Stream Water Quality Assessment of Dr. Abubakar Sola Saraki Memorial Abattoir, Ilorin, Kwara State, Nigeria

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***Abstract*-Dr. Abubakar Sola Saraki Memorial abattoir is a new abattoir constructed to ensure meats are prepared in hygienic environment and safe guard health of citizenry. Its operation is belief to be impacting greatly on the environment through discharge of animal wastes into environmental media. This study aims at finding out physiochemical parameters/ quality of the stream water where the abattoir effluents are discharged. Water samples were collected in three different locations (Upstream, Midstream and Downstream) along the course of the stream. Laboratory analysis were carried out on the water samples collected using Atomic Absorption Spectrophotometry (AAS) technique. The parameter considered; pH, Temperature, Total Dissolve Solid (TDS), Electrical conductivity (EC), and heavy metals (Zn, Pb, Cu, Ca and Cr).**

Results: The result for heavy metals revealed; Zn (0.08-0.16mg/l), Pb (0.0mg/l), Cu(0.02-0.05mg/l), Ca(0.04-1.80mg/l) and Cr(0.0mg/l) all fall within WHO maximum permissible limit of Zn(3.0mg/l), Pb(0.0145mg/l), Cu(1.0mg/l), Ca(180mg/l) and Cr(0.05mg/l). The pH, EC, Temperature and TDS were found to be within the two standards. However, the turbidity values of 11-81NTU were found to be above WHO and SON standard of 5NTU and 15NTU respectively. From the survey, very high turbidity could be an indication of high microbial load which renders the water not suitable for domestic and industrial use. Strict hygienic management of the abattoir waste needs to be enforced by concerned authorities.

***Keywords:* Heavy metal, wastewater, human health, abattoir**

I. INTRODUCTION

Livestock products are vital food for the growing world population. However, poor management of the resultant wastes from abattoirs especially through run off and its discharge into various water bodies such as stream, rivers, lakes and oceans has contributed greatly to environmental pollution.

Continuous discharge of wastes into environmental media signals great danger for the organismal survival, therefore this called for monitoring, protection and management of water resources. Increasing activities of man along the water bodies globally has become a phenomena calling for attention [15, 31].

Discharges from slaughtering of animals which come inform of solid, liquid and fats could be highly organic. The condensed meat, undigested ingest, bones, hairs, and aborted fetuses all form part of the solid waste. Dissolved solids, blood, guts contents, urine, and water forms constitute the liquid part, while fat waste consists of fat and oil. These depositions contribute to nutrients (nitrogen and phosphorus) enrichment of the medium due to pollution bloom in growth of oxygen-depleting microbes, adversely affect the aquatic ecosystems and result in eutrophication [32]. Eutrophication brings about increase in biomass of phytoplankton and macrophyte vegetation, increase blooms of gelatinous zooplankton (marine environment), growth of benthic and epiphytic algae, increase toxins from bloom-forming algal species, loss of commercial and sport fisheries, disruption of food webs, organoleptic problems, extinction of some organism, costly purification procedure, and gradual loss of aesthetic value of the water body [9, 23].

[5] opined that shortage in diet is due to pollution caused through the destruction of phytoplankton which could increase fish yield. All over the world, abattoir activities affect the environment consciously or unconsciously [1].

Production of animal products for food should not only primarily target uncontaminated food but search light should also be on production of meat without impacting adversely on human existence [3].

There is need to awake the consciousness of the abattoir operators to discharge their wastes in environmental friendly manner.

The specific objectives of this work include:

i. To assess the quality of stream water around Dr. Abubakar Saraki abattoir on its physical properties
ii. to evaluate heavy metals pollution of River Akerebiata from unregulated discharge of abattoir effluent.
iii. Data from this work will aid regulatory bodies to monitor anthropogenic activities at the abattoir and create public awareness

Heavy Metals

Metals are elements, present in chemical compounds as positive ions, or in the form of cations (+ ions) in solution. They are among the famous environmental pollutants due to their high toxic effects, abundance and ease of accumulation by various plant and animal organisms. Heavy Metals include Cadmium (Cd), Copper (Cu), Lead (Pb), Zinc (Zn), Mercury (Hg), Arsenic (As), Silver (Ag), Chromium (Cr), Iron (Fe) and Platinum group elements

Accumulation of heavy metals in the soil could be as a result of effluent from wastewater plants, mining, power generation and agricultural processes [13]. Trace elements such as copper and zinc which are also key to ecosystem and human health are found naturally in the environment.

[16], identified at least twenty (20) metals to be toxic, and averagely these metals are found environment in quantities that are hazardous to the environment and human health. Extended exposure or exposure at high levels can have serious consequences for humans as these metals tend to bioaccumulation in tissues [25]. Heavy metals are extremely persistent in the environment; they are non-biodegradable, non-thermo degradable and therefore readily accumulate to toxic levels [7].

[30] reported that animals which feed on contaminated plants and drink from polluted waters, as well as marine lives that breed in heavy metal polluted waters which accumulate heavy metals in their tissues and milk especially if nursing of their young ones with breast milk. [21] said most Nigeria rivers are heavily loaded with heavy metals at a heavy beyond local and international permissible limit. Heavy metals such as copper, iron, chromium and Nickel are essential metals in biological systems, whereas Cadmium and Lead are essential metals but are toxic, even in trace amount [12]. While heavy metals such as Fe, Mn, Cr, Ag etc. which many are known as essential elements for growth, but almost all become phytotoxic at higher concentration and cause considerable amount of environmental degradation and ecological damage to water, air and soil [20].

[10] reported that heavy metal bioaccumulation requires serious monitoring while [26, 27] reported and linked Heavy metal toxicity to damaged or reduced mental and central nervous function, low energy, and damage to blood properties, kidneys, liver, lungs and other vital organs in the body

It is therefore imperative that study be carried out to find out the level of some of these heavy metals in surface water around abattoir and its likely attendance effects on organisms especially humans.

Description of the Study Area

The study area for this project is Dr. Abubakar Sola Saraki Memorial Abattoir, Akerebiata, Ilorin East Local Government Area, Kwara State, Nigeria with Coordinate: Latitudes (8° 30' 0'N and Longitudes 4° 32' 60'E).

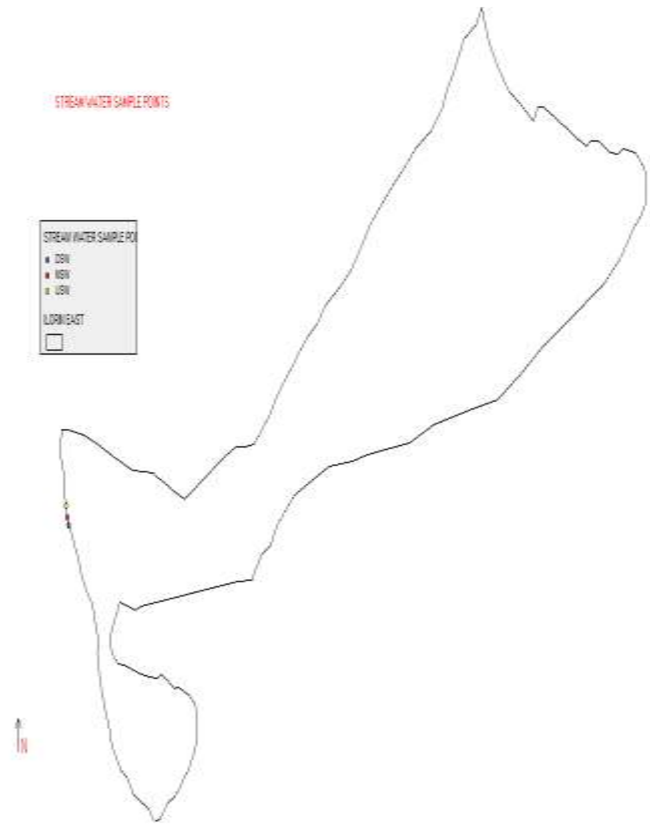

Figure 1: Map of Ilorin East Local Government showing the stream water sample points

Water samples were collected randomly at three different locations along the effluent flow path from the abattoir of the stream (lower stream, Mid-stream and lower stream) with each point having three samples S1 to S3 at distances of 100 m apart between hours of 12.00 and 12.30pm. This time was preferred to allow the effluent from the abattoir reach the stream. Sample bottles were rinsed twice with the water obtained from the stream prior to collection and the sample bottles were filled completely to prevent any loss of dissolved gases from the water samples analysis using plastic sample container which will helps to prevent losses due to adsorption, volatilization and contamination by foreign substances.

Procedure

All the samples were collected on the same day in the mid-day for various physical and chemical analyses. The plastic containers were labelled appropriately using a marker with the information on collection point. Water samples were collected and preserved in a refrigerator with a temperature between 0°C and 4°C in nine clean plastic bottles prior to analysis [6].

The laboratory analysis on the samples were conducted as prescribed by [2]. The water quality parameters measured includes; pH, Temperature, Electrical Conductivity (EC), Total Suspended Solids, Turbidity and Heavy Metals (Lead, Zinc, Copper, Calcium and Cr).

Table1: Description of sampling points.

Sampling Point	Description	Surrounding Activities
Upstream (Station 1)	A point (about 100m) before the introduction of abattoir waste which served as the control sample point	A point (about 100m) before the introduction of abattoir waste
Midstream (Station 2)	Point of effluent discharge	Slaughter house, market, lairage furnace / processing section
Downstream (Station 3)	A point (about 100m) after the effluent mixes with the receiving water body	Uncultivated land, domestic waste dumpsite. Defunct oil servicing company, market

II. MATERIALS AND METHODS

All analysis works were done at the Chemistry Laboratory of the University of Ilorin using the Atomic Absorption Spectrophotometer technique (AAS). Reagents and chemicals for heavy metal determination, physicochemical and others parameters used include a known concentration of the samples used for AAS calibration, distilled water was used to minimize sample concentration during analysis. 10% HCl acid was used for overnight soaking of the sampling bottles and concentrated nitric acid was used for sample preservation. The procedure was repeated for the sample in three replicates [14].

The physico-chemical analysis of the various water quality parameters results as well as heavy metals will be compared with WHO [28] water quality guideline:

Electrical Conductivity, Total Dissolved Solids (TDS) and Temperature were measured by a calibrated Hach Sension 156 conduct meter in Micro Siemens per centimetre, µS/cm or ms/cm, mg/L and % respectively while the pH were measured using HANNA meter HI 8424 with pH probes.

III. RESULT AND DISCUSSION

Physico-Chemical Analysis of Water Samples

The concepts of water quality criteria and characterization are the basis for any kind of water pollution control. The results of the physicochemical parameters of the abattoir wastewater samples investigated in the present study are presented below.

Conductivity is a measure of the ability of aqueous solution to carry an electric current that depends on the presence and total concentrations of ions, their mobility and valance and on the temperature [18]. In this work, conductivities of the water samples collected from water samples collected were determined at room temperature (i.e 25 ^{0}C).

Table 2: Physical parameters results

Water points	pH	Temp. (^{0}C)	Turbidity(NTU)	EC Ms/cm	TDS (ppm)
USW1	7.00	27.60	60.00	413.00	371.20
USW2	7.20	27.70	47.00	0.56	406.00
USW3	6.80	27.60	17.00	0.53	385.00
Mean	**7**	**27.63**	**41.33**	**0.56**	**401.33**
MSW1	7.10	27.40	25.00	0.55	391.00
MSW2	7.00	27.60	62	0.57	409.00
MSW3	6.80	27.60	11	0.55	396.00
Mean	**6.97**	**27.53**	**32.67**	**398.67**	**355.87**
DSW1	6.60	27.60	76.00	0.62	444.00
DSW2	6.80	27.50	78.00	0.67	447.00
DSW3	6.50	27.60	81.00	0.67	475.00
Mean	**6.6**	**27.57**	**78.33**	**0.65**	**455.33**

DSW=Upstream water,

MSW=Mid-stream water

DSW=Downstream water

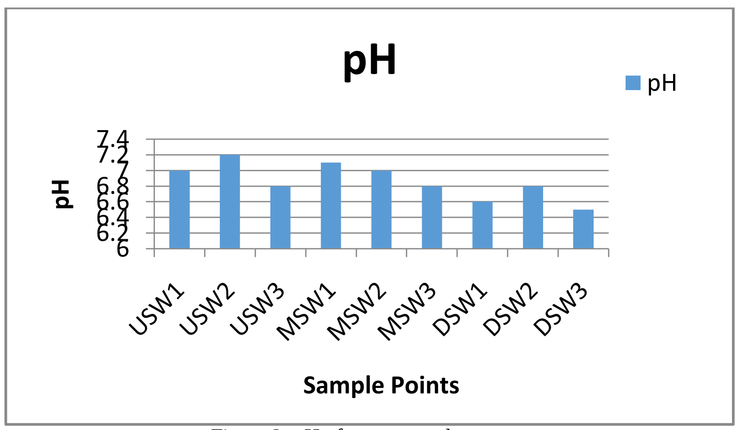

Figure 2. pH of water samples

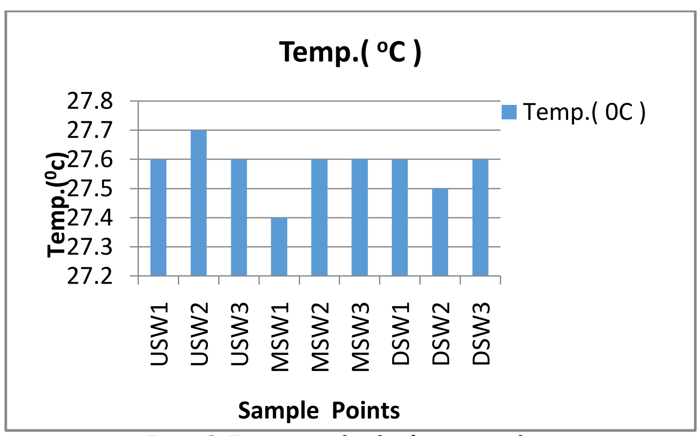

Figure 3. Temperature levels of water sample

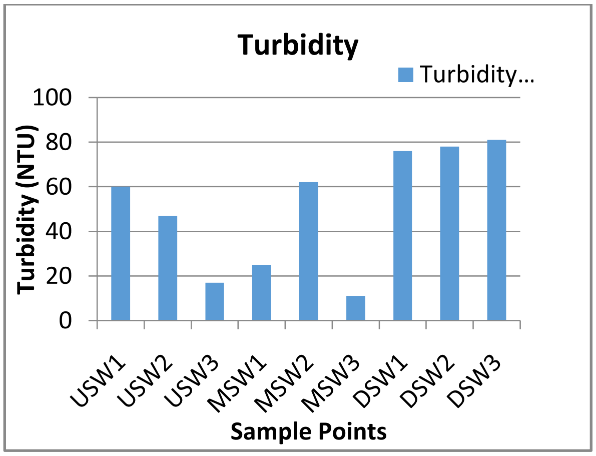

Figure 4: Turbidity level of sample water

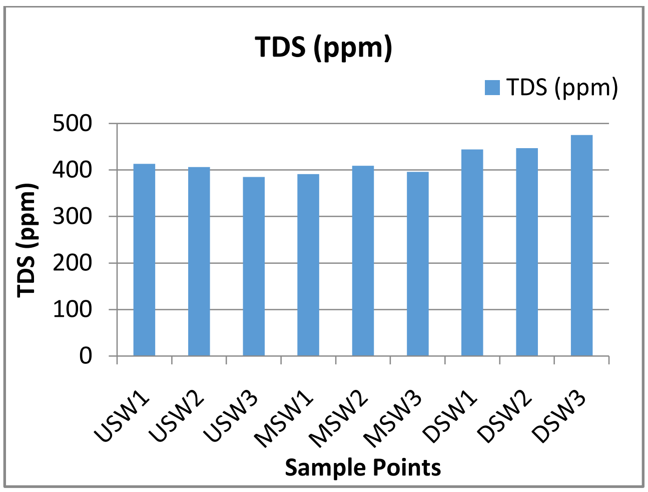

Figure 5: Total Dissolved Solid level of water samples

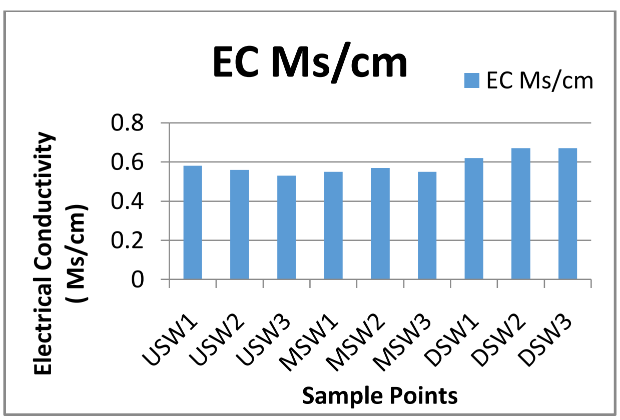

Figure 6: Electrical Conductivity level of water samples

Table 3: Heavy metals result in water samples

Water samples	Pb	Cu	Cr	Ca	Zn
USW1	0.00 0.00	0.020 0.030	0.00 0.00	0.50 0.60	0.10 0.10
USW2	0.00 0.00	0.030 0.030	0.00 0.00	0.60 0.70	0.08 0.08
USW3	0.00 0.00	0.020 0.030	0.00 0.00	0.80 0.70	0.08 0.08
Mean	**0.00**	**0.026**	**0.00**	**0.65**	**0.086**
MSW1	0.00 0.00	0.030 0.030	0.00 0.00	1.8 1.7	0.13 0.14
MSW2	0.00 0.00	0.040 0.040	0.00 0.00	0.7 0.7	0.16 0.16
MSW3	0.00 0.00	0.030 0.030	0.00 0.00	0.7 0.8	0.10 0.10
Mean	**0.00**	**0.033**	**0.00**	**1.06**	**0.13**
DSW1	0.00 0.00	0.030 0.030	0.00 0.00	0.7 0.7	0.11 0.11
DSW2	0.00 0.00	0.000 0.000	0.00 0.00	0.4 0.4	0.90 0.80
DSW3	0.00 0.00	0.02 0.02	0.00 0.00	0.8 0.8	0.80 0.80
Mean	**0.00**	**0.016**	**0.00**	**0.63**	**0..57**

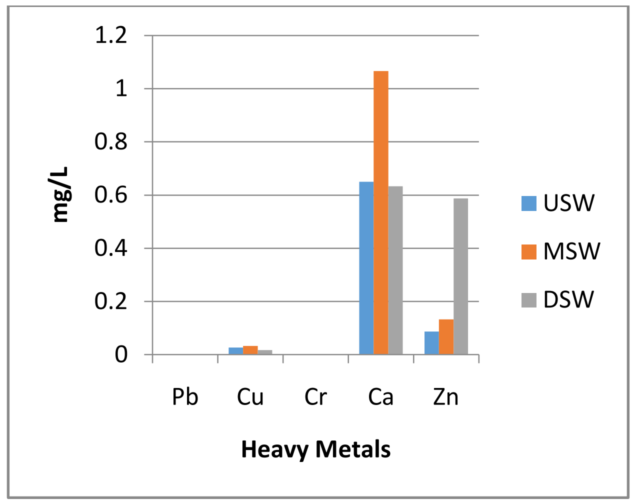

Figure 7: Heavy metal concentration in water sample

The temperature of the samples ranges between 27.40°C-27.70°C, these range in results are similar to the study done by [4, 19]. who identified in their studies that most abattoir have temperature of 28.5°C-28.8°C. The temperature falls within the [28] permissible limit of <40°C. Temperature influences the amount of dissolved oxygen in water which in turn influences the survival of aquatic organisms.

The pH is the measure of acidity and alkalinity of water. The pH ranged from 6.50 -7.20 with a mean value of 6.87 falls within WHO standards of 6.5-8.5 compares with 4.9 to 7.2 reported by Masse and Masse on similar study where all the samples were slightly alkaline [17]. Therefore, these water samples were unlikely to cause health problems such as acidosis based on similar work done by [8]. However, [22] reported that pH influences the bacterial population growth and diversity in surface water. The pH of the surrounding medium changes through the introduction of metabolic waste by microbes.

The TDS value of the result obtained from the analysis downstream has the highest value of 475mg/L while upper stream (100 m away from point of discharge) has lowest value of 385 mg/L. All value obtained falls below WHO standard of <1200 mg/L. Most often, high levels of TDS are caused by the presence of potassium, chlorides and sodium and interfere with the taste of the water (organoleptic property) to consume. Some of the individual mineral salts that makeup TDS pose a variety of health hazards to living organisms and as reported by [11] are an indication of the degree of dissolved substances such as metal ions in the water. Electrical conductivity is the ease to which a substance allows free flow of electricity through the ions in electrolytes of water sample.

The values of EC ranged from 0.53 to 0.67 Ms/cm, were down stream water sample has the highest value while upper stream water sample (100 m away to the point of discharge) recorded lowest. All the samples were within the permissible limits of WHO maximum permissible level of the conductivity of 0.900 ms/cm. This shows that the water samples are not saline, the concentration of salts dissolved in the water is minimal, and the salt content of a water body is determined by its ability to conduct an electric current the higher the salt concentration, the larger the current that can be conducted and the higher the EC of the water. Any level above World Health Organization (WHO) standards can pose health risk of defective endocrine functions and also total brain damage with prolonged exposure. All the water samples have their EC values less than the highest tolerable values.

The concentration of Zinc ranged between 0.08-0.16 mg/L, the upper stream water has the lowest concentration of Zinc of 0.08 mg/L while midstream water has the highest concentration of Zinc (0.16 mg/L) respectively the permissible limit of the WHO standard of 1.5 mg/L. This is an indication that zinc is highly concentrated at the point of discharge of the abattoir effluent.

The concentration of Lead in the water samples collected was 0.0 mg/L which is an indication that the water is lead free thus within the WHO limit of 0.1 mg/L, this could be attributed to absence of electrical or industrial waste around the abattoir as well as the stream.

The conductivity level in the abattoir wastewater sample was found to be 0.53 - 0.67Ms/cm, therefore the electrical conductivity of the Akerebiata abattoir wastewater sample is within WHO tolerance limits of 1mS/cm.

The concentration of TDS in the abattoir wastewater sample was found to be 385 - 475ppm and also known as part per million which is within the WHO limits of 1000mg/L (1g/L).

The concentration of heavy metals in abattoir wastewater sample is as presented in which averagely shows that the levels of Pb, Cu, Ca, Cr and Zn were within the WHO recommended standard limits, nevertheless Calcium was found to be high at the point of discharge of the effluent into the stream.

The physical parameter as discussed above also all fall within permissible limits with the exception of turbidity with the value of 11-81NTU as against WHO standard of 5NTU and [24] of 10NTU.

IV. CONCLUSION

This study assessed the quality of stream water around Dr. Abubakar Sola Saraki Memorial Abattoir. The major source of surface and groundwater pollution is indiscriminate discharge of untreated abattoir effluents directly into the ground surface or the surface water bodies resulting in serious surface and groundwater contamination. This loss of water quality is causing health hazards and death of human beings. This problem is aggravated by inadequate awareness, scarce financial resources, lack of wastewater treatment facilities, and ineffective environmental laws.

The concentration of the heavy metals verification like Pb, Cd, Ca, Cu and Zn reported above indicate that there is significant difference in the concentration of the some of the pollutants taken at different sample points. High concentration of Ca at the point of discharge can be attributed to influence of bony materials which are rich in calcium washed down into the stream from the abattoir.

Although some of the results like EC and TDS are slightly in line with permissible limits of WHO standard, 2006. The high turbidity values indicate that the stream water could harbor a lot of microorganisms which are harmful to plants and animals alike.

The toxic level of harmful materials can aggravate due to the continuous generation of the effluents. This calls for concern, as most of the analysed values were above the recommended standards, which obviously signals danger to human health and that of plants life. Residents living in abattoir vicinity may in no distant time begin to experience severe consequences of pollutants from abattoir activities located in their neighbourhood. It was also found out that the streams around abattoir are being contaminated due to the discharge of the effluents from animal processing into the water bodies.

In view of the findings of this work, and in addition to the fact that the abattoir is located in the heart of the town and the fact that the discharge of untreated abattoir wastes may continue unabated, the following recommendations are hereby made:

(i) Efforts should be made to commence activities towards the relocation of the abattoir to an area away from residential areas.
(ii) Immediate steps should be taken to put in place machinery that will enable treatment of the abattoir wastes before they are disposed.
(iii) Aggressive public awareness and enlightenment on possible impacts of pollution from abattoir wastes should be embarked upon by relevant agencies.

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