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THE MICROBIOLOGICAL QUALITY AND SOME PHYSICAL PARAMETERS OF DIFFERENT WATER USED AT A MUNICIPAL ABATTOIR IN NIGERIA

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ABSTRACT

This study determined the microbiological and some physical quantities and effect of the two different water sources used for meat processing at the Lafenwa abattoir, Abeokuta, Nigeria. Water sources identified are the Lafenwa river and Tap water supply. A total of 33 samples were collected and analyzed. The total viable of bacteria count (TVC) of the samples was determined by pour plate technique while the most probable number (MPN) of coliform count was by the multiple tube method. The mean TVC for the two spots on the river is $3.34x10^7$ cfu/ml and the mean MPN is 1600 /100ml. For the tap water, the mean TVC and MPN were $1.56x10^7$ cfu/ml and 890 /100ml respectively. The TVC values were significantly higher ($p<0.01$) for river samples when compared to that of tap water. There was no significant difference in the MPN/100ml values for SpotB of the river and tap samples ($p>0.05$). Potentially pathogenic Bacteria isolated from the water samples include: *Eschericia coli, Pseudomonas aeruginosa, Staphylococcus aureus, and Klebsiella spp.* The water samples from the river appeared creamy, highly turbid, particulate with pungent odour. The mean pH, temperature, dissolved oxygen (DO) and Biological Oxygen Demand (BOD) values were 5.4, 28.8^{o}C, 8.1 mg/l and 7.0 mg/l respectively. The tap water samples were clear, odourless, and colorless with mean pH, temperature, DO and BOD values of 6.8, 28.1^{o}C, 15.3mg/l and 3.1mg/l respectively. There was significant differences in the DO and BOD values of river samples compared to tap water ($p<0.01$) This study revealed that the two available water sources to the abattoir investigated had qualities below the recommended WHO standard for drinking water hence not safe for meat processing. It is however recommended that the use of the Lafenwa river should be discouraged by proper enlightenment programmes for the butchers and provision of adequate supply of safe water for meat processing. In addition treatment facilities for water before use should be made available at the various abattoirs in the country.

KEY WORDS: Microbial, Physical, Water qualities, Abattoir, Hygiene.

INTRODUCTION

Good quality water or potable water has been defined as that which does not contain chemical substances or disease causing micro-organisms in amount that is deleterious to human health and well being (Ihekoronye and Ngoddy 1985; Alonge, 2005).

Moreover, water is a varied entity with respect to physical, microbiological and chemical characteristics which has a bearing on its quality. Various water sources differ in these characteristics making one preferred than the other (Gracey, 1996).

The hygienic processing of meat which is safe and fit for human consumption is hinged on the ability to provide adequate potable water. Water in the abattoir is essential for animals awaiting slaughtering, personnel use, washing of meat, hides and skins and general routine cleaning of the abattoir (Alonge, 2005). Water used for cleaning procedures must meet international standards (Fonseca et al., 2000) thereby not constituting health risk to the populace.

Poor quality water or polluted water coming in contact been with meat has been found to contaminate meat and could serve as vehicles for transmission of major enteric diseases such as Cholera, Typhoid, Hepatitis, Ameobic and bacillary dysentery (W.H.O., 1996). There are recent publications that indicate that zoonotic diseases are yet to be eliminated or fully controlled in over 80% of the public abattoirs in Nigeria (Cadmus et al., 1992; Olugasa et al 2000). These can be attributed to lack of ante-mortem and post-mortem inspection of animals before and after slaughtering, poor quality water, poor cleaning and sanitation, poor personal hygiene and improper abattoir waste disposal and spillage to the environment.

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This work shows our findings on the physical and bacteriological quality of water sources used for meat processing at the Lafenwa municipal Abattoir.

MATERIALS AND METHODS:

STUDY LOCATION: The Lafenwa municipal abattoir is located at Abeokuta North local government area of Ogun state, Nigeria and being located on the geographical map reference latitude 3^0 19.665'E and longitude 7^0 09.775'N with an area of 16,762 KM. It has a population of about 4,054,272. This is a major abattoir in Ogun state and supplies 80% of meat consumed by the populace within and around Abeokuta. The abattoir is being supplied with water from a river and also from a tap source.

SAMPLE COLLECTION: A total of fourteen water samples were collected from each of the two river points and five samples from the tap source. Glass wares used were thoroughly sterilized in the autoclave at 120°c for 3 hours. Duplicates of 250ml of water samples were collected at a time from each sample source and preserved in ice cooler for both bacteriological and physical analysis. Laboratory work commenced within 2-6 hours of collection.

PARAMETERS MONITORED AT STUDY SITE:

Parameters taken at the point of water collection included water temperatures using digital thermometer (Model 275-K) as described by FAO 1997, the water pH was determined using the Hanna Digital pH meter, Organoleptic appearance, odour and taste were also assessed according to methods described by Alonge 2005.

DISSOLVED OXYGEN (DO) AND BIOLOGICAL OXYGEN DEMAND:

At the laboratory, the dissolved oxygen was measured using the digital DO Meter (Model Jenway 162K). The Biological oxygen demand was taken 5 days thereafter and subtracted from initial Dissolved oxygen value.

BACTERIOLOGICAL EXAMINATION:

The total viable of bacteria count (colony forming units/ml) was analyzed by the pour plate method as described by Baker *et. al.,* (1999). After the serial dilution of the water samples, 0.1ml of the diluted water was poured on sterile nutrient agar which was then incubated at 37°C for 24 hours. The colonies were counted using the colony counter and the colony forming units/ml calculated.

The most probable number was derived by using the multiple tube technique as described by WHO 1997. Most probable number for presumptive coliform count /100ml was determined based on the number of positive and negative results. Bacterial isolates were identified based on colonial appearance, cellular morphology and biochemical characteristics according to Barrow and Feltham (1993). Confirmed *E. coli* isolates were sub-cultured on sorbitol MacConkey (SMAC) (oxoid®) agar and incubated at 37°C for 24 hours. Pale yellow, non-sorbitol fermenting colonies were tested with *E. coli* O157 latex agglutination test kit (Oxoid®) and *E. coli* H:7 antiserum (Difco®) by slide agglutination test.

None of the tested isolates produced positive reaction to *E coli* O157 latex agglutination test kit and *E coli* H7 antiserum .

RESULTS

The results of the physical analysis of water sources are summarized in Table 1 . The pH values for Spot A of the river ranged from 4.50 to 6.70(mean 5.40), Temperature was from 28.20°c to 30.00°c (28.79^0c), DO was 7.15mg/l to 9.12mg/l (8.08mg/l) and BOD 6.01 to 8.00mg/l (7.00mg/l). The pH, temperature, DO and BOD for Spot B ranged from 4.80 to 6.70(5.5), 28.70^0c to 30.00^0c (28.97^0c), 7.39mg/l to 9.32mg/l (8.30) and 6.05 to 8.20mg/l (7.05) respectively. The river samples were creamy brown, turbid, particulate with highly offensive odour and taste.

On the other hand tap water samples had pH, temperature, DO and BOD ranging between 6.00 to 7.20 (6.80), 27.80^0c to 28.50^0c (28.00^0c), 14.25mg/l to 16.95 mg/l (15.3) and 2.11 to 4.01mg/l respectively. Tap samples were clear, colourless, odourless, tasteless and not particulate.

Spot A was slightly acidic with slight significant difference when compared to tap water.

The river samples had a significantly lower DO values when compared with that of tap source while the BOD values were significantly higher than that of Tap water.

The summary of the microbiological analysis are represented in Table 2 . The total viable count for Spot A, B and Tap had high values of $3.70x10^7$, $3.33x10^7$ and $1.56x10^7$cfu/ml respectively. The total viable bacteria count values of the river sample were significantly higher (<0.01) when compared with that of tap water. The MPN were also very high for all the water sources. The values were 1604.1, 1671.4 and 890 coliform count/ 100ml for Spot A, Spot B and tap respectively. There was no significant difference in the values of spot B of the river when compared with that of tap water.

The total viable bacteria count values of the river sample were significantly higher (<0.01) when compared with that of tap water. All values were higher than the WHO recommendation of $1.0x10^2$cfu/ml and 2 coliform count/100ml.

Pathogenic organisms isolated from the different water samples included *Eschericia coli, Pseudomonas aeruginosa, Staphylococcus auerus and Klebsiella spps.* No *Ecoli* O157:H7 was isolated in this study.

DISCUSSION

Water of good drinking quality should comply within certain physical, chemical and microbiological standards, which are designed to ensure that water is palatable and safe according to Tebutt (1983) .Water samples collected from different sources of supply to the abattoir did not comply with international limits for drinking water as recommended by W.H.O. (1999). All values were higher than the W.H.O recommendation of $1.0x10^2$cfu/ml and 2 coliform count/100ml in this study.

From the physical analysis, the sampled river (A and B) were slightly acidic with an average pH of 5.40 and 5.51 when compared to WHO/FAO recommended value of 6.8 to 8.5. The general low pH values obtained may be due to levels of high free carbon dioxide which consequently promote the bacterial load in water as confirmed in by Edema et al 2001. This is very important

because low pH level leads to an increase in the toxicity of poisons of water pathogens (Alli, 1991) and consequently affecting aquatic life (Narfanda, 2008). This was evident in the river water that was being used in the abattoir. The pH level of water is influenced by several factors and processes including temperature discharge of waste effluents, acidic precipitation, microbial activity and decay process (South African water quality guidelines, 1996). The pH level of tap water was relatively within the normal range when compared with international standards.

The temperature from the river and tap sources was 28.00c and 28.8^0c respectively which is characteristic of tropical environment (Mulusky, 1974). Alabaster and Iloyd 1980 also reported temperature range of 26 to 30^0c and attributed it to the insulating effect of increased nutrient load due to Industrial discharge. An increase or rise in water temperature has also been reported to adversely affect aquatic life due to rate of accelerated oxidation, faster oxygen demand and depletion of oxygen water content by living organisms in the water (Chukwu, et al 2008).

The dissolved oxygen content within the river (Spot A and B) were found to be with mean values of 8.08mg/l and 8.30mg/l while that of tap was relatively within the normal range of 15 to 17 mg/l. The type of life in natural water will depend on the dissolved oxygen present. Most microorganisms use free oxygen or dissolved oxygen for reproduction (Nduka et al., 2008). The low DO experienced may be attributable to the high water temperature and disposal of abattoir effluents directly into the river. This may have caused the high level of organic constituents which consequently results in a low DO. The BOD levels were also low which also may indicate that it is heavily contaminated with microbes which themselves come from the abattoir effluent.

The high most probable number (MPN/100ml) for river samples can be attributable to the abattoir and human activities as well as direct drainage of abattoir wastes into the river. On the other hand the high MPN of tap water is likely linked to seepage due to pipe breaks or damage resulting in the contamination of the water. All river samples had faecal coliforms which was reminiscent with the work conducted by Simiyu 1996.

The higher total viable of bacteria counts for the river samples than tap water can be attributed to the poor drainages opening into the river. It is obvious that illegal dumping of domestic wastes and faeces also affect bacteria concentration in run off (Okonkwo, 2008).

Besides, (Richman,1997) noted that dangerous microorganisms could be present in these types of water sources. Banwo 2006 reported also that the presence of bushes, shrubs and other small animals could also contribute to the contamination of free running water by these pathogenic organisms.

No E coil 0157:H7 was detected in the water sources to the abattoir. This organism which is one of the most highly pathogenic strain of *E coli* has been associated with bloody diaorrhea and renal failure in children (Paton and Paton,1998). It is food or water borne and faecal contamination from cattle has been implicated in most outbreaks. Hence of public health concerns.

In conclusion, water supplied for meat processing in the Lafenwa abattoir is grossly contaminated and could serve as vehicle for the transmission of infectious diseases to the public. The pathogenic organisms and indicator organisms of faecal contamination makes the water as unfit and unsafe to consumers health.

It is however recommended that access to potable water by the people should be addressed and the Government should work towards provision of safe water for the public which is part of the millennium development goal that should be achieved. In addition further use of the river for meat processing and discharge of abattoir effluents into the river should be prohibited. Also water quality control measures should be practiced in other to alleviate or minimize acute or chronic problems associated with water related diseases.

TABLE I: Physical Parameters Of Various Water Sources To The Abattior

Sampling site	pH mean±SD	Temperature (^{o}C) mean±SD	DO (mg/L) mean±SD	BOD (mg/L) mean±SD	Colour	Odour	Presence of particles
River (spot A)	5.40±(0.70)	28.80±(0.46)	8.08±(0.51)	7.00±(0.49)	Creamy brown	Offensive	Particulate
River (spot B)	5.50±(0.60)	28.90±(0.59)	8.30±(0.53)	7.05±(0.75)	Creamy brown	Offensive	Particulate
Tap	6.08±(0.42)	28.10±(0.24)	15.29±(0.89)	3.14±(0.63)	Colourless	odourless	Non-particulate

Values in brackets are SD of mean.

TABLE 2: Showing The Mean Values Of Mpn/100ml And Total Viable(Bacteria) Count For Different Water Sources.

Sampling site	MPN/100ml	Cfu/ml x 10^7
Spot A	1607.1 ±(369.20)	3.7±(1.70)
Spot B	1671.4±(314.90)	3.3±(1.70)
Tap	890.0±(673.30)	1.5±(0.70)
W.H.O Recommendations	2	0.001

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