

Efficiency of Some Chemical Reagents with Ultrafiltration System in the treatment of Abattoir Wastewater

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ABSTRACT

The study seeks to evaluate the concentration of some toxicants in abattoir wastewater prior to treatment and after treatment using ultrafiltration system. Samples of water were gathered from the reservoir of wastewater in the Gwagwalada abattoir, Abuja, Nigeria without treatment and labelled S1. Some of the water was subjected to treatment using Chlorine + Alum + Lime (S2), another with Chlorine + Alum + Lime + Activated carbon (S3). Physico-chemical parameters such as: pH, colour, nitrates etc. were analyzed. Trace metals (Zn, Cu, Fe, Pb, Mn, Ni, Co and Cd) levels in the water samples were investigated using Atomic Absorption Spectrophotometer (AAS). Concentration of pesticide residues ($\mu\text{g/L}$), antibiotics and bacterial growth were also evaluated. The S1, S2 and S3 nitrate concentrations were 271.20, 22.40 and 26.57 mg/L respectively. Level of Zinc, Copper and Lead in the trio samples investigated were within the range 0.14 to 0.24 mg/L, 0.15 to 0.24 mg/L and 0.06 to 0.17 mg/L respectively. Dichlorvos, Lambda-cyhalothrin and Chlorpyrifos were found in the 3 water samples in varying concentration. Only sample S1 shows microbial growth of *Salmonella* spp., *Escherichia coli*, *Pseudomonas* spp., and *Shigella* spp. at 52.00 ± 8.49 , 58.00 ± 31.11 , >100 and 10.50 ± 0.71 CFU/100ml respectively. In S1, 0.05 $\mu\text{g/L}$ of oxytetracycline and 0.34 $\mu\text{g/L}$ of levofloxacin were found. This study has shown that treating wastewater from the abattoir using ultrafiltration method with some reagents such as Chlorine, Alum, Lime and Activated Carbon can help in removing toxicants and purify it before releasing it into the environment

Keywords: Abattoir, Antibiotics, Heavy metals, Pesticides, Ultrafiltration, Wastewater

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INTRODUCTION

The discharge of effluent (also known as wastewater), rinsing of butchered animals post-slaughter, and the disposal of animal remains along with bodily fluids have led to significant environmental issues, impacting not only aquatic ecosystems but also posing risks to human health (Ahmadu *et al.*, 2020). This issue has been ongoing for an extended period but has escalated notably over the past few decades, getting to a vital and concerning level in Nigeria (Arimoro and Ikomi, 2008).

It has been reported that many abattoirs in Nigeria are strategically located near surface water bodies to access affordable water supplies required for animal processing and to serve as a disposal site for the runoff generated during meat processing engagements (Omole and Ogbiye, 2013). The water plied during slaughtering activities has the potential to gather contaminants, faecal products, and even malicious bacteria (Mijinyawa and Lawal, 2008; Ramesh *et al.*, 2009). Untreated abattoir effluent is a combination of fats, proteins, and fibers, leading to a significant presence of organic matter with a possibility of contaminating the rivers and sewage networks (Mulu and Ayenew, 2015).

These wastewater streams are often identified by elevated levels of organic compounds, including parameters like biological oxygen demand (BOD) (the receiving water body, potentially could experience eutrophication) and chemical oxygen demand (COD), along with elevated levels of N, P, malicious microorganisms, suspended solids, and fats, oils, and grease (FOG), arising from sources like blood, carbohydrates, faeces, proteins, and feathers (AL-Mutairi, 2006; Kobya *et al.*, 2005; Oh *et al.*, 2014; Yordanov, 2010). The significant presence of organic matter can be connected to the remaining blood in the effluent (Debik and Coskun, 2009; Dlangamandla *et al.*, 2016).

The advancement of innovative approaches for wastewater treatment includes pressure-driven

membrane processes such as ultrafiltration (which aids in the removal of colloids, suspended particles, and macromolecular substances) and reverse osmosis (which eliminates mineral compounds and low-molecular organic substances) (Yordanov, 2010). Ultrafiltration exhibits outstanding effectiveness in eliminating minute particles, as well as pathogenic microorganisms and environmentally harmful enriched substances (Spasov and Dinkov, 2002). This approach can also decrease the necessity for chlorination and eliminate nitrogen and phosphorus nutrients. Wastewater treated through traditional treatment plants is typically released into the environment, while membrane filtration technology can generate water of sufficient purity for household consumption, crop irrigation, and industrial applications (Ramesh *et al.*, 2009).

Surface assimilation on activated carbon is regarded as one of the most effective techniques employed in the water treatment operation (Keerthana and Thivyatharsan, 2018). Activated carbons possessing a diverse pore size distribution, substantial specific surface area, and unique surface chemistry are extensively employed as versatile adsorbents for capturing substances in both gaseous and liquid phases (Yadav *et al.*, 2015). They are also frequently utilized as adsorbents in the removal of various organic compounds, dyes, heavy metals, industrial pollutants, herbicides, pesticides, and numerous other toxic and hazardous substances (Reza *et al.*, 2020). Activated carbons of this nature can be manufactured from a range of source materials, including coffee wastes (Obaya *et al.*, 2020), coal (Sun, 2016), coconut shell (Gratuito *et al.*, 2008), plantain fruits (Ekpete *et al.*, 2017), maize cob (Egbon *et al.*, 2013), rice husk (Ahiduzzaman and Sadrul Islam, 2016) and sawdust (Yang *et al.*, 2017).

The use of antibiotics in agriculture has exacerbated the proliferation of antibiotic resistance in the human population through the environmental spread of interchangeable

resistance genes (Heuer *et al.*, 2011). Wastewater from abattoirs has the potential to pollute both surface and groundwater. The discharge of abattoir effluent introduces pathogens that can negatively impact land and water quality, posing risks to human, animal, and aquatic ecosystem health while also posing a threat to overall environmental safety (Atuanya *et al.*, 2018). The practices associated with livestock farming and animal processing, including the production of beef, hides, and leather, have had long-term detrimental effects on both land and water resources (Sawalha *et al.*, 2019). Wastewaters or effluents from Abattoir has been reported to frequently contain various pharmaceuticals, including diclofenac, oxytetracycline, tetracycline, and others (Sim *et al.*, 2013; Wei *et al.*, 2011) typically used to treat livestock diseases and endoparasites. Another significant concern is the potential impact of long-term environmental exposure to low concentrations of antibiotics, which can range from nanograms per liter (ng/L) to micrograms per liter ($\mu\text{g/L}$) (Munoz *et al.*, 2017).

This study is undergone to evaluate the concentration of toxicants (heavy metals, low biological oxygen demand, dissolved oxygen, pesticides, antibiotic microbes that can cause infections) in abattoir wastewater prior to treatment and after treatment using ultrafiltration system.

METHODOLOGY

Study Area

Gwagwalada town in the Federal Capital Territory (FCT), Abuja, can be characterized as one of the densely populated areas and serves as the headquarters of one of the oldest councils in the Federal Capital Territory, Abuja (Ejaro, 2013). Gwagwalada town is situated approximately 55 kilometers from the Federal Capital City (FCC) within the Federal Capital Territory. Its geographical coordinates place it between latitude $08^{\circ}55'N$ and $09^{\circ}00'N$ and longitude $07^{\circ}00'E$ and $07^{\circ}05'E$. (Balogun, 2001). The Gwagwalada Abattoir is located in the new

Kutunku area of Gwagwalada, situated between latitude $8^{\circ}55'$ and $8^{\circ}60'$ North and longitude $7^{\circ}05'$ and $7^{\circ}11'$ East. More precisely, the coordinates of the Gwagwalada Abattoir are within the range of latitude $8^{\circ}55'59''N$ to $8^{\circ}55'55''N$ and longitude $7^{\circ}03'54''E$ to $7^{\circ}03'50''E$.

Collection of water samples

Samples of water were gathered manually from the top 30 cm of the reservoir of wastewater from the Gwagwalada abattoir, Abuja, Nigeria. The water samples, each totaling 1 liter, were collected in triplicate using amber glass bottles. These samples were collected using a composite sampling technique within a 4-hour interval. Subsequently, all collected samples were stored at a 4°C temperature before additional analysis.

Group of water samples

Untreated wastewater was labelled S1, Treated wastewater sample using Chlorine + Alum + Lime was labelled S2 while Treated wastewater using ultrafiltration (Chlorine + Alum + Lime) with activated carbon was labelled S3.

Physico-chemical determination

The pH and electrical conductivity of the collected water samples were determined using a pH meter (HI-99130, Italy) and an electrical conductivity meter (JENWAY, multi-3410, UK), respectively. Additionally, Gravimetric method was plied to determine the samples total dissolved solids (TDS) (Sawyer *et al.*, 1994).

The total dissolved solids (TDS) of each sample were calculated plying the following formula:

$$\text{TDS (mg/L)} = \{(A - B) \times 1000\} \div \text{sample's volume}$$

A represent the evaporating dish weight plus the dried residue
B represents the evaporating dish weight

Dissolved oxygen in mg/L was measured using two different techniques: the optical technique of ProODOmeter and the galvanic technique of ProPlus meter (1.25 mil PE), both manufactured by YSI Inc., Yellow Springs, Ohio, USA.

The turbidity of the water samples was determined using calibrated standard instruments (DeZuane, 1997) alongside the American Public Health Association (APHA) (2017), American Society for Testing and Materials (ASTM), and a turbidity meter (model 2100P Turbidimeter HACH, Colombia, USA) provided by Arachem (M) Sdn. Bhd. Each water sample was kept for few minutes in the sample holder in order to stabilize the reading which were then recorded. Nitrates and nitrites concentration were determined as stated in Olu (2021) and the standard methods of APHA (2017). Also, biological oxygen demand (BOD) was evaluated.

Pesticide standards

Plying Yusuf *et al.* (2022) method, pesticide standard of 99% purity was acquired from Sigma-Aldrich (St. Louis, MO, USA). HPLC-grade ethyl acetate from E. Merck (Darmstadt, Germany) was plied in dissolving the stock solutions and the evaluated pesticides from the water samples, include Chlorpyrifos, Glyphosate, Dichlorvos, Cypermethrin, and LAMBDA-cyhalothrin.

HPLC-DAD analyses

The analysis was conducted using an Agilent Technologies Series 1200 high-performance liquid chromatography (HPLC) system from Waldbronn, Germany, which was equipped with a diode array detector (DAD). The chromatographic column used was an Agilent Zorbax SB C18 column with dimensions of 250 mm × 4.6 mm × 5 µm, and the analysis was performed at a constant temperature of 25°C in the oven. Acetonitrile was the mobile phase plied with ultrapure water for 5 min by the utilization of a 30:70 v/v gradient, for 10 min 100% acetonitrile and for 5 min 15:85 v/v.

Antibiotics analysis

Fifty milligram (50 mg) each of Metronidazole, Trimethoprim, Sulphamethoxazole, Ampicillin and Cloxacillin standard were weighed separately into 50 mL volumetric flasks and approximately 25 mL of HPLC grade methanol was added to

each flask and the solution shaken for 5 min to ensure complete dissolution of the actives. To prepare the stock solution, 1 mg/mL was achieved by filling up to the mark with HPLC-grade methanol. Subsequently, lower concentration calibration standards, specifically 500, 200, 100, 50, and 10 µg/mL, were derived from the stock solution and then transferred into HPLC vials for further examination.

HPLC Analysis of Samples

Two (2) µL of each sample was carried with the aid of the mobile phases (10 mM KH₂PO₄) (pH :3.0) (88%v/v) and Acetonitrile 2 4(HPLC grade) (12%v/v)) over the Stationary Phase (WatersXterra C18 with dimensions of (250 mm x 4.6 mm I.D, 5 µm) at a flow rate of 1.0 mL/min. The column temp was 30°C and the detector wavelength was 265 nm. The samples were run for 20 min each.

Bacteriological examination

This was done to determine the concentration of bacteria and other microorganisms in the wastewater and treated samples as illustrated by Olu *et al.* (2021) and Ikhide *et al.* (2022) where most probable number (MPN) test was carried out in three (3) steps namely; presumptive, confirmatory and completed test to evaluate the count of bacterial isolates.

RESULTS AND DISCUSSION

Physico-chemical parameters encompass the conventional parameters employed in water quality assessments (Hamaidi-Chergui and Errahmani, 2019). These parameters comprise dissolved oxygen, pH, temperature, salinity, and nutrients like nitrogen and phosphorus. Additionally, they encompass measurements related to pollutants such as herbicides, insecticides, and metals (Alengebawy, 2021). Table 1 shows the different means of physico-chemical parameters readings obtained from the different water samples analyzed in this study with the available permissible limit stated by World Health Organization and Standard Organization of Nigeria as a guideline.

Water conductivity is a representation of its capacity to conduct an electrical current (Mulu and Ayenew, 2015). In this study from Table 1, the untreated water sample from the abattoir had an electrical conductivity of 773.85 $\mu\text{S}/\text{cm}$ which was reduced in the treated water samples. The water sample treated with Chlorine (3 mg/L) + Alum (20 mg/L) + Lime (15 mg/L) (S2) and the one treated with Treated with Chlorine (3 mg/L) + Alum (20 mg/L) + Lime (15 mg/L) + Activated Carbon (S3) were 303.4 and 266.9 $\mu\text{S}/\text{cm}$ respectively.

As stated by Asibor *et al.* (2020), the pH level is crucial for microorganisms as it plays a significant role in regulating the activity of enzymes, hormones, and proteins that control metabolism, growth, and development. From Table 1, the untreated water sample (S1) from the abattoir pH is 6.59, the S2 water sample had pH 6.53 and each pH was within the range of permissible limit as shown in Table 1 by World Health Organization and Standard organization of Nigeria. The S3 water sample had a pH of 5.79. All the three water samples had pH lower in contrast to pH ranges of 6.9–8.8 of earlier studies on wastewater from likewise abattoirs in Nigeria (Raheem and Morenikeji, 2018). Wastewaters from abattoir are alkaline in nature typically due to the high concentration of organic compounds, primarily made up of proteins (Ogbomida *et al.*, 2016; Padilla-Gasca *et al.*, 2011) but that did not take place with the abattoir water sample used in this study.

Dissolved oxygen (DO) is a critical parameter for the existence of aquatic organisms and is also applied to assess the freshness of a river (Kolawole *et al.*, 2011). In this study from Table 1, the DO was low in the untreated abattoir water sample with a concentration of 0.75 mg/L. The low level of DO can be attributed to the high nutrient composition from the abattoir effluent (Mulu *et al.*, 2013). The DO concentration increased after treatment for both S2 and S3 with a value of 5.01 and 4.51 mg/L respectively.

Biodegradable organic matter present in receiving waters can lead to increased rivalry for oxygen within the environment, resulting in elevated levels of BOD and a subsequent decrease in DO. This situation is harmful to aquatic life and can also impact the quality of sediments and surrounding soil (Asibor *et al.*, 2020). In this study, the BOD of the untreated wastewater has a concentration of 81.81 mg/L. The BOD concentration decreased after treatment for both S2 and S3 with a value of 2.08 and 0.68 mg/L respectively. A drastic reduction in slaughter house wastewater after treated using ultrafiltration method was also reported by Asibor (2020), Eze and Eze (2018) and Yordanov (2010). The BOD values for the treated water were below the maximum acceptable limit as illustrated in Table 1.

Color in water is a measurement of its aesthetic quality or visual appearance (Mulu and Ayenew, 2015). In this study, the wastewater from the abattoir is brownish in color while two treated water samples (S2 and S3) were colorless as indicated in Table 1.

As shown in Table 1, the wastewater (S1) had a high turbidity value of 121.00 NTU, it reduced when subjected to treatment, as indicated with S2 and S3, with the values 12.10 and 30.10 NTU respectively. The elevated levels of turbidity are expected, as they result from the direct dislodge of effluents from the abattoirs (Akpor and Muchie, 2011; Ezeoha and Ugwuishiwu, 2011; Kwadzah and Iorhemen, 2015; Ojo, 2014). The appearance of such a high concentration of turbidity diminishes the aesthetic quality of the receiving water (Asibor *et al.*, 2020).

According to Eze and Eze (2018), total dissolved solids (TDS) serve as an indicator of the presence of various chemical contaminants, including calcium, chloride, magnesium, nitrates, phosphate, potassium, and sodium and an elevated TDS values are indicative of hard water, which can lead to the accumulation of scale in pipes, valves, and filters. This scale buildup can

impair system performance and increase maintenance expenses. It's important to note that high TDS levels can be particularly toxic when accompanied by abnormal pH, high turbidity, or reduced oxygen levels (Eze and Eze, 2018). In this study the wastewater had a TDS (592.85 mg/L) value higher than the acceptable limit as indicated in Table 1. The total dissolved solids were seen to increase in both treated water with concentration value of 1480 mg/L and 1307 mg/L.

Nitrate is one of the chemical parameters commonly utilized as index to assess water quality (Olu, 2021). In this study, the nitrate concentration (271.20 mg/L) from the untreated wastewater from the abattoir was far higher than the acceptable maximum limit as indicated in Table 1.

Nitrate pollution is thought to result from both livestock manure and the application of inorganic fertilizers in agricultural practices (Olu, 2021).

Industrial effluents, motor vehicles, and wastewater treatment have been recognized as contributors to nitrate pollution in the environment (Alimohammadi *et al.*, 2018; Asghari *et al.*, 2018; Khosravi *et al.*, 2018). High concentrations of nitrate have been associated with eutrophication (Adeolu *et al.*, 2016). On the other hand, the treated water samples (S2 and S3) had a nitrate concentration value of 22.40 mg/L and 26.57 mg/L respectively and these were below the permissible maximum limit as specified in Table 1.

In this study from Table 1, the nitrite concentration in the untreated wastewater from the abattoir was 139.30 mg/L, and this was very high compared to the permissible limit specified by WHO and SON as indicated in Table 1. However, the nitrite reduced in the two treated wastewater (S2 and S3) as 10.20 mg/L and 11.14 mg/L respectively.

TABLE 1: Physico-chemical characteristics of water samples

Parameter	S1	S2	S3	SON ¹	WHO ²
E.C (µS/cm)	773.85	303.4	266.9	1000.0	1000.0
TDS (mg/L)	592.85	1480	1307	500.0	500.0
pH	6.59	6.529	5.792	6.50-8.50	6.50-8.50
DO (mg/L)	0.75	5.01	4.51	6.5-8.00	6.5-8.00
BOD (mg/L)	81.81	2.08	0.68	-	3.0-6.0
Nitrate (mg/L)	271.20	22.40	26.57	50	50
Nitrite (mg/L)	139.30	10.20	11.14	0.2	0.2
Turbidity (NTU)	121.00	12.1	30.1	5.0	5.00
Colour	Brown	Colourless	Colourless	Colourless	Colourless

1: Standard Organization of Nigeria (SON), 2015

2: World Health Organisation (WHO), 2006

EC-Electrical conductivity, TDS- Total dissolved solids, DO- Dissolved oxygen, BOD- Biological oxygen demand

S1= Untreated Water

S2= Treated with Chlorine (3 mg/L) + Alum (20 mg/L) + Lime (15 mg/L)

S3= Treated with Chlorine (3mg/L) + Alum (20mg/L) + Lime (15mg/L) + Activated Carbon

Table 2 shows the different mean concentrations (mg/L) of metals obtained from the different water samples analyzed in this study with the available permissible limit specified by WHO, SON and United States Environmental Protection Agency (USEPA) as a guideline.

Heavy metals are categorized as environmental pollutants due to their toxic influence on the ecosphere (Khalid *et al.*, 2020; Olu *et al.*, 2022). As divulged in Table 2, Cadmium and Cobalt were not detected in any of the water sample analyzed. Hassana and Nuradeen (2021) also reported that Cadmium was not detected in the abattoir wastewater which they investigated.

It is well known that acute zinc toxicity in humans can lead to symptoms such as nausea, dehydration, weakness, abdominal pain, muscle coordination difficulties, and kidney dysfunction (Elemile *et al.*, 2019). Chronic exposure to high levels of zinc can increase the risk of blood cell deformities and may also harm the pancreas (Vaishaly *et al.*, 2015) while elevated copper levels can lead to chronic anemic condition (Iqbal *et al.*, 2011). In this study from Table 2, the zinc and copper concentrations of the three samples investigated were within the range 0.14 to 0.24 mg/L and 0.15 to 0.24 mg/L. These results were below the acceptable maximum limit by WHO, SON and USEPA as indicated in Table 2. This observation implies that treatment effected on the wastewater from the abattoir were able to remove some zinc and copper in the wastewater sample.

Lead as a contaminant can accrue in the bones, blood vessels and other vital organs as time progress (Nazir *et al.*, 2015). Lead is not only a carcinogen but also affects the central nervous system of individuals exposed to it. It can result in delayed mental and physical growth in children and may impair their attention span and learning abilities (Omole *et al.*, 2018). In this research work, the level of lead in the three samples of water were higher than the acceptable limit as specified

in Table 2, the range was 0.06 mg/L to 0.17 mg/L. Although the treatment of the wastewater did cause reduction in the Lead concentration especially with the presence of activated carbon. Unlike this study, Hassana and Nuradeen (2021) did not detect lead in the abattoir wastewater and the activated carbon treated water sample.

In this study from Table 2, the sodium and calcium concentrations in the treated wastewater were higher than their respective concentrations i.e., 11.24 mg/L and 14.16 mg/L in the raw wastewater from the abattoir, the spike in the concentration of these two elementals can be attributed to the presence of lime and alum among the reagents that were used in the filtration process.

Magnesium is a vital nutritional element for human beings, serving as one of the micro-elements responsible for various functions such as maintaining cell membrane integrity, facilitating nerve transmission, supporting muscle function, and assisting in DNA replication (Bala *et al.*, 2016). In this study from Table 2, The magnesium levels were higher in wastewater with a concentration of 6.34 mg/L and also the S3 sample concentration was higher than the acceptable limit as illustrated in Table 2. This simply could be said that the activated carbon did not permit effective removal of magnesium from the wastewater.

The potassium was well reduced in the water sample without activated carbon- S2 having a value of 9.87 mg/L compared to the one which pass through activated carbon S3 (11.89 mg/L) that also increased the potassium concentration of the filtered wastewater. The wastewater from the abattoir (S1) has a potassium concentration of 10.07 mg/L

In this study, iron was found in the wastewater from the abattoir (S1) at a concentration of 1.05 mg/L and this was higher than some permissible limit specified by some global agency except

WHO as specified in Table 2 but the treated water (S2 and S3) had no traces of iron in it.

In this study, the manganese in the wastewater from the abattoir was 0.32 mg/L and it was

reduced to 0.13 and 0.21 mg/L in the two treated wastewater S2 and S3 respectively. The water treated with activated carbon could not remove the manganese effectively when compared to where it is absent.

TABLE 2– Metal content (mg/L) of the water samples

Samples	S1	S2	S3	WHO (2011)	SON (2015)	USEPA (2008)
Cd	NA	NA	NA	0.003	0.003	0.005
Pb	0.17	0.09	0.06	0.01	0.01	0.015
Na	11.24	13.49	13.25	200	200	-
Co	NA	NA	NA	-	-	0.1
K	10.07	9.87	11.89	-	-	-
Zn	0.24	0.16	0.14	3	3	5
Cu	0.27	0.15	0.17	2	1	1.3
Fe	1.05	NA	NA	2	0.3	0.3
Mn	0.32	0.13	0.21	0.4	0.20	0.05
Mg	6.34	0.17	4.80	-	0.20	-
Ca	14.16	136.84	148.44	75	-	-

NA- Not ascertained

S1= Untreated Water

S2= Treated with Chlorine (3 mg/L) + Alum (20 mg/L) + Lime (15 mg/L)

S3= Treated with Chlorine (3 mg/L) + Alum (20 mg/L) + Lime (15 mg/L) + Activated Carbon

Table 3 shows the different concentrations (µg/L) of pesticide residues obtained from the different water samples analyzed in this study with the available permissible limit specified by World Health Organization as a guideline.

Wastewaters from abattoir frequently contain pesticides plied in the treatment of livestock to eradicate ectoparasites. Additionally, they may contain polycyclic aromatic hydrocarbons (PAHs) originating from human activities, especially the processing of animal skin at the slaughter site (Olaniran *et al.*, 2019). In this study from Table 3, the five pesticides investigated were LAMBDA cyhalothrin, Chlorpyrifos, Dichlorvos, Cypermythrin, Glyphosate. None of the water sample had the presence of Cypermythrin, Glyphosate was obtained as shown in Table 3. Multiple categories of pesticides designed to combat particular pests are manufactured to

enhance crop production and quality (Oladokun *et al.*, 2020). One frequently used organophosphate pesticide, possessing insecticidal characteristics, is Dichlorvos (2,2-dichlorovinyl dimethyl phosphate), which is frequently put on crops, stored goods, and for treatment of animal (Moraes *et al.*, 2015; Thredgold *et al.*, 2019). In this research work from Table 3, dichlorvos was found in all the three samples of water at a concentration of 130 µg/L level, this is far above the acceptable limit as specified in Table 3. Also, the treatment applied to the wastewater from the abattoir could not remove organic substance like dichlorvos.

Lambda-cyhalothrin bears resemblance to pyrethroid, specifically cyhalothrin, which consists of four isomers. Lambda-cyhalothrin is derived from two of these isomers. Its mode of action impacts an organism's nervous system by

interfering with the gating mechanism of sodium channels responsible for generating and transmitting impulses of the nerve (Nwadinigwe, 2010). In this study from Table 3, the pesticide Lambda-cyhalothrin was found in the three samples of water, 0.33 µg/L in the wastewater from the abattoir, and 0.28 µg/L in two treated water sample respectively. These concentrations were higher than the acceptable limit as illustrated in Table 3.

Chlorpyrifos is an all-around organophosphorus pesticide that contains chlorine and is commonly employed to manage agricultural and household

insects (Sasikala *et al.*, 2012; Tomlin, 2015). Chlorpyrifos, serves as the active ingredient in various insecticides and characterized by its considerable acute mephitic (Noworyta-Głowacka *et al.*, 2012). Chlorpyrifos exhibits potent and indiscriminate pursuit to both human and animal subjects (Lutz and Pałczyński, 2005). In this research work from Table 3, the Chlorpyrifos in the three water samples i.e., the wastewater from the abattoir and the two treated water samples S2 and S3 were 162.85, 162.97 and 163.01 µg/L respectively. These concentrations were higher than the acceptable limit as illustrated in Table 3.

TABLE 3 – Water samples and pesticide residues

SAMPLE	LCµg/L	Chlorpyrifos µg/L	Dichlorvos µg/L	Cypermethrin µg/L	Glyphosate µg/L
S1	0.33±0.00	162.83±0.05	130.45± 0.00	NA	NA
S2	0.28	162.97	130.03	NA	NA
S3	0.28	163.01	130.01	NA	NA
Acceptable Limit	0.1*	30**	30***	-	-

LC- LAMBDA cyhalothrin, * van Leeuwen *et al.* (2008), **-WHO, 2004, ***- WHO, 2016, NA- Not ascertained
 S1= Untreated Water
 S2= Treated with Chlorine (3 mg/L) + Alum (20 mg/L) + Lime (15 mg/L)
 S3= Treated with Chlorine (3 mg/L) + Alum (20 mg/L) + Lime (15 mg/L) + Activated Carbon

Table 4 shows the different means (CFU/100ml) of bacterial populations in the different water samples analyzed in this study with the available permissible limit specified by World Health Organization as a guideline.

Abattoir wastewater discharged has been found to contain various bacteria, including *Escherichia coli*, *Staphylococcus aureus*, *Klebsiella* species, *Salmonella* species, *Enterobacter* species, *Shigella* species, and *Proteus* species and when blood and

fat are permitted to be channeled through the effluent, the cost of treatment rises significantly. (Joseph *et al.*, 2021; Otolorin *et al.*, 2015).

In this study, the wastewater from the abattoir, show that there was growth of *Salmonella* spp., *E. coli*, *Pseudomonas* spp., and *Shigella* spp. at 52.00 ± 8.49, 58.00 ± 31.11, >100 and 10.50 ± 0.71 CFU/100ml. On the contrary, there was no microbial growth from the two treated water samples S2 and S3 as indicated in Table 4.

TABLE 4 – Selected Bacterial species in the water samples

SAMPLE	<i>Salmonella</i> spp. (CFU/100 mL)	<i>Escherichia coli</i> (CFU/100 mL)	<i>Pseudomonas</i> spp. (CFU/100 mL)	<i>Shigella</i> spp. (CFU/100 mL)
S1	52.00 ± 8.49	58.00 ± 31.11	>100.00	10.50 ± 0.71
S2	NG	NG	NG	NG
S3	NG	NG	NG	NG
WHO (2006)	0 per 100 mL	0 per 100 mL	0 per 100 mL	0 per 100 mL

CFU = Colony forming unit, NG= No growth

S1= Untreated Water

S2= Treated with Chlorine (3 mg/L) + Alum (20 mg/L) + Lime (15 mg/L)

S3= Treated with Chlorine (3 mg/L) + Alum (20 mg/L) + Lime (15 mg/L) + Activated Carbon

Table 5 shows antibiotic residues (µg/L) in the different water samples analyzed in this study. Oxytetracycline (OTC) is generally plied to treat bacterial attack in humans, are also broadly applied to farm animals for prophylactic and therapeutic purposes, as well as for growth promotion. This is due to their low toxicity status, all-around activity, and cheapness (Kong *et al.*, 2012; Watanabe *et al.* 2010). Despite at reduced levels, oxytetracycline and its transformation products have been demonstrated to promote the emergence of antibiotic-resistant bacteria (ARB) and antibiotic resistance genes (ARG) evolution, expedition, mobilization, and transmission to pathogens (Bengtsson-Palme and Larsson 2015; Huang *et al.*, 2012; Lundstrom *et al.*, 2016). In this study from Table 5, 0.05 µg/L of oxytetracycline was detected in the raw wastewater (S1) from the abattoir. It was also present in the two treated water sample at a

concentration close to that found in the untreated wastewater.

Levofloxacin belongs to the fluoroquinolone drug class as a bactericidal drug, which works by straight inhibiting bacterial DNA production (Bush *et al.*, 2011). It has proficient averse to other prominent respiratory organisms; such as; *Chlamydia pneumoniae*, *Haemophilus influenzae*, *Legionella* spp., *Moraxella catarrhalis*, and *Mycoplasma* spp. (Yew *et al.*, 2011). Levofloxacin additionally exhibits greater *in-vitro* activity against *Mycobacterium tuberculosis*, making it the desired choice among fluoroquinolones for second-line antitubercular treatment (Anderson and Perry, 2008). In this study from Table 5, levofloxacin was found to be 0.34 µg/L in the wastewater from the abattoir. The treated water S2 and S3 had a reduced concentration of levofloxacin in the tune of 0.30 and 0.15 µg/L respectively.

TABLE 5 – Selected antibiotic residues in the samples of water

Sample	Oxytetracycline µg/L	Levofloxacin µg/L
S1	0.05±0.00	0.34±0.00
S2	0.04±0.36	0.30±0.09
S3	0.08±0.14	0.15±0.63

S1= Untreated Water

S2= Treated with Chlorine (3 mg/L) + Alum (20 mg/L) + Lime (15 mg/L)

S3= Treated with Chlorine (3 mg/L) + Alum (20 mg/L) + Lime (15 mg/L) + Activated Carbon

CONCLUSION

This study has shown that treating wastewater from the abattoir using an ultrafiltration method with some reagents such as Chlorine, Alum, Lime and Activated Carbon can help in removing toxicants (heavy metals, high biological oxygen demand, low dissolved oxygen, pesticides, antibiotic, microbes that can cause infections,) and also purify it before releasing them into the environment. Considering from the environmental and economic perspective, Ultrafiltration presents itself as a potentially efficient stand-in treatment application in contrast to traditional wastewater treatments. However, purification of wastewater irrespective of its source before releasing it into the environment and water bodies remain a high task to be achieved in developing countries of which Nigeria is not an exception.

Recommendations

With the findings made in this study, the authors made the following suggestions

1. The water quality of the effluent from the abattoir should always be measured and recorded in order to put some measures in place towards responding promptly to any emergent hazard.
2. Livestock breeders should be trained more on the proper usage of pesticides on their animals.

The administration of antibiotics should be done by veterinary doctors or experts that will not allow their abuse and prevent its introduction into the environment via wastewater from abattoir

AUTHORS' CONTRIBUTION

NOBLE-OKEREKE, H.: Developed experimental design of the research and the manuscript first draft.

ANAGA, S.O.: Worked on the data analysis and edited the manuscript,

UNAEZE, C.H.: Involved in collection of samples and drafting of manuscripts

YUSUF, H.O.: Involved in the data interpretation and manuscript editing

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CONFLICT OF INTEREST

There is no conflict or biased interest from the authors in conducting this study

REFERENCES

- Adeolu, A.T., Okareh, O.T. and Dada, A.O. (2016) Adsorption of chromium ion from industrial effluent using activated carbon derived from plantain (*Musa paradisiaca*) wastes. *Am J Environ Protect* 4(1), 7–20. <https://doi.org/10.12691/env-4-1-2>
- Ahiduzzaman M. and Sadrul Islam A. K. (2016). Preparation of porous bio-char and activated carbon from rice husk by leaching ash and chemical activation. *Springer Plus*, 5(1), 1248
- Ahmadu, J., Eze, O.F., Kesiena, O., Hanis, B., and Michea, F. (2020). Effects of Abattoir Waste on the Surface Water Quality of Dei-Dei River, Abuja, Nigeria. *International Journal of Environmental Chemistry* 4(2), 38-45
- Akpor, O.B. and Muchie, M., (2011). Environmental and public health implications of wastewater quality. *African Journal of Biotechnology*, 10(13), 2379–2387.
- Alengebawy, A., Abdelkhalek, S. T., Qureshi, S. R. and Wang, M. Q. (2021). Heavy Metals and Pesticides Toxicity in Agricultural Soil and Plants: Ecological Risks and Human Health Implications. *Toxics*, 9, 42.
- Alimohammadi, M., Latifi, N., Nabizadeh, R., Yaghmaeian, K., Mahvi, A.H., Yousefi, M., Foroohar, P., Hemmati, S., and Heidarinejad Z., (2018). Determination of nitrate concentration and its risk

- assessment in bottled water in Iran, *Data Brief* 19, 2133–2138. <https://doi.org/10.1016/j.dib.2018.06.110>
- AL-Mutairi, N.Z. (2006). Coagulant toxicity and effectiveness in a slaughterhouse wastewater treatment plant, *Ecotoxicology and Environmental Safety* 65, 74-83.
- American Public Health Association (APHA) (2017). *Standard Methods for the Examination of Water and Wastewater* (23rd ed.). American Public Health Association, Washington DC.
- Anderson, V.R., and Perry, C.M. (2008). Levofloxacin: a review of its use as a high-dose, short-course treatment for bacterial infection. *Drugs*. 68(4), 535-65. <https://doi.org/10.2165/00003495-200868040-00011>
- Arimoro, F. O., and Ikomi, R. B. (2008). Response of Macroinvertebrate Communities to Abattoir Wastes and other Anthropogenic activities in a municipal stream in the Niger Delta, Nigeria. *Environmentalist* 28, 85–98.
- Asghari, F.B., Mohammadi, A.A., Dehghani, M.H., and Yousefi, M. (2018). Data on assessment of groundwater quality with application of ArcGIS in Zanjan, Iran, *Data Brief* 18, 375. <https://doi.org/10.1016/j.dib.2018.03.059>
- Asibor, G., Edjere, O., and Azubuike, C. (2020). Status of discharged abattoir effluent and its effects on the physico-chemical characteristics of Orogodo river, Delta State, Nigeria. *Water Pollution* 15, 51-60
- Atuanya, E. I., Nwogu, N. A., and Orah, C. U. (2018). Antibiotic resistance and plasmid profiles of bacteria isolated from abattoir effluents around Ikpoba river in Benin city, Nigeria. *Journal of Applied Sciences and Environmental Management*, 22(11), 1749–1755.
- Bala, J., Moumouni, A. and Musa, S.S. (2016). Influence of abattoir wastes on groundwater quality in Keffi, North Central Nigeria. *J Environ Sci Toxicol. Food Technol.* <https://doi.org/10.9790/2402-1010013542>
- Balogun, A. (2001). *The position and influence of the Gwagwalada Area Council*. pp.35-42, University of Lagos press.
- Bengtsson-Palme, J. and Larsson, D.J. (2015). Antibiotic resistance genes in the environment: prioritizing risks. *Nature Views - Microbiology*, 13, 116-123.
- Bush, K., Courvalin, P., Dantas, G., Davies, J., Eisenstein, B., Huovinen, P., Jacoby, G.A., Kishony, R, Kreiswirth, B.N., Kutter, E., Lerner SA, Levy S, Lewis K, Lomovskaya O, Miller, J.H., Mobashery, S., Piddock, L.J., Projan, S., Thomas, C.M., Tomasz, A., ... Zgurskaya, H.I. (2011). Tackling antibiotic resistance. *Nat Rev Microbiol.* 9(12), 894-896. <https://doi.org/10.1038/nrmicro2693>.
- Debik, E. and Coskun, T. (2009). Use of the Static Granular Bed Reactor (SGBR) with anaerobic sludge to treat poultry slaughterhouse wastewater and kinetic modeling. *Bioresource Technology* 100, 2777–2782.
- DeZuane, J. (1997). *Handbook of Drinking Water Quality*. John Wiley & Sons.
- Dlangamandla, C., Dyantyi, S. A., Mpentshu, Y. P., Ntwampe, S. K. and Basitere, M. (2016) Optimisation of bioflocculant production by a biofilm-forming microorganism from poultry slaughterhouse wastewater for use in poultry wastewater treatment. *Water Science and Technology* 73 (8), 1963–1968
- Egbon E. E., Idode V. O., Egbon E. I. and Chukwuma P. A. (2013). Treatment of Saloon Waste Water Using Activated Carbon. *Chemical and Process Engineering Research*, 17, 24-28
- Ejaro, S.P. (2013). Land accessibility problem in Nigeria: A case study of Gwagwalada. *Research Journal of Social Science and Management* 2, 160-162.

- Ekpete O. A., Marcus A. C. and Osi V. (2017). Preparation and Characterization of Activated Carbon Obtained from Plantain (*Musa paradisiaca*) Fruit Stem. *Hindawi*, 1-6.
- Elemile, O.O., Raphael, D.O., Omole, D.O., Oloruntoba, E.O., Ajayi, E.O. and Ohwavborua, N.A. (2019). Assessment of the impact of abattoir effluent on the quality of groundwater in a residential area of Omu-Aran, Nigeria. *Environ. Sci Eur.* 31, 16-25. <https://doi.org/10.1186/s12302-019-0201-5>
- Eze, C. N. and Eze, P. C. (2018). Effect of abattoir waste on the physicochemical and bacteriological qualities of New-artisan River in Enugu, Nigeria. *Nigerian Journal of Technology (NIJOTECH)* 37(1), 262 – 267
- Ezeoha, S.L. and Ugwuishiwu, B.O., (2011). Status of Abattoir Wastes Research in Nigeria. *Nigerian Journal of Technology.* 30(2), 143–148.
- Gratisito M. K., Panyathanmaporn T., Chumnanklang R. A., Sirinuntawittaya N., Dutta A. (2008). Production of activated carbon from coconut shell: optimization using response surface methodology. *Bioresources Technology.* 99(11), 4887 – 4895
- Hamaidi-Chergui, F., and Errahmani, M.B. (2019). Water quality and physicochemical parameters of outgoing waters in a pharmaceutical plant. *Applied Water Science*, 9, 165.
- Hassana A.L. and Nuradeen L. T. (2021). Evaluation of the efficiency of constructed activated carbon for the treatment of abattoir wastewater. *Science World Journal* 16(2), 172-178
- Heuer, H., Schmitt, H., and Smalla, K. (2011). Antibiotic resistance gene spread due to manure application on agricultural fields. *Current Opinion in Microbiology*, 14(3), 236–243.
- Huang, M., Yang, Y., Chen, D., Chen, L., and Guo, H. (2012). Removal mechanism of trace oxytetracycline aerobic sludge. *Process Safety and Environmental Protection*, 90(2),141-146.
- Ikhide, E. C., Olu, J., Yusuf, H.O., Bello, Z. and Onyekwule, M.C. (2022). Antimicrobial effect of Sodium hypochlorite and Aloe vera (*Aloe barbadensis* miller) under varying conditions on coliform isolated from Oil polluted water from Apapa, Lagos. *Environ. Stud. J.* 1(1), 36-45. <https://doi.org/10.36108/esj/2202.10.0130>
- Iqbal, M.A., Chaudhary, M.N., Zaib, S., Imran, M., Ali, K and Iqbal, A. (2011). Accumulation of heavy metals (Ni, Cu, Cd, Cr, Pb) in agricultural soils and spring seasonal plants, irrigated by industrial waste water. *J Environ Technol. Manag.* 2, 3
- Joseph M. O., Ibrahim B., Zaky S. K., Abdulkadir S., and Auta I.K. (2021). Bacterial Assessment of Effluents from Selected Abattoirs into Adjoining Water Bodies in Kaduna Metropolis. *Science World Journal*, 16 (1), 29-34.
- Keerthana. K and Thivyatharsan. R. (2018). Evaluation of the efficiency of constructed wetland and activated charcoal for the treatment of slaughterhouse wastewater. *International Journal of Research Publications* 6(1), 1-12.
- Khalid, F. A., Babiker, K. A., Sheikh, I. E., Kamble, S. A.R., Quadri, S.H. (2020). Presence of Heavy Metals in Slaughterhouse Wastewater, A Study at Al Sahafa Abattoir Khartoum, North Sudan. *International Journal of Innovative Science and Research Technology* 5(3), 573-576
- Khosravi, R., Eslami, H., Zarei, A., Heidari, M., Baghani, A.N., Safavi, N., Mokamme, A., Fazlzadehe, M., and Adhami, S. (2018). Comparative evaluation of nitrate adsorption from aqueous solutions using green and red local montmorillonite

- adsorbents, *Desalin. Water Treat.* 116, 119–128.
- Kobyas, M., Senturk, E., and Bayramoglu, M. (2005). Treatment of poultry slaughterhouse wastewater by electro-coagulation, *Journal of Hazardous Materials*, 133, 172–176.
- Kolawole, O.M., Ajayi, K.T., Olayemi, A.B. and Okoh, A.I. (2011). Assessment of water quality in Asa River (Nigeria) and its indigenous *Clarias gariepinus* fish. *International Journal of environmental Research and Public Health*, 8(11), 4332–4352.
- Kong, W., Li, C., Dolhi, J.M., Li, S., He, J., and Qiao, M. (2012). Characteristics of oxytetracycline sorption and potential bioavailability in soils with various physical–chemical properties. *Chemosphere*, 87(5), 542–548.
- Kwadzah, T.K. and Iorhemen, O.T. (2015). Assessment of the impact of abattoir effluent on the water quality of River Kaduna, Nigeria. *World Journal of Environmental Engineering*, 3(3), 87–94.
- Lundstrom, S.V., Ostmanb, M., Bengtsson-Palme, J., Rutgeresson, C., Thoudal, M., car, T., Blanck, H., Eriksson, K., Tysklind, M., Flach, C., and Larsson, D.J. (2016), Minimal selective concentrations of tetracycline in complex aquatic bacterial biofilms. *Science of the Total Environment*, 553, 587–595.
- Lutz, W. and Pałczyński, C. (2005). Immunotoksykologia. Immunosupresja. Immunotoksyny wywołujące immunosupresję układu odpornościowego. Instytut Medycyny Pracy im. Prof. J. Nofera. 80–81, Łódź.
- Mijinyawa, Y. and Lawal, S. (2008). Treatment efficiency and economic benefit of Zratech poultry slaughterhouse wastewater treatment plant. Ibadan, Nigeria, *Scientific Research and Essay*.
- Moraes, A.C., Prado, E.J.R., Faria, V.P., Giro, T., Manrique, W.G., and Belo, M.A. (2015). Clinical safety of dichlorvos (45%), cypermethrin (5%) and piperonyl butoxide (25%) administered by spray on the skin of cattle. *Rev MVZ Córdoba*. 20, 4874–4883.
- Mulu, A. and Ayenew, T. (2015). Characterization of Abattoir Wastewater and Evaluation of the Effectiveness of the Wastewater Treatment Systems in Luna and Kera Abattoirs in Central Ethiopia. *International Journal of Scientific and Engineering Research*, 6(4), 1026–1040
- Mulu, A., Ayenew, T. and Berhe, S., (2013). Impact of Slaughterhouses Effluent on Water Quality of Modjo and Akaki River in Central Ethiopia. *International Journal of Science and Research*, 4(3), 899–907.
- Munoz, M., Autenrieth, R. and Mendoza-Sanchez, I. (2017). *Environmental occurrence of Oxytetracycline and the potential selection of antibiotic resistance in bacteria*. 16th World water congress, international water resource association.
- Nazir, R., Khan, M., Masab, M., Ur Rehman, H., Ur Rauf, N., Shahab, S., Ameer, N., Sajed, M., Ullah, M., Rafeeq, M., and Shaheen, Z. (2015). Accumulation of Heavy Metals (Ni, Cu, Cd, Cr, Pb, Zn, Fe) in the soil, water and plants and analysis of physico-chemical parameters of soil and water collected from Tanda Dam kohat. *J. Pharm. Sci. Res.* 7(3), 89–97.
- Noworyta-Głowacka, J., Bańkowski, R., Siennicka, J., Wiadrowska, B., Beresińska, M., and Ludwicki, J.K. (2012). Influence of chlorpyrifos on the profile of subpopulations of immunoactive cells and their phagocytic activity in an experimental *in vivo* model. *Ann. Agric. Environ. Med.* 19(3), 483–485.
- Nwadinigwe, A. O. (2010). Effects of the Insecticide, Lambda-cyhalothrin on the Growth, Productivity and Foliage Anatomical Characteristics of *Vigna unguiculata* (L) Walp. *Bio-Research*, 8(1), 583 – 587.
- Obaya V. A. E., Montañó O. C. and Vargas R. Y. M. (2020). Preparation of Activated Carbon

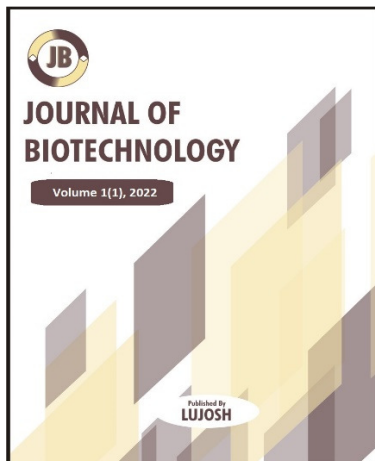
- from Coffee Waste as an Adsorbent for the Removal of Chromium (III) from Water. Optimization for an Experimental Box-Behnken Design. *Journal of chemistry*. 2(1), 2-10
- Ogbomida, E.T., Kubeyinje, B., and Ezemonye, L.I. (2016). Evaluation of bacterial profile and biodegradation potential of abattoir wastewater. *African Journal of Environmental Science and Technology*, 10(2), 50–57.
- Oh, J. H., Park, J. and Ellis, T. G. (2014). Performance of on-site pilot static granular bed reactor (SGBR) for treating dairy processing wastewater and chemical oxygen balance modeling under different operational conditions. *Bioprocess. Biosyst. Eng.* 38, 353–363.
- Ojo, J.O. (2014). Environmental impact assessment of effluents from Oko-Oba municipal abattoir at Agege, Lagos State, Nigeria. *Global Advanced Research Journal of Agricultural Science*, 3(10), 317–320.
- Oladokun, E.I, Sogbanmu, T.O., and Anikwe, J.C. (2020). Sublethal concentrations of dichlorvos and paraquat induce genotoxic and histological effects in the *Clarias gariepinus*. *Environmental Analysis Health and Toxicology* 35(3), Article ID: e2020013, <https://doi.org/10.5620/eaht.2020013>
- Olaniran, E.I., Sogbanmu, T.O., and Saliu, J.K. (2019). Biomonitoring, physicochemical and biomarker evaluations of abattoir effluent discharges into the Ogun River from Kara Market, Ogun State, Nigeria using *Clarias gariepinus*. *Environ. Monit. Assess.* 191, 44.
- Olu, J. (2021). Assessment of nitrate and its health risk capability in groundwater used by residents around a dumpsite in Lagos, Nigeria. *Archives of Ecotoxicology*, 3(3), 75-80. <https://doi.org/10.36547/ae.2021.3.3.75-80>
- Olu, J., Yusuf, H.O, Akhigbe, C.I and Abiamere O. C. (2022). Heavy metal contamination, pollution indices and health risk assessment of soil around an asphalt production company in Badagry, Lagos, Nigeria. *Environ. Stud. J.* 1(1), 14-35. <https://doi.org/10.36108/esj/2202.10.0120>
- Olu, J., Yusuf, H.O., Ikhide, C.E., and Okokoro, H. (2021). Evaluation of Biological Antimicrobial Effect of Aloe Vera on Coliform Isolates in Leachate from a Dumpsite. *Bacterial Empire* 10(10), 275-278. <https://doi.org/10.36547/be.275>
- Omole, D.O. and Ogbiye, A.S. (2013) An evaluation of slaughterhouse wastes in south-west Nigeria. *American Journal of Environmental Protection*, 2(3), 85–89.
- Omole, D.O., Ogbiye, A.S., Longe, E.O., Adewumi, I.K., Elemile, O.O. and Tenebe, T.I. (2018). Water quality checks on river Atuwara, South-West Nigeria. *WIT Trans. Ecol. Environ.* 228,165–173.
- Otolorin G. R., Okolocha E. C., Ameh V. O., Mshelbwala P. P., Danjuma F. A., and Dzikwi A. A. (2015). Public Health Risk of Abattoir Operation in Zango Abattoir Zaria, Kaduna State Nigeria. *Annual Research and Review in Biology*, 5(2), 139-146.
- Padilla-Gasca, E., Lopez-Lopez, A. and Gallardo-Vaidez, J. (2011). Evaluation of stability factor in the anaerobic treatment of slaughterhouse wastewater. *Journal of Bioremediation and Biodegradation*, 2, 114–124.
- Raheem, N.K. and Morenikeji, O.A. (2018). Impact of abattoir effluents on surface waters of the Alamuyo stream in Ibadan. *Journal of Applied Sciences and Environmental Management*, 12(1), 73–77.
- Ramesh, Y. A., Nelson. H. M. and Singh, R. (2009). Recycling of poultry process wastewater by ultrafiltration. *Innovative Food Science and Emerging Technologies*, 10, 1- 8.
- Reza S. M. D., Yun C. S., Afrose S., Radenahmad N., Abubakar M. S., Saidur R., Taweekun J.

- and Azad A. K. (2020). Preparation of activated carbon from biomass and its applications in water and gas purification, a review. *Arab Journal of Basic and Applied Sciences*, 27(1), 208–238.
- Sasikala, C., Jiwal, S., Rout, P., and Ramya, M. (2012). Biodegradation of chlorpyrifos by bacterial consortium isolated from agriculture soil. *World J. Microbiol. Biotechnol.*, 28, 1301–1308.
- Sawalha, H., Alsharabaty, R., Sarsour, S. and Al-Jabari, M. (2019). Wastewater from leather tanning and processing in Palestine: characterization and management aspects. *J. Environ. Manag.* 251, 109596.
- Sawyer, C. N., McCarty, P. L. and Parkin, C. F. (1994). *Chemistry for Environmental Engineering*, McGraw-Hill.
- Sim, W.J., Kim, H.Y., Choi, S.D., Kwon, J.H. and Oh, J.E. (2013). Evaluation of pharmaceuticals and personal care products with emphasis on anthelmintics in human sanitary waste, sewage, hospital wastewater, livestock wastewater and receiving water. *J. Hazard Mater.* 248–249, 219–227.
- Spasov, Hr. and Dinkov, K. (2002). Removing of infecting microorganisms during wine production through membrane filtration. *Bulgarian Journal of Agricultural Science*, 8, 581–586.
- Standard Organisation of Nigeria (SON) (2015). *Nigerian Standard for Drinking Water Quality*. ICS 13.060.20
- Sun, F., Gao, J., Yang, Y., Zhu, Y., Wang, L., Pi, X. and Qin, Y. (2016). One-step ammonia activation of Zhundong coal generating nitrogen-doped microporous carbon for gas adsorption and energy storage. *Carbon*, 109, 747–754.
- Thredgold, L., Gaskin, S., Chloe, Q., and Pisaniello, D. (2019). Exposure of agriculture workers to pesticides: the effect of heat on protective glove performance and skin exposure to dichlorvos. *Int. J. Environ. Res. Public Health* 16(23), 4798
- Tomlin, C.D.S. (2015). *The Pesticide Manual: A World Compendium*, 15th ed.; British Crop Protection Council: Hampshire, UK.
- U.S. Environmental Protection Agency (USEPA) (2008). *Wire and Cable Insulation and Jacketing: Life-Cycle Assessments for Selected Application*. Office of Pollution Prevention and Toxics, Design for the Environment. EPA-744-S-08-001.
- Vaishaly, A.G., Mathew, B.B., and Krishnamurthy, N.B. (2015). Health effects caused by metal contaminated ground water. *Int J. Adv. Sci. Res.* 1(2), 60–64
- van Leeuwen, L.C., Vos, J.H., and Mensink, B.J.W.G. (2008). *Environmental risk limits for lambda-cyhalothrin*. RIVM Letter report 601716001
- Watanabe, N., Bergamaschi, B., Loftin, K., Meyer, M., and Harter, T. (2010). Use and Environmental Occurrence of Antibiotics in Freestall Dairy Farms with Manured Forage Fields. *Environmental Science and Technology*, 44(17), 6591–6600.
- Wei, R., Ge, F., Huang, S., Chen, M., and Wang, R. (2011). Occurrence of veterinary antibiotics in animal wastewater and surface water around farms in Jiangsu Province, China. *Chemosphere* 82 (10), 1408–1414.
- World Health Organization (WHO) (2004). *Chlorpyrifos in Drinking-water*. Background document for development of WHO Guidelines for Drinking-water Quality.
- World Health Organization (WHO) (2006). *Guidelines for drinking-water quality* [electronic resource]: incorporating first addendum. Vol. 1, Recommendations. – 3rd ed. electronic version for the Web.
- World Health Organization (WHO) (2011). *Revision of guidelines for Drinking water quality* 4th ed. world health organization Geneva, Switzerland.
- World Health Organization (WHO) (2016). *Dichlorvos in Drinking-water*. Background document for development of WHO Guidelines for Drinking-water Quality.

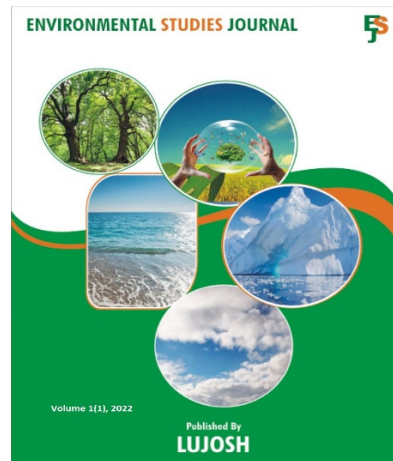
- https://www.who.int/water_sanitation_health/water-quality/guidelines/chemicals/dichlorvos-background-jan17.pdf
- Yadav D., Kapur M., Kumar P. and Mondal M. K. (2015). Adsorptive Removal of Phosphate from Aqueous Solution Using Rice Husk and Fruit Juice Residue. *Process Safety and Environmental Protection*, 94, 402-409.
- Yang, H., Wang, Y., Liu, Z., Liang, D., Liu, F., Zhang, W., and Chen, W. H. (2017). Enhanced thermal conductivity of waste sawdust-based composite phase change materials with expanded graphite for thermal energy storage. *Bioresources and Bioprocessing*, 4, 52. <https://doi.org/10.1186/s40643-017-0182-4>
- Yew, H.S., Anderson, T., Coughlan, E., and Werno, A. (2011). Induced macrolide resistance in *Mycoplasma genitalium* isolates from patients with recurrent nongonococcal urethritis. *J. Clin. Microbiol.*, 49, 1695–1696
- Yordanov, D. (2010). Preliminary study of the efficiency of ultrafiltration treatment of poultry slaughterhouse wastewater. *Bulg. J. Agric. Sci.* 16, 700–704
- Yusuf, H.O., Olu, J., Dantanko, F. and Hilili, J.M. (2022). Assessment of selected pesticide contamination of surface and ground water samples from an agrarian settlement in Kuje area council, Abuja, Nigeria *Environ. Stud. J.* 1(1), 46-61. <https://doi.org/10.36108/esj/2202.10.0140>

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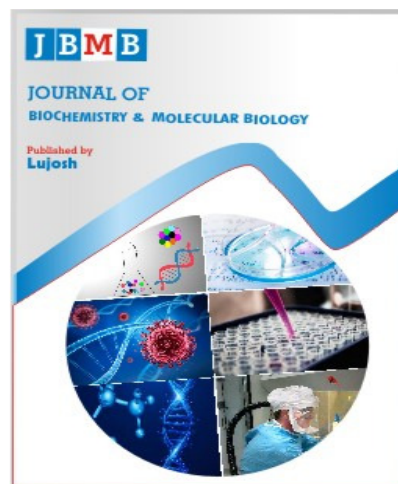
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