MICROBIAL CHARACTERIZATION OF THE WASTE WATER FROM A MAJOR ABATTOIR AND IT'S RECEIVING SURFACE WATER IN ABEOKUTA, NIGERIA

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SUMMARY

This study was conducted to assess the different methods of waste disposal at the Lafenwa abattoir and the environmental and public health implication. In addition, the microbial status of the effluent and its receiving surface water were investigated to determine total viable and coliform counts using surface plating and multiple tube test techniques, respectively. Bacterial and fungal contaminants were isolated and identified by standard microbiological procedures. Waste disposal in the abattoir was by open dumping of solid wastes while effluent was discharged into the nearby Ogun River, which is also used by butchers for meat processing. The mean Total Bacteria Count (TBC) and Total Coliform Count (TCC) for waste water during and after slaughtering were 5.2x10^7, 4.9x10^7 and 4.26x10^7, 3.06x10^7 cfu/ml respectively while the receiving surface water had mean TBC and TCC of 4.15x10^7, 3.83x10^7, and 3.89x10^7, 2.87x10^7 cfu/ml respectively. Bacterial organisms isolated from the effluent include Enterobacter aerogenes, Hafnia alvei, Erwinia mollitivora, Edwardsiella ictaluri, Enterobacter amnigenus and Escherichia coli O157strains while Proteus mirabilis, Staphylococcus spp, Pseudomonas aeruginosa, Enterobacter intermedius, Yersinia aleksiciae, Serratia odorifera, Enterobacter cloacae, Enterobacter aerogenes and Escherichia coli O157 strains were isolated from the surface water. The fungal species isolated were Trichoderma spp, Trichophyton spp, Aspergillus spp, Scedosporium spp and Coccidiodes spp.

Keywords: Wastewater disposal, abattoir, surface water, food safety, Public Health, Nigeria.

INTRODUCTION

The abattoir is a specialized facility approved and registered by the regulatory authority for inspection of animals, hygienic slaughtering, processing and effective preservation and storage of meat products for human consumption (Alonge 2001). In addition, appropriate facilities to ensure safe disposal of abattoir wastes in a manner that will not constitute a potential hazard to public health, animal health and the environment is considered very essential. Most abattoirs in Nigeria have no facilities for waste treatment; wastes are either disposed on open dumps or are discharged into nearby streams, hence constituting an environmental menace (Adeyemo et al., 2002).

Waste water or effluent generated from the abattoir is characterized by the presence of a high concentration of whole blood of slaughtered food animals and suspended particles of semi-digested and undigested feeds within the stomach and intestine of slaughtered and dressed food animals (Coker et al., 2001). In addition, there may also be the presence of pathogenic microorganisms, such as Salmonella, Escherichia coli (including serotype O157:H7), Shigella, parasite eggs and amoebic cysts (Bull et al., 2001) which are of public health importance. Recent studies have shown that zoonoses from abattoir wastes are yet to be fully controlled in more than 80% public abattoirs in Nigeria (Cadmus et al., 1999). Also, several pathogenic bacteria and fungi species has been isolated from abattoir wastewater and surface water; including Staphylococcus, Escherichia coli, Streptococcus, Salmonella, Aspergillus, Mucor, Saccaromyces spp and Penicillium spp (Adebawale et al., 2010; Coker et al., 2001 and Adesomoye et al., 2006).

These pathogens isolated might threaten public health by migrating into ground water or surface water, wind or vectors like animals, birds and arthropods which can help to transmit diseases (Gauri, 2004). The risk of epidemics, water contamination and pollution, annihilation of biotic life, global warming and soil degradation by waste materials are real problems confronting developing countries where issues concerning waste management have been grossly neglected (Adedipe, 2002; Adeyemi and Adeyemo, 2007). In Nigeria, adequate abattoir waste management is lacking in all public abattoirs such that large solid wastes and untreated effluents are common sites (Adeyemo, 2002).
MATERIALS AND METHODS

Waste water samples from the major channel for effluent outflow and water samples from the receiving surface water, (which is also used for meat processing) were collected for microbial investigation using sterilized 250ml bottles. Sampling was carried out during and post slaughtering once a week for a period of 3 months (November 2009 to January 2010). Samples were transported to the laboratory in isothermal boxes with ice for microbial analyses.

Total Bacteria and Total Coliform Counts were determined using sterile Nutrient and MacConkey agar plates which were inoculated aseptically in duplicates with 1 ml aliquot of 10^7 and 10^8 of 1 in 10 serially diluted on samples using surface plate technique. The inoculated plates were incubated at 30°C for 24 hours (Boulter et al., 2002).

For detection and identification of E. coli O157, samples were inoculated on Sorbitol MacConkey-BCIG Agar (Oxoid) supplemented with cefixime-tellurite selective supplement (Oxoid). Straw coloured colonies suspected to be E. coli O157 were subjected to biochemical test for E. coli identification. Isolates with characteristics consistent with those of E. coli were further confirmed E. coli O157 using dryspot Eschericia coli O157 test kits (Oxoid).

Fungal isolation and identification were carried out by inoculation of samples onto Potato dextrose agar (PDA) plates supplemented by Streptomycin (100µg/ml) and inoculated with 1 ml aliquot of dilution 10^-4 after a tenfold serial dilution of the effluent and water samples using the surface plate technique. Inoculated plates were incubated at 30°C for 72 hours (Adesemoye and Adedire, 2005). Fungal colonies were studied morphologically. Smears were made from each colony and stained with Lactophenol Cotton Blue for microscopy at x40 magnification.

RESULTS

Solid wastes generated included ruminal contents, horns, hooves, fat, meat trimmings and animal faeces which are disposed as open dumps around the abattoir. Liquid wastes including blood, urine and water used for various activities in the abattoir were discharged without pre-treatment; into the Ogun River which is also used for meat processing for human consumption.

The mean TBC and TCC for waste water during and after slaughtering were 5.2x10^7, 4.9x10^7 and 4.26x10^7, 3.06x10^7 cfu/ml respectively while the contaminated receiving surface water had mean TBC and TCC of 4.15x10^7, 3.83x10^7, and 3.89x10^7, 2.87x10^7 cfu/ml respectively (P>0.05). Escherichia coli O157 was detected in 8 (16%) of all 50 samples examined (Table 1). Other bacterial organisms identified in the samples include Bacillus spp, Staphylococcus spp, Pseudomonas spp, Enterobacter spp, Hafnia alvei, E. coli, Erwinia spp, Proteus spp and Klebsiella spp (Table 2) while the fungi are Trichoderma spp, Trichophyton spp, Aspergillus spp, Scedosporium spp and Coccidioides spp (Table 3).

Table 1: Frequency of isolation of E.coli O157 isolates.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Frequency of E.coli O157 isolates (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Effluent</td>
<td>4(8.0)</td>
</tr>
<tr>
<td>Contaminated Surface Water</td>
<td>4(8.0)</td>
</tr>
</tbody>
</table>
Table 2: Bacteria isolated from Abattoir Effluent and Contaminated Surface Water.

<table>
<thead>
<tr>
<th>ORGANISM</th>
<th>ABATTOIR EFFLUENT</th>
<th>SURFACE WATER</th>
</tr>
</thead>
<tbody>
<tr>
<td>BACTERIA</td>
<td>Bacillus spp</td>
<td>Enterobacter intermedius</td>
</tr>
<tr>
<td>Staphylococcus spp</td>
<td>Erwinia carotovora</td>
<td></td>
</tr>
<tr>
<td>Pseudomonas spp</td>
<td>Erwinia chrysanthesis</td>
<td></td>
</tr>
<tr>
<td>Enterobacter aerogens</td>
<td>Proteus mirabilis</td>
<td></td>
</tr>
<tr>
<td>Enterobacter cloacae</td>
<td>Klebsiella oxytoca</td>
<td></td>
</tr>
<tr>
<td>Hafnia alvei</td>
<td>Klebsiella plantocele</td>
<td></td>
</tr>
<tr>
<td>Escherichia coli</td>
<td>Klebsiella pneumoniae subsp. pneumoniae</td>
<td></td>
</tr>
<tr>
<td>Bacillus spp</td>
<td>Escherichia coli</td>
<td></td>
</tr>
<tr>
<td>Staphylococcus spp</td>
<td>Pseudomonas spp</td>
<td></td>
</tr>
</tbody>
</table>

Table 3: Fungi isolates from the abattoir effluent and contaminated surface water.

<table>
<thead>
<tr>
<th>Organism</th>
<th>Abattoir effluent</th>
<th>Contaminated surface water</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fungi</td>
<td>Trichoderma spp</td>
<td>Aspergillus spp</td>
</tr>
<tr>
<td>Trichophyton spp</td>
<td>Coccidioides spp</td>
<td></td>
</tr>
<tr>
<td>Aspergillus spp</td>
<td>Trichophyton spp</td>
<td></td>
</tr>
<tr>
<td>Scedosporium spp</td>
<td>Scedosporium spp</td>
<td></td>
</tr>
</tbody>
</table>

DISSCUSSION

The study revealed that the waste disposal methods at the Lafenwa abattoir are open dumps and effluent discharge into the nearby Ogun River. Most, if not all abattoirs in Nigeria uses these methods of disposal (Adeyemo 2002). These methods are currently prohibited in most developed countries because it provides no safeguard against risks to human health and the environment and is unlikely to foster public confidence in waste management. Unfortunately this is still a common practice in most developing countries due to lapses in the governmental policies and programmes in these countries. The primary food safety risk associated with these methods of disposal is the potential for pathogen, chemical contaminants being transferred to humans directly or through other animals (Ekugo 1998).

The microbial analyses of the waste water and receiving surface water showed that the mean total bacteria and total coliform counts exceeded the Federal Environmental Protection Agency (FEPA1999) and World Health Organization (W.H.O 2004). A similar study carried out by Adebowale et al (2010) on the surface water revealed that the total bacteria (cfu/ml) and E coli counts/100ml exceeded the recommended limits hence making this source of water unfit for meat processing. These serve as legible indicators of the extent of the pollution of the water body used for meat processing at the abattoir. The presence of Eschericia coli O157 strains in both waste water and receiving water body as well as other pathogens (especially the Enterobacteraeae, many of which are associated with gastroenteritis in humans) indicate the need for waste water treatment before discharge into water bodies after complying with international limits. The reported relatively high prevalence of E coli O157 strains (8%) from the waste water and the contaminated river (8%) in this study poses a major concern as other studies by various authors in Nigeria, reported low prevalence of 0.5 -2% (Luga 2006., and Agbogu et al., 2005).

CONCLUSION

The results obtained from the investigation showed that the use of this contaminated water for meat processing by butchers portends a serious public health risk to consumers who purchase their meat from this abattoir. There is therefore an urgent need to discourage the use this water for meat processing by butchers so as to safeguard the health of the populace. Untreated animal wastes discharge into surface waters should be totally prohibited and proper animal waste management should be enforced so that these unacceptable practices do not constitute persisting environmental, animal and human health hazard.
REFERENCES


