



Abattoir wastewater quality in South Western Nigeria

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ABATTOIR WASTEWATER MAY be defined as water that has been used in the cleaning up of slaughtered cattle, sheep, goat and pig carcasses, the floor of slaughter hall, personnel and slaughter equipment. Abattoir wastewater is characterized by presence of high concentration of whole blood of the slaughtered food animals and suspended particles of semi-digested and undigested feeds within the stomach and intestine of slaughtered and dressed food animals. Since slaughtering and dressing of food animals take place in an abattoir, it becomes easier to refer to the wastewater from this industrial system as "abattoir wastewater". This study determined the physico-chemical and patho-bacteriological qualities of abattoir wastewater from Bodija Municipal Abattoir in Ibadan city, South Western Nigeria.

Some effects of abattoir wastewater

Recent publications show that zoonotic diseases (i.e diseases of animals that are transmissible to humans and vice versa) are yet to be eliminated or fully controlled in over 80% of the public abattoirs in Nigeria (Olugasa et al, 2000 and Cadmus et al, 1999). Thus, they are serious environmental health risks to the public. Some of these infectious diseases are tuberculosis, colibacillosis, salmonellosis, brucellosis and helminthoses. These are common examples of zoonoses prevalent in slaughtered cattle population in South Western Nigeria. Official statistics indicated that between 200 and 500 heads of cattle were slaughtered per day in Bodija Municipal Abattoir between 1998 – 2000. Sources of water for cleaning and sanitation in this facility were boreholes, wells, nearby streams and rainwater collected in tanks. An approximate of 40,000 liters of water is used daily to clean up the carcasses of slaughtered animals.

There has been no sewage treatment system constructed for managing wastewater from the abattoir at Bodija in Ibadan. Wastewater thus flow along a drainage cannal only to run off somewhere along roadsides and according to slope of the topography, eventually emptying into a stream, the Bodija-Agbowo stream in Ibadan North Local Government Area of the city. Domestic animals being free-range and are usually part of human dwelling homes, in Ibadan, often visit the stream, drink from it and even swim in it, especially the pigs.

However, since a substantial quantity of abattoir wastewater runs daily into Bodija-Agbowo stream, it is likely that the black discolouration and foul odour down-

stream must have come from this contact. Moreover, since whole blood is a rich protein medium for bacterial growth, it is expected that intestinal bacterial flora of slaughtered animals and other organisms from pathological lesions on slaughtered animal tissues would suspend in the wastewater and possibly multiply in the stream environment.

Materials and method

The Bodija abattoir is located in Ibadan North Local Government Area of Oyo State, Nigeria. Ibadan North Local Government is within Ibadan city - the largest city in West Africa (Filani et al, 1994), with land size covering an area of 240 km² and with human population in excess of 3million. The city is located on geographic grid reference longitude 3°5' E and latitude 7°20' N. Four large sized slaughter halls for cattle, goat, sheep and pig butchering are present in Bodija abattoir. The largest two of these are strictly for cattle butchering. A large one is for sheep and goat, while another large one is for pig slaughter. Ten samples were collected daily at hourly specifications. Each sample was 20mls in volume. Three samples were collected during slaughter. Two samples were collected 3 hours after slaughter. Two samples were collected 6 hours after slaughter. Three samples were collected 9 hours after slaughter. Daily samples were collected in this way on 5 non-consecutive days. Thus a total of 50 samples of wastewater were collected for laboratory assessment.

On each of these samples, immediate spectrophotometer measurement was conducted to determine Total (suspended and dissolved) Solids (TS) concentration. The samples were then kept on the shelves for about 2 weeks after the date of collection. Physical changes at the end of 2 weeks on shelf were determined in the same way as on the fresh samples.

A total of 100 plates of Nutrient Agar and 50 plates of Blood Agar were prepared in the laboratory to cultivate bacteria in pre-use water and wastewater samples collected. Thirty (30) plates were prepared daily for inoculation of 10 samples (20 Nutrient and 10 Blood Agar plates). The Agar plates were then incubated for four days. Colonies of bacteria that grew on the plates were observed visually and their physical characteristics described as they appeared on the plates. A total of 150 Glass slide smears were made from the colonies that grew. The slides were stained with Giemsa Stain. The organisms present were viewed and identified under Light Microscope.

Results

Water provision was manual by women fetched in bowls and sold to butchers. Between 600 and 1000 of these bowls are provided daily to butchers for cleaning up of carcasses and washing butchers' tools, hands, legs, faces and clothing. Tissue parts such as the pair of lungs, heart, and intestines from a slaughtered cattle were usually dipped into a bowl of water to get them thoroughly cleaned up from blood and ingesta.

Cattle gastro-intestinal ingesta included undigested feed materials and semi-digested intestinal feeds. These are all poured out soon after butchering into the drainage within the slaughter hall. The total (suspended and dissolved) solids (TS) in abattoir wastewater samples and pre-use water are provided in the table below. The highest value was obtained in wastewater samples collected 9 hours after slaughter. The lowest value was obtained in pre-use water samples.

There was no colour nor odour changes in the pre-use water collected from the abattoir. There were characteristic black precipitates at the base of the wastewater sample bottles after two weeks on shelf. The sludge in each bottle smelled exceedingly foul. There was a significant difference ($P < 0.05$) in mean total solids between each of the wastewater samples and pre-use water.

Seven pathogenic species of bacteria species were identified from the colonies that grew on the Agar plates prepared. These species were *Staphylococcus*, *Streptococcus*, *Salmonella*, *Escherichia coli* *Norcadia* species and an unconfirmed bacillus species. These organisms also fermented glucose and lactose in-vitro.

Discussion and conclusions

A chemical reaction in the form: $\text{Hb} + \text{H}^+(\text{bacteria}) \rightarrow \text{C}_{(\text{ppt})} + \text{H}_2\text{S} + \text{NH}_3$ is inferred to have taken place as a result of bacterial metabolism that gave the above physical chemical changes in abattoir waste water. The black coloured sludge is attributable to carbon precipitate, while the foul odour is attributable to a mixture of hydrogen sulphide and ammonia gases.

Another major problem posed by abattoir wastewater is that quite many of the pathogens of slaughtered animals have the potential for surviving in the environment and thus affecting animal and human health eventually. Thus, there is critical need for the establishment of wastewater treatment facility capable of filtering blood from the wastewater and rendering present pathogens inactive.

This paper presents the results obtained from a study on the cause of black discolouration and foul odour of Bodija-Agbowo stream within Ibadan North Local Government

Table 1: Physico-chemical properties of abattoir wastewater at Bodija, Ibadan, Nigeria.

Specimen	Colour	TS (mg/l)	Odour	Colour after 2 weeks on shelf	Odour at 2 weeks	Chemical inference	Pathogenic bacteria (\pm)
Pre-use water	Colourless	300	Odourless	Colourless	Smells like rotten egg	Nil	+
During slaughter	Reddish	16,000	Smells like fresh cattle blood	Black with precipitates	Smells like rotten egg	Carbon, H_2S + NH_3 present	++
After 3 hours collection	Reddish brown	14,000	Smells like fresh cattle blood	Black with precipitates	Smells like rotten egg	Carbon, H_2S + NH_3 present	+++
After 6 hours collection	Dark red	16,000	Smells like cattle faeces	Black with precipitates	Smells like rotten egg	Carbon, H_2S + NH_3 present	+++
After 9 hours collection	Black	19,000	Smells slightly like rotten egg.	Black with precipitates	Smells like rotten egg	Carbon, H_2S + NH_3 present	+++

Area of Ibadan city in South Western Nigeria. It was found that the discolouration and foul odour of the stream are attributed to anaerobic degradation of haemoglobin in the blood-rich abattoir wastewater that discharged into the stream. The black colour is associated with carbon element, while the odour is associated with a mixture of hydrogen sulphide and ammonia gas.

References

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