

Original article

## THE WATER QUALITY AND SANITARY CONDITIONS IN A MAJOR ABATTOIR (BODIJA) IN IBADAN, NIGERIA

<sup>1\*</sup>ADEYEMO, O. K., <sup>2</sup>AYODEJI, I. O. AND <sup>3</sup>AIKI-RAJI, C. O.

Departments of <sup>1</sup>Veterinary Public Health / Preventive Medicine and <sup>3</sup>Veterinary Microbiology / Parasitology, University of Ibadan, Ibadan, Nigeria..

<sup>2</sup>Federal College of Animal Health and Production Technology, I.A.R.&T., Ibadan.

Twelve wells were assessed using their physico-chemical and bacteriological parameters as indices. The organoleptic properties including appearance, odour and taste were used for the physical assessment while flame photometry, atomic absorption spectrophotometer, titration, gravimetry and evaporation to dryness were used to determine the chemical constituents and the serial dilution technique used in determining the total bacterial count, coliform count and faecal streptococcus count. Biochemical tests were carried out to further characterize the organisms isolated. The sanitary conditions on the slaughter slabs and within the abattoir grounds was also assessed to determine the effect on the water quality of the wells used in dressing carcasses and other activities. All the wells sampled were clear and without colour, odour and taste with PH and temperature values ranging between 6.41 – 6.75 and 24.5°C – 28.4°C respectively. The mean values obtained in the samples from groups A, B and C for calcium, magnesium, sodium, potassium, zinc and copper were all within the WHO, 1971; 1995 recommendations while the iron, (3.00mg/L); Lead (0.09mg/L); chloride (312.07mg/L) and total solid (2100.00mg/L) in group A samples exceeded the recommended values of 0.1-1.00mg/L; 0.05mg/L; 200mg/L and 500-1500mg/L respectively. Results from the bacteriological analysis indicates that samples from wells A and B were highly contaminated with pathogenic bacteria including *Escherichia coli*, *Pseudomonas aeruginosa*, *Bacillus subtilis*, *Enterobacter aerogenes* and faecal streptococcus, with group A having the highest mean bacterial count ( $15.4 \times 10^4$ ) and group C having the least ( $2.0 \times 10^4$ ). No pathogenic bacteria were isolated from samples in group C. The activities within the abattoir were being carried out in a most unhygienic manner. The public health importance of using contaminated water in dressing carcasses and other activities including consumption of the water without any form of treatment by butchers and abattoir workers and the implications of the sanitary condition of the abattoir on the water quality are discussed in the text.

**Keywords:** Water, Quality, Sanitation, Abattoir

\*Author for correspondence (adeyemo@skannet.com)

### INTRODUCTION

While the slaughtering of animals result in meat supply and useful by-products like leather and skin, livestock waste spills can introduce enteric pathogens and excess nutrients into surface waters and can also contaminate ground waters [Meadows, 1995]. These leachates consist largely of solids, microbial organisms and in special situations chemicals and shallow wells like hand-dug wells are more dangerously polluted [Ifeadi, 1982]. 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 fetuses. The liquid waste is usually composed of dissolved solids, blood, gut contents, urine and water. As population grows and urbanization increases, more water is required and greater demand is made on ground and surface water and an even greater amount of organic and inorganic wastes are speared back into water sources so that less potable water becomes available [Shuval, 1972]. Water is regarded as being polluted when it is unfit for its intended use [Turk, 1980].

The self-purification process of ground water is a function of the depth of the soil and the concentration of the pollutant in the percolating water [Ifeadi, 1982]. The water used for cleaning procedures must meet drinking water standards [Fonseca *et al*, 2000] and potable water is one that does not contain chemical substances or microorganisms in amounts that could cause hazards to health [Alonge, 1991].

Bacteriological examination of water is therefore a powerful and foremost tool in order to foreclose the presence of microorganisms that might constitute a health hazard [Bonde, 1977]. Microorganisms commonly used as indicators of water quality include: coliforms, *Faecal streptococci*, *Clostridium perfringens*, and *Pseudomonas aeruginosa* [Bonde, 1977; Alonge, 1991]. The physico-chemical and microbiological analyses of surface and groundwater are important towards a meaningful impact assessment of domestic and industrial activities on these water bodies [Amund and Odubella, 1991].

This work presents our findings on the quality of water of the wells sited within and around Bodija abattoir, which is primarily used by butchers in

dressing carcasses and also serves as a source of drinking water for the abattoir workers. The effect of the sanitation problems in the abattoir on the water quality was also emphasized.

## MATERIALS AND METHODS

A total of twelve wells were sampled during this study. Four of the wells were sited within the ground of the abattoir (group A), four were about 50m-80m away from the abattoir (group B) and four were in a residential area about 500m-1000m away from the abattoir (group C and the control). All glass wares used in the collection of samples were sterilized in an autoclave at a temperature of 120°C for three hours before duplicate samples of 100ml and 2 liter of each of the well water was collected for bacteriological and physico-chemical analyses respectively according to the procedure described in [APHA, 1995].

**Physico-Chemical Assessment:** Organoleptic properties such as appearance, odour and taste were assessed [Alonge, 1991], PH was determined using a PH meter and temperature was measured at the point of collection using a thermometer with a range of 10°C-50°C. Chemical constituents of the samples were determined using flame photometer, atomic absorption spectrophotometer, titration, gravimetry,

evaporation to dryness and colorimetry [APHA, 1995].

**Bacteriological Assessment:** The method of Miles and Misra described by Collins and Lynes, 1976 was adopted to obtain the microbial counts. All media used: nutrient agar for bacterial count; macconkey agar for coliform count and M-enterococcus agar for faecal streptococcus count were sterilized in an autoclave at 121°C for 15 minutes [APHA, 1995].

Samples were cultured on the prepared medium in duplicate and incubated aerobically at 37°C for 48 hours and the colonies formed were counted using colony counter and expressed as colony-forming units per milliliter (cfu/ml) of the sample. Various biochemical tests were carried out on the isolates for bacterial characterization. One-millimeter broth culture of each isolate was used for each test. Some photographic shots showing butchers' activities and sanitation problems were taken on the slaughter slabs and around the abattoir.

## RESULTS

The result of the physico-chemical analyses is presented as Table 1 while that of the bacterial count and characterization is presented as Tables 2 and 3 respectively.

**Table 1:** Physico-Chemical Values and Composition of the Well Water used by Butchers in Bodija Abattoir Ibadan, Nigeria.

Values and Constituents	Group A (within The abattoir)	Group B (50m-80m to the abattoir)	Group C (500m-1000m from the abattoir)	Maximum Values (WHO, 1971; (1995)**
pH Range	6.57± 1.67	6.41 ± 0.89	6.75 ± 0.55	7.0-8.5 (<8.0)
Temperature (°C)	26.1± 1.05	27.8 ± 0.64	25.8 ± 1.22	-
Sodium (mg/L)	40.00 ± 4.12	35.00 ± 2.17	46.30 ± 2.11	-
Potassium (mg/L)	127.01± 2.45	73.80 ± 1.88	125.00 ± 1.67	-
Calcium (mg/L)	143.00 ± 4.33	81.30 ± 11.90	131.30 ± 22.15	75-200 (*)
Magnesium (mg/L)	27.00 ± 1.50	13.20 ± 2.10	12.30 ± 2.44	30.00 (*)
Zinc (mg/L)	0.06 ± 0.03	0.02 ± 0.02	0.07 ± 0.12	5.0-15.00 (3.00)
Iron (mg/L)	3.00 ± 0.78	0.44 ± 0.67	0.82 ± 0.56	0.10-1.00 (0.30)
Copper (mg/L)	0.39 ± 0.21	0.30 ± 0.33	0.32 ± 0.11	0.05-1.50 (1.00)
Manganese (mg/L)	0.67 ± 0.07	1.18 ± 0.31	2.19 ± 0.45	0.05-0.50 (0.50)
Lead (mg/L)	0.09 ± 0.016	0.02 ± 0.014	0.01 ± 0.012	0.10 (0.01)
Total solids (mg/L)	2100.05 ± 20.54	950.00 ± 51.54	750.00 ± 43.00	500-1500 (*)
Total hardness (Mg/L)	371.25 ± 10.23	133.25 ± 22.89	151.00 ± 11.90	100-500 (*)
Total chloride (mg/L)	312.07± 11.12	134.75 ± 7.88	94.85 ± 12.44	200 (250)

\* All Values Are Mean ± Standard Error Of Mean (SEM); \*Values In Brackets () Are W.H.O, 1995 Guideline Values

**Table 2:** Mean Bacterial, Coliform and Faecal Streptococcus Counts (Cfu/MI) of The Wells Sampled at Bodija Abattoir, Ibadan, Nigeria

Samples	Bacteria Count (X 10 <sup>4</sup> )	Coliform Count (X 10 <sup>4</sup> )	Faecal Streptococcus Count (X 10 <sup>4</sup> )
Group A (Within the abattoir)	15.4 ± 2.55	6.9 ± 1.12	8.8 ± 1.23
Group B (50m-80m to the abattoir)	11.0 ± 2.48	5.6 ± 1.46	4.3 ± 1.55
Group C (400m-500m to the abattoir)	2.0 ± 1.10	NONE	NONE
Acceptable value for potable water (Alonge, 1991)	Less than 0.001	NONE	NONE

The organoleptic assessment showed that the samples from all the wells were clear, without odour and taste. The PH range of the samples in groups A, B and C was 7.0-8.3 with a mean of 6.57, 6.41 and 6.75 respectively, the temperature ranged between 24.5°C – 28.4°C with a mean of 26.1°C, 27.8°C and 25.8°C for samples in groups A, B and C respectively depending on the environmental condition at the time of collection of the samples (Table I).

From Table 1, group A samples had a higher mean elemental composition for most of the elements considered: Calcium (Ca<sup>++</sup>), Magnesium (Mg<sup>++</sup>), Potassium (K<sup>+</sup>) and Copper (Cu<sup>++</sup>) with mean values of 143.00, 27.00, 127.00 and 0.39mg/L respectively). Also group A samples had higher mean value for total hardness (371.25). For Sodium (Na<sup>+</sup>), Zinc (Zn<sup>++</sup>) and Manganese (Mn<sup>++</sup>), the mean values were higher in samples from group C (46.30, 0.07 and 2.19 mg/L respectively).

All the values obtained for the three sites however fall within the normal range recommended by W.H.O (1971, 1995). The levels of Iron (Fe<sup>++</sup>), 3.00mg/L; Lead (Pb<sup>++</sup>), 0.09mg/L; total solids, 2100.00 and chloride (Cl<sup>-</sup>), 312.07mg/L in samples from group A are higher than the recommended values (0.10-1.00, 0.05, 500-1500 and 200.00mg/L respectively). Also the Manganese level from all the sites sampled was higher than the standard value (0.05-0.50mg/L).

All the samples from the three sites (A, B and C) had high mean bacterial count (x 10<sup>4</sup>): 15.4, 11.0, 2.0 cfu/ml. However only in samples from groups A and B was coliforms and faecal streptococcus isolated with mean coliform count (x 10<sup>4</sup>): 6.9 and 5.6 and mean faecal streptococcus count (x 10<sup>4</sup>): 8.8 and 4.3 respectively (Table II).

Table 3 shows other bacteria which were isolated and characterized using the biochemical tests carried out on the isolates along with the coliform and faecal streptococcus already identified as being present in samples from groups A and B. The sanitary condition of the slaughter slabs, wells and the drainages within the abattoir are presented as Plates I-IV.

**Plate 1:** A slaughter slab showing a well, and butchers skinning the carcass of cattle on the dirty and bare floor**Table 3:** Pathogenic Organisms Isolated From the Wells Sampled

SAMPLES	ISOLATED ORGANISMS
Group A (Within the grounds of the abattoir)	<i>Echerichia coli</i> <i>Streptococcus feacalis</i> <i>Pseudomonas aeruginosa</i> <i>Enterobacter aerogenes</i> <i>Bacillus subtilis</i>
Group B (50m-80m to the abattoir)	<i>Echerichia coli</i> <i>Streptococcus feacalis</i> <i>Pseudomonas aeruginosa</i>
Group C (Bodija residential area)	NONE

**Plate 2:** Butchers Dressing Carcasses In A Slaughter Hall Amidst Blood And Manure

## DISCUSSION

Bodija abattoir is a major abattoir located in Ibadan north local government area of Ibadan, Oyo state, Nigeria. Ibadan is the largest city in West Africa and the second largest in Africa, with

land size covering an area of 240km<sup>2</sup> and with human population of 1, 222, 570 by 1991 census.

The city is located on geographic grid reference longitude 3° 5E, latitude 7° 20N [Filani *et al*, 1994]. Animals slaughtered in Bodija abattoir alone accounts for 65.93% of the total animal in Oyo state [Abiola, 1995].



**Plate 3:** An Open Drainage And Pipes, Which Are No Longer Useful



**Plate 4:** Manure mixed With Blood flowing into an open Drainage from the main slaughter hall

The waste from the slaughtering and dressing grounds in Bodija abattoir are washed into open drainages untreated and the leachates from the series of decomposition processes of these wastes percolate into the underlying aquifers to contaminate the hand-dug wells [Abiola, 1995], which serves the dual purpose of drinking water for the butchers and others working in the abattoir, and dressing of the carcasses to be sold for human consumption.

The result of this study shows that all the samples from the three different sites were not chemically polluted as almost all the values obtained for both the organoleptic and the physico-chemical analyses were within the recommended values [WHO, 1971; WHO, 1995], (Table I). However the high levels of iron, lead, chloride and total solids in group A samples and manganese in the samples from all the sites can be attributed to underground sources of pollution which might result from high concentration of mineral salts due to the geological nature of the bedrock in which the aquifer is situated, inadequate seals, split casings, wrong choice of

material for casing which may lead to rusting and corrosion and hence pollution of the water supply [Ifeadi, 1982].

All the samples from sites A and B were heavily polluted with pathogenic organisms mainly of faecal origin, although site C had some microbial counts, it was however free of pathogenic organisms used as indicator of pollution as shown in Tables 2 and 3, since Any water source used for drinking or cleaning purposes should not contain any organism of faecal origin [Sabongari, 1982; Akeredolu, 1991]. Natural waters usually contain not only large numbers of microorganisms but also a wide variety and such waters may be perfectly good to drink. The sanitary quality of portable water is determined primarily by the kinds of microorganisms present rather than by the microbial count *per se* [Bonde, 1977].

It was discovered from this study that the sanitary condition under which carcasses are being dressed at Bodija abattoir is far from ideal as seen in Plates I and II. Pipe-borne water is no longer available (Plate III) and the wells dug in replacement are not well maintained, water is retrieved from the wells using manual drawing buckets which are left lying around in the muck on the slaughter slabs and are re-used at will. The drains are open and unkempt due to inadequate supply of water.

The pathogenic organisms isolated from waters used by the butchers in Bodija abattoir not only makes the water unsafe for human consumption [Alonge, 1991], but it also makes it unfit for the purpose of dressing carcasses [Akeredolu, 1991; Fonseca *et al*, 2000]. The situation at Bodija abattoir is just an indication of what is operating in other abattoirs in the country; there is therefore a need for the government to address the issue of provision of adequate and safe water for the activities in all the abattoirs in Nigeria.

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