Sahel J. Vet. Sci. Vol. 9, No. 2, pp. 63 - 67 (2010)

1605-8954/10/$25.00 + 00

Sahel Journal of Veterinary Science

Bacteriological Assessment of Quality of Water Used at the Bodija Municipal Abattoir, Ibadan, Nigeria

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ABSTRACT

The water used for cleaning procedures and meat processing in the abattoir must meet drinking water standards. It must be free of chemical substances or microorganisms in amounts that could cause hazards to health. The bacteriological status of water supply to the Bodija Municipal Abattoir, Ibadan, Oyo State, Nigeria, was evaluated. Water samples from different sources within and around the abattoir were collected and examined. Average coliform count per 100 ml and confirmatory *Escherichia coli* counts per 100ml respectively were determined using the multiple tube method. The surface tank had the highest mean coliform count of 173.6 ± 10.9 per 100 ml, while the borehole had the lowest mean count of 17.0 ± 8.1 coliform per 100 ml. The confirmatory *Escherichia* coliform count per 100 ml was highest for wells (20.8 ± 18.5) and lowest for borehole (1.0 ± 0.07). A significantly higher number of the samples($p<0.05$) 68% had a range of 161 to 200 coliform counts per 100 ml while 90% of the total samples had *E. coli* count per100 ml within the range of 1 to 40 count per 100 ml. Pathogenic bacteria isolates obtained from this study include *Escherichia coli*, *Klebsiella* spp., *Pseudomonas aeruginosa* and *Proteus* spp. This suggests that the bacteriological status of water used at the Bodija municipal abattoir was below the recommended standard of WHO (*E. coli* < than 1) thus posing health and food safety risks on the public that depend on the meat from the abattoir. It is hereby recommended that the government should address the issue of provision of adequate and safe water for the activities and facilities for water treatment should also be provided in all the abattoirs in Nigeria in order to safe guard the health of the populace.

Key words: Assessment, bacteriology, water quality, abattoir

INTRODUCTION

An abattoir is a building that is used for the slaughtering of food animals for human consumption (Blood *et al*., 2007). This building must be registered and approved by the government for hygienic slaughtering of food animals. The hygienic processing of meat that is safe, wholesome and fit for human consumption is hinged on the ability to provide adequate potable water. Large quantity of quality water is required for animals to be slaughtered, personnel use, washing of meat, hides and skins and general routine cleaning of the abattoir. The water should be drinkable, reliable and uninterrupted, as well as free from chemical substances or micro-organisms in amount that could cause hazards to health (Alonge, 2005). It must be colourless, odourless and tasteless.

Food processing plants including the abattoir require several litres of water (149,358 litres) which comes directly in contact with food as well as working surface. Since the source of water supply is mostly wells and rivers, water from these sources are bound to contain pathogenic microorganisms which when untreated contaminates meat processed for human consumption. Unhygienic disposal of abattoir waste has also been found to contribute to livestock waste spillage which can introduce enteric pathogens and excess nutrients into surface water and can also contaminate ground water (Meadows, 1995). The wastes from slaughtering and dressing in the Bodija Abattoir are washed into open drainages untreated and the leachates from the series of decomposition processes of these waste can introduce enteric pathogens and excess nutrients into surface waters and also percolate into underlying aquifers to contaminate hand- dug wells, which serve the dual purpose of drinking water for butchers and others working in the abattoir and dressing of carcasses to be sold for human consumption (Abiola 1995). Some of these pathogens that could constitute health hazards to the public include *Escherichia coli*, *Salmonella spp.*, *Shigella spp., Vibrio cholera*, and *Entamoeba histolytica.*

Microbiological examination of water is meant to determine the sanitary quality of the water and its level of

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contamination with wastes (Alonge, 2005). Water is examined to detect *Escherichia coli* which indicate faecal contamination since this bacterium is a normal intestinal flora and its presence in water alerts public health officials to the possible presence of other human and animal pathogens. The aim of this study is to ascertain whether the water used in the Bodija abattoir is potable and fit for meat processing and has no health hazards.

MATERIALS AND METHODS

Bodija abattoir is located in Ibadan North Local Government Area of Ibadan in Oyo State. Ibadan is a highly populated city, with land mass covering an area of 240 square kilometers and with human population of one million, two hundred and twenty-two thousand, five hundred and seventy (1,222,570) by 1991 census (Adeyemo, 2002). The abattoir is located on geographical grid reference longitude 3°5′E, latitude 7°20′N (Filani, 1994). Oyo state has a temperature of 27 - 29°C and relative humidity of 65%. Animals slaughtered at Bodija abattoir alone accounts for 65.93% of the total animals slaughtered in Oyo (Abiola, 1995). The Abattoir comprises of Administrative blocks for veterinary meat inspectors, superintendents and sanitary officers. There is also a large lairage/control post (this is where animals are rested for 24 hours before slaughtering), six slaughter halls for cattle, pigs, sheep and goats and a cattle market close to the lairage. The water source to the abattoir includes four functional wells within and around the abattoir, public tap (i.e., government water supply), tank and a borehole.

A total 3 samples for each source were collected at a week interval for a period of one month during the wet season. Water samples from the identified functional wells were collected using a 250 ml sterile bottle to which a sterile stone was attached to act as sink. The bottle was lowered into the well with the aid of two chords attached to the stopper and the neck of the bottle. Water collected from the tap was done by first flaming the mouth of the tap for 4 - 5 minutes. Thereafter, water was allowed to flow for 5 minutes before samples were collected in a 250 ml bottle. Water samples from the Borehole were also collected in like manner. For the tank, hands were disinfected with Hibitane^{R} and allowed to air dry. A sterile 250 ml sterile bottle was lowered into the tank for collection. Samples were labelled, stored and transported in coolers to the laboratory within an hour after collection.

Water samples taken from these different water sources to the abattoir were made to undergo presumptive coliform count technique using multiple tube method (Markie and MacCartney, 1996) and Eijkman's test for faecal coliform and confirmed *Escherichia* coliform count.

Presumptive coliform count

The presumptive coliform count method was used to determine the coliform count/100 ml of the various sources of water to the abattoir. Water samples of 50 ml volume and five 10 ml volume were pipetted into sterile tubes containing corresponding volumes of double strength MacConkey broth and five 1ml volumes of water was pipetted into vessels containing 5ml single strength MacConkey broth. Media were incubated aerobically at 37°C for 48 hours with a control. Bottles that showed acid production (color change to yellow) and gas production after 48 hours were considered "presumptive positive" while those showing no acid and gas production were considered "presumptive negative". The most probable number (MPN) of coliform based on the numbers of positive and negative results were determined from a MPN table. (Markie and MacCartney, 1996)

Confirmatory tests

Confirmed *E. coli* counts per 100 ml were determined by sub culturing the positive presumptive coliform samples into freshly prepared MacConkey broth and a peptone water broth. The media were incubated at 44°C for 24 hours. Tubes showing lactose fermentation and gas production were inoculated with 0.5 ml Kovac's Reagent. A red ring in the samples showed in the positive cases. *E-coli* NTCC10418 (standard organism) was used as a positive control. (Markie and MacCartney, 1996)

Identification of organisms

Bacteria organisms were isolated and identified by sub culturing presumptive positive tubes on blood agar and MacConkey agar. They were then incubated at 37°C for 24 hours.Identification of isolates after 24 hours were carried out. Colonies were then subjected to biochemical tests for further identification (Buchanan *et al.,* 1974). The results were analyzed using the analysis of variance (ANOVA).

RESULTS

The mean value for presumptive *coliform* count sampled showed 159 coliforms/100 ml for wells, 98.7coliforms /100 ml for tap, 16.7coliforms/100 ml for borehole, 123.7 and 161 coliforms/100 ml for tank and stream, respectively. Result showed no significant difference between the different water sampled ($p<0.05$). The mean value for the confirmatory *E. coli* count/100 ml for each sample analyzed showed that the wells had 21 *E. coli* count/100 ml, 10 *E. coli* count/100 ml for tap, 1 *E. coli* count/100 ml for borehole, 5 and 8 *E. coli* count/100 ml for stream and tank respectively. Figure 1 shows mean presumptive coliform counts/100 ml and mean confirmatory *Escherichia coli*/100 ml in the different water sources to the abattoir

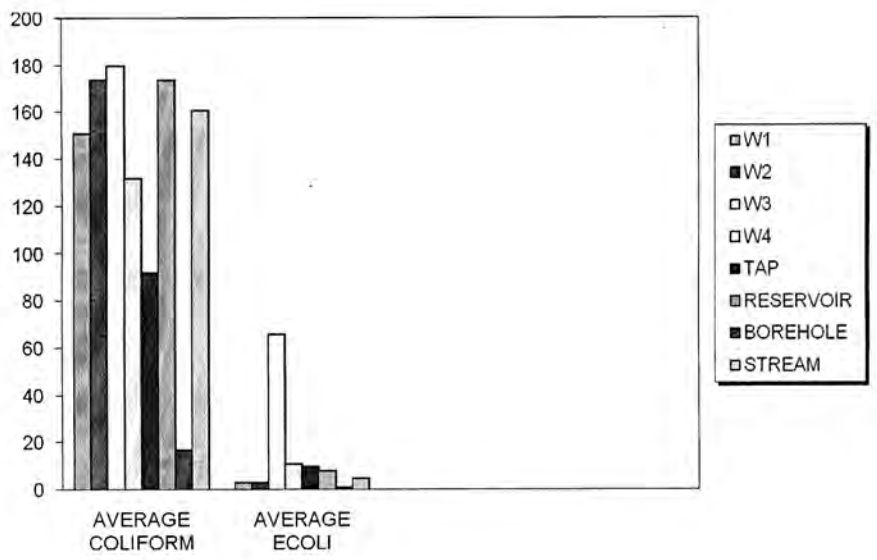

Fig. 1. Mean distribution of presumptive coliform and confirmatory *Escherichia coli* count/100 ml of different water sources

Table 1 shows the distribution of presumptive coliform counts and confirmatory *E. coli* counts of water samples. For presumptive count 18.2% (4) of the total samples and 90% (20) of the total sample for the *E. coli* counts falls within the range of 1 - 40 coliform/*E. coli* count/100 ml. A total of 68.2% (5) of the samples collected had their presumptive coliform count within the range of 161 - 200 coliforms.

Table 1. Distribution of presumptive coliform counts and confirmatory *E. coli* counts

MPN of coliform/100 ml	Coliformcount in %	*E. coli* count in %
1 - 40	4(18.2)	20(90.9)
41- 80	11(4.55)	0(0)
81-120	2(9.09)	2(9.1)
121-160	0(0)	0(0)
161-200	15(68.2)	0(0)

The Table 2 shows the average distribution of coliforms and *E. coli* count/100 ml of various sampled sources. Table 3 indicates the distribution of bacteria isolates from different water supplies sampled. The prevalence of *Klebsiella spp* for the total isolates 20%, *Klebsiella oxytocum* 7.5% , *proteus* spp. had 7.5%, *Escherichia coli* 55%, *Pseudomonas aeruginosa* 7.5% and *Pseudomonas* spp. 2.5%. The wells yielded 50 % (20 out of 40) of the isolates obtained in this study showing that they were more contaminated. No *Streptococcus faecalis* was isolated during the course of study.

Table 2. Average distribution of presumptive coliform and confirmatory *E. coli*/100 ml of sampled sources.

Source	Average coliform count	Average *E. coli* count
W1	151	3
W2	174	3
W3	180	66
W4	132	11
Tap tank	92	10

Table 4 indicates the result of biochemical tests carried out for identification of bacterial isolates. The bacteria isolated included *Klebsiella spp, proteus spp, Eschericia coli, Pseudomonas aeruginosa* and *Klebsiella oxytocum*

DISCUSSION AND CONCLUSION

Potable water is that which is free from microorganisms and chemical substances in concentrations which could cause illness in any form (WHO, 1984). The detection of coliforms and *E. coli* is an indication of faecal contamination of sources of water supply to the abattoir. The presence of not more than 3 coliforms/100 ml may be tolerated provided faecal *E. coli* count/100 ml is zero (WHO,1984) which none of the water sources fulfilled. The increase trend of *E. coli* count from the borehole to the surface tanks and the tap could be as a result of the unhygienic state and storage since the tanks were in dirty state and uncovered. Also there could be possibility of leakages or rust pipe. The wells also recorded a high mean value for coliform and *E. coli* count per 100 ml. This can be attributed to poor drainage facilities and abattoir waste spillage which could contribute to the high level of faecal contamination of the wells (Abiola, 1995). The daily activities of the butchers such as the use of dirty and multiple drawers to fetch water may also contribute to the heavy contamination with pathogenic organisms (Adeyemo, 2002). Water shortage to the abattoir contributes to butchers depending on the use of unprotected sources that is, the stream under study. The stream used by these butchers is unfit for human use and meat processing because of the presence of coliforms and *E. coli* which indicates faecal contamination. This source of water can serve as vehicle for waterborne illnesses when such water is used for meat processing without treatment.

The pathogenic organisms isolated from water used by the butchers 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, 2000).

Table 3. Distribution of bacterial isolates in different water sources

Isolates	Ks	Ko	Ec	Ps	Pa	Pr	Total
W1	3	-	3	-	-	-	6
W2	-	-	3	-	-	-	3
W3	3	1	3	-	-	1	8
W4	-	-	3	-	-	-	3
Tap	-	-	3	-	-	1	4
Tank	2	3	-	3	-	9	
Bore hole	-	-	3	-	-	-	3
Stream	1	-	1	1	-	1	4
Total	8	3	22	1	3	3	40

W1 = Well number 1; W2 = Well number 2; W3 = Well number 3; W4 = Well number 4; *Ks* = *Klebsiella* spp.; Ko = *Klebsiella oxytocum;* Ec = *Escherichia coli;* Ps = *Pseudomonas* spp.; Pa = *Pseudomonas aeruginosa;* Pr = *Proteus* spp.

Table 4. Biochemical tests for the identification of bacteria isolates

Gram reaction	Urease	Oxidase	Indole	Citrate	Lactose	Motility	Isolates
GNB	+	-	-	+	+	-	*Klebsiella* spp
GNB	+	-	+	+	-	+	*Proteus*
GNB	-	-	+	-	+	+	*Eschericia coli*
GNB	-	+	-	+	-	+	*Pseudomonas aeruginosa*
GNB	+	-	+	+	+	-	*Klebsiella oxytocum*

GNB= Gram negative bacilli; + = positive; - = negative

The situation in the Bodija abattoir is an indication of exactly what is happening in the other abattoirs in Nigeria (Adeyemo, 2002). It is highly recommended that the government should address the problem of inaccessibility of the public to adequate and safe drinking water since every country is working towards achieving the millennium development goal of safe water for all by year 2025. Also proper drainage facilities for abattoir effluents be provided so as to prevent waste spills that can introduce enteric pathogens and excess nutrients into surface water and contamination of the ground waters. Promotion of awareness/education programme among the public as well

as butchers in our various abattoirs by public health workers should be encouraged through proper financing by both the government and the private sectors. This will impact on the people the effect of some unhygienic practices on water quality and the various health implications that could arise from such practices. Adequate collection and storage practices, proper cleaning of tanks, covering of available wells and water treatment before use should be practiced. Also, routine microbial quality evaluation should be conducted for all the water supplies used by the public and at the abattoirs.

REFERENCES

Abiola, S.S. (1995). Assessment of abattoir and slaughter slabs in Oyo State. *Nig. J. Anim. Prod.* 5, 54-62.

Adeyemo, O.O. (2002). Unhygienic operation of a city abattoir in southern Nigeria: Environmental Implication. *Ajeam/Ragee* 4, 23-28.

Akeredolu, F.A (1991). Setting water quality standards for Nigeria. *Proc. of First National Control on Water Quality Monitoring and Status in Nigeria*. Kaduna, Nigeria. pp 216-224.

Alonge, D.O. (2005). *Potable water; Meat and Milk Hygiene*. Alfas Press Nig. Company, Ibadan, Nigeria. pp. 32-43.

Blood, D.C., Studderts, V.P. and Gay, C.C. (2007). *Vet. Dictionary*, 3rd ed. Saunders Elsevier Limited, London. pp. 1- 2166

Buchanan, R.E and Gibbons, N.E. (1974). *Bergey's Manual of Determinative Bacteriology*, 8th ed. The Williams and Wilkins Company, Baltimore, USA.

Filani, M.O. (1994). Ibadan Region, Re-Charles Publication in Conjunction with Cornell Publications, Ibadan, Nigeria Company.

Fonseca, L.F.L (2000). Concentration of hardness, alkalinity and nitrates in water used for cleaning of milking equipments in Brazilian Dairy Farms. *Proc. Xth ISAH,* Maastricht, The Netherlands. pp. 100-103

Mackie and MacCartney. (1996). Examination of water. In: *Practical Microbiology*, 14th ed. Churchill and Livingstone, london. pp. 883-922.

Meadows, R. (1995). Livestock legacy. *Environ. Hlth Perspec.* 103(12), 1096; 1100.

WHO (1984). Guidelines for drinking water quality: Recommendations. 1, 91-130.