



A RESEARCH ON VEGETABLES CULTIVATED IN KOFAR MARUSA WATERWAY AND AJIWA DAM GARDENS AND THEIR PARASITIC CONTAMINATION

ABSTRACT

This study investigated the parasitic contamination on vegetables cultivated in KofarMarusa and Ajiwa Dam Gardens in Katsina State. 50 samples each of Lettuce, Carrot, Cabbage and Amaranthus were collected from each of the two gardens and processed using wet method. Parasites such as hookworm, *E. histolytica*, *E. vermicularis*, *Schistosoma*, *paragonimus*, *B.*

AHMAD LAWAL NUHU¹, DANJUMA MUHAMMAD¹, AISHA DANJUMA MUHAMMAD²

¹Department of Biology. School of Sciences, Federal College of Education, Katsina ²Department of Business Education, Federal College of Education, Katsina

Introduction

Parasites are organisms which do not only obtain their food from other living creatures but also used other animals as host. Studies on parasites are of public health concern which calls for urgent attention because millions of people in the world have been infected by parasites, thus causing serious ailments and diseases among human population (Bekele et al., 2017). This infection is yet to come to an end. It is estimated that, about 300 species of parasitic helminthes are associated with humans (Doyle & Wi, 2003). Food is the major pathway which most parasitic helminthes infect the human population. Vegetables in human diet are very important for healthy living and well-being. Vegetables provides nutrients such as vitamins, minerals, protein and fibers to the human body. These nutrients protect the human body from a number of infectious



coli and ascaris were detected in the vegetables. Sixty-seven percent (67.5%) of vegetables cultivated in Kofar Marusa waterway gardens tested positive for parasite contamination while 42% of the same vegetables cultivated in Ajiwa Dam gardens tested positive for parasite contamination. Lettuce is the most parasite contaminated vegetable with 45 (90%) and 31 (62%) prevalence while the least parasite contaminated is carrot with 7 (14%) and 3 (6%) prevalence for both Kofar Marusa and Ajiwa Dam gardens respectively. The observed parasite prevalence do not significantly differ from the expected prevalence for Kofar Marusa ($\chi^2 = 28.64; p > 0.05$) and Ajiwa Dam ($\chi^2 = 22.10; P > 0.05$). Density of parasite in Lettuce ($F_{1, 19} = 4.851; p < 0.05$), Cabbage ($F_{1, 19} = 1.714; p < 0.05$) and Amaranthus ($F_{1, 19} = 1.231; p < 0.05$) from the two sites significantly differs with higher parasite density in Kofar Marusa than in Ajiwa Dam garden except for parasite contamination in carrot which do not significantly differ ($F_{1, 19} = 0.067; p > 0.05$). It was concluded that, vegetables cultivated in Kofar Marusa waterway are more parasite contaminated than vegetables cultivated in Ajiwa Dam as such, vegetables should be washed properly with salt or any other safety means to sanitize vegetables before eating.

Keywords: Parasite, Vegetables, Kofar Marusa Waterway, Ajiwa Dam, Gardens

Acknowledgements: The researchers of this work are hereby acknowledging Tertiary Education Trust Fund (TETFUND) for sponsoring this research under the Institution Based Research (IBR), equally Federal College of Education Katsina as well as the reviewers and publishers of this work are acknowledged by the researchers.

diseases. In addition, most vegetables and fruits also help in regulating the body weight, diabetes and hypertension. Despite these health benefits, vegetables tend to be a major way for the transmission of parasitic infections when contaminated (Tefera et al., 2014) as a result of



various associated factors related to cultivation. The use of contaminated wastewater to irrigate crops, fruit and vegetables therefore is the cause of foodborne parasitic infection. El and Said (2012) reported that, the consumption of raw vegetables without proper washing is an important route in the transmission of parasitic diseases. Outbreaks of intestinal parasitic infections that were associated with raw vegetables have been reported from developed and developing countries (Fumilayo et al., 2019). As such, many parasites have been considered problems confined to developing countries and places with poor sanitation.

Idahosa (2011) detected more than half of the common vegetables (e.g. cabbage, lettuce, carrot, spinach, pumpkin, garden egg, tomatoes, and waterleaf) sold in various markets in Jos South, Plateau State, Nigeria contains Cysts of *Entamoeba coli*, (2.0%) *Entamoebahistolytica* (4.0%), *Hymenolepis nana* (0.8%), *Trichuristrichiura* (2.0%), *Ascarislumbricoides* (2.4%), were Hookworm species (28.2%) and *Strongyloidesstercoralis* (60.4%) has the highest infestation. Benti and Gemechu (2014) also detected prevalence of 22.22% *Ascarislumbricoides* eggs and 18.06% *Giardia intestinalis* cysts in spinach; 8.33% (6/72) *Entamoebahistolytica* cyst in spinach, 12.5% (9/72) in lettuce and 8.33% (6/72) in cabbage samples cultivated and irrigated with wastewater of Awash River in Adama Woreda, Ethiopia. Adejumo and Morenikeji (2015) stated that 11.6% of 250 vegetables (Cabbage, Lettuce, Carrot and Cucumber) sold in five different markets in Ibadan, Nigeria contains parasitic helminthes where ova of *Ascarislumbricoides*, Hookworm larvae and larvae of *Strongyloidesstercoralis* has prevalence of 51.7%, 27.6% and 20.7% respectively.

Parasitic infestation on vegetables therefore tends to be ubiquitous in areas prone to aridity. Vegetable farmers in Katsina State, Nigeria often use wastewater from drainages and dams to irrigate crops due to inadequate water supply and short period of rainfall. The land surrounding Ajiwa dam is used for irrigation farming. Most vegetables supply to neighbouring markets are produced therein. Kofar Sauri waterway on the other hand, is a long drainage extending from the North-Eastern to the South-Western part of Katsina Metropolis. Kofar Marusa waterway is a pathway for wastewater from the



settlement around this part which vegetable farmers use to irrigate their crops. It is of outmost importance to study the possible parasitic contamination of vegetables produced in these areas. This study therefore, uncover and compare the prevalence of parasitic worms on vegetable Cultivated in KofarMarusa Waterway and AjiwaDam Gardens.

Statement of the Problem/Justification

Vegetables forms a vital component of human diet which are essential for healthy living. They supply important nutrients or elements which aid the immune system in its function. On a sad note, vegetables are reported to harbor intestinal parasites such as *Ascarislumbricoides*, *Taenia species*, *Fasciola hepatica*, *Hymennolepis nana*, *Echinococcus species*, *Schistosoma* among other parasites. Parasitic infection therefore becomes a public health concern.

Parasite-infected vegetables takes place when sewage, raw manure and/or wastewater are used to cultivate the vegetables. Consumption of vegetables cultivated in an unkempt and un-sanitized environment especially in their raw form are likely to exacerbate parasitic infection among the populace. Most vegetables (e.g. Amaranthus, lettuce, cabbage and carrot) cultivated around Ajiwa Dam and KofarMarusa Waterway Areas are irrigated using the water available in these areas, thus forming a major vegetable supply to markets for sales and consumption. It is therefore necessary to identify the level of parasitic infection of vegetables cultivated in those areas. This study therefore investigates the prevalence of parasitic contamination on four popularly cultivated vegetables(Lettuce, Carrot, Cabbage and Amaranthus) in KofarMarusa Waterway and Ajiwa Dam Gardens

Methodology

Description of the Study Area

Katsina State lies between latitude 11.7 and 13.22 north and longitude 6.52 and 9.2 east. It occupies a total land area of about 23,930km², with an estimated human population of 5.3 million of which majority lives in rural areas. The state extends to three major savanna zones; drier Sahel zone in the north, Sudan and Guinea Savanna in the middle and the Southern Zone respectively (Katsina State Water Board, 1991). Ajiwa Dam and



KofarMarusa Waterway are located in Batagarawa and Katsina Local Government Areas respectively. These two study areas are aligned to the drier Sahel Zone as such, experiences short period of rainfall and longer period of aridity. Vegetable Farmers usually practice irrigation farming to make vegetables available during the dry season.

Sample Collection

Fifty (50) samples each of four vegetables (Lettuce, Carrot, Cabbage and Amaranthus) were randomly selected from five sub-gardens in KofarMarusa and in Ajiwa Gardens which makes up 200 samples from each study area. The samples were preserved in clean polythene bags and bottles with 10% formalin and transported to parasitology laboratory of the department of Biological Sciences, Ahmadu Bello University, Zaria, and subjected to parasitological analyses using wet method i.e. formol-ether concentration as described by Brow and Neva (1994). 10-12ml of the strained suspension was recorded and yielded 0.5-1ml of centrifuged sediment. Fecal sediment was mixed thoroughly with 10ml of 10% formalin, 3ml diethyl-ether and centrifuged at 2000rpm for 2minutes. Applicator stick was used to rim off the plug of debris formed at the top of the tube while the entire supernatant was poured off, leaving a small volume of sediment formalin drained from the sides of the tube. The sediment at the bottom of the tube was removed with Pasteur pipette and smeared on slides and examined on microscope. All negative sample were further subjected to formalin-ether concentration technique.

Lugol iodine smear was prepared and used to stain the gastrointestinal helminth parasites, by taking 4 drops of Lugol Iodine solution into a test tube, four drops of fecal concentrate were placed into test tube containing Lugol Iodine solution and thoroughly mixed using application stick. Two drops of Lugol Iodine and fecal concentration mixture was placed on slide and 1-2 drops of trichrome stain was added and mixed with an applicator stick. The preparations were covered using cover slip and examined microscopically at $\times 10$ and $\times 40$ objective light microscope.

Data Analysis

Prevalence and specificity of parasites ova and cyst was calculated and expressed in percentage. Chi-square test and Analysis of Variance



(ANOVA) was used to test the significance of the prevalence and comparison of the parasites respectively found in the two study area. All the null hypotheses were tested at 0.05 level of significance.

Result and Discussion

Result

Of the four categories of vegetables collected from the two sites, 67.5% of the vegetables cultivated in KofarMarusa waterway gardens tested positive for parasite contamination while 42% of the same vegetables cultivated in Ajiwa Dam gardens tested positive for parasite contamination. Lettuce is the most parasite contaminated vegetable with 45(90%) and 31(62%) prevalence while the least parasite contaminated is carrot with 7(14%) and 3(6%) prevalence for KofarMarusa and Ajiwa Dam gardens respectively (table 1). Chi-square test shows that, the observed parasite prevalence do not significantly differs from the expected prevalence for KofarMarusa ($\chi^2 = 28.64; p > 0.05$) and Ajiwa Dam ($\chi^2 = 22.10; P > 0.05$).

The highest parasite infestation in Lettuce cultivated in KofarMarusa Waterway Gardens is *E. vermicularis* 48(30.6%), followed by hookworm ova 24 (15.3%), cyst of *E. histolytica* 24(15.3%), *Schistosoma* cyst 23(14.6%), Cyst of *B. coli* 15(9.6%). For cabbage, 40(43.5%) prevalence of *E. vermacularis* was the highest infestation, followed by 30(32.6%) *paragonimus* cyst and 22(23.9%) *schistosoma* ova. The highest infestation in Amaranthus is 48(33.6%) of cyst of *Ascaris* followed by 42(29.3%) cyst of *B. coli* and 27(18.9%) ova of hookworm (table 2). The highest parasitic contamination in Lettuce cultivated in Ajiwa Dam gardens is cyst of *B. coli* (16(38.1%)), hookworm ova 14(33.3%) and *schistosoma* ova 12(28.6%), while *E. vermacularis* was the only infestation on cabbage. For amaranthus, 26(40%) of *E. vermacularis* is the highest infestation followed by 21(32.3%) cyst of *Ascaris* and 18(27.7%) ova of hookworm (Table 3).

In table 4, there is significant difference in the density of parasite found in Lettuce ($F_{1, 19} = 4.851; p < 0.05$), Cabbage ($F_{1, 19} = 1.714; p < 0.05$) and Amaranthus ($F_{1, 19} = 1.231; p < 0.05$) cultivated in KofarMarusa and Ajiwa Dam Gardens. However, parasite density in carrot cultivated in KofarMarusa Waterway and in Ajiwa Dam do not show any significant



difference ($F_{1, 19} = .067$; $p > 0.05$). This means the density of parasite contamination on vegetables produced in KofarMarusa are significantly higher compared to parasite contamination on vegetables produced in Ajiwa Dam gardens.

Table 1: Analysis of Samples Collected from KofarMarusa and Ajiwa Dam

Vegetable Type	KofarMarusa		Ajiwa Dam	
	No. Examined	No. Positive (%)	No. Examined	No. Positive (%)
Lettuce	50	45 (90%)	50	31 (62%)
Carrot	50	7 (14%)	50	3 (6%)
Cabbage	50	40 (80%)	50	23 (46%)
Ammaranthus	50	43 (86%)	50	27 (54%)
Total	200	135 (67.5%)*	200	84 (42%)**

* $\chi^2 = 28.64$; $p > 0.05$. ** $\chi^2 = 22.10$; $p > 0.05$

Table 2: Frequency and Percentage of Occurrence of Various Parasite Species on Vegetables in KofarMarusaGarden

	KofarMarusa			
	Lettuce	Carrot	Cabbage	Amaranthus
Hookworm ova	24 (15.3%)	ND	ND	27 (18.9%)
Hookworm cyst	ND	35	ND	ND
Cyst of E. hystolystica	24 (15.3%)	ND	ND	ND
Hysin casts	8 (5.1%)	ND	ND	ND
E. vermicularis	48 (30.6%)	ND	40 (43.5%)	ND
Schistosoma Cyst	23 (14.6%)	ND	ND	ND
Schistosoma Ova	15 (9.6%)	ND	22 (23.9%)	26 (18.2%)
Paragonimus Cyst	ND	ND	30 (32.6%)	ND
Cyst of B. coli	15 (9.6%)	ND	ND	42 (29.3%)
Cyst of Ascaris	ND	ND	ND	48 (33.6%)

Table 3: Frequency and Percentage of Occurrence of Various Parasite Species on Vegetables in Ajiwa Dam Garden

	Lettuce	Carrot	Cabbage	Amaranthus
Hookworm ova	14 (33.3%)	24	ND	18 (27.7%)
Hookworm cyst	ND	ND	ND	ND
Cyst of E. hystolystica	ND	ND	ND	ND
Hysin casts	ND	ND	ND	ND



E. vermicularis	ND	ND	22	26(40%)
Schistosoma Cyst	ND	ND	ND	ND
Schistosoma Ova	12(28.6%)	ND	ND	ND
Paragonimus Cyst	ND	ND	ND	ND
Cyst of B. coli	16(38.1%)	ND	ND	ND
Cyst of Ascaris	ND	ND	ND	21(32.3%)

Table 4: One-ANOVA of Parasite Density in Vegetables Cultivated in KofarMarusa Waterway and Ajiwa Dam Gardens

		Sum	of	Mean		
		Squares	df	Square	F	Sig.
Lettuce	Between Groups	661.250	1	661.250	4.851	.041*
	Within Groups	2453.700	18	136.317		
	Total	3114.950	19			
Carrot	Between Groups	6.050	1	6.050	.067	.798**
	Within Groups	1620.900	18	90.050		
	Total	1626.950	19			
Cabbage	Between Groups	245.000	1	245.000	1.714	.007*
	Within Groups	2573.200	18	142.956		
	Total	2818.200	19			
Amaranthus	Between Groups	304.200	1	304.200	1.231	.012*
	Within Groups	4446.600	18	247.033		
	Total	4750.800	19			

Discussion

This study examined and compare parasitic contamination on vegetables irrigated with KofarMarusa waterway and Ajiwa Dam. Detection of parasites on vegetables in gardens must be as a result of unhygienic



practices. The study revealed that, 67.5% of the vegetables cultivated in KofarMarusa waterway gardens tested positive for parasite contamination, with Lettuce 45(90%) been the most parasite contaminated vegetable. Forty-two percent (42%) of the vegetables cultivated in Ajiwa Dam gardens tested positive for parasite contamination with Lettuce 31(62%) also been the highest parasite contaminated vegetable. The least parasite contaminated is carrot with 7(14%) and 3(6%) prevalence for both study sites. This finding agrees with the finding of Idahosa (2011) who also found Lettuce as the highest multiple parasitic contaminated and carrot as the least multiple parasites contaminated. The finding of this study some worth contradicted the finding of Fumilayo et al., (2019) who detected that, amaranthus was highest parasitic contaminated in Illorin and tomato was the least parasitic contaminated vegetable. The variation in the findings may be due to environmental difference. Although, lettuce was not part of the study sample in Fumilayo, et al. Moreover, Lettuce and most green leafy vegetables have rough surfaces which create a nice surface for parasitic eggs, larvae and/or cyst attach to them very easily(Adejumoke & Morenikeji, 2015) while carrot have smooth surface and even buried in the ground. Parasitic contamination of vegetables is usually exacerbated and spread by ineffective and unhygienic practices.

The comparison of parasite density on the four studied vegetables cultivated in KofarMarusa and Ajiwa Dam gardens showed disparity. Vegetables cultivated in KofarMarusa waterway gardens are more contaminated than those cultivated in Ajiwa Dam except for parasite density in carrot which are equally parasite contaminated in the two gardens. Though, it was previously reported that Ajiwa Dam harbours different parasitic helminth such as Trematodes, Nematodes and Cestodes(Zubairu, 2016) however, the KofarMarusa Waterway seems to harbour a significant bulk of parasites because the waterway is a very long trench which extends from the northeast to Southwest of Katsina city, collecting all sort of refuse, dirty and wastewater from smaller gutters linking streets and homes of the surrounding environment. On the other hand, Ajiwa Dam is a large water body which do not connect to drainages collecting wastewater from homes. Parasites thrive well and multiply



quickly in untidy environment. This reason may account for the higher vegetable contamination in KofarMarusa than in Ajiwa Dam gardens

Conclusion

The present study confirms and compare the level of parasitic contamination of vegetables especially vegetables grown in two popular gardens in Katsina City (KofarMarusa waterway and Ajiwa dam). Both helminthes (e.g. hookworm, *Ascaris*, *schistosoma*) and unicellular parasites (*E. histolytica*, *E. coli*, *B. coli* e.t.c) form the parasite species infested in the vegetables. Lettuce is the most and multiple parasite contaminated while carrot is the least parasite contaminated compared to other vegetables studied. The parasite contaminations are serious and significantly prevalent in the vegetables. However, vegetables cultivated and irrigated using the water in KofarMarusa waterway are more parasite contaminated than vegetables cultivated in Ajiwa Dam.

Recommendation

Based on the findings of this study, the following are hereby recommended:

1. Agricultural extension workers should ensure they demonstrate to vegetable farmers the needs for sanitizing farm lands before and during cultivation.
2. Health facilitators should enlighten the public about the risk level involve in the consumption of vegetables especially in their raw form.
3. Vegetables should be washed properly with salt or any other safety means to sanitize vegetables before eating.

References

- Abba, A. M., Mudassir, I., Abdulhamid, Y., Omenesa, R. L. and Udoh, E. J. (2018). Seasonal Prevalence of Helminth Parasites of Fishes and their Relation with Water Quality Parameters in Ajiwa Reservoir, Katsina State, Nigeria. *Allied Academies Journals*, 18-24.
- Adebisi, O.R. (2008). Gastrointestinal helminthes and public health: Overview of a neglected sector. *The Internet Journal of Vetenary Medicine*, 4(2), 1 – 7.
- Adejumoke, A., & Morenikeji, O. (2015). Prevalence of intestinal parasites in vegetables sold in major markets in Ibadan City , South-West Nigeria. *Global Journal of Pure and Applied Sciences*, 21, 7–12. DOI: <http://dx.doi.org/10.4314/gipas.v21i1.2>



- Ahmed, A. and Gidado, S. M. (2018). Prevalence of schistosomiasis among schoolchildren in Iyatawa and Faduma Communities, Rimi Local Government Area, Katsina State. *Katsina Journal of Natural and Applied Sciences*, 7(1), 10 – 17.
- Ahmed, A. (2020). Prevalence of schistosomiasis among schoolchildren in iyatawa and faduma communities , Rimi Local Government Area , Katsina. *Katsina Journal of Natural and Applied Sciences*, 7(1), 10 – 17.
- Anosike, J.C., Zaccheaus, V.O., Adieyongo, C.M., Abanobi, O.C., Dada, E.O., Oku, E.E., Keke, I.R., Uwaezuoke, J.C., Amajuoyi, O.U., (2006). Studies on the intestinal worms (Helminthiasis) intestation in a central Nigerian rural Community. *Journal of Applied Science and Environmental management*, 10(2), 61 – 66.
- Bekele, F., Tefera, T., Biresaw, G., & Yohannes, T. (2017). Parasitic contamination of raw vegetables and fruits collected from selected local markets in Arba Minch town , Southern. *Infectious Diseases of Poverty*, 1–7. <https://doi.org/10.1186/s40249-016-0226-6>
- Benti, G., & Gemechu, F. (2014). Parasitic contamination on vegetables irrigated with Awash River in selected farms , Eastern Showa. *Journal of Parasitology and Vector Biology*6(7), 103–109. <https://doi.org/10.5897/JPVB2014.0150>
- Dalhatu, A.K., Khan, A.A. and Umar, Z.D. (2016). Study of root-knot problems in Ajiwa Dam Area, Katsina State, Nigeria. *International Journal of Environment*, 4(1), 204 – 209.
- Doyle, M. E., & Wi, M. (2003). *Foodborne Parasites*. November 1996.
- Edungbola, L.D. (1990). Editorial: parasitologists and the challenges of the decade. *The Nigerian Journal of Parasitology*, 2(1), 9 – 11.
- El, D., & Said, S. (2012). Detection of parasites in commonly consumed raw vegetables. *Alexandria Journal of Medicine*, 48(4), 345–352. <https://doi.org/10.1016/j.ajme.2012.05.005>
- Food and Agricultural Organization (FAO, 200). Distribution and impact of helminth diseases of livestock in developing countries. *FAO corporate document repository Agriculture and Consumer Protection*.
- Fumilayo AJ, Mosunmola OJ, Kayode AI, Adedokun AR, Zagi HT, Buru AS (2019). Intestinal Parasites Isolated in Vegetables Sold in Most Important Markets within Ilorin Metropolis. *J Trop Dis* 8:342. doi:10.35248/2329-891X.19.8.342
- Idahosa, O. T. (2011). Parasitic contamination of fresh vegetables sold in Jos markets. *Global Journal of Medical research*, 11(1), 21 – 25.
- Kogi, E., Umoh, J. U. & Vajime, C. G. (1991). Intestinal parasites and gastronteritis among patients attending the university clinic, Samaru Zaria, Nigeria. *The Nigerian Journal of Parasitology*, 12; 77 – 80.
- Mbata C. A. Nyenke C. U. Obi-Thomas J. N. Isoma C. J. Adewoye M. O. (2017). Burden of Intestinal Parasites on Selected Vegetables Sold in Major Markets in Port Harcourt Metropolis. *Sokoto Journal of Medical Laboratory Science*, 2(3): 188 – 194.
- Ogbe, M. G. & Ododu, L. A. (1990). Gastrointestinal helminthiasis in schools in Epe Local Government Area, Lagos State, Nigeria. *The Nigeria Journal of Parasitology*, 9(11), 91 – 94.
- Tefera, T., Biruksew, A., Mekonnen, Z., & Eshetu, T. (2014). Parasitic contamination of fruits and vegetables collected from selected local markets of Jimma Town , Southwest Ethiopia. *International Scholarly Research Notices*, 2014, 1 – 8. <http://dx.doi.org/10.1155/2014/382715>



- Ukoli, F.M.A. (1990). *Introduction to parasitology in tropical Africa*. Text flow Limited, Ibadan, Nigeria. pp. 464
- Zubairu, U. (2016). Study of root-knot problems in Ajiwa Dam Area, Katsina State, Nigeria. *International Journal of Environment*, 4(1), 204 – 209. <https://doi.org/10.3126/ije.v4i1.12189>