Geohelminth contamination of fruits and vegetables cultivated on land irrigated with waste-water in Gusau Local Government Area, Zamfara State, Nigeria

***Nasiru, M., Auta, T.** and **Bawa, J. A.**
Department of Biological Sciences, Federal University, Dutsin-Ma, Katsina State, Nigeria
*Corresponding author: mannasgus@gmail.com

Abstract

The study assessed the contamination of *Amaranthus cruentus* (green), *Lactuca sativa* (lettuce), *Corchorus olitorius* (tossa jute), *Lycopersicon esculentum* (tomatoes), *Capsicum annuum* (Chilli pepper) and *Solanum marcrocarpon* (garden eggs), grown on soil irrigated with household effluents and river water in some selected gardens in Gusau, Zamfara State, by geohelminth ova and larvae. The fruits and vegetables (250 g each) purchased from four gardens were washed in 500 ml of normal saline (0.85% NaCl) and examined for geohelminth ova and larvae, using formalin-ether concentration method. Out of the 132 ova and 26 larvae obtained from four gardens, 104 (65.8%) were *Ascaris lumbricoides,* 28 (17.7%) *Trichuris trichiura,* 24 (15.2%) hookworm and 2 (1.3%) *Strongyloides stercoralis.* Vegetables had more parasite stages than the fruits. *Amaranthus cruentus* (green) was the most contaminated 65 (41.1%) and the least was *Solanum macrocarpon* (garden egg) 4 (2.5%). The samples were to some extent contaminated with either helminth ova, larvae or both, with the vegetables being more contaminated than the fruits. These differences in the level of contamination were statistically significant (p<0.01). There is the need for prevention of contamination at all points of the vegetables and fruits cultivation to consumption. This can be achieved through effective health education programme to emphasize the composting of human night soil and animal dung before use as manure.

Keywords: fruits, vegetables, geohelminths, ova, larvae.

Accepted: 25 November, 2015.

Introduction

Geohelminths are soil-transmitted parasitic nematodes whose life cycle does not involve intermediate hosts or vectors. They infect many animals, including humans, and are spread by the faecal contamination of soil, foods and water. Four species of geohelminths cause widespread diseases in human: *A. lumbricoides,* the large round worm, which causes ascariasis; *T. trichiura,* the whipworm, which causes trichuriasis; *S. stercoralis,* the thread worm which causes strongyloidiasis; *A. duodenale* and *N. americanus* which causes ancylostomiasis and necatoriasis respectively (Celia and Walcolm, 2002).

The global distribution of these intestinal parasites has been documented by (WHO, 1998; Kang *et al,* 1998; WHO, 2008), and the global prevalence depends not so much on the regional ecological conditions, but more on the local standard of social and economic development (Cheesbrough, 1992; Eneanyas and Njom, 2003; Emeka *et al,* 2006). Geohelminthiasis is promoted by poor hygiene habits, such as indiscriminate disposal of human and animal faeces. This habit permits contact of faeces and its accompanying microbial load, including geohelminth ova, with soil. Soil is an important vehicle for development and transmission of geohelminth ova (Emeka *et al,* 2006).

In developing countries such as Nigeria, a considerable amount of human and animal wastes are discharged into the soil daily (Nock *et al,* 2003; Emeka *et al,* 2006), leading to seedling of the soil, with pathogenic organisms including geohelminth ova and larvae. Ova in the soil become the main source of infection particularly to children (Adeyeba and Akinlabi, 2002). Faecal contamination of food or water and use of night soil as fertilizer, are the major routes of transmission (Larry, 1998).

Many studies in Nigeria have shown the prevalence of geohelminths to be high (Cowper, 1967; Ejezie, 1981; Auta *et al,* 2013; Auta *et al,* 2014). The prevalence of these parasites is promoted by several epidemiological factors such as poor sanitation, poor personal hygiene and other socio-cultural practices including the use of urban waste-water in irrigation (Larry, 1998; Eneanya and Njom, 2003). These factors are important in the transmission of helminth parasite from one host to another, and from the soil to a host. Often, transmission of geohelminths is by faecal-oral route through eating contaminated food or water (Eneanya and Njom, 2003). Raw fruits and vegetables have been known to serve as vehicle of transmission of human disease, because it can be directly or indirectly contaminated via polluted water, dirty hands, contaminated soil, flies, animals or animal products (Larry, 1998; Nodbergh, 2004). In developing countries, the continued use of untreated waste-water and manure as fertilizer for the production of fruits and vegetables is a major contributing factor to contamination, thereby causing numerous diseases (Larry, 1998).

There is a dearth of information on the transmission of geohelminthiasis in some part of northern Nigeria, especially Gusau, Zamfara State, where local farmers usually package and take their fruits and vegetables to the city markets in unhygienic condition. It is a common practice among the farmers, in the study-area around to fill surface of the drainages (culverts), soak away with earth materials, leave it overnight and excavate and use as manure in the vegetable gardens. They also purchase human faeces emptied from pit latrines by environmental workers and use as manure in such gardens. Hence, this study assessed the contamination of some common fruits and vegetables with geohelminths ova.

Materials and methods

Study area

The study was carried out in Gusau Local Government Area of Zamfara State (13^0N, 05^0E; 24^0, 10^0E), north-western Nigeria between November 2009 and March 2010. The Local Government Area occupies a land mass of 4,875.00 sq km (Topo Sheet, 1990), with a population of about 383,712 people (NPC, 2006). Gusau is situated in the Northern Guinea Savannah Zone of Nigeria, with the annual temperature ranging from 17^0C-31^0C. It has a tropical continental climate with distinct wet and dry seasons and duration of rainfall is from April to October with precipitation ranging from 10 mm in April, to 310 mm in August and 13 mm in October. The relative humidity is about 50% and reaching 96% during rains (ZADP, 2008). Agriculture is the main occupation of the people. The main crops grown are millet, maize, guinea corn and vegetables.

Four large gardens (A, B, C and D) that cultivate fruits and vegetables within Gusau Metropolis were randomly selected (Madawaki, Galadima, Mayana and Tudun Wada Districts) for this research. Garden A is located in Mayana district area (western part of Gusau City) between Latitude 12^0 05′ N and Longitude $6^0$41′ E; Garden B is situated in Galadima District Area (Northern part of Gusau City) between Latitude 12^0 06′ N and Longitude $6^0$14′ E; Garden C is located in Madawaki District Area (north-western part of Gusau City) between Latitude 12^0 06′ N and Longitude $6^0$41′ E; and Garden D is located in Tudun Wada District Area (eastern part of Gusau City) between Latitude 12^0 53′ N and Longitude $6^0$39′ E.

Sample collection

The samples of leafy vegetables; *Amaranthus*/green, lettuce, and Tossa jutes and fruits; tomatoes, Chilli pepper and garden eggs were collected and/ or purchased from the farmers in the early hours of the morning, between 0600 and 0700 hours. The samples were transported to the Parasitology Laboratory in the Department of Biological Sciences, Usmanu Danfodiyo University, Sokoto, in sterile polythene bags for parasitological analysis.

Laboratory analysis

Fruits and vegetables were examined using concentration technique as described by WHO (1991), with slight modification. 250 g of each type of fruit and vegetable were weighed and washed in 500 ml of normal saline (0.85% NaCl). Each suspension was strained through a piece of double layered sieve, which filtered off coarse sandy particles but allowed the passage of helminth ova, cyst and larvae. The used saline was left for about 24 hours for sedimentation to take place. The top layer was discarded and the remaining saline-centrifuged at 1,200 rpm for 15 mins. The supernatant was discarded and the residue carefully collected. The suspension was then pipetted and two drops were placed on clean slide for microscopic examination under objective lenses x10 and x 40. Helminth ova and larvae were identified using keys provided by Jeffrey and Leach (1975) and Cheesbrough (1998).

Statistical analysis

Chi-square (x^2) test was used to determine association between geohelminthic ova and larvae contamination and the different types of fruits and vegetables, and location of gardens.

Results

Out of the four gardens examined, Garden A (Hayin Gulbi) was found to be contaminated with 17 (10.8%) geohelminth ova only, no larvae were recovered. Garden B (Bulka Area) had 43 (27.2%) helminth ova and larvae; Garden C (Gadar Baga) 54 (34.2%) and Garden D (Near Water Board), 44 (27.8%). The result shows that Garden C (Gadar Baga) had the highest contamination, followed by Garden B (Bulka) and least contamination was Garden A (Hayin Gulbi). All the fruits and vegetables sampled from the four gardens (A, B, C, and D) were contaminated with helminth ova, larvae or both and there was a significant difference in the occurrence of geohelminth stages among the gardens ($p<0.01$), as presented in Table 1.

The most frequent geohelminth ova/larvae detected in all the gardens were those of *A. lumbricoides* 104 (65.8%). Others were *T. trichiura*, 28 (17.7%), hookworm 24 (15.2%) and *S. stercoralis* 2 (1.3%). Vegetables were more contaminated than fruits (Table 2). *Amaranthus cruentus* (green) was the most contaminated with 65 (41.1%) geohelminth ova/larvae, followed by *Lactuca sativa* (lettuce) 42 (26.6%), and *Corchorus olitorius* (tossa jute) 28 (17.1%). No helminth larvae were detected in both *Capsicm annuum* (chilli pepper) and *Solanum marcropcarpon* (Garden ova) and the least contaminated was *S. marcropcarpon* (garden eggs).

Table 1: Total distribution of geohelminth ova and larvae recovered from study sites.

Study Area	*Ascaris lumbricoides* Ova (%)	*Trichuris trichiura* Ova (%)	Hookworm Larvae (%)	*Strongyloides stercoralis* Larvae (%)	Total (%)
Garden A	13 (8.2)	4 (2.5)	0 (0.0)	0 (0.0)	17 (10.8)
Garden B	25 (15.8)	7 (4.4)	10 (6.3)	1 (0.6)	43 (27.2)
Garden C	32 (20.6)	11 (7.0)	10 (6.3)	1 (0.6)	54 (34.2)
Garden D	34 (21.2)	6 (3.8)	4 (2.5)	0 (0.0)	44 (27.8)
Total	**104 (65.8)**	**28 (17.7)**	**24 (15.2)**	**2 (1.3)**	**158**

$\chi^2 = 11.85$; $df = 3$; $p<0.01$.

Table 2: Total distribution of geohelminth ova and larvae among fruits and vegetables.

Vegetables/fruits	*Ascaris lumbricoides* Ova (%)	*Trichuris trichiura* Ova (%)	Hookworm Larvae (%)	*Strongyloides stercoralis* Larvae (%)	Percentage (%) Positive
Amaranthus cruentus	39 (24.7)	12 (7.6)	13 (8.3)	1 (0.6)	65(41.1)
Lactuca sativa	26 (16.5)	9 (5.7)	6 (3.8)	1 (0.6)	42(26.6)
Corcorus clitoris	19 (12.0)	5 (3.2)	4 (2.5)	0 (0.0)	28(17.7)
Lycopersicum esculentum	6 (3.8)	0 (0.6)	0 (0.6)	0 (0.0)	8 (5.1)
Capsicm annuum	10 (6.3)	1 (0.6)	0 (0.0)	0 (0.0)	11 (7.0)
Solanum marcrocarpon	4 (2.5)	0 (0.0)	0 (0.0)	0 (0.0)	4 (2.5)
Total	**104 (65.8)**	**28 (17.7)**	**24 (15.2)**	**2 (1.3)**	**158**

$\chi^2 = 67.75$; $df = 5$; $p<0.01$.

Discussion

Geohelminth ova and larvae were recovered from the fruits and vegetables examined in the study-area. This presents a major public health problem arising from faecal pollution. This could be attributed to the poor hygiene habits of the people, right from the planting to harvesting period, which is often associated with the use of human faeces and animal dung as manure, as well as use of urban waste-water for irrigation. It is a common practice by the farmers in the study-area around Gusau to fill surface of the drainages and soakaway with earth materials, leave it overnight, excavate and use as manure in the vegetable gardens. They also purchase human faeces emptied from pit-latrines by environmental workers and use as manure in such gardens.

Vegetable samples from the gardens presented a greater degree of contamination with helminth ova. The high contamination associated with vegetables, may be due to the fact that vegetables are closer to the soil than fruits and their leaf folds could retain some dirt, which cannot be easily removed by slight washing (Umoh, 2001), or because the fruits are higher above the soil level than the vegetables (Eneanya and Njom, 2003). It may also be attributed to the poor sanitary conditions and ignorance (Sam-Wobo *et al, 2004*). *A. cruentus* (green) was the most contaminated of the vegetables 84 (41.6%), followed by *L. sativa* (lettuce) 57 (28.2%) and *C. olitorius* (tossa jute) 33 (16.3%).

Considering the vegetables and fruits from the study-areas, *Amaranthus* (green) from Garden C (Gadar Baga) was the most contaminated, Garden B (Bulka) was next and least contaminated was Garden A (Hayin Gulbi) which may be associated with the sources of water for irrigation. Parasitic disease transmission may be influenced by poor environmental condition, poor personal hygiene and the use of human and animal wastes as manure as well use of urban waste water for irrigation.

The soil-transmitted helminths recovered in this study, includes *A. lumbricoides*, *T. trichiura,* Hookworm and *S. stercoralis*, with *Ascaris lumbricoides* being the most encountered (66.8%). *A. lumbricoides* has been widely reported to be the most prevalent helminthes in the tropics (Auta *et al,* 2013; Auta *et al,* 2014). Ova of *T. trichuira* were also detected. It is a geohelminth which has received renewed attention during the past decade because of the increasing recognition that it has important effect on growth. Stunted growth has been demonstrated in trichuriasis even in moderate infection (Enenya and Njom, 2003).

Hookworm is directly responsible for blood loss leading to iron deficiency anaemia which may have profound effect in children and adults (Nordberg, 2004). *S. stercoralis* which can cause a chronic persistent infection in man, especially in compromised hosts (Shuval, 1989) was detected only on lettuce. Although the percentage occurrence of *S. Stercoralis* in this study is low, yet it deserves greater attention.

Conclusion

The study highlights the potential risk of contracting geohelminth infections through ingestion of unwashed fruits and vegetables grown on waste-water irrigated field, where the use of human faeces are largely employed as manure/fertilizer. The importance of washing raw fruits and vegetables properly before consumption.

Prevention of contamination at all points of the food chain, from production to the final consumption, could be achieved through effective health education programme, and the composting of human night soil and animal dung before use as manure. The use of properly composted manure and treated irrigation water will minimize the risk of contamination of fruits and vegetables. Farmers should be discouraged from using untreated human faeces as fertilizer for agricultural purposes. Public health enlighten should be stepped up among the consumers of these vegetables.

Acknowledgement

The authors wish to acknowledge Dr. Kabir Abdullahi, Head of Zoology Unit, Usmanu Danfodiyo University, Sokoto, Nigeria, for his assistance, guidance and valuable suggestions toward completion of this research work.

References

Adeyeba, O. A. and Akinlabi A. M. 2002. Intestinal parasitic infections among school children. *American Society for Microbiology;* 437-446.

Auta, T., Kogi, E. and Oricha, K. A. 2013. Studies on the intestinal helminths infestation among primary school children in Gwagwada, Kaduna, North Western Nigeria. *Journal of Biology, Agriculture and Healthcare 3(7):* 48-53.

Auta, T., Wartu, J. R., Bawa, J. A. and Jabbi, A. M. 2014. A comparative study on the prevalence of intestinal helminthes among rural and sub-urban pupils in Gwagwada, Nigeria. *Journal of Parasitology and Vector* Biology *6(6):* 87-91.

Celia, V. H. and Walcolm, W. K. 2002. The geohelminths: *Ascaris, Trichura* and Hookworm. *World Class Parasite 2:* 1-75.

Cheesbrough, M. 1992. *Medical Laboratory Manual for Tropical Countries. (17) 2nd* University Press Cambridge. Batteworth and Company Ltd., pp. 323-341.

Cliver, D. O. 1997. Food Microbiology: Fundamentals and Frontiers Washinton, DC, *American Society for Microbiology,* 437-446.

Cowper, S.G. 1967. A review of helminthiasis in the Western Region of Nigeria with special cultivated on land irrigated with urban waste water in Zaria and Kaduna, Nigeria. *Nigerian Journal of Parasitology 22:* 95-104.

Ejezie, G. C. 1981. The parasitic diseases of school children in Lagos. *Acta Tropica 38:* 79-84.

Emeka, E.P., Inyama U., Nduka F. and Melariri, P. 2006. The role of the environment in the epidemiology of soil-transmitted human helminthic parasites (geohelminths) in Okigwe Imo State, Nigeria. *Journal of Research in Biosciences 2:* 28-32.

Eneanya, C. T and Njom, V. S. 2003. Geohelminth contamination of some common fruits and epidemiology of soil-transmitted human helminthic parasites (geohelminths) in Okigwe, Imo State, Nigeria. *Journal of Research in Biosciences 2:* 28-32.

Jeffery, H. and Leach, R. M. 1975. *Atlas of Medical Helminthology. 2nd Edition*. Longman Group Ltd. Hong Kong, 121.

Kang, G., Mathew, M. S., Rajan, D. P., Daniel, J. D., Mathan, M. M., Mathan, V. I. and Muliyil, J. P. 1998. Prevalence of intestinal parasites in rural Southern Indians. *Tropical Medicine and International Health 3(1):* 70-5.

Larry, R. B. 1998. *Surface decontamination of fruits and vegetables eaten raw*. A review. Food Ltd. Hong Kong, 121.

National Population Commission. 2006. Zamfara State Reports. Census 2006 Populations; from NPC Office, Gusau.

Nock, I. H., Duniya, D. and Galadima, M. 2003. Geohelminth eggs in soil and stool of pupils of some primary schools in Samaru, Zaria, Nigeria. *Nigerian Journal of Parasitology 24:* 115-22.

Nordberg, E. 2004. *Communicable Diseases; 3rd Edition.* A manual for health workers in sub- Sahara Africa. African Medical and Research Foundation. Nairobi, Kenya, pp. 192-207.

Sam-Wobo, S.O., Mafiana, C.F., and Idowu, O. 2004. Reinfection patterns of ascariasis among school children in Ogun State, Nigeria. *Nigerian Journal of Parasitology 25:* 7-13.

Shuval, H. I. 1989. *Guidelines for the safe use of wastewater and excreta in agriculture and aquaculture.* Measures for Public Health Production. Geneva. WHO. 72-73.

Topographic Sheet. 1990. *Gusau South-West Topographic Sheet, 2nd Edition*, (No. 54). Ailed Surveyors, P.O. Box 4118, Surulere, Lagos, with Scale of 1:50,000.

Umoh, V. J., Okafo, O. C. and Galadima, M. 2001. Contamination by helminthes of vegetables in Enugu, Southeast Nigeria. *The Nigerian Journal of Parasitology 24:* 1 23-128.

WHO. 1961. *Control of soil-transmitted helminth.* World Health Organization Geneva, 25-28.

WHO. 1991. *Basic Laboratory Methods in Medical Parasitology.* World Health Organization, Geneva, pp. 9-24.

WHO. 1998. Intestinal parasite control: Burden and trends. Document No. 17. WHO/CTD/SIP/98.1

WHO. 2008. *Soil-transmitted helminth, WHO Geneva, Epidemological Record,* 83-237-252. WHO/CDT/HTM/ 98:23.

ZADP. 2008. *Weather Reporting Format.* ADP-Zamfara State Agriculture Development Project. PCU/ADP Annex III Annual Report 2008.

Citation: Nasiru, M., Auta, T. and Bawa, J. A.
Geohelminth contamination of fruits and vegetables cultivated on land irrigated with waste-water in Gusau Local Government Area, Zamfara State, Nigeria.
The Zoologist, 13: 6-9 December 2015, ISSN 1596 972X.
Zoological Society of Nigeria.