounds [6]. Such contamination of water bodies from abattoir wastes could constitute to significant environmental and public health hazards [4, 7, 8]. Potential health risks from waterborne pathogens have been recorded in water contaminated with abattoir effluents such as the occurrence of diseases like diarrhoea, typhoid and cholera [9; 10].

The organic load of abattoir wastewater could be very high, hence abattoir effluents usually increase levels of nitrogen, phosphorus and total solids in receiving water body considerably. Excess nutrients cause the water body to become choked with organic substances and organisms. When the concentration of organic matter exceeds the capacity of the micro-organisms in water that break down and recycle the organic matter, it encourages rapid growth, or blooms of algae, leading to eutrophication [11]. The improper management of abattoir wastes and subsequent disposal either directly or indirectly into river bodies portends serious environmental and health hazards to both aquatic life and humans.

This study was carried out to determine the physico-chemical and microbiological characteristics of effluents generated from the abattoir as well as those of the surrounding water body these effluents are discharged into.

2. MATERIALS AND METHODS.

2.1 Sample collection

The samples were collected with sterile flasks at different points of discharge from the slaughter house and the Point of Entry (POE) of the effluent into Otamiri River. The samples were

Comment [A1]: Time and duration for collection

How many sites were selected

How many total number of samples collected

Comment [A2]: Collected by whom

Were the staff trained for collection packing and transport of samples .

Who selected the sites

Was there consent taken from site owners for collection of samples

immediately taken to the laboratory for analysis using standard procedures for examination of water and wastewater [26].

Comment [A3]: Name of the facility, department ?

2.2 Measurement of physico-chemical parameters

The temperatures and pH of the samples were measured using a mercury thermometer and a Hanna pH meter PHS 25-H198107 model respectively. Determination of Total Dissolved Solids (TDS), Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) were carried out using the methods described by [26].

Comment [A4]: Were the temperature recorded at the site or at the laboratory ?

Comment [A5]: Which place this test was carried out ?

2.3 Culture media preparation

Culture media used which included Nutrient Agar (NA), Potato dextrose Agar (PDA), MacConkey Agar (MA) and Salmonella-Shigella Agar (SSA) were all prepared according to the manufacturer's specification. Ten-fold serial dilutions of the effluents were carried out and 0.1 ml each of the diluted samples was aseptically introduced into appropriate agar plates followed by the addition of sterile prepared media using the pour plate technique. The plates were incubated at 37°C for 24 hours for bacteria and 72 hours for fungi. Biochemical tests were carried out on pure bacterial isolates using standard methods as described by [12] and [13]. Macroscopic and microscopic examinations including staining for morphological characteristics were carried out on bacterial and fungal isolates for identification based on the characteristics observed.

Comment [A6]: Kindly share photograph of each media plate before and after inoculation

Comment [A7]: Kindly mention the staff who performed the dilutions and have they received formal training in the specific test technique

Comment [A8]: Method adopted kindly mention

3. RESULTS

3.1 Microbiological Assessment of the Samples

The results of the total bacterial counts (TBC), total coliform count (TCC), total fungal count (TFC) and total Salmonella count (TSC) of the samples are presented in Fig 1. The microbial counts of the effluent samples obtained at source were higher than that of point of entry (POE) into the river. Bacterial and fungal species recovered from the abattoir wastewater are presented in Table 1. The microorganisms isolated from the abattoir wastewater samples included: *Escherichia coli*, *Bacillus* sp, *Salmonella* sp, *Micrococcus* sp, *Staphylococcus* sp, *Aspergillus* sp, *Candida* sp and *Mucor* sp. However, there was similarity in the microbial distribution in the samples as both the effluent (E) and point of entry (POE) samples had *Staphylococcus* species, *Salmonella* species and *Escherichia coli* isolated from them.

Comment [A9]: Did the study have a control site, samples collected in the same region but without abattoir.

Site from same river at a higher level than the abattoir exposure

If not how does the study compare species in the river without abattoir and with abattoir

Comment [A10]: Why no control was used in the study.

How does the author determine that same organisms are not present in sites without abattoir exposure

Comment [A11]: Photograph of colonies and microscopic finding kindly attach

Comment [A12]: This is an obvious finding

3.2 Physico-Chemical Analysis of the Samples

The physico-chemical results of the samples are shown in Table 2. The results were within the Federal Environmental Protection Agency (FEPA) permissible level. The BOD, COD and TDS values for effluent sample (E) were higher than that of the POE into the river. The temperature value was 25°C for both samples. The pH values for the samples were slightly acidic and basic with values, 6.58 and 7.30 for effluent and point of entry, respectively.

Comment [A13]: This would depend the time of the day at which sample is collected

Comment [A14]: Scientific reason for this finding

Table 1 Bacterial and Fungal isolates from effluent samples

Sample Code	Bacterial Isolates	Fungal Isolates
E ^a	<i>Listeria</i> sp, <i>Staphylococcus</i> sp, <i>Salmonella</i> sp, <i>E.coli</i> ,	<i>Candida</i> sp
POE ^a	<i>Staphylococcus</i> sp, <i>Micrococcus</i> sp, <i>Salmonella</i> sp, <i>E.coli</i> ,	<i>Mucor</i> sp, <i>Aspergillus</i> sp

E – Effluent sample; POE= Point of Entry sample

^aSame alphabet shows there is similarity in microbial distribution between the locations.

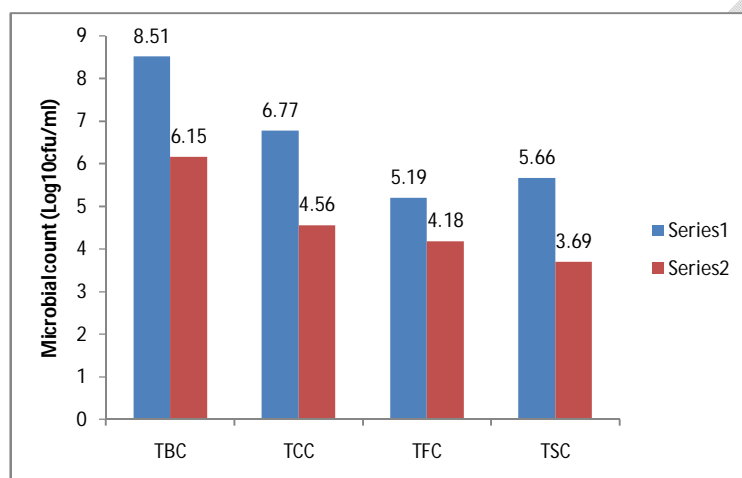


Fig 1: Total Microbial Count (log₁₀CFU/ml) of the Abattoir waste water Samples

Keys: TBC= Total Baterial Count; TCC= Total Coliform count; TFC= Total fungal count; TSC = Total salmonella Count; **Series1** = Effluent sample; **Series2** = Point of entry sample.

Table 2. Physico-chemical Attributes of the Abattoir Wastewater samples

Parameters	E	POE	FEPA Standard Limit
Temperature (°C)	25.0	25.0	<40
BOD (mg/l)	5.10	4.30	50

COD (mg/l)	8.58	7.90	80
TDS (mg/l)	1400	1000	2000
pH	6.58	7.30	6-9

Keys: E= Effluent sample from source;POE= Point of Entry sample

4. DISCUSSION

The isolation of *Escherichia coli*, *Bacillus* sp, *Salmonella* sp, *Micrococcus* sp, *Staphylococcus* sp, *Aspergillus* sp, *Candida* sp and *Mucor* sp (Table1) corroborates the results of [1,14,15], who also isolated similar organisms. The similarity index done using Sorenson's coefficient showed high degree of similarity in the microbial distribution of the wastewater samples. This also agrees with the report of [1]. Similar pathogenic microorganisms had been isolated from abattoir wastewater in different parts of Nigeria by [16; 17]. According to [18] and [19], any water body with such a level of contamination will be neither good for domestic use nor should supposed be discharged directly into the environment without treatment. The wastewater from the abattoir is washed into open drainage and these wastes may introduce enteric pathogens into the nearby river and thus serve as a vehicle for gastrointestinal infections The occurrence of these microorganisms is an indication of high contamination levels of the receiving water bodies. These organisms could cause illnesses such as diarrhoea, aspergillosis and other health complications [15, 20, 21].

Furthermore, the effluent sample obtained from source of discharge had higher counts of 8.51Log₁₀cfu/ml, 6.77 Log₁₀cfu/ml, 5.19Log₁₀cfu/ml, and 5.66Log₁₀cfu/ml for TBC, TCC, TFC and TSC respectively. The high count of these organisms in these effluents may possibly be due to their high content of wholeblood which served as a rich protein medium for microbial growth[20, 22].

The physic-chemical analysis showed that the effluent sample had a higher BOD, COD, and TDS values than the POE sample. The higher values of these parameters for effluent samples from source are in agreement with the report of [16, 23]. This could be attributed to the fact that the effluent usually contains fat, blood, bones, and other substances which are rich in nutrients and also support microbial growth [24].

The temperature of the samples were 25°C and these were within the acceptable limit of <40°C reported by [26] and also regarded as the normal temperature range for effluent discharge. Temperature is one of the most important environmental features in waste water. It controls behavioural characteristics of organisms and solubility of gases and salts in water [25]. The pH of the samples, as recorded pH 6.0 – 9.0, were also within the limit for effluent meant for discharge add were also in tandem with the results obtained by [1], however [26] obtained pH of 5.7-6.7 for abattoir wastewater.

Comment [A15]: Kindly split the two words

Comment [A16]: How many sites in the study in total, out of that how many following the standard protocol and how many did not follow standard protocol for discharge of abattoir and waste products kindly mention

Comment [A17]: What is considered as normal range kindly specify

The BOD of both samples at source (E) and point of entry (POE) into river were 5.10mg/l and 4.3mg/l respectively and were within the FEPA permissible level [29]. The COD values were also within FEPA permissible level of <80mg/l. The low level of COD and BOD may be an indication that oxidation of organic matter is taking time due to high microbial contamination [27, 28]. The low level of COD and BOD obtained in this study are not in agreement with other works done by [1 and 24], having reported high COD and BOD levels. The TDS of the samples were within the permissible level of FEPA as recorded.

5. CONCLUSION

This study has revealed that abattoir activities and management have direct and indirect negative effects on the environment and public health. The results also showed that discharges from the abattoir may pose serious health issues if discharged directly into the river, making the river water unfit for domestic usage. The microbial and physico-chemical properties of the abattoir effluent as recorded make it very important for abattoir owners to treat their effluents properly before they are introduced into the surrounding water bodies. It is also important that water obtained from the nearby river is treated before they are used for domestic purposes to prevent occurrence of zoonotic diseases. Government agencies and other stakeholders should develop methods for monitoring the treatment of abattoir waste for reasons of environmental conservation and public health.

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Comment [A18]: All parameters are within limits of fepa

Kindly verify technique

Since the study does not have a control it is difficult to compare results without exposure

Comment [A19]: Hence kindly verify the technique and results and eliminate errors in performing the test recording or interpretation

Comment [A20]: How can the autho say this when all physio chemical tests are within fepa limit

Comment [A21]: Incomplete finding as the study does not tell about the organisms found in the river without abattoir exposure

Comment [A22]: All of these are within limit as found in this study

Comment [A23]: How many abattoir owners were selected for the study how many were following and how many are not following ,

How many have license for running the shop kindly verify

Comment [A24]: How is it supposed to be treated kindly give a brief description

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