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Research Article

Effect of Abattoir Effluent on surrounding underground water quality: A Case Study of governor road abattoir at Ikotun, Lagos state.

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ABSTRACT

The effect of abattoir effluent on the quality of underground water along Governor Road has been studied; physicochemical and bacteriological parameters of the water samples were examined to assess the quality and extent of pollution through seepage of waste from abattoir sites into underground water. Ten water samples including abattoir effluent. The result of physicochemical analysis for underground water samples from B – E houses (44% of total samples collected) are fair and in range of the reference value of World Health Organization (WHO) acceptable standard. Samples F–J; collected from underground water sources from residents situated close to the abattoir representing 56% of water samples collected; have some values out of acceptable reference range of W H O standard; show high values of turbidity, total hardness and high amount of dissolved oxygen. However, it was observed that analysis of trace/toxic heavy metal gave acceptable result as these are present in small quantities. Microbiological analysis was positive due to the presence of coliform in three out of nine samples representing 33% of samples collected; were found to be specimens from residences located close to the abattoir. The remaining 6(67%) were far sites form abattoir; hence analysis gave good result within acceptable reference range. Except House E that has total plate count of 120 cfu/ml; others have values within W H O standard. Finally; we advised residents of the sample sites at least to boil water to kill germ before consumption; if possible regular treatment of water with chlorine for disinfection. Borehole sinking is advised rather than ordinary well.

Keyword: Abattoir, Effluent, Water quality, Surrounding, Physiochemical, Bacteria.

1.0 INTRODUCTION

Abattoir also known as slaughter house; an Abattoir has been defined as a premise approved and registered by the controlling authority for hygienic slaughtering and inspection of animals, possessing and effective preservation and storage of meat products for human consumption[1].

While the slaughtering of animals results in significant meat supplies, a good source of protein and production of useful by-product such as leather, skin and bones; the processing activities involved sometimes result in environmental pollution and other health hazard that may threaten animal and human health.[1] defined meat hygiene as a system of principle designed to ensure that meat products are safe, wholesome and processed in a hygienic manner and are fit for human consumption. Animals are slaughtered in abattoirs for sale to the public.

Previous studies have shown that the characteristics of abattoir wastes and effluents vary from day to day depending on the number and type of stocks being processed[2,3]. These wastes from abattoir operation can also be separated into solid, liquid and fat. These wastes are highly organic. The solid waste includes condensed meat, undigested feed, bones, horns, hair, and aborted foetus. The liquid waste is usually composed of dissolved solids, blood, gut content, urine and water; while fat waste consist of fat oil, grease which are characterised with high organic levels. Animal waste is usually microbiologically contaminated by microorganisms living naturally or

entering it from the surroundings such as those resulting from processing operations[4]. The killing of animals for community consumption is inevitable in most nations of the world and dated back to antiquity. Public abattoir has been traced back to Roman civilization and in France by 5th and 6th centuries; slaughter houses were among the public facilities. In Italy, a law of 1890 required that a public abattoir be provided in all communities of more than six thousand inhabitants. Similar things were reported in Norway, Sweden, Denmark, Netherlands and Romania. Weobong et al reported that in United Kingdom abattoir or slaughter house perform a vital role in processing cattle and sheep from farm and transforming them into carcass meat[5]. He revealed that in 2001, there were about 360 licensed red meat abattoirs in UK; in nearly every town and neighborhood was provided with slaughter house or slaughter slab. Adie, et al published on slaughter facilities for tropical conditions and observed that abattoir may be situated in urban, rural and nominated industrial site and that each has advantages and disadvantages[6]. The advantages of rural site according to him out-weighed those of the other sites and recommended that a rural location be chosen where possible. He recommended that abattoir should be built on firm gently slope and away from other buildings such as residential areas and factories. He further suggested that the site for abattoir should be away from town boundaries including projected town boundaries. Waste generated by abattoir is potential environment quality problems.

In Nigeria, Sridhar reported that a cow bought for slaughtering produces 328kg of waste in form of dung, bone, blood, horn and hoof[7]. Forster submitted that the disposal of waste product is a problem that has always dominated the slaughter sector and on average; 45 percent of the waste consists of non meat substances[8]. The characteristics of slaughter house waste and effluent vary from day to day depending on the number, types and stock being processed and the method [5, 9]; however reported that waste can affect water, land or air quantities; if proper practices of management are not followed. Animal waste can be valuable for crops but can cause water quality impairment. It also contains organic solid, trace heavy metals, salts, bacteria, viruses, other micro organism and sediment. The waste from animals can also be washed into stream if unprotected and reduces oxygen; thereby endangering aquatic life. [9] also reported that improper animal waste disposal can lead to animal disease being transmitted to human through contact with animal faeces. [5] reported that abattoir effluent reaching streams contributed significant level of nitrogen, phosphorous and oxygen demand and other nutrient resulting in steam pollution. [10] attributed excessive nitrate in New Zealand ground waters to concentrated livestock manure usage. The wells in the meat processing area sometimes results in being polluted. Wells in vicinity of abattoir which serves as source of water to abattoir constitute high risk for the butchers and users of the wells. Medical experts were reported by [11] to have associated some diseases with abattoir activities; which include pneumonia, diarrhoea, Typhoid fever, Asthma, Wool Sorter disease, respiratory and chest disease. *E. coli* infection source was reported to be undercooked beef which has been contaminated; often in abattoir with faces containing the bacterium [12]. These diseases can spread from the abattoir to the neighborhood via vectors animals. However, growing population with increase in demand for meat has resulted in increased abattoir related pollution and has attracted intervention in many developed countries. There is high level of awareness on pollution from animals and over the years several measures have been put in place to protect the public health and the environment [13]. According to [14] in 1992, the European Commission introduced a pan – European fresh meat directives signed to standardise structures in the United Kingdom. Similarly, intervention was recorded was in United State of America with the introduction of [15]. In the contrary, little intervention or response had been made in the developing nations.

The pollution load on a water body from abattoir effluent can be quiet high. For example studies done in Canada [16] and Nigeria [6] showed very high contaminant level in abattoir effluent. Most of these are known to be hazardous to human beings and aquatic life. Likewise, improper disposal of effluent from slaughter house could lead to transmission of pathogens to human and cause disease such as *Bacillus*, *salmonella* infection, Brucellosis and helminthic disease and infections [17]. [18] reported that in developed countries an estimated 80% of all diseases and over one third of deaths are caused by consuming contaminated water. This work is to investigate the bacteriological, physiochemical characteristics and various toxic elements of Abattoir waste, as affected underground water sources in the surrounding houses near the abattoir.

2. MATERIAL AND METHODOLOGY

2.1 Study Area

The Governor Road Abattoir, located at Ikotun; in Alimosho Local Government area of Lagos state; that fairly dense populated. The abattoir although at a small scale; considering the population of people in the area and the number of animal slaughtered for public consumption; has not received much research

attention before now. Ten samples were collected around the abattoir including abattoir effluent as shown and tagged A – J in Table 1 and Figure 1 below. No pipe borne water in the area as most residences depend on tube well (borehole) and well for their source of water.

TABLE: 1
SHOWING THEGEOGRAPHICAL POSITIONING SYSTEM (GPS) LOCATION OF SAMPLE SITE

S/N	SAMPLES	LOCATION
1	ABATTOIR WASTE WATER A	31N528548/UTM726605
2	HOUSE B	S/S 31N528709/UTM726720
3	HOUSE C	S/S 31N528736/UTM726716
4	HOUSE D	S/S 31528729/UTM 726614
5	HOUSE E	S/S 31N528664/UTM726687
6	HOUSE F	S/S 31N528579/UTM726616
7	HOUSE G	S/S 31528619/UTM 726661
8	HOUSE H	S/S 31N528664/UTM726687
9	HOUSE I	S/S 31N528668 /UTM726588
10	HOUSE J	S/S 31N528691/UTM726606

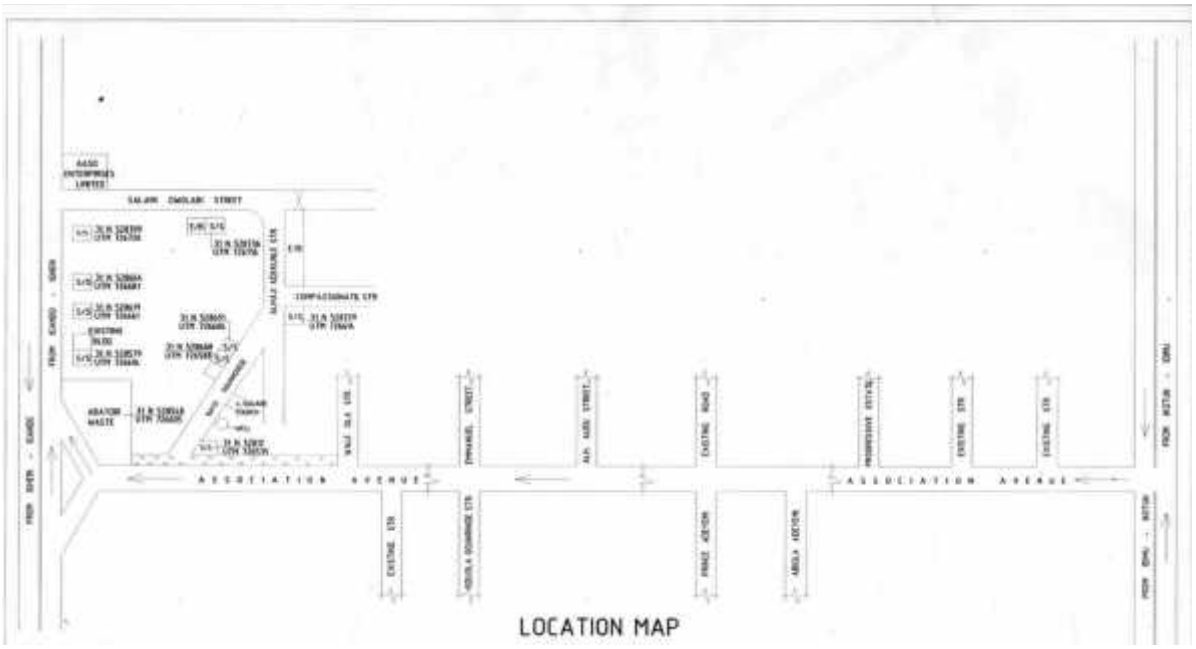

FIG: 1
SAMPLE SITE LOCATION MAP

KEY
S/S: Sample Site
E/B: Existing Building

The wastes from the slaughtering and the dressing grounds in the abattoir are washed into open drainages untreated and are carried into a nearby stream. Leachates from the series of decomposition processes of these wastes percolate into the underlying aquifers to contaminate underground water; which serves the dual purpose of dressing carcasses to be sold for human consumption and drinking water for the butchers and others working in the abattoir and surrounding houses. The animal wastes like intestinal contents are usually dumped in a place within the abattoir and have formed a dunghill which generates a lot of odour.

2.2 Collection of Samples

Nine water samples tagged B-J were collected from nine (9) houses around the abattoir. A sample of effluent tagged A was collected from abattoir which was analyzed and compared to the other nine samples collected (water samples) from the surrounding residences. The samples were collected aseptically with five (5) liters plastic keg filled to the three quarter of the brim and covered immediately to avoid external contamination; then transferred immediately to the laboratory for analysis. The analyses were carried out in Lagos State Environmental Protection Agency (LASEPA) laboratory.

2.3 Bacteriological and Physiochemical Analysis

The standard analytical methods that were used for determination of bacteriological and physico-chemical parameter of water and waste water were from American Public Health Association series of standard methods of examination of Water and Effluent [19](APHA, 1998; [20]Kosamu et al, 2011)

3.1 RESULT OF ABATTOIR WASTE WATER (A) AND HOUSE B -E SAMPLES

TABLE 3.1.1
PHYSICAL

PHYSICAL	RESULT					W.H.O STANDARD
	A	B	C	D	E	
Colour	4,653	NA	NA	NA	NA	250Pt.Co. APHA
Appearance	Brownish	Colourless	Colourless	Colourless	Colourless	Colourless
Temperature	27.4^{O}C	26.8	26.8	26.8	26.8	35-40
Taste	NA	**NA**	**NA**	**NA**	**NA**	Tasteless
PH	6.73	5.6	4.9	4.6	5.6	6.5-8.5
Odour	N.A.	Odourless	Odourless	Odourless	Odourless	Odourless
Turbidity	7.88	1.4	0.1	0.1	0.8	5 NTU (mg/l)
Conductivity	284.3	0.17	0.23	0.78	0.34	1.0 mscm
Salinity	N.A.	**NA**	**NA**	**NA**	**NA**	0.1ppt
Total Suspended Solid	1,028mg/l	0	0	0	0	30 mg/l
Total Dissolved Solid	72mg/l	**0**	**0**	**0**	**0**	1,200 mg/l
Total Solid mg/l	1,100mg/l	**NA**	**NA**	**NA**	**NA**	1000mg/l

NA = NOT ANALYSED NS = NOT SPECIFIED ND = NOT DETECTED

TABLE 3.1.2
CHEMICAL

CHEMICAL	RESULT					W.H.O STANDARD
	A	B	C	D	E	
Total Acidity	380mg/l	105	26	112	18	NS
Total Alkalinity	1,285mg/l	25	25	30	15	200mg/l
Total Hardness	NA	28	38	62	80	100mg/l
Chloride	34mg/l	0	5	25	17	250mg/l
Fluoride	NA	NA	NA	NA	NA	1.5mg/l
Nitrates	NA	NA	NA	NA	NA	10mg/l
Phosphate	NA	NA	NA	NA	NA	5mg/l
Sulphates	NA	NA	NA	NA	NA	250mg/l
Phenol	NA	NA	NA	NA	NA	1.0mg/l
Residual Chlorine	NA	NA	NA	NA	NA	
Oil and Grease	0mg/l	NA	**NA**	**NA**	**NA**	0.4mg/l(max)
Dissolved Oxygen	3.08mg/l	4.90	4.88	4.63	4.62	2.0mg/l(min)
Chemical Oxygen Demand	2,069mg/l	NA	NA	NA	NA	200mg/l
Biological Oxygen Demand	517mg/l	NA	NA	NA	NA	50mg/l

NA = NOT ANALYSED NS = NOT SPECIFIED ND = NOT DETECTED

TABLE 3.1.3
TRACE/TOXIC HEAVY METAL

TRACE / TOXIC HEAVY METAL	RESULT					W.H.O STANDARD
	A	**B**	**C**	**D**	**E**	
Calcium	NA	NA	NA	NA	NA	200mg/l
Magnesium	1,4747mg/l	0.0501	0.0570	0.1663	0.1604	150mg/l
Sodium	0.3705mg/l	0.0852	0.4659	0.5670	0.5222	200mg/l
Potassium	NA	NA	NA	NA	NA	<20mg/l
Zinc	0.0169mg/l	0.0000	0.0000	0.0000	0.0000	1.5mg/l
Copper	NA	NA	NA	NA	NA	0.5mg/l
Aluminum	NA	NA	NA	NA	NA	0.2mg/l
Manganese	0.0287mg/l	0.0012	0.0018	0.0000	0.0000	0.5mg/l
Iron	0.4110mg/l	0.0062	0.0000	0.0185	0.0224	0.03mg/l
Nickel	0.0008mg/l	0.0000	0.0000	0.0000	0.0000	0.02mg/l
Cobalt	NA	NA	NA	NA	NA	NS
Cadmium	0.0005mg/l	0.0005	0.0000	0.0000	0.0000	0.002mg/l
Arsenic	NA	NA	NA	NA	NA	0.015mg/l
Silver	0mg/l	0.0000	0.0000	0.0000	0.0000	NS
Mercury	NA	NA	NA	NA	NA	0.002mg/l
Lead	0mg/l	0.0190	0.0000	0.0000	0.0001	0.015mg/l
Chromium	NA	NA	NA	NA	NA	0.10mg/l

NA = NOT ANALYSED NS = NOT SPECIFIED ND = NOT DETECTED

TABLE 3.1.4
MICROBILOGY

MICROBIOLOGY	RESULT					W.H.O STANDARD
	A	B	C	D	E	
Total Plate Count	80	50	30	20	120	100cfu/ml
Total Coliform Count	Positive	15	0	15	3	Nil
Confirmatory Feacal Coliform Test	Positive	Positive	Negative	Positive	Negative	Negative

NA = NOT ANALYSED NS = NOT SPECIFIED ND = NOT DETECTED

RESULT OF HOUSE F - J SAMPLES
TABLE: 3.2.1
PHYSICAL

PHYSICAL	RESULT					W.H.O STANDARD
	F	G	H	I	J	
Appearance	Colourless	Colourless	Colourless	Colourless	Colourless	Colourless
Temperature	26.7	26.8	26.8	26.7	27.0	35-40^{O}C
Taste						Tasteless
PH	5.9	4.3	5.8	6.1	6.3	6.5-8.5
Odour	Odourless	Odourless	Odourless	Odourless	Odourless	Odourless
Turbidity	19.3	0.1	7.2	7.7	7.9	5 NTU (mg/l)
Conductivity	0.61	0.84	0.61	0.61	0.62	1.0 mscm
Salinity						0.1ppt
Total Suspended Solid	2	0	0	0	1	30 mg/l
Total Dissolved Solid	**NA**	**NA**	**NA**	**NA**	NA	1,200 mg/l
Total Solid mg/l	**NA**	**NA**	**NA**	**NA**	NA	1000mg/l

NA = NOT ANALYSED NS = NOT SPECIFIED ND = NOT DETECTED

TABLE: 3.2.2
CHEMICAL

	RESULT					W.H.O STANDARD
	F	G	H	I	J	
Total Acidity	16	62	11	9	15	NS
Total Alkalinity	30.0	20.0	15.0	15.0	35.0	200mg/l
Total Hardness	130	56	104	84	72	100mg/l
Chloride	11. 0	63.0	14.0	17.0	13.0	250mg/l
Fluoride	NA	NA	NA	NA	NA	1.5mg/l
Nitrates	NA	NA	NA	NA	NA	10mg/l
Phosphate	NA	NA	NA	NA	NA	5mg/l
Sulphates	NA	NA	NA	NA	NA	250mg/l
Residual Chlorine	NA	NA	NA	NA	NA	0.4mg/l(max)
Dissolved Oxygen	7.85	4.85	8.10	7.78	7.78	2.0mg/l(min)

NA = NOT ANALYSED NS = NOT SPECIFIED ND = NOT DETECTED

TABLE: 3.2.3
TRACE/TOXIC HEAVY METAL

	RESULT					W.H.O
	F	G	H	I	J	STANDARD
Calcium	NA	NA	NA	NA	NA	200mg/l
Magnesium	0.6303	0.3480	0.8954	0.8365	0.7083	150mg/l
Sodium	0.6426	1.2328	0.4592	0.8365	0.7032	200mg/l
Potassium	NA	NA	NA	NA	NA	<20mg/l
Zinc	NA	NA	NA	NA	NA	1.5mg/l
Copper	NA	NA	NA	NA	NA	0.5mg/l
Aluminum	NA	NA	NA	NA	NA	0.2mg/l
Manganese	0.0012	0.0018	0.0000	0.0005	0.0000	0.5mg/l
Iron	0.0062	0.0000	0.0185	0.0224	0.0120	0.02mg/l
Nickel	0.0000	0.0000	0.0000	0.0000	0.0000	0.02mg/l
Cobalt	NA	NA	NA	NA	N.A	NS
Cadmium	0.0001	0.0000	0.0000	0.0000	0.0000	0.002mg/l
Arsenic	NA	NA	NA	NA	NA	0.015mg/l
Silver	0.0000	0.0000	0.0000	0.0000	0.0000	NS
Mercury	NA	NA	NA	NA	NA	0.002mg/l
Lead	0.0000	0.0000	0.0000	0.0000	0.0000	0.015mg/l
Chromium	NA	NA	NA	NA	NA	0010mg/l

NA = NOT ANALYSED NS = NOT SPECIFIED ND = NOT DETECTED

TABLE: 3.2.4
MICROBIOLOGY

	RESULT					W.H.O
	F	G	H	I	J	STANDARD
Total Plate Count	5	10	25	2	10	100cfu/ml
Total Coliform	2400	0	37	0	1200	Nil
Confirmatory Feacal Coliform Test	Positive	Nil	Nil	Negative	Negative	Negative

NA = NOT ANALYSED NS = NOT SPECIFIED ND = NOT DETECTED

4. DISCUSSION

From the results obtained in Table 3.1.1, the waste water from the abattoir has unacceptable colour with high amount of suspended solids etc. Similarly, the PH for samples B - F in Table 3.1.1 and samples F – J in Table 3.2.1 fall below the acceptable standard except Sample A. This agreed with the work done by [21]. Chemical analysis shows high amount of dissolved oxygen in all samples in conformity with acceptable standard. However, Sample A which shows high values of alkalinity[7]. According to [17]; it was observed that the characteristics of abattoir wastes and effluents vary from day to day depending on the number and types of stocks being slaughtered. It was observed that analysis of trace/toxic heavy metal gave acceptable results in all the samples except in Sample A in Table 3.1.3 which gave higher values than the standard in magnesium and iron.

Microbiological analysis was positive due to the presence of coliform, apparently due to faecal contamination from the abattoir waste water which seeped into surrounding underground water. While three out of nine samples i.e. B and D of Table 3.1.4

and F in Table 3.2.4 representing 33% of samples collected were found to be specimen from residences located close to the abattoir are positive for faecal coliform. However, House E in Table 3.1.4 has a total plate count of 120 cfu/ml; other samples have values within W H O standard. These results agreed with previous studies made by [8, 11] in Ogbomosho town; that abattoir waste water has considerable range of biological and chemical pollutants. The remaining 6 (67%) were far sites from abattoir; hence analysis gave good result within acceptable reference range [22].

5.1 CONCLUSION

Inference that can be drawn from the analysis of the abattoir effluents and surrounding portable water is the closer to abattoir, the less portable the water for consumption [6].

5.2 RECOMMENDATION

- Abattoir should be sited relatively far from residential areas, [18] Abattoir activities should be done in an environmental friendly manner in strict compliance with environmental health and safety regulations [8]. Disposal of abattoir wastes must be done in an environmental friendly manner to mitigate contamination [23].
- The state environmental protection agency should actively monitor activities of the abattoirs and ensure compliance with health and safety standard [24].
- It is advisable that residents of areas close to abattoir should make borehole instead of wells to mitigate contamination, it was observed that water source specimens that did not pass, was a well hence infiltration with pollutants are easily achieved, regular periodic treatment of water and boiling before drinking are also recommended.

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