Zainab & Omoaka. *Afr. J. Clin. Exper. Microbiol.* 2026; 27 (2): 212 - 219 https://www.afrjcem.org

African Journal of Clinical and Experimental Microbiology. ISSN 1595-689X Apr 2026; Vol.27 No.2
AJCEM/2455. https://www.ajol.info/index.php/ajcem

Original Article **Open Access**

Prevalence of parasitic contamination of wastewater samples from selected slaughter houses in Benin City, Edo State, Nigeria

*Omoruyi, Z., and Omoaka, E. D.

Department of Medical Laboratory Science, School of Basic Medical Sciences, University of Benin, Benin City, Edo State, Nigeria
*Correspondence to: zainab.omoruyi@uniben.edu; Tel: +234 803 700 2791

Abstract:

Background: Wastewater from slaughterhouses can contain a variety of parasites, including protozoa and helminths. This study was designed to systematically examine wastewater samples from selected slaughter houses in Benin-City, Edo State, and determine the prevalence parasite contamination and spatial distribution of these parasites, to inform future public health and environmental protection strategies.
Methodology: Wastewater samples (n=120) collected from four randomly selected slaughterhouses (Ikpoba Hill, New-Benin, Oluku, and Ugbowo) in Benin-City, Edo State, Nigeria, were examined for the presence of parasites. The samples were processed using standard parasitological techniques, involving saline and iodine wet preparations on the slides, which were then examined under compound light microscope at 10x and 40x magnifications. The modified Ziehl-Neelsen staining procedure was performed for detection of *Cryptosporidium* ova.
Results: Of the 120 wastewater samples examined, 118 tested positive for parasites, giving a parasitic contamination rate of 98.3%, with a total of 360 parasites detected. *Ascaris lumbricoides* was the most prevalent (n=85, 23.6%), followed by *Taenia* spp (n=51, 14.2%) and *Balantidium coli* (n=48, 13.3%). Other notable parasites detected were *Fasciola hepatica* (n=37, 10.3%) and *Strongyloides stercoralis* (n=32, 8.9%). Conversely, less prevalent parasites included *Chydonis spherieus* (n=1, 0.3%), *Amoeba* spp (n=2, 0.6%), Hookworm (n=2, 0.6%), and Pin worm (n=2, 0.6%). There was no significant difference in the prevalence of parasites across the four locations (p=0.545).
Conclusion: The results of this study provide a comprehensive assessment of parasitic contamination in abattoir wastewater in Benin-City, highlighting substantial public health risks associated with the effluents.

Keywords: Parasites, Wastewater, Slaughterhouses, Public Health

Received Sep 22, 2025; Revised Dec 23, 2025; Accepted Dec 24, 2025

Prévalence de la contamination parasitaire des eaux usées provenant d'abattoirs sélectionnés à Benin City, État d'Edo, Nigéria

*Omoruyi, Z., et Omoaka, E. D.

Département des Sciences Laboratoire Médical, Faculté des Sciences Médicales Fondamentales, Université de Benin, Benin City, État d'Edo, Nigéria
*Correspondance à: zainab.omoruyi@uniben.edu; Tél.: +234 803 700 2791

Résumé:

Contexte: Les eaux usées des abattoirs peuvent contenir divers parasites, notamment des protozoaires et des helminthes. Cette étude visait à examiner systématiquement des échantillons d'eaux usées provenant d'abattoirs sélectionnés à Benin City, dans l'État d'Edo, afin de déterminer la prévalence de la contamination parasitaire et la distribution spatiale de ces parasites, dans le but d'éclairer les futures stratégies de santé publique et de protection de l'environnement.
Méthodologie: Cent vingt échantillons d'eaux usées (n=120) prélevés dans quatre abattoirs sélectionnés aléatoirement (Ikpoba Hill, New-Benin, Oluku et Ugbowo) à Benin City, État d'Edo, Nigéria, ont été analysés afin de détecter la présence de parasites. Les échantillons ont été traités selon les techniques parasitologiques standard, notamment par préparation humide à l'iode et au sérum physiologique, puis examinés au microscope optique à des grossissements de 10x et 40x. La coloration de Ziehl-Neelsen modifiée a été utilisée pour la

détection des œufs de *Cryptosporidium*.
Résultats: Sur les 120 échantillons d'eaux usées analysés, 118 se sont révélés positifs pour les parasites, soit un taux de contamination parasitaire de 98,3%, pour un total de 360 parasites détectés. *Ascaris lumbricoides* était le parasite le plus fréquent (n=85, 23,6%), suivi de *Taenia* spp (n=51, 14,2%) et de *Balantidium coli* (n=48, 13,3%). Parmi les autres parasites notables détectés figuraient *Fasciola hepatica* (n=37, 10,3%) et *Strongyloides stercoralis* (n=32, 8,9%). À l'inverse, les parasites moins fréquents comprenaient *Chydonis sphérieus* (n=1, 0,3%), *Amoeba* spp (n=2, 0,6%), les ankylostomes (n=2, 0,6%) et les oxyures (n=2, 0,6%). Aucune différence significative n'a été observée dans la prévalence des parasites entre les quatre sites (p=0,545).
Conclusion: Les résultats de cette étude fournissent une évaluation complète de la contamination parasitaire des eaux usées d'abattoirs à Benin City, soulignant les risques importants pour la santé publique associés à ces effluents.

Mots-clés: Parasites, eaux usées, abattoirs, santé publique

Introduction:

The slaughterhouse industry stands as a critical pillar of the global food supply chain, providing meat and other animal products to a vast and ever-growing human population. However, this indispensable industry also generates a significant volume of wastewater, a by-product that can harbour a wide array of pollutants, including a complex community of parasites (1). The presence of these organisms in abattoir effluents is a matter of profound concern, as many, such as the helminth *Ascaris lumbricoides* and the tapeworm *Taenia saginata*, are well-documented to cause severe health problems in humans, ranging from intestinal blockage and malnutrition to other life-threatening complications (2). These parasites find their way into the wastewater stream through multiple pathways, including the slaughtering process itself, the improper handling and storage of animal waste, and the use of contaminated water for cleaning and processing activities (3).

The risk posed by parasitic contamination is particularly acute in developing nations like Nigeria, where the slaughterhouse industry serves as a crucial component of the national economy and a primary source of protein for millions of people (4,5). Despite its economic importance, the sector is plagued by systemic challenges, most notably the widespread absence of proper wastewater treatment and disposal infrastructure (6). This deficiency allows untreated effluents to be discharged directly into the environment, contaminating surface and groundwater sources and posing a direct threat to both aquatic life and human populations. Several studies conducted across Nigeria have corroborated this problem. For instance, a study in Ibadan revealed that a staggering 75% of wastewater samples from local slaughterhouses were contaminated with parasites, including the highly pathogenic *A. lumbricoides* and *T. saginata* (7).

Parasitic particles, which include the resilient helminth ova and protozoan oocysts, are of particular concern due to their robust nature. They are not only found more frequently in wastewater than in other surface waters but are also notoriously resistant to conventional treatment methods such as chlorination or ozonation, which are commonly used in water and wastewater treatment systems (8). The pathogenic protozoa, in particular, are major causes of human gastroenteritis and pose significant global public health challenges. Numerous water-borne disease outbreaks of giardiasis, amoebiasis, cryptosporidiosis, and balantidiosis have been reported worldwide, highlighting the global scale of the problem (9,10).

In Nigeria, common parasites found in wastewater, such as *A. lumbricoides*, *Trichuris trichiura*, *Ancylostoma duodenale*, and various protozoan like *Entamoeba histolytica* and *Giardia lamblia*, are known contributors to a range of health issues, including stunted growth, impaired nutrient absorption, cognitive deficits, and anaemia (11). The primary mode of transmission for these infections is the faeco-oral route, typically through the consumption of contaminated water or food. Effective control, therefore, hinges on a multifaceted approach that includes improving environmental conditions, implementing proper wastewater treatment, promoting good personal hygiene, and addressing underlying issues of poor sanitation, poverty, and a lack of public health education (12).

In Benin-City, Edo State, the disposal of untreated wastewater from slaughterhouses constitutes a significant environmental and public health crisis. Abattoir effluents are rich in organic waste, fecal matter, and a high concentration of parasites that can survive for extended periods, posing serious health risks to local communities, especially through the contamination of essential water sources (13). Despite the clear and present danger, there is a notable lack of specific, localized data regarding the examination of parasites in wastewater from Benin-City's slaughterhouses.

This knowledge gap is a major hindrance, as it prevents the development of targeted and effective health interventions and public awareness programs tailored to the

specific context of the city. Consequently, this study was designed to bridge this gap by systematically examining the presence of parasites in wastewater from selected slaughter houses in Benin-City, Edo State, and evaluating the prevalence and spatial distribution of these parasites to inform future public health and environmental protection strategies.

Materials and method:

Study area:

The study was conducted at four selected abattoirs in Benin-City, Edo State, Nigeria. The chosen locations were Ikpoba Hill slaughterhouse, situated in Ikpoba-Okha Local Government Area (LGA); New-Benin slaughterhouse located in Oredo LGA; and Oluku and Ugbowo slaughterhouses, both situated in Ovia North-east LGA. The geographical coordinates of the study area are approximately latitude 6.3379° N and longitude 5.6123° E.

Study design:

A descriptive cross-sectional study design was employed to examine the presence of parasites in wastewater. The study involved random selection of four slaughter houses within Benin-City for sample collection and subsequent laboratory analysis.

Ethical approval:

Ethical approval for this study was obtained from the Research and Ethics Committee, Ministry of Health, Edo State, Nigeria. A verbal consent was secured from the management and workers of the participating slaughterhouses prior to the collection of samples to indicate their approval of the study.

Sample collection and transportation:

Twenty-four hours prior to sample collection, 1ml of formal saline was prepared and added to 20ml sterile universal containers. Fresh wastewater samples were collected in the morning from the abattoirs shortly after the slaughtering process using the clean containers. A total of 120 samples were collected (30 samples in each of the four selected abattoirs).

The wastewater samples were carefully transferred into pre-labelled, sterile universal containers, and transported to the microbiology laboratory of the Department of Medical Laboratory Science, University of Benin, within two hours of collection for analysis using standard parasitological methods.

Laboratory analysis of wastewater samples:

Standard parasitological technique used for the examination of parasites in samples was the Bailenger method, as modified by Ayres and Mara (14). The samples were first homogenized, and the suspension was then filtered into conical cups using surgical gauze and allowed to rest for 60 minutes. After settling, the clear supernatant was carefully discarded, and 4 ml of the filtered samples were transferred into 10 ml test tubes. These samples were then centrifuged at 2000rpm for 3 minutes, following which the cloudy supernatant was discarded, leaving only the pellet for further analysis.

The wastewater sediment from the test tubes was examined using saline and iodine mounts prepared on clean grease-free slides. The slides were examined under the light microscope and the parasites observed were recorded. The modified Ziehl-Neelsen (ZN) staining technique was performed for *Cryptosporidium* detection. The slide was observed under the light microscope for presence of *Cryptosporidium* oocysts by placing a drop of immersion oil on the smear and viewed with oil immersion objective lens.

Statistical analysis of data:

Data obtained were analyzed using the IBM SPSS version 27.0 software. Descriptive statistics, including percentage and frequency distributions, were computed. The difference in the parasite prevalence between the four locations was determined using the Chi square test. A *p* value of less than 0.05 was considered statistical significance.

Results:

Of the 120 wastewater samples examined, parasites were detected in 118 samples (98.3%), while only 2 samples (1.7%) were parasite-free (Fig 1). A total of 360 parasites were identified in the wastewater samples with *A. lumbricoides* being the most prevalent, accounting for 23.6% (n=85), followed by *Taenia* spp (14.2%, n=51) and *B. coli* (13.3%, n=48). Other notable parasites included *F. hepatica* (10.3%, n=37) and *S. stercoralis* (8.9%, n=32). Conversely, less prevalent parasites included *Chydonis sphe-rieus* (0.3%, n=1), *Amoeba* spp (0.6%, n=2), hookworm (0.6%, n=2), and pinworm (0.6%, n=2) (Fig 2 & Table 1).

Fig 3 shows that the highest frequency of parasites from the wastewater was recorded in New Benin (31.4%), followed by Oluku (25.3%), Ugbowo (23.1%), and Ikpoba Hill (20.3%). However, there was no significant difference in the frequency of parasite detected across the four locations (p= 0.545). The highlights of the variation in parasite frequency across different locations revealed that *A. lumbricoides* was the most frequent parasite overall with 23.6% (n= 85/360), with the highest frequency of detection in Ugbowo (32.5%, n=27/83), followed by Ikpoba Hill (21.9%, n=16/73) and

Oluku (21.9%, n=20/91), and the least frequency in New Benin (19.5%, n=22/113), but this was not statistically significant (x^2= 4.986, p=0.1728).

Similarly, *B. coli* was most frequently identified in Ikpoba Hill (39.7%, n=29/73), with statistically significant lower frequencies of detection in New Benin (10.6%, n=12/113), Oluku (4.4%, n=4/91), and Ugbowo (3.6%, n=3/83) (x^2=57.8, p<0.0001). Conversely, certain parasites, such as *Ascaris suum* were detected exclusively in Oluku, *C. spherieus* exclusively in Ugbowo, and hookworm and roundworm exclusively in Ikpoba Hill (Table 1).

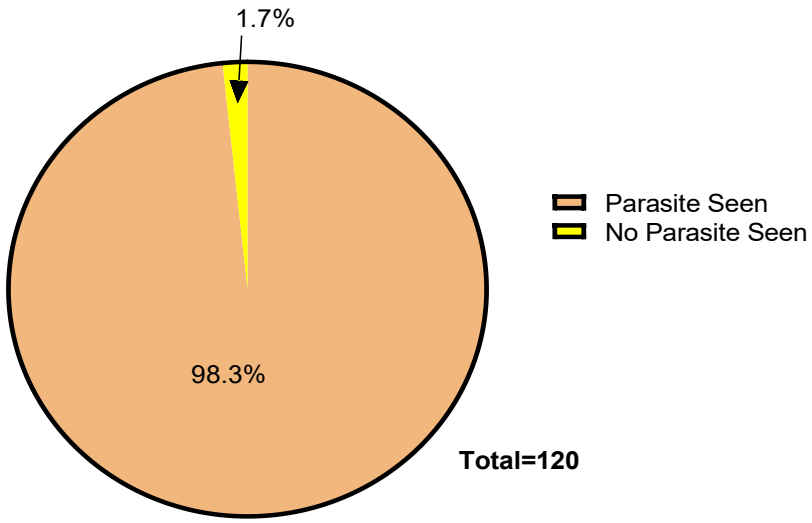

Fig 1: Prevalence of parasites in wastewater samples from slaughter houses in Benin-City, Nigeria

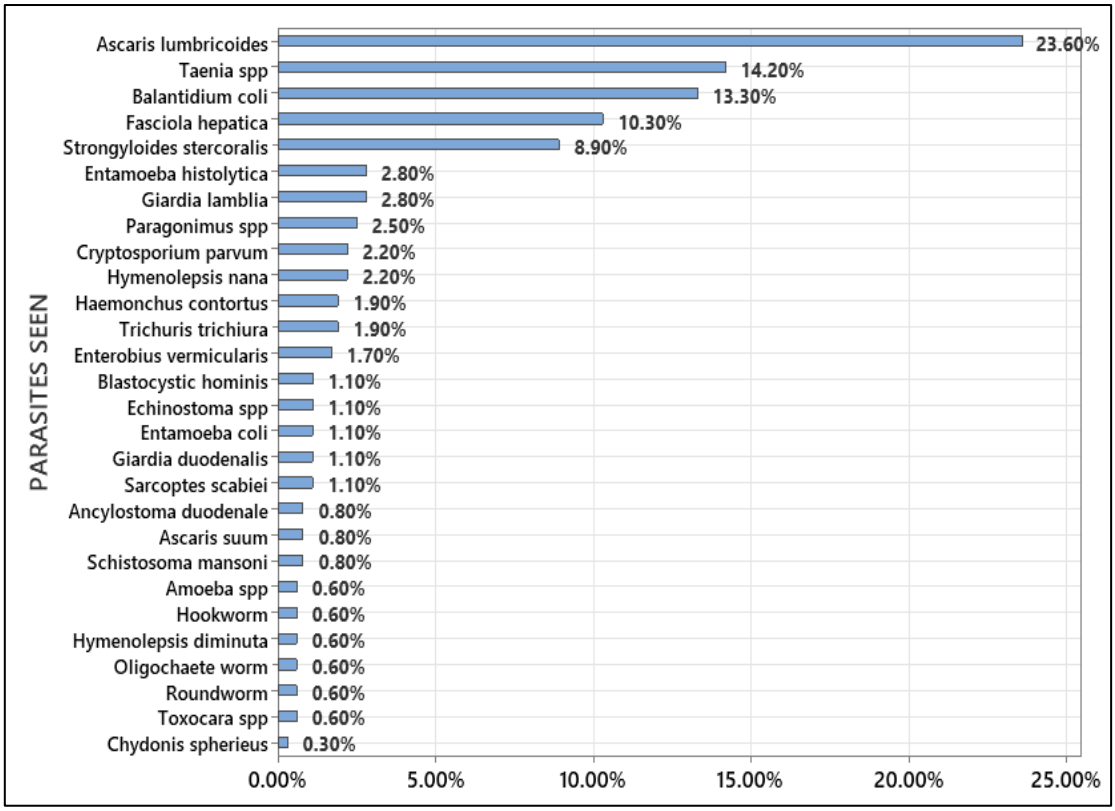

Fig 2: Frequency distribution of parasites from wastewater samples from slaughter houses in Benin City, Nigeria

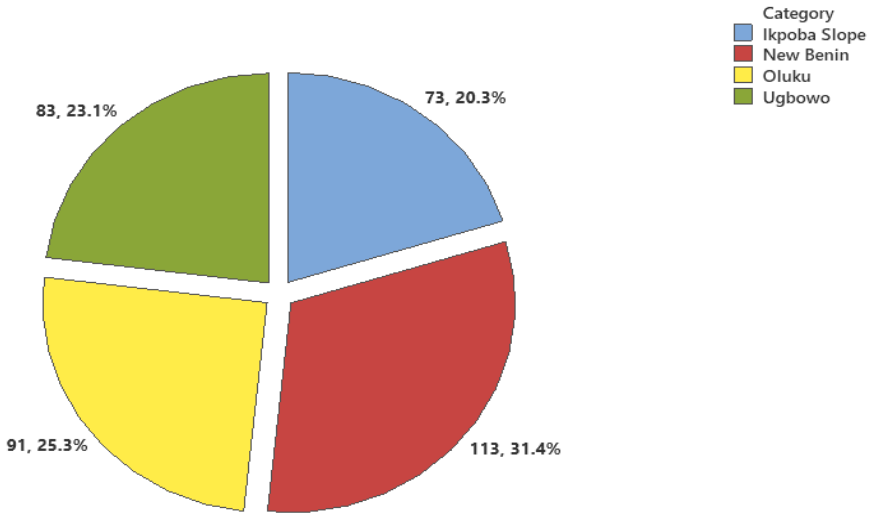

Fig 3: Prevalence of parasites in wastewater samples from slaughter houses according to locations in Benin City, Nigeria

Table 1: Frequency distribution of parasites in wastewater samples from slaughter houses in four locations in Benin City

Parasite	Ikpoba Hill (%)	New Benin (%)	Oluku (%)	Ugbowo (%)	Total (%)
Amoeba spp	0	1 (0.9)	1 (1.1)	0	2 (0.6)
Ancylostoma duodenale	0	1 (0.9)	2 (2.2)	0	3 (0.8)
Ascaris lumbricoides	16 (21.9)	22 (19.5)	20 (21.9)	27 (32.5)	85 (23.6)
Ascaris suum	0	0	3 (3.3)	0	3 (0.8)
Balantidium coli	29 (39.7)	12 (10.6)	4 (4.4)	3 (3.6)	48 (13.3)
Blastocystis hominis	2 (2.7)	0	1 (0.9)	1 (1.2)	4 (1.1)
Chydonis spherieus	0	0	0	1 (1.2)	1 (0.3)
Cryptosporidium parvum	0	2 (1.8)	3 (3.3)	3 (3.6)	8 (2.2)
Echinostoma spp	0	2 (1.8)	0	2 (2.4)	4 (1.1)
Entamoeba coli	1 (1.4)	1 (0.9)	1 (0.9)	1 (1.2)	4 (1.1)
Entamoeba histolytica	3 (4.1)	2 (1.8)	3 (3.3)	2 (2.4)	10 (2.8)
Enterobius vermicularis	1 (1.4)	2 (1.8)	1 (0.9)	2 (2.4)	6 (1.7)
Fasciola hepatica	6 (8.2)	23 (20.4)	5 (5.5)	3 (3.6)	37 (10.3)
Giardia duodenales	1 (1.4)	1 (0.9)	2 (2.2)	0	4 (1.1)
Giardia lamblia	1 (1.4)	3 (2.7)	4 (4.4)	2 (2.4)	10 (2.8)
Haemonchus contortus	1 (1.4)	3 (2.7)	3 (3.3)	0	7 (1.9)
Hookworm	2 (2.7)	0	0	0	2 (0.6)
Hymenolepsis diminuta	0	1 (0.9)	0	1 (1.2)	2 (0.6)
Hymenolepsis nana	1 (1.4)	2 (1.8)	5 (5.5)	0	8 (2.2)
Oligochaete worm	1 (1.4)	0	0	1 (1.2)	2 (0.6)
Paragonimus spp	0	2 (1.8)	2 (2.2)	5 (6.0)	9 (2.5)
Roundworm	2 (2.7)	0	0	0	2 (0.6)
Sarcoptes scabiei	1 (1.4)	1 (0.9)	2 (2.2)	0	4 (1.1)
Schistosoma mansoni	1 (1.4)	1 (0.9)	1 (1.1)	0	3 (0.8)
Strongyloides stercoralis	0	16 (14.2)	9 (9.9)	7 (8.4)	32 (8.9)
Taenia spp	2 (2.7)	13 (11.5)	15 (16.5)	21 (25.3)	51 (14.2)
Toxocara spp	0	1 (0.0)	1 (1.1)	0	2 (0.6)
Trichuris trichiura	2 (2.7)	1 (0.9)	3 (3.3)	1 (1.2)	7 (1.9)
Total	**73 (20.3)**	**113 (31.4)**	**91 (25.3)**	**83 (23.1)**	**360 (100.0)**

Discussion:

The results of our study indicate a remarkably high prevalence of parasitic contamination, with 98.3% of the wastewater samples testing positive for parasites, emphasizing the substantial public health concerns linked to abattoir wastewater. This prevalence differs from 54.5% of parasite contamination rate reported in Jos Metropolis (15) and the study by Bolaji et al., (16) who reported 68.5% contamination rate in abattoir effluents in Oyo State, Nigeria. The variation in contamination rates may be attributed to differences in the types of livestock slaughtered, the volume of wastewater produced, and the specific waste management practices at each location (17).

The array of parasites identified in the wastewater highlights the complexity of contamination dynamics within the slaughterhouses. *Ascaris lumbricoides*, the most prevalent parasite (23.6%), is known for its robust environmental resilience and ability to endure harsh conditions, corroborating our findings (18). The high prevalence of *Ascaris* spp in abattoir wastewater has been consistently reported in other studies as a common contaminant in Minna, Niger State, Nigeria (19). Other commonly identified parasites such as *Taenia* spp (14.2%) and *B. coli* (13.3%) suggest a significant zoonotic potential as these species are frequently linked to livestock (20). The presence of these parasites underscores the public health risk posed to both abattoir workers and residents of adjacent communities through direct contact or the consumption of contaminated water (21). The detection of other protozoan species, such as *E. histolytica* and *G. lamblia*, aligns with findings from similar studies of abattoirs in Minna Metropolis, Niger State, Nigeria (19).

The identification of parasites in the samples from the abattoirs strongly suggests that deficient wastewater management practices and poor sanitation are significant contributors to the contamination levels observed at these sites (22). Additionally, the high frequency in New Benin (31.4%) further supports this hypothesis. Despite these high frequencies in New Benin, there was no statistically significant difference in the frequency of parasite detection across the locations (p= 0.545), indicating that parasitic contamination is a widespread issue in the abattoirs studied, and not confined to specific geographic areas. This suggests that inefficient waste management practices and limited regulatory oversight are systemic problems throughout the study sites (23).

Certain parasites displayed location-specific distribution patterns such as the exclusive presence of *Ascaris suum* in Oluku and the sole detection of hookworm and pinworm in Ikpoba Hill. These findings imply that localized variations in livestock management, types of animals slaughtered, and waste disposal practices may significantly influence parasite prevalence (24). For instance, the high frequency of *F. hepatica* identification in New Benin abattoir (20.4%, n=23/113) could be linked to the types of livestock processed at that particular facility, as different animal species serve as hosts for specific parasitic organisms. This observation points to the influence of local factors on the distribution of parasitic contamination, even within a single urban area (25).

The high prevalence of parasitic contamination in abattoir wastewater presents significant risks to public health, especially in urban and peri-urban areas where untreated effluent could contaminate water supplies and agricultural land (26). The prominence of helminths like *A. lumbricoides* suggests that improper waste disposal could lead to widespread soil-transmitted infections, further exacerbating public health challenges. The presence of zoonotic parasites such as *Taenia* spp and *B. coli* elevates the risk of both direct and indirect transmission to humans, particularly those working in abattoirs and residents in adjacent communities (27). These findings underscore the urgent need for the enforcement of more stringent wastewater treatment regulations and the implementation of enhanced sanitation protocols in slaughterhouses. The persistence of parasites like *A. lumbricoides*, known for its ability to withstand harsh environmental conditions, further compounds the risks associated with wastewater contamination (28).

This study highlights the significant public health risks posed by parasitic contamination in abattoir wastewater, which has far-reaching implications for water safety and the transmission of zoonotic diseases. The findings emphasize the necessity for a multifaceted approach to mitigate these risks, including the implementation of advanced wastewater treatment technologies, stricter regulatory enforcement, and targeted public health education for both abattoir workers and nearby communities (29).

Conclusion:

This study provides a comprehensive assessment of parasitic contamination in wastewater from slaughterhouses in Benin-City, highlighting the substantial public health risks associated with abattoir wastewater. The findings indicate a remarkably high prevalence, with 98.3% of wastewater samples testing positive for parasites, confirming the wide-

spread nature of parasitic contamination in the study area. The presence of a diverse array of parasites, including *A. lumbricoides*, *Taenia* spp, and *B. coli*, demonstrates the complexity of the contamination dynamics and the zoonotic potential of these parasites.

The findings of this study emphasize the urgent need for improved wastewater management practices in abattoirs, especially given the implications for public health, water safety, and zoonotic disease transmission. The high prevalence of helminths, in particular, underscores the need for more stringent regulatory measures to mitigate the risks of soil-transmitted infections, especially in urban and peri-urban settings. The localized variations in parasite types suggest that factors such as livestock health and waste disposal practices play a role in shaping parasite distribution, further necessitating targeted interventions.

Based on the findings of this study, several recommendations are proposed to mitigate the public health risks posed by parasitic contamination in abattoir wastewater, and these include improved wastewater management, stricter regulatory enforcement by local authorities, public health education of abattoir workers and residents on risk of zoonotic infection and hygiene practices, and local interventions such as improving livestock management practices, enhancing waste disposal protocols, and addressing environmental conditions that favour parasite survival. Further studies should explore the molecular characterization of the parasites identified in this study to better understand their transmission dynamics. Additionally, research into the environmental factors influencing parasitic contamination could provide valuable information for developing more effective control measures

Contributions of authors:

ZO designed and directed the study; ZO and OED performed the laboratory analysis; OED performed statistical analysis of data; and ZO and OED wrote the manuscript and approved the final version submitted for publication.

Source of funding:

This study received no specific grant from any funding agency.

Conflict of interest:

Authors declare no conflict of interest

References:

1. Egwunyenga, A. O., Ighodaro, O. M., Okungbowa, O. I., and Omoregie, A. I. Prevalence and identification of parasites in wastewater from slaughterhouses and its public health implications. J Environ Health Eng. 2023; 21 (5): 1-10
2. Okoh, O. I., and Ibe, S. N. Assessment of parasitic contamination in abattoir wastewater and its impact on surrounding water bodies. Environ Monit Assess. 2023; 195 (7): 689. doi:10.1007/s10661-023-11221-w.
3. Adewumi, T. O., Okunlola, I. A., Adebayo, A. M., and Ojo, O. A. A comparative study of parasitic load in wastewater from different slaughterhouses in a metropolitan city. Sci Total Environ. 2023; 860: 160322.
4. Idowu, O. M., and Adeyemi, A. O. Evaluation of helminth eggs and protozoan cysts in slaughterhouse effluents and potential risks to human health. J Water Health. 2023; 21 (2): 363-375. doi: 10.2166/wh.2023.080
5. Ojo, J. A., Adeyemi, A. A., Ogunmodede, O. S., and Oladipo, E. K. Detection of *Cryptosporidium* and *Giardia* in slaughterhouse wastewater using molecular methods. J Parasitol Res. 2022; 121 (10): 2863-2871.
6. Akinbo, A. A., and Adebayo, A. M. Parasitic contamination of wastewater from abattoirs and the associated environmental risks. Environ Pollut. 2022; 306: 119336.
7. Adeleke, A. A., Ojo, J. A., Ojo, O. A., and Adeyemi, A. O. The use of wastewater from abattoirs for irrigation: A study on the presence of parasites and their implications. Water Air Soil Pollut. 2022; 233 (8): 305. doi: 10.1007/s11270-016-2947-3.
8. Eze, C. O., and Okeke, I. B. Antibiotics Resistant patterns of bacteria Isolated from slaughterhouse wastewater. J Infect Publ Health. 2023; 16 (6): 944-949.
9. Ibrahim, M. A., Adamu, A., Sani, A. A., and Muhammad, A. Assessment of heavy metal contamination in wastewater from abattoirs and its public health implications. Chemosphere. 2023; 330: 138734.
10. Okonkwo, I. O., Okeke, B. C., and Ilechukwu, I. Removal of pathogens from slaughterhouse wastewater using constructed wetlands. Ecol Eng. 2022; 185: 106794.
11. Adeyemo, O. A., Okeke, I. B., and Eze, C. O. A review of the treatment methods for slaughterhouse wastewater. Environ Technol Innov. 2023; 30: 103096. doi: 10.1016/j.eti.2023.103096
12. Olanrewaju, O. F., and Adebayo, A. Impact of Abattoir Effluents on Surface Water Quality in Benin City. J Environ Prot. 2023; 14(6): 345-358.
13. Omoregie, A. I., Okungbowa, O. I., and Egwunyenga, A. O. Prevalence of *Giardia* and *Cryptosporidium* in wastewater from abattoirs in Benin City. NJP. 2022; 43 (2): 201-206. doi: 10.4314/njpar.v43i2.11
14. Ayres, R. M., and Mara, D. D. Analysis of wastewater for use in agriculture: a laboratory manual of parasitological and bacteriological techniques. World Health Organization (WHO). 1996
15. Daminabo, V., and Damen, J. Prevalence of Intestinal Parasites from Abattoir Effluents in Jos Metropolis, Nigeria. Int J Photochem Photobiol. 2020; 4 (1): 1-10. doi: 10.11648/J.IJPP.20200401.11
16. Bolaji, A., Oloyede, S., Adekunle, C., Ajayi, A.,

Adeyemo, T., and Ojewuyi, R. Prevalence of pathogenic intestinal parasites and entero-pathogenic bacteria in faecal samples obtained from abattoirs in Ogbomoso, Oyo State, Nigeria. Alexandria J Vet Sci. 2023; 77 (2): 117-122. doi: 10.5455/ajvs.148234

17. Ekhator, O., and Ighodaro, I. Assessment of the effectiveness of different treatment methods for abattoir wastewater in Benin City. Water Sci Technol. 2023; 87 (10): 2141-2151.
18. Imade, P. E., and Osagie, I. Public health risks associated with the discharge of untreated abattoir wastewater into the environment. Int J Environ Sci Dev. 2022; 13 (12): 453-458. doi: 10.18178/ijesd.2022.13.12.1557.
19. Osazuwa, O., Okonkwo, I. O., and Ighodaro, I. The use of biofilters for the removal of parasites from abattoir wastewater. J Clean Prod. 2023; 398: 136593.
20. Ehi-Eromosele, C. O., and Omokaro, O. Occurrence of zoonotic parasites in abattoir wastewater and associated public health concerns. Heliyon. 2022; 8 (11): e11589. doi: 10.1016/j.heliyon.2022.e11589.
21. Igbinosa, O. I., Igbinosa, E. O., and Aigbe, O. O. Microbial and parasitic contamination of wastewater from abattoirs in Edo State, Nigeria. J Microbiol Biotechnol Food Sci. 2023; 13(1): e6379.
22. Eguae, P. O., and Obasohan, E. The impact of slaughterhouse wastewater on soil and groundwater quality. Environ Chall. 2022; 7: 100502.
23. Omoruyi, I. O., and Omoregie, A. I. Evaluation of the effectiveness of coagulation-flocculation in the treatment of abattoir wastewater. Water Resour Ind. 2023; 31: 100214. doi:10.1016/j.wri.2023.100214
24. Omoregbe, F., and Enabulele, E. A comparative analysis of abattoir wastewater treatment methods in Benin City. Afr J Environ Sci Technol. 2022; 16 (1): 1-10.
25. Agho, T., and Omoregbe, F. The role of regulations in managing slaughterhouse wastewater discharge in Benin City. EPL. 2023; 53 (1): 1-10.
26. Osawaru, M. E., Idahosa, I. O., and Okungbowa, O. I. An investigation of the parasitic load in abattoir wastewater and its implications for public health in Benin City. J Environ Health. 2022; 85 (2): 1-8.
27. Eguavoen, O. O., and Okonofua, F. E. Assessment of the efficiency of a sequencing batch reactor for treating abattoir wastewater. Chem Eng J Adv. 2023; 16: 100404. doi: 10.1016/j.ceja.2023.100404.
28. Aiwansone, C. E., Okungbowa, O. I., and Ighodaro, I. Identification of parasites and assessment of the water quality of slaughterhouse wastewater. Water Qual Expos Health. 2022; 14 (4): 321-330.
29. Sha-Amu, H., D., Ibrahim, K. and Gimba U. N. Physicochemical Parameters and Abundance of Pathogenic Protozoans and Helminths in Abattoirs within Minna Metropolis, Niger State, Nigeria. J Appl Sci Environ Manag. 2024; 28 (1): 11- 20. doi:10.4314/jasem.v28i1.32