THE INTERNATIONAL JOURNAL OF SCIENCE & TECHNOLEDGE

Effect of Abattoir Wastes and Tissue Paper Industrial Effluents on Physico-chemical Properties of River ILO, Ota, Ogun State, Nigeria

Yusuff, K. O.
Post Graduate Student, Department of Aquaculture and Fisheries Management,
Federal University of Agriculture, Abeokuta, Abeokuta, Ogun State, Nigeria
Agbon, A. O.
Senior Lecturer, Department of Animal and Environmental Biology,
Federal University Oye-Ekiti, Oye, Ekiti State, Nigeria
Omoniyi, I. T.
Former Head of Department, Department of Aquaculture and Fisheries Management,
Federal University of Agriculture, Abeokuta, Abeokuta, Ogun State, Nigeria

Abstract:
This study was carried out to evaluate the effects of abattoir waste and tissue paper industrial effluents on River Ilo, Ota, Ogun State. It assessed the physical and chemical parameters of the river. Water samples were taken at five different locations along the river for a period of 24 weeks. Sampling was done during the late rainy season (August to October) and during the early dry season (November to January). The sampling Stations were: upstream (SS1) which served as control, tissue paper effluent discharge point (SS2), mid-point tissue paper and abattoir effluent discharge point (SS3), the abattoir effluent discharge point (SS4) and downstream (SS5). The physico-chemical parameters of the water samples were analyzed using standard analytical methods and results of laboratory analysis were analyzed using analysis of variance (ANOVA) and Duncan's Multiple Range Test (DMRT). Results indicated significant differences ($p<0.05$) in all parameters between the sampling stations, except for temperature. Sampling Stations SS2 and SS4 had the highest mean values for all parameters except dissolved oxygen. This study revealed that the discharge of abattoir waste and tissue paper effluents into river Ilo had brought about a wide range of fluctuations in physico-chemical parameters of the river.

Keywords: *abattoir waste, tissue paper effluents, river Ilo, physico-chemical parameters*

1. Introduction

Water is a vital resource for agriculture, manufacturing, transportation and many other human activities. Despite its importance, water is the most poorly managed resource in the world (Fakayode, 2005). In farming areas, the routine application of agro-chemicals is the major source (Altman and Parizek, 1995; Emongor *et al*, 2005). In urban areas, the careless disposal of industrial effluents and other wastes may contribute greatly to the poor quality of the water (Chindah *et al*, 2004; Emongor *et a*l; 2005; Furtado et al, 1998 and Ugochukwu, 2004).

The pulp and paper industry, because of its diverse nature, can release a wide range of compounds into the aquatic environment. Research done on pulp and paper effluents has implicated fiber and suspended solids, colour and turbidity, and organic and nutrient enrichment loads as the three conventional pollutant factors with adverse environmental impacts (Owens, 1991).

Slaughter activities, if not properly controlled, may pose dangers to the farmers, butchers, the environment as well as the consumers. Abattoir effluent reaching streams may contribute significant level of nitrogen, phosphorus and biochemical oxygen demand and other nutrients, there by resulting in stream pollution (Chukwu *et al.,* 2008). These effluents will reduce stream physical and chemical qualities, more so pathogens from cattle waste could be transmitted to humans. The objective of this study is to determine the physical and chemical characteristics of River Ilo and assess the impact of these effluents on the physico-chemical characteristics of the river.

2. Materials and Methods

2.1. The Study Area

Map of Ota showing River Ilo and the sampling stations is shown in Figure 1. The Ota segment of River Ilo where a tissue paper industry discharges its effluent and an abattoir is located is the main thrust of the study.

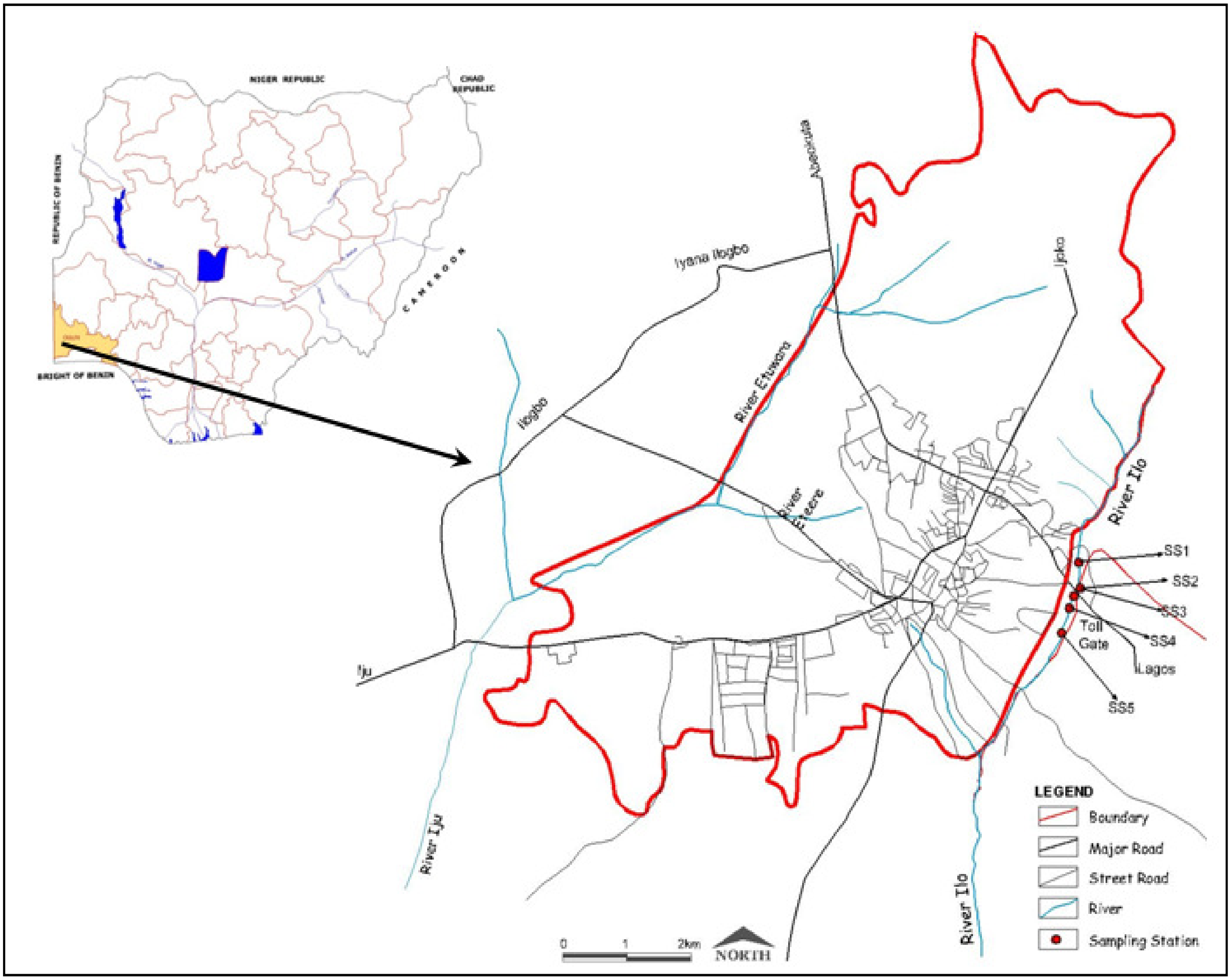

Figure 1: Map of Ota showing River Ilo, Ota, Ogun State and the Sampling Stations
Source: Field Survey (2013)

Water samples were collected at five different points along the flow path of River Ilo. The description of the sampling stations and their distances apart are indicated in Table 1.

Designation	Distance Apart (m)	Features
SS1 SS2	- 350	Sampling station located upstream of tissue paper industrial effluent discharge point. Serves as control. Tissue paper industrial effluent discharge point.
SS3	70	A point between tissue paper industrial effluent discharge point and abattoir effluent discharge point.
SS4	100	Abattoir point of effluent discharge
SS5	350	Downstream of the point of Abattoir effluent discharge

Table 1: Sampling Stations Description
Source: Field Survey (2013)

2.2. Water Sample Collection

Water samples were collected in duplicate from each sampling stations in the morning between the hours of 7.00 and 8.00am. Samples to be taken for analysis were collected in labeled 1.5 litre plastic bottles. All sampling containers were thoroughly cleaned before use and rinsed with the appropriate sample before the final sample collection. The water samples were transported to the laboratory immediately for physico- chemical analysis of the samples.

2.3. Measurements of Water Physico - Chemical Parameters

Water temperature was determined in-situ using mercury-in-glass thermometer. pH was determined using pH meter (HANNA instruments, pH 211 Micro processor pH meter). The method of measurement for dissolved oxygen(DO) was by the electrometric method using a DO 300 water proof portable meter. A Lovibond Comparator Disc was used to determine a colour similar to that of the sample and results were taken in colour standard of Hazen units, HU.

The method of mass difference (Ademoroti, 1996) was used to determine total solids while for total dissolved solids (TDS) and electrical conductivity, Mettler multi-parameter meter (HANNA, USA) was used and the results were taken and recorded as mg dissolved solids per litre of sample and micro Siemens per centimeter (µS/cm) respectively. The difference between the values obtained from both the total solids and total dissolved solids was recorded for total suspended solids of the water samples.

i.e. TSS = TS - TDS

HACH 2100 Turbidimeter was used for turbidity determination. Ethylene diamine tetraacetic acid (EDTA) titrimetric method was employed (APHA et at; 1998) for total hardness (TH) and Calcium hardness. The result was taken in ppm (part per million). The difference between the results obtained from total hardness and calcium hardness was recorded for magnesium hardness i.e.

Mg hardness = Total hardness – Ca hardness.

Nitrate and Phosphate was determined via the use of the Portable Spectrophotometer (HACH DR/2400) and results read at mg/L NO_3^- - N and mg/L PO_4^{3-} respectively. The Argentometric (Mohr) method was employed in chloride determination

2.4. Data Analysis

The physico-chemical data collected were subjected to statistical evaluation. One way Analysis of Variance (ANOVA) to test for significance among the means, and Duncan Multiple Range Test (DMRT) to separate significant means using Generalized Linear Model (GLM) were done.

3. Results

The level of significant differences in each physico-chemical parameter among the sampling stations is shown in Table 2.

Parameters	Units	SS1	SS2	SS3	SS4	SS5	ANOVA	WHO
Temperature	^{O}C	27.35^{a} (24.8–30.6)	27.53^{a} (24.8–30.1)	27.35^{a} (24.5–30.0)	27.42^{a} (24.6–30.1)	27.30^{a} (24.7 – 30.0)	0.15	< 35
pH		6.32^{b} (5.83-6.99)	6.73^{a} (6.20-7.23)	6.58^{ab} (6.21-7.59)	6.60^{ab} (6.22-7.08)	6.67^{ab} (6.40-7.48)	0.29	6.0 – 9.0
Dissolved Oxygen	mg/L	5.08^{a} (1.59-7.49)	3.05^{d} (0.62-6.12)	4.19^{b} (1.37-6.48)	3.57^{c} (0.46-6.87)	4.21^{b} (1.13-6.85)	93.01	> 5
Colour	HU	30.00^{e} (15-80)	65.42^{a} (30-400)	34.38^{d} (20-85)	51.88^{b} (25-150)	42.08^{c} (30-80)	111.98	5
Total Solid	mg/L	97.53^{e} (59.5-185.7)	382.19^{a} (102.9-2150)	153.95^{d} (89.2-242.9)	340.79^{b} (111.3-401.8)	189.38^{c} (93.3-286.7)	8580.81	NS
TDS	mg/L	59.22^{e} (40.9-91.3)	163.21^{b} (58.2-325.0)	99.57^{d} (48.7-594.0)	222.29^{a} (59.3-291.0)	189.94^{c} (57.9-146.1)	15307.7	500
TSS	mg/L	53.28^{b} (16.9-99.7)	179.97^{a} (26.3-1825)	83.07^{b} (10.4-129.1)	185.00^{a} (14.5-262.2)	99.83^{b} (10.4-173.5)	5.67	20
Turbidity	mg/L	39.43^{e} (10-87.9)	139.49^{a} (42.2-1180)	49.45^{d} (15.8-94.5)	119.20^{b} (37.1-826.9)	61.16^{c} (27.0-247.3)	NS	5
Conductivity	µS/cm	143.55^{e} (48.7-189.5)	375.68^{b} (146.5-701)	230.36^{d} (123-1302)	491.70^{a} (147.2-5300)	262.58^{c} (142.5-261.3)	NS	250
Total Hardness	mg/L	34.79^{d} (21-69)	88.33^{a} (32-163)	45.83^{c} (22-73)	64.83^{b} (31-89)	64.13^{b} (33-96)	265.24	500
Ca Hardness	mg/L	28.83^{e} (16 - 50)	65.04^{a} (23 - 100)	41.92^{d} (22 - 66)	57.46^{c} (26 – 82)	58.71^{b} (27 – 93)	181.07	-
Mg Hardness	mg/L	5.96^{c} (1 – 21)	23.63^{a} (3 – 79)	4.25^{e} (0 – 10)	7.38^{b} (1 – 21)	4.99^{d} (0 – 20)	237.58	-
Nitrate	mg/L	1.98^{e} (0.44 - 3.52)	7.28^{b} (0.1 - 10.2)	2.74^{d} (0 - 5.72)	9.25^{a} (0.1 – 66.0)	2.95^{d} (0 – 6.6)	5931.97	10
Phosphate	mg/L	0.34^{d} (0.16-0.83)	0.27^{e} (0 – 0.51)	0.40^{c} (0.14-0.88)	0.73^{a} (0.3-1.16)	0.46^{b} (0.21-1.11)	31.94	-
Chloride	mg/L	38.25^{e} (32 – 48)	60.13^{a} (39 – 111)	40.96^{c} (34 – 52)	54.42^{b} (27 – 153)	40.89^{c} (32 – 50)	37.98	250

Table 2: Mean Values of Physico-Chemical Parameters at the Sampling Stations from August 2010 to January 2011

SS: Sampling Station; NS: Not Supplied

Different superscript within a row indicates significant different at p < 0.05

Source: Field Survey (2013)

4. Discussion

The water temperature of all the sampling stations was not significantly affected. However, sampling station 2 (SS2) recorded the highest mean value, followed by sampling station 4 (SS4). Since a degree rise in temperature increases the rate of chemical reaction, this shows that there is decomposition of organic matters by coliforms, leading to heat generation and this might have contributed to the high-water temperature at these sampling stations. The pH obtained from this study was 6.18-6.92 which is within the WHO tolerance limits of 6.0-9.0 for the discharge of wastewater from all industries into river. However, the mean pH value for all the sampling stations shows that River Ilo is slightly acidic.

The mean Dissolved Oxygen (DO) values obtained from the study fell below 5mg/L except for SS1. The standard for sustaining aquatic life is stipulated at 5mg/l, a concentration below this value adversely affects aquatic biological life, while concentration below 2mg/l may lead to death for most fishes (Chapman, 1997). Complete absence of DO results to anaerobic condition, putrefaction and the development of foul odour. Also lack of DO in acute cases may cause the water body to become dead or devoid of aquatic life (Chukwu *et al*, 2008).

The values of other physico-chemical parameters such as colour, total solids, TDS, TSS, conductivity, total hardness, Ca hardness, Mg hardness, nitrate and chloride have their values increase sporadically at SS2 and SS4, the points of effluent discharge. However, these values are lowered at SS3 and SS5, showing natural and self purification of the river. Phosphate value was highest only at SS4 and high phosphate value of a stream could lead to oxygen reduction with subsequent effect on aquatic organisms (D" Amelio, 2007).

In conclusion, using WHO (2004) recommended limits as bases for comparison, the level of DO, colour, TSS, conductivity and odour were above the acceptable range for all sampling stations except for SS1 where they are lower, where parameters are within the recommended limit, the values were mostly on the high side, tending towards the edge, especially at SS2 and SS4 where the effluents are discharged into the river. This study has shown that the effluent from the two industries have a negative impact on the water quality of the receiving river and continued discharge without treatment of the effluents in the river may result in severe accumulation of contaminants along the river course.

5. References

i. Ademoroti, C.M.O. (1996). Standard Methods for Water and Effluent Analysis. Foludex Press Ltd, Ibadan. P18pp

ii. Altman S.J. and Parizek R.R. (1995). Dilution of Non-Point Source Nitrate in Ground Water. J. Environ. Quality, 24, 707 – 717.

iii. Chapman, D. (1997). Water Quality Assessment. A Guide to the Use of Biota, Sediments and Water in Environmental Monitoring, Second Edition. E & FN Spon, London, UK.

iv. Chindah A. C., Braide A. S. and Sibeudu O.C., (2004). Distribution of Hydrocarbons and Heavy Metals in Sediment and a Crustacean (Shrimps-Penaeus notialis) from the Bonny/new Calabar River Estuary, Niger Delta. Ajeam-Ragee, 9, 1-14.

v. Chukwu, O, Mustapha, H.I, and Abdul Gafar, H.B. (2008). The Effect of Minna Abattoir Waste on Surface Water Quality II. Environmental Research J. 2(6), 339-342.

vi. D'Amelio, S. (2007). Preliminary Water Quality at Spring Bank Dam. Thames River, London, Ontario. Trout Unlimited Canada Technical Report No: O-020 (pp. 7-11).

vii. Emongor V., Kealotwe E., Koorapetse I., Sankwasa S. and Keikanetswe S., (2005). Pollution Indicators in Gaberone Effluent. J. Appl. Sci., 5, 147-150.

viii. Fakayode S. O., (2005). Impact of Industrial Effluents on Water Quality of the Receiving Alaro River in Ibadan, Nigeria, Ajeam-Ragee, 10, 1-13.

ix. Furtado A.A.L.; Albuquerque R.T; Leite S.G.F. and Pecanha R.P. (1998). Effect of Hydraulic retention Time on Nitrification in an Airlift Biological Reactor. Brazilian Journal of Chemical Engineering 15, 1-7.

x. Owens J.W. (1991). The Hazard Assessment of Pulp and Paper Effluents in the Aquatic Environment: A Review, Environmental Toxicology Chemistry, Volume 10:15 11-1540.

xi. Ugochukwu C.N.C. (2004). Effluent Monitoring of an Oil Servicing Company and Its Impact on the Environment. Ajeam-Ragee, 8, 27-30.

xii. World Health Organization (WHO) (2004). World Health Organization Guidelines for Drinking Water Quality (3rd Edition) Genera, Switzerland.