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 \((2.0 \times 10^5 - 2.1 \times 10^5 \text{ cfu/mL})\) and total fungal count \((1.5 \times 10^5 - 2.0 \times 10^5 \text{ cfu/mL})\). 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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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], 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.

MATERIALS AND METHODS

2.1 Study Area

Ogbe abattoir is located within coordinates of longitude 05º31.965'-05º32.890' N and latitude...
007º15.685’S-007º18.010’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 causal 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 2.0L 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 2.1×10^6 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 Oggunnusi 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)    | $2.1 \times 10^5$ | $1.8 \times 10^5$ | $2.0 \times 10^5$ | $1.0 \times 10^5$ |
| TFC (cfu/mL)     | $1.5 \times 10^5$ | $2.0 \times 10^4$ | $2.0 \times 10^5$ | $2.0 \times 10^4$ |

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

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

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

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

| Isolates         | Wet season | Control | Wastewater | Control |
|------------------|------------|---------|------------|---------|
| Absidia sp.      | -          | -       | 15.00      | -       |
| Aspergillus sp.  | 40.00      | 33.30   | 20.00      | 33.33   |
| Fusarium sp.     | 26.67      | 13.30   | 20.00      | 13.33   |
| Geotrichum sp.   | 13.33      | 13.30   | 15.00      | -       |
| Cladosporium sp. | -          | -       | 15.00      | 6.67    |
| Penicillium sp.  | 20.00      | 40.00   | 15.00      | 46.67   |
| Rhizopus sp.     | -          | -       | -          | -       |
| Total            | 100.00     | 99.90   | 100.00     | 100.00  |

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

| Isolates      | Wet season | Control | Wastewater | Control |
|---------------|------------|---------|------------|---------|
| Candida sp.   | 54.55      | 40.00   | 33.30      | 50.00   |
| Saccharomyces sp. | 36.36   | 40.00   | 44.40      | 37.50   |
| Torulopsis sp. | 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 Geotriptis 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. Oggunusu 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 shorterm. 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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