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Impact of Abattoir Wastes on the Physicochemical Properties of Soils within Port Harcourt Metropolis

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----------ABSTRACT----------

The impact of abattoir wastes on the physicochemical properties of soils within Port Harcourt metropolis has been investigated. Soil samples from twelve different abattoir locations within Port Harcourt metropolis labeled ABP1 to ABP12 were analyzed for possible contamination of physicochemical and heavy metal parameters. Theywere equally compared with a control site of no abattoir activities (ABPc) as well as WHO and FEPA standard set limits. The soil temperature which was carried out in-situ gave an average value of 30.0^{0}C. The mean values of the physicochemical parameters revealed that pH and electrical conductivity had average values of 7.00 and 78.33µScm^{-1} respectively. Chloride, salinity and nitrates had average values of 335.00mgKg^{-1}, 601.74mgKg^{-1} and 39.30mgKg^{-1} respectively. These values were slightly higher than both the control site as well as the standard set limit byWHO. Thus, indicating the possibility of contamination/pollution from the abattoir activities. However, average the values for the phosphates, sulphates and heavy metals (Pb, Cu, Cd, Ni, Cr) though slightly higher than those of the control site (ABPc) were all within the standard set limits by WHO and FEPA. Statistical correlation equally showed positive correlations between chloride and salinity (1.0000), phosphate and cadmium (0.9939), conductivity and iron (0.9485). Also, negative correlations were equally observed between sulphate/chloride and sulphate/salinity with same values of -0.9192. Therefore abattoir activities within Port Harcourt metropolis imparts negatively on the arable soil and measures should be put in place for proper control.

Keywords: *Abattoir waste, physicochemical, Soils, Correlation, Heavy metals, Port Harcourt*

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I. INTRODUCTION

Human activities create vast amounts of various wastes and pollutants, the release of these materials into the environment sometimes cause serious health problems. According to Yakowitz 1988, waste is any substance, solution mixture or article for which no direct use is envisaged but which is transferred for processing, dumping, elimination by incineration or other methods of disposal. Abattoirs, also known as slaughter houses are places where animals are butchered for food. Abattoir act (1998) defined abattoir as any premise(s) used for or in connection with the slaughter of animals whose meat is intended for human consumption and include a slaughter house, but does not include a place situated on a farm (Bridges *et al*., 2000). Abattoir effluents or waste is the residual material obtained from the abattoir after the slaughter of animals like cattle, sheep, goats etc. These effluents comprise of materials like blood, urine, faeces, water, bones etc. (Osemwota 2010). Various organs of cattle such as the muscle, blood, liver, kidney, viscera and hair have been found to contain heavy metals (Jukna, 2006). In many countries, pollution arises from activities in meat production as a result of failure in adhering to good manufacturing practices (GMP) and good hygiene practices (GHP). Consideration is hardly given to safety practices during animal transport to the abattoir, their slaughter and their dressing. For example, during dressing, the oesophagus of cattle and sheep should be sealed to prevent leakage of animal contents. These ineptitudes often lead to contamination from hide, hooves and content of alimentary tract during evisceration and negatively impact on the environment, including microbes in the soil and surface and ground water (Hinton *et al.*, 2000).

In Port Harcourt metropolis south-south Nigeria, these abattoir facilities are located in every nook and cranny including residential neighborhoods with indiscriminate dumping of these wastes in the soil, consequently, altering the soil composition and the environment. A specific example of what happens is logging of contaminated water in the soil. In such situations, oxygen becomes less available as an electron acceptor, promoting denitrifying bacteria to reduce available nitrate into gaseous nitrogen which enters the atmosphere with resultant negative effects. Also, anaerobic archaea (methanogens) may produce excessive methane at a higher rate than aerobic methane oxidizing bacteria (methanotrophs) could cope with, thus contributing to

greenhouse effect and global warming. Increase in methane is of concern because it is five times more effective as a greenhouse gas than CO_2 (Madigan *et al*., 2003). However, in Nigeria, like many developing countries, the control of the discharge of untreated wastes into the environment is still a problem, despite the establishment of Federal Environmental Protection Agency (FEPA) since 1998 (Adeyemo, 2003).

Rabah*et al* in 2010 reported the microbiological and physico-chemical assessment of soil contaminated with abattoir effluents in Sokoto metropolis, Nigeria. His result revealed high counts and varieties of microorganisms most of which are pathogenic in the soil contaminated with the abattoir effluents. Also, it revealed a significant difference between the counts in the contaminated soil and the uncontaminated soil. The contaminated soil contained a number of chemicals which although in small quantities points to high microbial activities in such soil. The present study aims at investigating the impact of abattoir effluents/wastes on the physicochemical properties and heavy metal concentrations of soils within Port Harcourt metropolis.

II. MATERIALS AND METHODS

2.1 Sample Collection and Preparation

Several soil samples were collected randomly from twelve different abattoir sites located within ObioAkpor LGA in Port Harcourt Metropolis, Rivers State, Nigeria. The samples were grouped into twelve (12) major areas: and labeled ABP1 to ABP12. A control site where abattoir activities have never taken place was equally selected and labeled ABPc. Sample collection was carried out using a soil auger at depth of 20cm - 30cm. The samples were properly bagged and shipped to the laboratory for analysis.

2.2 Methodology

All reagents used were of analytical grade (BDH and Aldrich) without further purification.

2.2.1 Physicochemical analysis of the soil samples: The physicochemical qualities of the soil samples were determined using standard methods for analysis of soil according to Piper (1994), Udo&Ogunwale (1986) and the Association of Official Analytical Chemists (AOAC, 1990). The parameters determined were:the soiltemperature, whichwas determined in-situ using an infra-red thermometer.

A crushed portion of the air dried soil sample was thoroughly mixed with water in the ratio of 1:1 by volume and used for determination of pH and electrical conductivity of the soil. Theelectrometric API-RP 45 EPA method was adopted using a JENWAY 3015 pH/conductivity Meter. Chloride ion concentration was determined by argentometric method while sulphate ion was done using the turbidometric method. Concentration of phosphate in the soil samples was determined by the molybdenum blue method while nitrate ion concentration was determined following the brucine method.

5g portion of the air-dried soil sample was digested in aqua-regia prior to heavy metal analysis according to methods previously reported (Odu*et al*. (1985). The filtrate was made up to 100 mL with deionized water and the concentrations of the heavy metals, Fe, Pb, Cu, Cd, Ni and Cr were determined using atomic absorption Spectrophotometer (AAS) (Perkin Elmer Aanalyst 200) following the standard procedures as given in APHA (1995).

III. RESULTS AND DISCUSSION

Results for the physicochemical and heavy metals present in abattoir soils from the twelve different locations and control site within Port Harcourt metropolis in Rivers State Nigeria is presented in tables 1.0 and 2.0 respectively.

Table 1.0 presents the mean values of the results for the physicochemical parameters of the soil samples from various abattoir sites. From the results the pH values recorded for the soil samples ranged from 6.22 to 7.42 with a mean value of 7.00. With the exception of two sampling sites, (ABP2 and ABP8) the pH values of all other sites were slightly above the control site (ABPc). However, these values all fell within the WHO 1988 set limit (6.5 -8.5). Interestingly, there appears a significant increase in pH when compared to the pH value of soils within Niger Delta region as reported by Ekeke and Okonwu, (2013), Tukura et al., (2007), Iwegbue et al., (2009), and Ovasogie and Ofomaja(2007) which are known to be quite acidic. This increase in pH could be attributed to the type of the wastes deposited from the slaughter houses which results in reduced anerobic in the soils (Odu*et al*., (1985). Conductivity values ranged from 50µScm^{-1} to 110µScm^{-1} with an average value of78.33µScm^{-1}.These values were comparatively higher when compared to previous works of Onwuka and Uzoukwu 2008. However when compared to WHO 1998 the values all fell within acceptable standard limit. Thus indicating that irrespective of the activities within the abattoir sites, the concentration of dissolvable ions did not exceed the standard set limit.

Other parameters studied were chloride and salinity with values ranging from 280.00 mg kg^{-1} to 370.00 mg kg^{-1} and 475.05.08 - 689.37 mg kg^{-1} respectively. Values for both parameters were considerably higher than the values obtained from the control site (ABPc). In addition, the values were equally higher than the standard set limit by WHO 1998. This gives an indication of possible effluent contamination on the surrounding soil and its

organisms as a result of butchering activities. High concentrations of chloride can cause toxicity problems in crops and reduce the yield. The toxicity results from accumulation of chloride in the leaves. Mean values of nitrates, phosphates and sulphatesare 39.30mg kg^{-1}, 1607.67mg kg^{-1} and 302.91mg kg^{-1} respectively. These values though high were observed to be lower than that recorded from the control site. Thus activities at the abattoir sites seem to deplete the concentrations of these parameters. This may be attributed to increased microbial activities as a result of the large deposits of animal wastes. Similar results have be reported by Sumayya*et al* 2013.Additionally, the constant washing may equally wash off these nutrients into the receiving water bodies.

Table 1.0 Results of concentration of physicochemical parameters present in soil samples from abattoir sites located within Port Harcourt metropolis

Sample ID	*pH*	*EC (μScm^{-1})*	*Chloride ($mgKg^{-1}$)*	*Salinity ($mgKg^{-1}$)*	*Nitrate ($mgKg^{-1}$)*	*Phosphate ($mgKg^{-1}$)*	*Sulphate ($mgKg^{-1}$)*
ABP1	7.25	70.00	370.00	667.88	58.94	1517.00	131.43
ABP2	6.22	90.00	340.00	613.73	38.38	2199.00	177.14
ABP3	7.42	80.00	360.00	649.83	32.96	949.00	165.72
ABP4	7.02	110.00	350.00	631.79	24.08	555.00	342.86
ABP5	6.41	60.00	280.00	579.18	31.82	1147.00	382.84
ABP6	7.15	90.00	370.00	667.88	68.92	1974.00	165.72
ABP7	7.22	70.00	380.00	663.54	36.46	2096.00	334.66
ABP8	6.24	80.00	330.00	689.37	42.86	1949.00	473.16
ABP9	7.52	60.00	290.00	531.19	34.12	855.00	365.36
ABP10	7.44	70.00	310.00	475.05	35.84	1947.00	242.16
ABP11	7.32	80.00	360.00	640.22	34.48	1949.00	388.18
ABP12	6.82	90.00	350.00	611.31	28.58	1155.00	265.62
Mean	**7.00**	**78.33**	**335.00**	**601.74**	**39.30**	**1607.67**	**302.91**
ABPc	6.41	50.00	210.00	379.08	35.92	2147.00	582.86
WHO (std 1998)	6.4-8.5	Below 100	200	200	40 and above	40 and above	250 and above

Results of the concentration of the heavy metals (Fe, Pb, Cu, Cd, Ni and Cr) studied are presented in table 2.0. From the results obtained, a mean concentration value of Fe was 607.20mg kg^{-1},while the mean concentration values of Pbwas 9.18mgL^{-1}. Cu, Cd, Ni and Cr had mean concentration values of 5.19mgL^{-1}, 0.58mgL^{-1}, 4.52mgL^{-1} and 4.96mgL^{-1} respectively. These values were all within the FEPA 1998 standard set limit though, when compared with the values from our control site (ABPc) they were comparatively higher. This indicates that of a truth, activities at the abattoir sites actually affect the heavy metals concentration negatively.Osakwe et al 2003 reported similar behaviorin the soil of Okpai, Delta state Nigeria. However this impact has not lead to pollution with regards to heavy metal. Therefore, constant monitoring of activities in these abattoir sites will go a long way in preventing bioaccumulation of these heavy metals in region.

Table 2.0 Results of heavy metals present in abattoir soils from Port Harcourt metropolis

Sample ID	*Fe ($mgKg^{-1}$)*	*Pb ($mgKg^{-1}$)*	*Cu ($mgKg^{-1}$)*	*Cd ($mgKg^{-1}$)*	*Ni ($mgKg^{-1}$)*	*Cr ($mgKg^{-1}$)*
ABP 1	571.11	8.33	4.14	0.43	2.86	5.56
ABP 2	656.60	12.50	7.54	0.46	4.71	4.68
ABP 3	580.10	8.30	3.45	0.43	5.71	5.61
ABP 4	644.60	8.33	4.74	0.57	4.66	5.67
ABP 5	574.10	7.17	4.07	0.71	3.18	4.25

ABP 6	581.50	9.33	6.14	0.63	4.86	5.32
ABP 7	646.20	10.50	5.59	0.74	4.42	5.18
ABP 8	586.30	8.60	6.45	0.48	5.34	4.56
ABP 9	611.60	9.43	4.14	0.52	3.83	4.67
ABP 10	597.30	7.17	4.07	0.61	2.96	5.86
ABP 11	676.60	11.60	6.50	0.54	4.77	5.11
ABP 12	560.40	8.90	5.45	0.58	4.52	4.96
Mean	**607.20**	**9.18**	**5.19**	**0.56**	**4.32**	**5.12**
ABP c	274.10	4.17	2.07	0.71	2.86	5.56
FEPA	1000-5000	15.0-25.00	7.0-80.00	2.0-3.0	0.0-100.0	0.0-100

Correlation study was carried out on all the parameters analyzed to understand the relationship among these parameters. Table 3.0 presents the correlation table for all the parameters investigated. Results from table 3.0 gave a positive correlation of 1.00 for chloride and salinity while phosphate and cadmium had a correlation of 0.9939. Conductivity/Iron and conductivity/Pb correlation was 0.9485 and 0.9313 respectively. Others include salinity and Iron correlation which gave a value of 0.9171 similar to that of chloride and iron. Copper/chromium correlation gave a value of 0.9509. Negative correlations were equally observed between sulphate/chloride and sulphate/salinity with same values of -0.9192.

Table 3.0: Correlation chart of physicochemical parameters and heavy metals for abattoir soil samples in Port Harcourt metropoli

Parameters	*pH*	*Conductivity (µS/cm)*	*Chloride*	*Salinity*	*Nitrate*	*Phospate*	*Sulphate*	*Fe*	*Pb*	*Cu*	*Cd*	*Ni*	*Cr*
pH	1	0.133237447	0.61136096	0.61136786	0.288452	-0.77118	-0.41775	0.335391	-0.12674	-0.61117	-0.34914	-0.13415	-0.6066
Conductivity		1	0.79663478	0.79663699	-0.15837	-0.30114	-0.75656	0.948464	0.931262	0.673714	-0.88352	0.662122	0.685409
Chloride			1	1	0.336395	-0.49946	-0.91917	0.917065	0.696498	0.241157	-0.8835	0.332948	0.195497
Salinity				1	0.33638	-0.49948	-0.91915	0.917071	0.696493	0.241148	-0.38683	0.33293	-0.31756
Nitrate					1	0.18755	-0.44449	0.058581	0.017485	-0.13519	0.071289	-0.35646	-0.31756
Phosphate						1	0.138835	-0.46349	0.022455	0.4279	0.993956	0.204132	0.23313
Sulphate							1	-0.8097	-0.76096	-0.40259	0.774597	-0.52717	-0.247
Fe								1	0.864404	0.510144	-0.78847	0.426733	0.536763
Pb									1	0.86167	-0.46239	0.642854	0.814194
Cu										1	-0.46239	0.606976	0.950918
Cd											1	-0.61237	-0.29536
Ni												1	0.482317
Cr													1

IV. CONCLUSIONS

Soil samples from twelve different abattoir locations within Port Harcourt metropolis have been investigated for possible contamination of its physicochemical and heavy metal parameters, and compared with a control site of no abattoir activities as well as WHO and FEPA standard set limits. The soil temperature which was carried out in-situ gave an average value of 30.0^0C. The mean values of the physicochemical parameters revealed that pH and electrical conductivity had average values of 7.00 and 78.33µScm^{-1} respectively. Chloride, salinity and nitrates had average values of 335.00mgKg^{-1}, 601.74mgKg^{-1} and 39.30mgKg^{-1} respectively. These values were slightly higher than both the control site as well as the standard set limit for WHO. Thus, indicating the possibility of contamination/pollution from the abattoir activities. However, average the values for the phosphates, sulphates and heavy metals (Pb, Cu, Cd, Ni, Cr) though slightly higher than those of the control site were all within the standard set limits for WHO and FEPA. Statistical correlation equally showed positive correlations between chloride and salinity (1.0000), phosphate and cadmium (0.9939), conductivity and iron (0.9485). Also, negative correlations were equally observed between sulphate/chloride and sulphate/salinity with same values of -0.9192. Therefore abattoir activities within Port Harcourt metropolis imparts negatively on the arable soil and measures should be put in place for proper control.

REFERENCES

[1]. Abattoir Acts 1988, Retrieved May 2016 from http://www.irishstatutebook.ie/eli/1998/si/12/made/en/print

[2]. Adeyemo OK (2003).Consequences of pollution and degradation of Nigerian aquatic environment on fisheries resources. The Environmentalist 23: 297-306.

[3]. American Public Health Association (APHA) (1998).Standard methods for examination of water and wastewater.American Public Health Association, American Water Works Association and Water Pollution Control Federation.20th edn. Washington DC, USA, pp 5-17.

[4]. Association of Official Analytical Chemists (AOAC) (1990).Methods of Analysis, 12th Edition, AOAC, Washington D. C., USA.

[5]. Bridges O, Bridges JW, Potter JF (2000). A generic comparison of the airborne risks to human health from landfill and incinerator disposal of municipal solid waste. The Environmentalist 20:325-334.

[6]. C.S. Piper, (1994) Soil and plant analysis. Inter-Science Punlishers Inc., New York.

[7]. Ekeke and Okonwu, (2013) Comparative studies on fertility status of soils of University of Port Harcourt, Nigeria. Research Journal of Botany, 8: 24-30.

[8]. FEPA, 1991.Guidelines and Standards for Environmental Pollution Control in Nigeria.Federal Environmental Protection Agency (FEPA). Nigeria.

[9]. Hinton, M. H., Mead, G. C. and Rowlings, C. (2000).Microbiology control in meat industry.Flair Flow Europe Technical Manual. FFe339A/00 May 2000. (www.exp.ie/flair.html).

[10]. Iwegbue, CMA.,Nwajei, G E., Eguavon, O., Ogala, J. E. (2009). Chemical fractionation of some heavy metals in soil profiles in vicinity of scrap dumps in Warri, Nigeria. Chem Spec Bioavail, 21(2) 99-110

[11]. Jukna C., Jukna V., Korsukovas A., Sargiuniene J., Skemaite M., Freezing and storage influence on meat Quality. Veterinarijairzootechnika, 2006, 33, 55, 39-42 (in Lithuanian; English abstract)

[12]. Madigan MT, Martinko JM, Parker J (2003). Brock biology ofmicroorganism.International edn. Prentice Hall Intern Ltd, London, pp 1020-1040.

[13]. Odu, C.T.I., Esurosu, O F., Nwaboshi, I C., Ogunwale, J. A. (1985) Environmental study (Soil and Vegetation) of Nigeria Agip Oil Company Operation Area. A report submitted to Nigeria Agip Oil Company Limited, Lagos, Nigeria. pp 102-107

[14]. Onwuka, O.A. and B.A. Uzoukwu, 2008.Studies on the physicochemical properties of soil from botanic garden.Scientia Africana, 7: 156-164

[15]. Osakwe, S A., Otuya O B., Adaikpo, E O (2003). Determination of Pb, Cu, Ni, Fe and Hg in the soil of Okpai, Delta state, Nigeria. J. Sci. and Environ. 3: 45-51.

[16]. Osemwota I.O. (2010) Effect of abattoir effluent on the physical and chemical properties of soils. Environ Monit. Asses 167:399-404

[17]. Oviasogie, P O., Ofomaja, A (2007). Available Mn, Zn, Fe, Pb and Physicochemical changes associated with soil receiving cassava mull effluent. J. Chem. Soc. Nig. 32(1):69-73.

[18]. Rabah, A. B., Oyeleke, S. B., Manga, S. B. Hassan, L. G., and Ijah, U. J. J. (*2010)* Microbiological And Physico-Chemical Assessment Of Soil Contaminated With Abattoir Effluents In Sokoto Metropolis, Nigeria. Science World Journal Vol 5 (3)

[19]. Sumayya B. U, Usman B. U, Aisha U.,Shahida A., Mohammad A., Yakubu M. S. and Zainab M. (2013) Determination of Physiochemical Qualities of Abattoir Effluent on Soil and Water in Gandu, Sokoto Journal Of Environmental Science, Toxicology and Food Technology Vol 4, (4), pp 47-50

[20]. Tukura, B W., Kagbu, J A., Gimba, C E (2007). Effects of pH and Total Organic Carbon on the distribution of trace metals in Kubanni Dam Sediments, Zaria, Nigeria. Sci World J. 2(3)1-6

[21]. Udo, E. J. and Ogunwale, J. A. (1986).Laboratory Manual for the Analysis of Soil, Plant and Water Samples,2nd Edition, Universityof Ibadan, Nigeria.

[22]. World Health Organization. WHO Report 2003. The World Health Report: Shaping the Future, World Health Organization, 1211 Geneva 27, Switzerland 2002

[23]. Yakowitz, H. 1988. Policy development issues with respect tocontaminatedsoil sites. In: Contuminatedsoil'88 (edsK. Wolf,W. J. Vanden Brink &F.J.Colon), Klewer AcademicPublishers, Dfordrecht, pp. 1515-1526.