



Characterization of Bacterial and Fungal Populations Present in the Wastewater Released by the Ogbe Slaughterhouse

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Authors' contributions

This work was carried out in collaboration among all authors. Authors NM, IC and NO designed the study. Authors NM, EI and OP performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors NO, EI, OP and OC managed the analyses of the study. Authors IC, NO, EI, OP and OC managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

This work aimed to characterize the bacterial and fungal concentrates present in the wastewater thrown by the Ogbe slaughterhouse. Bacterial and fungal concentrates from Ogbe slaughterhouse wastewater were evaluated at two seasons. Results obtained showed total heterotrophic bacterial count (2.0×10^5 - 2.1×10^5 cfu/mL) and total fungal count (1.5×10^5 - 2.0×10^5 cfu/mL). Bacterial isolates such as *Acinetobacter sp.* (0.50-3.65%), *Citrobacter sp.* (3.00-9.13%), *Escherichia sp.* (2.50-13.69%), *Klebsiella sp.* (2.50-14.16%), *Proteus sp.* (2.00-9.13%), and *Staphylococcus sp.* (11.00-

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13.69%) were higher in dry season than rainy season. *Bacillus sp.* (9.13-23.00%), *Enterobacter sp.* (0.00-3.00%), *Micrococcus sp.* (6.85-7.50%), *Pseudomonas sp.* (12.84-25.00%), *Salmonella sp.* (4.57-5.00%), *Serratia sp.* (0.00-1.50%) and *Streptococcus sp.* (4.57-13.00%) were higher in rainy season than dry season. Mould isolates such as *Absidia sp.*, *Aspergillus sp.*, *Fusarium sp.*, *Cladosporium sp.*, *Penicillium sp.*, and *Rhizopus sp.*, were observed in the present study. Apart from *Penicillium sp.*, the percentage occurrence of all the observed mould isolates in wastewater for the seasons were higher than their respective control. *Candida sp.*, *Saccharomyces sp.*, and *Torulopsis sp.* were among the yeast isolated from wastewater generated from Ogbe abattoir in this study. The observed isolates become important when their potential risk as pathogens as well as the intensified environmental health hazards they pose to humans living within the abattoir environment are considered.

Keywords: Abattoir; microbial concentrates; Ogbe; seasons; wastewater.

1. INTRODUCTION

Animal slaughtering for public consumption is normally done in abattoir. Abattoir is simply a place where animals such as cattle, cow, goats, and others meant for human consumption are killed, dressed and distributed for the purpose [1]. Apart from consumption, other parts of animals killed in abattoir are also distributed as raw materials to industries that require them for production purposes. On a general note, the slaughterhouse of animals forms an important component of livestock industry [2,3]. Nwachukwu, et al. [4] noted that outside the known functions of serving as killing, dressing and distribution point for animals used as food as well as raw materials, that abattoir also performs the function of reduction of unemployment to the populace.

Nafarnda, et al. [3] note that in Nigeria, the abattoir industry is an important component of the livestock industry providing domestic meat supply to over 150 million people and employment opportunities for teaming population. However, the industry is faced with lack of important facilities for the proper treatment of wastes and wastewater generated from it. The aftermath of this is environmental pollution [5,6]. The immediate abattoir environment serves as the recipient of wastes and wastewater generated from abattoir activities in Nigeria [7,8]. Such environment as seen in water bodies and the possible inherent effects of consuming water from such water bodies have also been reported [9-13].

Ogbe abattoir is among the abattoirs in Nigeria where the immediate environments serve as the recipients of wastes and wastewater generated from abattoir activities. Ogbe abattoir is owned and managed by Ahiazu Mbaize Local Government Authority. The abattoir is among the

abattoirs in Nigeria with no receiving water body where the wastes and wastewater generated are channeled. The immediate environment of Ogbe abattoir is polluted with wastes and wastewater from the abattoir. The generated wastes and wastewater pose as a potential risk and could constitute significant environmental public health hazards. The wastes and wastewater from the abattoir are sources of embarrassment that requires immediate remedy.

Nafarnda, et al. [3], and Armand-Lefevre, et al. [14] noted that pathogens present in animal carcasses or shed in animal wastes may include rotaviruses, hepatitis E virus, *Salmonella spp.*, *E. coli* O157:H7, *Yersinia enterocolitica*, *Campylobacter spp.*, *Cryptosporidium parvum*, and *Giardia lamblia*. The primary reservoir for *E. coli* O157:H7 has been reported to be healthy cattle in a study in Canada, although this bacterium is also endemic to swine and sheep [3]. These zoonotic pathogen can exceed millions to billions per gram of feces, and may infect humans. The pathogenic fungi found in animals are not left behind as well. The microbial characteristics of abattoir wastewater and its possible effect on receiving water bodies which is likely to cause pollution with intensified environmental and public health hazards has not been documented in different parts of Nigeria.

The present study evaluated the bacterial and fungal concentrate of wastewater generated from Ogbe abattoir for two seasons, and correlated its possible potential risk to harbor pathogens as well as environmental public health hazards.

2. MATERIALS AND METHODS

2.1 Study Area

Ogbe abattoir is located within coordinates of longitude 05°31.965'-05°32.890'N and latitude

Table 1. List of sampling points and sample collection area

Sampling stations	Sampling points	Sampling co-ordinates	Sampling co-ordinates	Types of samples collected
		Northing (N)	Easting (E)	
Ogbe abattoir	A	05° 31.884'	007° 6.964'	Wastewater
	B	05° 31.665'	007° 16.335'	Wastewater
	C	05° 31.578'	007° 16.315'	Wastewater
	D	05° 33.000'	007° 18.010'	Wastewater

007°15.685'-007°18.010'E. The climate of Ogbe falls within tropical climate with average relative humidity about 80%. The inhabitants of the area are mainly farmers, civil servants, petty traders and casual workers. The wet and dry seasons are the two distinct seasons of the area under study, with 70% of the annual rainfall between April and August; September to November tend to have about 22% of the rainfall while December to March are the driest months in the area under study. Wastes and wastewater from Ogbe abattoir through soil erosion and surface runoff are washed indiscriminately to the immediate environment. Some are deliberately discharged anyhow to the detriment of local population living close to the abattoir.

2.2 Identification of Sampling Points and Sample Collection

A total of four sampling points were considered in this study. The sampling stations, sampling point's codes, sampling points coordinates and samples collected are presented in Table 1.

Wastewater samples were collected from different sampling points coded A, B, C and D as the abattoir wastewater was running off the drainage system. The method described by Adesemoye, et al. [6] was used for the sampling. Sterile 2.0 L sample bottles were used to aseptically draw part of the abattoir wastewater. The samples collected from each sampling point were pooled together as composite samples. Control samples for the wastewater were collected from water stored in buckets used from washing meat and utensils in the abattoir. After collection, the samples were pooled together as composite sample.

3. RESULTS AND DISCUSSION

The Table of microbial groups of wastewater from Ogbe abattoir (Table 2) showed that THBC

ranged from 2.0×10^5 cfu/mL in dry season to 2.1×10^5 cfu/mL in wet season. The observed THBC was higher in wet season than dry season. THBC values observed in the present study were higher than their respect control. TFC ranged from 1.5×10^5 cfu/mL in wet season to 2.0×10^5 cfu/mL in dry season. The observed TFC in wastewater was higher in dry season. TFC values in wastewater were higher than their respective control.

Bacterial isolates such as *Acinetobacter sp.*, *Bacillus sp.*, *Citrobacter sp.*, *Enterobacter sp.*, *Escherichia sp.*, *Klebsiella sp.*, *Lactobacillus sp.*, *Micrococcus sp.*, *Micrococcus sp.*, *Proteus sp.*, *Pseudomonas sp.*, *Salmonella sp.*, *Serratia sp.*, *Staphylococcus sp.*, and *Streptococcus sp.*, were observed in the present study. The percentage occurrence of *Acinetobacter sp.* (0.50-3.65%), *Citrobacter sp.* (3.00-9.13%), *Escherichia sp.* (2.50-13.69%), *Klebsiella sp.* (2.50-14.16%), *Proteus sp.* (2.00-9.13%) and *Staphylococcus sp.* (11.00-13.69%) were higher in dry season than wet season. *Bacillus sp.* (9.13-23.00%), *Enterobacter sp.* (0.00-3.00%), *Micrococcus sp.* (6.85-7.50%), *Pseudomonas sp.* (12.84-25.00%), *Salmonella sp.* (4.57-5.00%), *Serratia sp.* (0.00-1.50%), and *Streptococcus sp.* (4.57-13.00%) were higher in wet season than dry season. Percentage occurrence of *Acinetobacter sp.*, *Escherichia sp.*, *Staphylococcus sp.*, and *Streptococcus sp.*, were lower than their controls for both seasons. Percentage occurrence of *Citrobacter sp.*, *Enterobacter sp.*, *Klebsiella sp.*, *Proteus sp.*, and *Serratia sp.* were lower in the wastewater against the control in wet season. The observation made on bacterial isolates of the present study is in line with earlier work of Ogunnusi and Dahunsi [15] on isolation and identification of microorganisms from abattoir effluents from Oyo, Oyo state, Nigeria. Anudike, et al. [16] and Akubugwo, et al. [17] have reported the environmental significance and implications of some of the isolated bacterial organisms observed in the present study.

Table 2. Microbial groups of wastewater from Ogbe abattoir

Microbial groups	Wet season		Dry season	
	Wastewater	Control	Wastewater	Control
THBC(cfu/mL)	2.1×10 ⁵	1.8×10 ⁵	2.0×10 ⁵	1.0×10 ⁵
TFC (cfu/mL)	1.5×10 ⁵	2.0×10 ⁴	2.0×10 ⁵	2.0×10 ⁴

THBC= Total Heterotrophic Bacterial Count; TFC= Total Fungal Count

Table 3. Percentage occurrence (%) of bacterial isolates from Ogbe abattoir wastewater

Isolates	Wet season		Dry season	
	Wastewater	Control	Wastewater	Control
<i>Acinetobacter sp.</i>	0.50	2.23	3.65	4.95
<i>Bacillus sp.</i>	23.00	12.30	9.13	7.92
<i>Citrobacter sp.</i>	3.00	4.47	9.13	4.95
<i>Enterobacter sp.</i>	3.00	5.58	-	3.49
<i>Escherichia sp.</i>	2.50	8.38	13.69	13.86
<i>Klebsiella sp.</i>	2.50	8.94	14.16	5.94
<i>Lactobacillus sp.</i>	-	1.12	-	2.97
<i>Micrococcus sp.</i>	7.50	8.38	6.85	6.93
<i>Proteus sp.</i>	2.00	7.82	9.13	7.92
<i>Pseudomonas sp.</i>	25.00	12.84	11.42	9.90
<i>Salmonella sp.</i>	5.00	-	4.57	-
<i>Serratia sp.</i>	1.50	2.79	-	7.92
<i>Staphylococcus sp.</i>	11.00	11.20	13.69	13.86
<i>Streptococcus sp.</i>	13.00	13.97	4.57	7.92
<i>Shigella sp.</i>	-	-	-	-
<i>Vibro sp.</i>	-	-	-	-
Total	100.00	100.00	99.99	99.99

Table 4. Percentage occurrence (%) of mould isolates from Ogbe abattoir wastewater

Isolates	Wet season		Dry season	
	Wastewater	Control	Wastewater	Control
<i>Absidia sp.</i>	-	-	15.00	-
<i>Aspergillus sp.</i>	40.00	33.30	20.00	33.33
<i>Fusarium sp.</i>	26.67	13.30	20.00	13.33
<i>Geotrium sp.</i>	13.33	13.30	15.00	-
<i>Cladosporium sp.</i>	-	-	15.00	6.67
<i>Penicillium sp.</i>	20.00	40.00	15.00	46.67
<i>Rhizopus sp.</i>	-	-	-	-
Total	100.00	99.90	100.00	100.00

Table 5. Percentage occurrence (%) of yeast isolates from Ogbe abattoir wastewater

Isolates	Wet season		Dry season	
	wastewater	Control	Wastewater	Control
<i>Candida sp.</i>	54.55	40.00	33.30	50.00
<i>Saccharomyces sp.</i>	36.36	40.00	44.40	37.50
<i>Torulopsis sp.</i>	9.09	20.00	22.20	12.50
Total	99.90	100.00	99.90	100.00

Table 4 shows the percentage occurrence of mould isolates from Ogbe abattoir wastewater for two seasons. From the Table, mould isolates such as *Absidia sp.*, *Aspergillus sp.*, *Fusarium sp.*, *Cladosporium sp.*, *Penicillium sp.*, and *Rhizopus sp.*, were observed in the present study. *Absidia sp.* (0.00-15.00%) and *Cladosporium sp.* (0.00-15.00%) were higher in

dry season against wet season, while *Aspergillus sp.* (20.00-40.00%), *Fusarium sp.* (20.00-26.67%), and *Penicillium sp.* (15.00-20.00%) were higher in wet season in wastewater than dry season. Apart from *Penicillium sp.* and *Geotrium sp.*, in wet season; as well as *Penicillium sp.* and *Aspergillus sp.* in dry season, the percentage occurrence other observed mould isolates in wastewater for the seasons were higher than their respective control. Ogunnusi and Dahunsi [15] have reported some of the observed fungal isolates from abattoir effluents in Oyo State, Nigeria. Duru, et al. [18] reported the environmental significance and implications of some of the mould organisms observed in the present study.

Candida sp., *Saccharomyces sp.*, and *Torulopsis sp.* were among the yeast isolated from wastewater generated from Ogbe abattoir (Table 5). *Candida sp.* (33.30-54.55%) was higher in wet season than dry season while *Saccharomyces sp.* (36.36-44.40%), and *Torulopsis sp.* (9.09-22.20%) were higher in dry season than wet season. *Candida sp.*, in wastewater for dry season and *Saccharomyces sp.*, in wet season were higher than their respective control.

4. CONCLUSION

Generally, most microbes are known to present environmental and health hazards, some of which could be longterm or shortterm. Hence, the importance of bacterial and fungal isolates of the present study lies on their potential risk as pathogens, and the intensified environmental health hazards they pose to humans living within the abattoir environment.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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