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Short Communication

Assessment of Helminth contamination in wastewater and irrigated vegetables at Kawo Irrigation Farm, Kaduna State, Nigeria

OPEN ACCESS

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ABSTRACT

The research aimed to investigate the presence of Helminths on vegetables grown with confluence of untreated municipal and abattoir wastewater in the Kawo abattoir irrigation farm, Kaduna State, Nigeria. The wastewater sample was collected from four different points designated as WW01, WW02, WW03, and WW04. Vegetable samples were also collected from these points and labeled: SP01, SP02, SP03, and SP04 (spinach) and LT01, LT02, LT03, and LT04 (lettuce). The laboratory analysis of the samples was conducted using standard parasitological techniques, including macroscopy and microscopy, for Helminths in the wastewater and fresh vegetable produce. *Ova of Fasciolopsis buski*, *Tania saginata*, *Cyst of Entamoeba histolytica* and *Ova of Ascaris lumbricoid* were found and above the recommended guidelines, which specify <1 nematode egg per liter of wastewater. This study observed that untreated wastewater used for irrigation at the study site contains hazardous Helminths. This practice can be dangerous to consumers and life-threatening to farm workers due to physical contact with the wastewater. The study recommended the use of stabilization ponds (aerobic, facultative, and maturation) before using the water for irrigation, the adoption of safer irrigation methods such as drip or sub-surface irrigation to minimize contact of crops with contaminants present in irrigation water, and the use of personal protective equipment such as gloves, boots, trousers, and long sleeve shirts during farm work to reduce the level of exposure.

KEYWORDS: *Abattoir, Farmers, Health, Sample, Tapeworm*

INTRODUCTION

Urban and peri-urban agriculture in some areas of many developing countries, at least to some extent depends on wastewater as a source of irrigation water (Khaled & Muhammad, 2016). In most parts of Nigeria, farmers prefer untreated wastewater even when freshwater is available because they earn higher profits. This shows that wastewater can be a more reliable source both in terms of availability and volume than rain or freshwater supply for irrigation systems. However, many households in poorer areas lack access to fertilizers and have a limited supply of fresh water; wastewater reuse at the individual level can provide a combined solution to these problems by supplying the water and nutrients needed for household food production, This practice is common amongst millions of farmers worldwide and it is estimated that 10%

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of the world's population consumes foods irrigated with Wastewater (WHO 2013).

The microbial population of untreated water is very diverse and dangerous microorganisms that can cause illness or disease are usually associated with human or animal faecal matter present in wastewater and surface water sources. Irrigation water contaminated with pathogens has often been blamed for food-borne illness outbreaks ((Blumenthal *et al*., 2000). It is important to carefully manage this risk when promoting the reuse of non-potable water sources to fulfil the water demand of agricultural irrigation activities. The pathogens are transmitted to the public through consumption of irrigated produce, especially crops eaten raw (Blumenthal *et al*., 2000). Several studies throughout the world have demonstrated a very close relationship between the consumption of fruits and vegetables irrigated with raw wastewater and many food-borne diseases like gastroenteritis, cholera, chemical toxicity etc (Sou *et al*., 2011).

Initial improvements in water quality can be achieved in many developing countries by at least the primary treatment of wastewater, particularly where wastewater is used for irrigation. Secondary treatment can be implemented at a reasonable cost in some areas, using methods such as waste-stabilization ponds, constructed wetlands, infiltration-percolation, and up-flow anaerobic sludge blanket reactors (Mara, 2003). Waste Stabilization pond are more suitable in area with available land and are very easy to operate and maintain at low cost (Verbya *et al*,. 2016) Wastewater is increasingly being used in the agricultural sector to cope with the depletion of freshwater resources as well as water stress linked to changing climate conditions. Treating wastewater is of a high significance to reduce pollutant contamination (Siharath *et al*,. 2023). As wastewater irrigation expands, research focusing on the human health risks is critical because exposure to a range of contaminants must be weighed with the benefits to food security, nutrition and livelihoods. (Dickin *et al*., 2016). (Abakpa *et al*., 2013) Conducted a study in Kano State Nigeria, which shows high-level contamination of irrigation water and irrigated vegetables as a result of point sources of effluents to the water bodies used for irrigation contributing significantly to the continuous influx of microorganisms throughout the year. The quality of the water and the irrigated vegetables exceeded standard microbiological limits. Helminthes and protozoan parasites enter the environment in feces from the intestinal tract of a wide range of domestic, wild, and companion animals used as manure for production. These pathogenic organisms can therefore pose a health threat to the farmers, of particular health importance is the transmission of intestinal helminths often referred to as Soil-transmitted Helminths (STHs). Soil-transmitted Helminthes infections are among the most common infections worldwide and affect the poorest and most deprived communities. They are caused by parasitic worms (Helminths) that are transmitted to people through contaminated soil. The main species of soil-transmitted Helminths that infect people are the roundworm (Ascaris lumbricoides), the whipworm (Trichuris trichiura), and the hookworms (Necator americanus and Ancylostoma duodenale) (Toze., 1997) . Soil-transmitted Helminths are transmitted by eggs that are passed in the feces of infected people. Adult worms live in the intestine where they produce thousands of eggs each day. In areas that lack adequate sanitation, these eggs contaminate the soil. People become infected with A. lumbricoides and T. trichiura by ingesting infective parasite eggs. This can happen in several ways.

Eggs attached to vegetables are ingested when the vegetables are not carefully cooked, washed, or peeled. Eggs are ingested from contaminated water sources. Eggs are ingested by children who play in soil and then put their hands in their mouths without washing them. Helminthes eggs require moist shady soil for embryonation of the eggs over five to ten days before they can cause infection (Toze, 1997).

Farmers and their households (especially children) engaged in wastewater irrigation are at a higher risk of Helminthes infection due to the duration and intensity of their contact with the wastewater and contaminated soils (Strunz,*et al*., 2014). Consumers of vegetables irrigated with wastewater, especially vegetables that are eaten without proper cooking or no cooking (spinach and lettuce) before consumption are also at risk of infection with pathogenic microorganisms found in the wastewater. Therefore there is the need to determine the risk of infection with those pathogenic microorganisms for the farmers and consumers. It has also been made abundantly clear that the approach of banning the largely informal practice will not work, therefore the main challenge is how to maximize the benefits of wastewater use while safeguarding public health and the environment as well. The research carried out in Kawo Abattoir irrigation farm aimed at identifying and quantifying Helminthic species in untreated municipal and abattoir wastewater and vegetables irrigated with contaminated water, assess the risk of Helminthic contamination to human health through consumption of irrigated vegetables and to determine the effect, quality and safety of vegetables irrigated with a confluence of abattoir and municipal wastewater.

MATERIALS AND METHOD

Study Area

The study site selected for this study is the Kawo Abattoir irrigation farm (Figure 1) which lies between latitude 100 34’ 40.8’’ E and longitude 070 26’39.1’’ N of Kaduna North Local Government Area Kaduna State Nigeria. Kaduna North lies completely in the part of Western Africa, well within the northern limit of the movement of the Intertropical Convergence Zone (ITCZ). It is characterized by two distinct seasonal regimes, oscillating between cool to hot dry and humid to wet season. The climate is tropical in Kaduna. When compared with winter, the summers have much more rainfall. The climate here is classified as Aw by the Köppen-Geiger system (Aw = Tropical wet and dry or savanna climate; with the driest month having precipitation less than 60 mm (2.4 in) and less than 4% of the total annual precipitation). The average annual temperature in Kaduna is 25.2 °C, and about 1211 mm of precipitation falls annually. The driest month is January. There is 0 mm of precipitation in January. In August, the precipitation reaches its peak, with an average of 284mm.

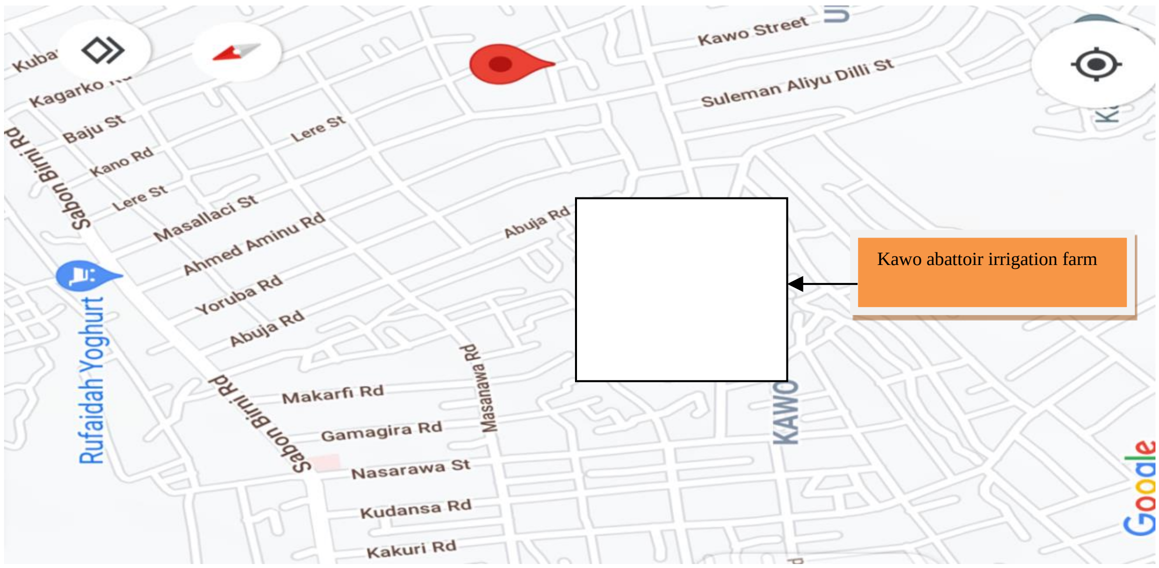

Figure: 1. Map of kawo Kaduna showing irrigation farm Area. (Google Earth, 2024)

Sampling

Sample collection for waste water

Wastewater samples were collected from four different points designated as WW01, WW02, WW03, and WW04. Wastewater from municipal, (which is the wastewater coming directly from municipal), Wastewater from Abattoir, (wastewater flowing from the abattoir), Wastewater from Irrigation (the point of confluence of the two wastewater above is now pumped and used for irrigation), and open well water (control) respectively. Wastewater samples were collected in 50ml clean sterile containers as shown (Plate 1). The samples were collected and transported in a cooler box to the laboratory for analysis within twenty-four hours of collection.

Plate 1: Wastewater sample

Sample collection for vegetables

Vegetable (spinach and lettuce) samples were collected under normal conditions, from three sampling points of each irrigation farm, put in paper bags, and then transported immediately to the laboratory where they were analysed within 24hrs. The same method was also applied to a control group of vegetables (spinach and lettuce) grown using open well water under identical conditions. The samples were designated as SP01, SP02, SP03, SP04 (spinach) and LT01, LT02, LT03, LT04 (lettuce).

Determination of Helminthes using Parasite direct microscope iodine method

Procedure for determination of Helminthes Parasite in wastewater

Two loops full of the sample were placed at the center of the clean dried sterilized microscope slide as shown in Plate 2 below. Two drops of 1% solution of grams iodine were mixed with the content and covered with the cover slip. The content was observed with low and high power objectives of the microscope as shown in plate 3 below for the cysts ova or larva of parasites, where the observation was recorded with the aid of a diagram. The experiment was conducted in the laboratory of the department of food and nutrition Kaduna polytechnic Kaduna State.

Procedure for determination of Helminthes Parasite in Vegetable

Ten grams of each vegetable sample was weighed and blended using an RM 206 model blender containing 100 ml of sterile saline solution for 2 min under sterile conditions. The blender was carefully disinfected to prevent any cross-contamination. Then the same method was employed as in Section "Sample collection for waste water" above.

Plate 2: Loops full of the sample preparation.

Plate 3: Observation of sample with microscope

RESULTS AND DISCUSSION

Results

A total of 4 samples for wastewater and 4 samples each of vegetable (spinach and lettuce) were collected and analyzed for *Helminthes*, Table 1 shows the result for *Helminthes* found in the Wastewater sample which was counted and observed to be above <1 nematode egg per liter of wastewater by (WHO 1989).

Table 1: Results of Parasite/Helminthes determination

S/N	Code	Sample Name	Identified Parasite (Seen)
1	WW01	Wastewater from Municipal	i. No ova or cyst of parasites
2	WW02	Wastewater from Abattoir	i. Ova of *fasciolopsis buski* ii. Segment of Tapeworm (*Tania saginata)*
3	WW03	Wastewater from Irrigation	i. Ova of *fasciolopsis buski* ii. Segment of Tapeworm (*Tania saginata)* iii. Cyst of *Entameoba histolytica* iv. Ova of *Ascaris lumbricoids*
4	WW04	Open well water (Control)	i. No ova or cysts of parasites
5	SP01	Spinach Farm A	i. No ova or cysts of parasites
6	SP02	Spinach Farm B	i. Ova of *faciolopsis buski*
7	SP03	Spinach Farm C	i. Ova of *fasciolopsis buski* ii. Cyst of *Entameoba histolytica*
8	SP04	Spinach Control	i. No ova or cysts of parasites
9	LT01	Lettuce Farm A	i. Cyst of *Entamoeba histolytica*
10	LT02	Lettuce Farm B	i. Ova of *faciolopsis buski*
11	LT03	Lettuce Farm C	i. Ova of *faciolopsis buski*
12	LT04	Lettuce Control	i. No ova or cysts of parasites

DISCUSSION

The results of the study revealed that no ova or cyst of parasites was found in the municipal wastewater. The ova of *Fasciolopsis buski*, Segment of Tapeworm (*Tania saginata*) were found in the Abattoir wastewater while ova of *Fasciolopsis buski*, *Tania saginata*, cyst of *Entamoeba histolytica*, ova of *Ascaris lumbricoids* was also dictated in the combines/confluence of the irrigation water. Thes could be as a result of contamination from the Abattoir waste. This confirms the acertion by Daryani et al (2008), that transmission of pathogenic organisms from irrigated soil to crops, grazing animals and humans is not unusual in some parts of the world.

Out of the four sample investigated of the spinach two of the sample was contaminated indicating (50%), and that of the lettuce out of the four sample investigated three of the sample was contaminated indicating (75%) which could be as a result of the edible part of spinach higher from the ground than that of lettuce. This is in conformity with the claim of a research conducted by (Minhas and Samra, 2004) that Pollution decreases if the vegetable edible plant parts are above the ground, while it increases if they are near the ground. Major sources of these parasites are as a result of inadequate modern toilet sanitary facilities and, a lack of public health enlightenment where people practice open defecation resulting in pollution of water sources and farmlands as in agreement with a report by (WHO., 2024) that over 1.5billion people globally do not have basic sanitary services such as private toilets or latrines, of which about 419 million still practice open defecation around street gutters, behind bushes or open water bodies. This is also in agrrement with Hassan (2023), that everal parasitic infections are associated with poor hygiene and environmental sanitation resulting in food and water.

containing ova, cysts or larva of these parasites

CONCLUSION AND RECOMMENDATIONS

This study observed that untreated municipal wastewater and vegetable produce at the study site contains Helminthes above the recommended guideline value of <1 ova of Helminths/l . From the findings of the research, it can be concluded that the wastewater is unfit for irrigation purposes and the vegetables are highly contaminated , therefore it is recommended that farmers should practice the use of a stabilization pond (aerobic, facultative, and maturation) before using the water for irrigation, Consumers of vegetables should wash them properly using vinegar, and adoption of safer irrigation methods such as drip or surface irrigation to minimize contact of crops with contaminants present in irrigation water especially for unrestricted irrigation, farmers should also be encouraged to use Personal Protective Equipment such as gloves, boots, trousers, and long sleeve shirts during farm work to reduce the level of exposure.

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Authors' contributions

AY, IUS & SOU were fully involved in data collection, data interpretation and writing first draft of the manuscript, AY & ML managed the literature aspect, AY, IUS & SOU were fully involved in the development of the methodology. All Authors come together to read double check and approved the final manuscript.

Ethics Committee Approval: N/A.

REFERENCES

Abakpa, G.O., Umoh, V.J., Ameh, J.B. & Yakubu, S.E. (2013). Microbial quality of irrigation water and irrigated vegetables in Kano State, Nigeria. *International Food Research Journal* 20(5): 2933-2938. http://www.ifrj.upm.edu.my/20%20(05)%202013/53%20IFRJ%2020%20(05)%202013%20Grace%20103.pdf

Blumenthal, U.J., Cifuentes, E., Bennett, S., Quigley, M. & Ruiz-Palacios, G. (2001) he risk of enteric infections associated with wastewater reuse: the effect of season and degree of storage of wastewater. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, 95(2): 131-137. https://doi.org/10.1016/S0035-9203(01)90136-1.

Daryani, A, G., Ettehad, H., Sharif, M., Ghorbani, L. & Ziaei, H. (2008). Prevalence of intestinal parasites in vegetables consumed in Ardabil, Iran. *Food Control.* 19:790-794.

Dickin SK, Schuster-Wallace CJ, Qadir M, & Pizzacalla K. A. (2016)Review of Health Risks and Pathways for Exposure to Wastewater Use in Agriculture. *Environ Health Perspect.* 124 (7): 900-909. https://www.doi.org/10.1289/ehp.1509995

Google Earth, (2024). Map of kawo Kaduna showing irrigation farm Area.

Hassan, A. A., Ojuromi, O. T. & Onyeahialam, O. (2013). Presence of parasitic ova, cysts and larvae on common fresh fruits and vegetables sold at some major markets in Ibadan, Oyo State, Nigeria. The Zoologist, 11:40-45. https://www.ajol.info/index.php/tzool/article/view/107278/97163

Khaled S. B, & Muhammad A. (2016). Field accumulation risks of heavy metals in soil and vegetable crop irrigated with sewage water in western region of Saudi Arabia, *Saudi journal of biological science*, 23, S32-S44 https://www.doi.org/10. 1016/ j.sjbs. 2015. 09.023

Mara, D., (2003). Domestic Wastewater Treatment in Developing Countries. Earthscan, UK,

Minhas, P.S. & Samra, J.S., (2004). Wastewater use in peri-urban agriculture: impacts and opportunities. Bulletin No. 1/2004, 78p. Central Soil Salinity Research Institute, Karnal. https://www.pseau.org/outils/ouvrages/earthscan_ltd_domestic_wastewater_treatment_in_developing_countries_2003.pdf

siharath, P., Xayyamunh, K., Vilaychaleun, S., Thammathevo, K., Sonemanivong, C., Kannitha, S., Nhaovarath, P., & Phommakone, B. (2023). Wastewater Treatment using The Photosynthetic Bacteria at Parksarp Village, Xaythany District, Vientiane Capital. *Asian Journal of Natural Sciences*, 2(4), 223–234. https://doi.org/10.55927/ajns.v2i4.5563

Sou, M., Yacouba, H. & Mermoud, A. (2011). Fertilising value and health risks assessment related to wastewater reuse in irrigation, case study in a Soudano-Sahelian city: Ouagadougou. http://www.journees-scientifiques.2ie-edu.org/js2011/sessions/pdf/sou_m.pdf

Strunz EC, Addiss DG, Stocks ME, Ogden S, Utzinger J, & Freeman MC(2014). Water, sanitation, hygiene, and soil-transmitted helminth infection: a systematic review and meta-analysis. *PLoS Med.*. https://www.doi.org/10.1371/journal.pmed.1001620

Toze S., (1997).Microbial pathogens in wastewater, Literature Review for Urban Water Systems. Multi-divisional Research Program. CSIRO Land and Water Technical report No 1/97.

Verbyla, M., Iriarte, M.M., Mercado Guzmán, A., Coronado, O., Almanza, M. & Mihelcic J.R. (2016). Pathogens and fecal indicators in waste stabilization pond systems with direct reuse for irrigation: Fate and transport in water, soil and crops. *Science of The Total Environment*, 551, 429-437. https://doi.org/10.1016/j.scitotenv.2016.01.159

WHO (1989) Health Guidelines for the Use of Wastewater in Agriculture and Aquaculture. Report of a WHO Scientific group, Technical Report Series No. 778 World Health Organization, Geneva. https://iris.who.int/handle/10665/39401

WHO, (2013). Guidelines for the safe use of wastewater, excreta and grey water: Wastewater use in agriculture (Volume 2).Report of a WHO Scientific Group. WHO Technical Report Series 778. World Health Organization, Geneva, Switzerland, pp74-219. https://www.who.int/publications/i/item/9241546832

WHO,(2024) Sanitation report (2024). https://www.who.int/news-room/fact-sheets/detail/sanitation