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ENVIRONMENTAL IMPLICATIONS OF UNHYGIENIC OPERATION OF A CITY ABATTOIR IN AKURE, WESTERN NIGERIA

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ABSTRACT

Slaughterhouse wastewater has a complex composition and very harmful to the environment. An effluent of a major city abattoir in Nigeria was studied for possible pollutants and effects of such pollutants on the environment. Findings showed that the various water samples were contaminated with *E. coli* and other enteric bacteria. The presence of coliform *staphylococcus aures* indicated the presence of microorganisms which are associated with water borne disease. Recommendations were made to ensure maintenance of good environmental condition in the city abattoirs particularly in the developing countries.

1. INTRODUCTION

While the slaughtering of animals results in significant meat supplies, a good source of protein and production of useful by-products such as leather, skin and bones, the processing activities involved sometimes result in environmental pollution and other health hazards that may threaten animal and human health. Alonge, 1991 defined meat hygiene as a system of principles designed to ensure that meat and meat products are safe, wholesome and processed in a hygienic manner and are fit for human consumption. Meat quality control is a system that regulates the measure of extrinsic materials such as chemical residues, toxins, pathogenic microorganisms and putrefied tissues, which could be present in meat and are deleterious to human health (Olugasa *et al.*, 2000). Animals are slaughtered in abattoirs for sale to the public. An abattoir has been defined as a premise approved and registered by the controlling authority for hygienic slaughtering and inspection of animals, processing and effective preservation and storage of meat products for human consumption (Alonge, 1991).

Previous studies have shown that the characteristics of abattoir wastes and effluents vary from day to day depending on the numbers and type of stocks being processed (Keely and Quinn, 1979; Litchfield, 1980; Tove, 1985). Abattoir operations produce a characteristic highly organic waste with relatively high levels of suspended solid, liquid and fat. The solid waste includes condemned meat, undigested ingesta, bones, horns, hairs and aborted foetuses. The liquid waste is usually composed of dissolved solids, blood, gut contents, urine and water. Animal food is always microbiologically contaminated by organisms living in it naturally or entering it from the surroundings, such as those resulting from processing operations (Lewicki, 1993). On going production quality control, washing and disinfection, are the main procedures of securing the hygiene of meat and meat products (Pezacki, 1970; Windyga *et. al.*, 1996). In the production of animal for food, more attention should be focused on the interactions between animal production and the environment, realizing environmental conditions and structures in animal production, which not only seek to produce wholesome and safe animal food but should also avoid environmental pollution and the associated human health risks.

Animals slaughtered in Araromi abattoir alone accounts for about 65% of the total animal in Akure, the capital city of Ondo State, Nigeria. The waste from the slaughtering and dressing grounds in the abattoir are washed into open drainages untreated and the leachates from the series of decomposition processes of these wastes can introduce enteric pathogens and excess nutrients into the surrounding surface waters and also percolate into the underlying aquifers to contaminate the hand-dug wells which serve the dual purpose of drinking water for the butchers and others working in the abattoir, and the people in the neighbourhood. With inadequate slaughtering and disposal facilities, the abattoir has also become a source of infection and pollution, attracting domestic and wild carnivores, rodents and flies, which are vectors of diseases. The area is rampant with filth and scattered rubbish, which is left uncollected, apart from the blood draining trenches through which the filth is scattered rather than eliminated.

Hygiene problems are not limited to slaughtering but are also associated with incorrect processing and marketing practices. Under tropical conditions, food of animal origin tends to deteriorate more rapidly and become an important vehicle for gastrointestinal infections, thereby endangering consumers' health. Some of the human infections acquired from meat and poor handling of food animals are shown in Table-1. This paper presents our findings on the sanitary-hygienic conditions of a major city abattoir in southwestern Nigeria, the environmental implications are discussed.

Table-1. Some human infections acquired from meat and the handling of food animals.

Bacterial	Viral	Parasitic
Anthrax, Q- fever, Campylobacteriosis, Ornithosis, Botulism, Staph. food poisoning Salmonellosis Brucellosis, Erysipelas, Streptococcosis, Tetanus, Yersiniosis, Clostridiosis, Listeriosis, Glanders, Leptospirosis, Tuberculosis.	Rift valley fever, Newcastle disease, Vesicular stomatitis, Contagious ecthyma	Taeniosis, Toxoplasmosis, Echinococcosis (indirect), Sarcosporidiosis, Trichinellosis, Fungal dermatophytosis

2. MATERIALS AND METHODS

The study was conducted in Akure, the capital of Ondo State in South west Nigeria which lies at latitude 7^o 16' north and longitude 5^o 13' East at an altitude of 351 m above mean sea level. The population of Akure based on the 1999 census is 386,550. Although, there are other abattoirs in Akure, Araromi abattoir was selected for this study based on its strategic location right at the city centre and also because it is the major abattoir which supplies about 65% of the meat for the city residence. The physicochemical and microbiological properties of the effluent was investigated for a period spanning 3 months (July-September, 2008) which falls within the rainy period in the region and during which appreciable flow occurred in the waste effluent receiving streams. The effluents from Araromi abattoir were discharged into a stream which in turn discharges into Ala River, major surface water that spanned the entire city. The solid wastes from the abattoir are evacuated and constantly trucked away for land disposal. Farmers are also encouraged to collect the material free of charge for use as manure. Horns are washed and neatly packed for further processing either for breakable plates or livestock feeds.

Samples of water were collected on different occasions from the vicinity of the abattoir site. All visitations and samplings were done as early as 6.30 am when slaughtering through processing to the sales of the meat were observed. All glassware such as Petri dishes, conical flask, measuring cylinder and test tube were washed with detergent, rinsed in clean water and dried in the drying cabinet. The glassware were then sterilized in the hot air oven (autoclaves) at 121^0C for 20 minutes. Effluents were collected from drains. Samples were preserved by addition of HNO_3 prior to laboratory analysis; other preservations were done by refrigeration to avoid loss of nitrate. Dissolved oxygen was on site by precipitation. The effluent was examined for physicochemical and microbiological characteristics. The results of the effluents were compared with WHO standards and the pollution determinants were determined. All the chemical analysis was carried out in accordance with guidelines of the Environmental Protection Agency (2002).

3. RESULTS AND ANALYSIS

The results of the study looked at the physicochemical and microbiological characteristics of the effluent from the abattoir.

3.1 Physicochemical characteristics

The result of the physicochemical analysis of the effluent is summarized in Table-2.

Table-2. Physicochemical characteristics of effluent from Araromi abattoir.

Parameter tested	Mean
Temperature	27.3^0C (± 9.25^0C)*
pH	7.41 (± 0.26)
Colour	Dark brown
Odor	Foul
Conductivity	19.0 x 10^2 (± 8.25)
Acidity (ppm)	0.9 (± 0.13)
Alkalinity (mg/l)	0.4 (± 0.05)
Dissolved Oxygen (ppm)	2,000 (± 231)
Total dissolved solid (mm/l)	240
Total suspended solid (mm/l)	480
Total Solid (mm/l)	685
Biochemical Oxygen Demand (mm/l)	42
Total Hardness	172.5
Chloride (mm/l)	4.6
Calcium	83
Magnesium	ND
Aluminium	ND
Lead	ND
Iron	7.3

* Standard deviation in parenthesis

The World Health Organization (WHO) classifies the extent of chemical levels in water for drinking purpose as either inoffensive or unobjectionable when it is within acceptable range for human consumption. It is considered inoffensive for any specific physical quantity when the value is far below the maximum value and/or when that specified physical quantity will have no detrimental effect on human health when it reaches up to the maximum level. It is also unobjectionable when the value of a specified

quantity is within the range of the highest desirable level but not up to the maximum permissible level. The result in Table-2 showed that the composition of the slaughterhouse is affected by the number of animals slaughtered and the disposal method employed. A significant part of the variation can be seen in the Total Suspended Solids (TSS) and the exhibited high dissolved oxygen and Biochemical Oxygen Demand (BOD). These are characterized by the varying amount of washed water, heads of animals and solid waste. The mean pH in sample was 7.41. WHO defines 6.5-8.5 as the suitable range for hydrogen concentration (pH) levels? The range in the effluent is considered inoffensive. However, due to the high proportion of total solids in the samples, one possible management option would be to include screens as a primary treatment process thereby reducing the total washdown to the rivers and streams.

3.2 Analysis of bacteriological quality

Results from the bacteriological analysis is presented in Table-3.

Table-3. Counts of biological organisms in sampled effluent per 100ml.

Sample	Coliforms	Other enteric bacteria (cfu/mu)
A	184	7.30×10^6
B	191	7.64×10^6
C	188	7.10×10^6
D	185	7.43×10^6
E	190	7.25×10^6

The results indicated that the various samples were contaminated in one way or the other with *E.Coli* and other enteric bacteria. It can be deduced from Table-3 that all the water samples used for the test were polluted biologically beyond permissible limits. The presence of coliform *staphylococcus aurens* was confirmed in the abattoir. The presence of this bacteria in intolerable number obviously constitute a serious public health hazards as the presence of these micro organisms is associated with water borne diseases since the waste is discharged into the streams. The seepage of the effluent to well and borehole also constitute a serious health hazard to the public. Further observation also showed that the surroundings of the abattoir gave offensive odours and breed mosquitoes due to the pile up paunch contents and other solid wastes, faeces, carcass, horns, scraps of tissue and other solid waste. Waste products are at best an embarrassment or nuisance and at worst serious pollutants. Such systems of production are not sustainable in the long-term and it is possible to develop integrated systems where local inputs are optimized and recycled, with a reduction in external inputs. Sustainable animal production means, that we are able to produce food animal and animal products without lasting damage to the environment, which means that essential elements like water, air and soil are left without dead loads and that by-products of animal production creates no animal and human health risks through environmental protection and animal waste management (Tielen, 2000). The role of livestock manure as a source of fertilizer should not be underestimated because all organic wastes are evidently needed in many parts of the world to restore the land to maximum productivity. However, few epidomological studies have established definitive adverse health impacts attributable to pathogenic organisms in agricultural reuse of wastewaters from abattoirs. Helminthic diseases caused by *Ascaris* and *Trichuris* spp. are endemic in areas of the world where raw untreated sewage is used to irrigate salad crops and vegetables eaten uncooked (Shuval, *et al.*, 1985; 1986). If sustainable agricultural systems are to be developed that are largely independent of external inputs, solid waste from slaughtered animals can be fermented in a tank, this produces compost and biogas. Biogas was being produced as early as the 1920s in a number of communal sewage farms in central Europe; but the primary consideration was not so much how to obtain additional energy, but rather the problem of rational and hygienic waste disposal (SPORE, 1993).

4. CONCLUSIONS

The results obtained from the investigation showed that effluents from the abattoir constitute potential hazards to the environment. The high level of Total Suspended Solid (TSS) and Conductivity indicates that the samples were heavily loaded with colloidal, organic, inorganic and suspended matters.

Clean technologies have been promoted to serve many purposes, such as the reduction of pollution generated by conventional abattoir operations, the improvement of process efficiency and energy conservation, leading to more cost-effective and profitable operation, and the optimization of the use of raw materials, thereby promoting a more efficient use of natural resources. The maintenance of good environmental conditions by disposing sewage and refuse in a sanitary manner in the abattoir starts with the definition of the minimum requirement for all the links in the production chain and these includes:

- Installation of necessary standard equipment and major functional units of the abattoir such as cold rooms, skinning machines, slaughtering machines and changing rooms for workers;
- Thorough and adequate training on sustainable animal production for the people involved in animal trade from farms to abattoirs and slaughterhouses, including periodic continuing education programs;
- Maintenance of proper hygiene within the abattoir and the environment, target areas for sanitization include: infrastructures and facilities contained therein, equipment, surrounding areas, abattoir workers and visitors;

- Periodic Sanitary-hygienic evaluation of abattoirs and slaughterhouses;
- Enforcement of existing health and hygiene regulations;
- Development of appropriate technology, which will take care of all the wastes being generated in the abattoir, including abattoir wastewater treatment and recycling for irrigation; and
- Compost and biogas production.

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