Parasitological Analysis of Vegetables Grown by Urban Farmers in Lagos State, Nigeria

***Olusegun-Joseph, Taiye Shade., [1]Akande, David .O. [2] and Izuka, Lilian [1]**
[1]Department of Biological Sciences,
Yaba College of Technology,Yaba Lagos.
[2]Department of Public Health,
Nigeria Institute of Medical Research (NIMR), Lagos.

Abstract: Food borne parasitic diseases are prevalent in major poor regions of the world and abound where waste from definitive hosts contaminate food, resulting in infections commonly occurring in children and immunocompromised individuals. This study assessed the degree of parasitic contamination of vegetables grown in Lagos, Nigeria. Fifteen (15) different species of vegetables were collected from various farms in Lagos for a period of 2months from August to October. One hundred and thirty eight (138) samples of the vegetables were washed in three wash solutions; physiological saline, glycine buffer and distilled water. The resulting wash solutions were strained and centrifuged to concentrate the parasitic stages and examined with the aid of a light microscope. A prevalence of 58.7% (81 samples) parasitic contamination was found, with various parasites including Hookworm*, Ascaris lumbricoides, Entamoeba coli, Fasciola* spp,*Giardia lamblia* and *Strongyloides stercoralis*. Hookworm and *G. lamblia* were found in all farm locations surveyed. *Lactuca sativa* had the highest contamination (17.7 %).Sedimentation technique was more sensitive for detection with a higher parasitic recovery rate (77.4%) than flotation technique (22.6%).The difference however was not statistically significant($p > 0.05$). Physiological saline was found to have the capability of dislodging more parasitic stages(58.1%) than other wash solutions. These findings suggest evidence for high risk of acquiring parasitic infection from the consumption of raw vegetables when not properly and hygienically prepared. Proper handling, washing and cooking of vegetable products is strongly advocated to reduce risk of parasitic infections.
Keywords— Endoparasites, Faecal oral, Food safety, Hygiene.

INTRODUCTION

Vegetables are the fresh and edible portions of herbaceous plants eaten fresh or prepared in a number of ways (Damen *et al*., 2007). Vegetables form a major component of human diet and contain valuable food ingredients such as vitamins and mineral elements which can be successfully be utilized to repair the body(Pam *et al*., 2015).

Small scale farming in cities is promoted as a way to reduce urban poverty and enhance improved food security in the face of rapid population growth (Prain and Dubbeling, 2011).Farm produce are often cultivated on banks of drainage channels and road verges, also dumpsites can be converted to vegetable gardens due to lack of access to land in urban centres. Cultivation of edible vegetables on such soil can lead to contamination (Ateyese *et al*., 2009), as such, consumption of fresh but raw vegetables can be source of transmission of intestinal parasites if not properly washed (Amaechi *et al*., 2016). Fertilization and irrigation are key factors in securing food supplies in many developing countries. The use of wastewater for irrigation and application of animal dungs and human excreta as manure to vegetable crops is known to promote the transmission of parasitic infections to humans through the handling and consumption of such vegetables. The poor quality of water used for vegetable irrigation is one of the reasons for the presence of pathogens in fresh vegetables such as lettuces, tomatoes and onions (Kpoda *et al*., 2015). Contamination can also occur on the field during planting, harvesting, processing, distribution to markets or even at home (Omowaye and Audu, 2012)

Little information is available about activities of farmers before and after harvesting agricultural produce.

[1]*Correspondence: Email: shadefame@gmail.com +2348069146210

Hence, this study was conducted to evaluate and highlight parasitic contaminants of vegetables as a result of certain farming activities and to determine effective technique to dislodge parasitic stages from contaminated vegetables to reduce transmission of such parasites which may pose a health risk.

MATERIALS AND METHODS

Study site and sample collection

Lagos state is the most populous city in Nigeria, it occupies an area of 3,577sqkm located between longitude 2º 42'Eand 3º 22' E and between latitude 6º 22'N and 6º 42'N(Oteri and Ayeni, 2016). The average temperature in Lagos is 27ºc and average annual rainfall is 1693mm. Five (5) Local Government Areas (LGA) were chosen because they are major areas in Lagos with high population density and large farms were observed in the localities during pre-sampling periods. One to two farms in each of the LGA were selected for sample collection, selection was random. Well-structured questionnaires enquiring about their activities on the farm pre and post harvesting of the vegetables were administered to the farmers. The questionnaires were translated and filled for the illiterate farmers.

Laboratory Analysis for Isolation of Parasites

Different vegetables planted in each selected farm were harvested into labelled sterile bags and transported to the laboratory for parasitological analysis according to the protocol of Lalonde and Gajadh (2016).Hundred grams (100g) of each vegetable samples were placed in plastic bottles and shaken on an orbital shaker for 1minute with 250ml of each of the following wash buffers , separately to ensure adequate buffer-sample contact.A total of 138 wash buffer samples were obtained comprising of 46 samples each for glycine buffer, physiological saline solution and distilled water.Subsequently, each wash water was analyzed for parasitic contamination by sedimentation and floatation techniques and also evaluated for their effectiveness in dislodging parasitic forms from the following vegetable samples;*Telfairia occidentalisi* (Pumpkin), *Corchorus* sp(Jute, ewedu), *Vernonia amygdalina* (Bitter leaf), *Murraya koenigii* (Curry), *Talinum triangulare* (Water leaf), *Celosia argentea* (Cockscomb, Shoko), *Amaranthus hybridus* (Amaranths, Tete), *Solanium marcrocarpon* (Eggplant leaf), *Allium wakegi* (Spring onion), *Rumex acetosa* (Spinach Dock,Yakuwa), *Lactuca sativa* (Lettuce), *Apium graveolens* (Celery), *Mentha longifolia* (Mint leaf), *Moringa* leavesand *Ocimum gratissimum* (Basil, Scent leaf). The sediment and inverted slides were examined under a light microscope with a magnification of x40 for parasite ova, larvae and cysts (Lalonde and Gajadh, 2016).

Data was analyzed using SPSS 20.0, chi square test and analyses of variance (ANOVA) were used.P value is considered significant if < 0.05.

RESULTS AND DISCUSSION

Eighty one,81(58.7 %) out of a total of one hundred and thirty eight (138) samples comprising of 15 types of vegetables including *Telfairia occidentalisi* (Pumpkin), *Corchorus sp(*Jute, ewedu), *Vernonia amygdalina (*Bitter leaf*), Murraya koenigii (*Curry*), Talinum triangulare (*Water leaf*), Celosia argentea (*Cockscomb, Shoko*), Amaranthus hybridus (*Amaranths, Tete), *Solanium marcrocarpon (*Eggplant leaf*), Allium wakegi (*Spring onion*), Rumex acetosa (*Spinach Dock,Yakuwa), *Lactuca sativa (*Lettuce*), Apium graveolens (*Celery*), Mentha longifolia (*Mint leaf), *Moringa* leavesand *Ocimum gratissimum (*Basil, Scent leaf), were found to be contaminated with six parasitic forms including hookworm (23.2%), *Giardia lamblia* (16.7%), *Fasciola* (10.9%), *Entamoeba coli* (5.1%), *Ascaris ova* (2.2%), and *Strongyloides stercoralis (0.7)* (Table 1).

These parasites were encountered in several forms such as ova, larvae and cyst. Several investigations have indicated that vegetables can be agents for transmission of parasites (Idahosa, 2011, Jasem *et al*., 2013 and Alade *et al*., 2013). There was multiple contamination with hookworm, *G. lamblia* and *Fasciola* species recorded during the study. Out of the seven farms surveyed from the five LGAs, Idi-araba farm in Mushin Local Government Area had the highest rate of parasite contamination on the vegetable samples acquired from it (21.7%) while Iyana-oba farm from Ojo Local Government Area was found to have the least level of contamination on the vegetables obtained from it (5.8%).The higher parasitic contaminants obtained from Idi araba farm may be as a result of the dense population of the area with massively polluted environment which was observed during survey period. Parasitic contamination of farm produce depends on several factors including using contaminated water for irrigation, applying untreated or improperly composed manure as fertilizer, fecal contamination from domestic animals and human beings and post-harvest handling (Amaechi *et al* ., 2016).Responses from the questionnaire showed that most of the farmers used bagged animal dung as a form of fertilizer and waste water for irrigation of the crops.

Lactuca sativa (lettuce) was found to have the highest parasitic contamination (17.7 %). This is in agreement with the result obtained by Idahosa (2011). The high infestation can be attributed to their leafy and folded nature which provides surface area for the parasitic stages to stick. Hajjami *et al.,* (2013), suggested that vegetables with dense foliage such as lettuce are usually more contaminated since the dense foliage would protect the helminth eggs against unfavorable conditions

Physiological saline had the highest dislodging capacity (58.1%) while distilled water had the lowest number of parasite dislodged by it (Table 2). There was statistically significant difference found between physiological saline and distilled water in dislodging hookworm larva at 0.05 level. This is an indication that washing vegetables with salty water may get rid of the parasitic contaminants better than washing with tap water. Contrary to the result obtained in this study, Akoma *et al.,* (2017) reported that distilled water dislodged more parasitic organisms when compared with normal saline. Lalonde and Gajadh, (2016) in their findings demonstrated that some washing buffers and processing methods are more effective than others for recovery and detection of oocysts from leafy vegetables.

All the farms had high levels of contamination. This may be so in that, in 45% of the farms visited, the farmers claim to irrigate their vegetables with water from a walk-in well, 33% use borehole, 11% use ponds and 11% use rainfall (Fig 1) .Furthermore, the farmers showed more preference for the use of bagged animal dung to NPK (Fig 2).

Similarly, it was observed that almost half of the farmers surveyed wash their produce on the farm with the same water used for irrigation, some other equal number do not wash after harvesting while about 14% wash only when demanded by the customer (Fig 3). These post-harvest activities could have contributed to parasitic contamination of the vegetables.

Of the two parasitological techniques employed for detection, sedimentation technique was found to be more sensitive with a higher parasitic recovery rate (77.4%) than flotation technique (22.6%) (Table 3), the difference however was not statistically significant($p > 0.05$). Sedimentation technique recovered most of the ova, cyst and larvae and the morphology of most parasites were retained. Sedimentation method is thought to provide certain advantages over floatation method, including less distortion of organisms and enhanced recovery of operculated parasite eggs, this was well demonstrated in the work of Truant *et al.,* (1981).

The findings of this study is similar to previous works done by Damen *et al.*,(2007), Idahosa, (2011), Omowaye and Audu, (2012), Alade *et al.*,(2013) and Amaechi *et al.,* (2016) from different states in Nigeria, however, the overall result obtained in this present study do not exactly represent the findings of these previous researchers since the area of study differ in environmental conditions, geographical location, type and number of samples collected and isolation methods used. However the results obtained from this study differ from others in that it indicates clearly that the contamination level of infested vegetables can be reduced by the use of salted water for washing as oppose to use of naturally obtained water especially for vegetables that are eaten in their raw state.

Table 1: Parasites isolated from vegetables collected from farms in Lagos state.

Parasites	Total samples examined.	No of contaminated samples (%)
Hookworm	138	32 (23.2)
Giardia lamblia	138	23 (16.7)
Entamoeba coli	138	7 (5.1)
Strongyloides stercoralis larva	138	1 (0.7)
Fasciola ova and metacercaria	138	15 (10.9)
Ascaris ova	138	3 (2.2)

Table 2: Wash solution used on the vegetables.

Wash solution	Total number examined	Parasite dislodgment frequency (%)
Glycine buffer	46	17 (27.4)
Physiological saline	46	36 (58.1)
Distilled water	46	9 (14.5)
Total	138	62

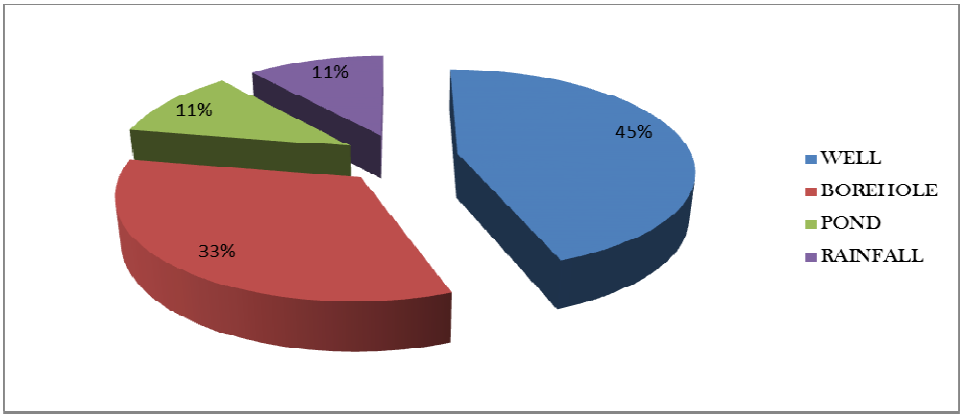

Fig. 1: Source of water supply at farm locations.

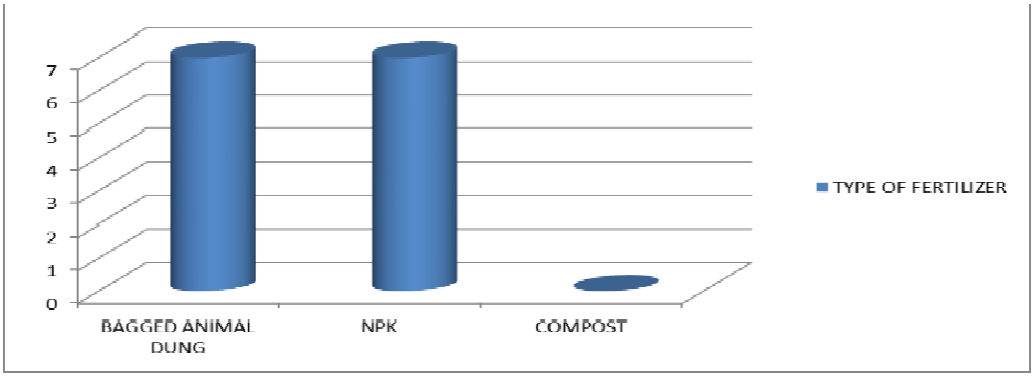

Fig. 2: Types of fertilizer applied to farmland

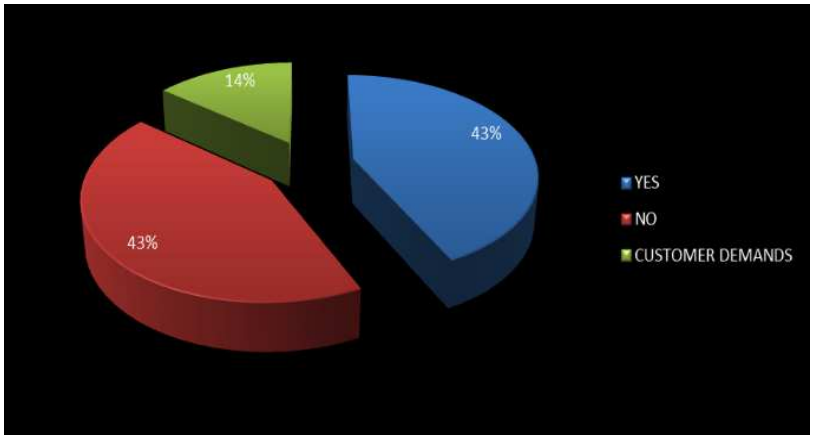

Fig. 3: Washing of farm produce after uprooting.

Table 3: Parasitological techniques

Techniques	**Frequency (%)**
Sedimentation technique	48 (77.4)
Flotation technique	14 (22.6)
Total	62

CONCLUSION

Vegetables consumed are often contaminated with parasites' eggs and cysts. This is indicated in the study conducted in Lagos , an urban area and humans are at risk of infection as vegetables are naturally part of human diet. This contamination is as a result of processes involved in the cultivation of these vegetables such as application of animal dung on to the soil, irrigation of the vegetables with wastewater and washing of the produce after harvesting with the same wastewater. Wastewater should be treated before being used to irrigate crops and farmers should be educated on proper composting of animal dungs while human faeces usage should be discouraged.NPK fertilizers should be made affordable and readily available to farmers. More importantly, vegetables that are eaten as salad, which are not cooked, should be properly washed with saline water.

Author's contributions

All authors contributed equally to the success of the paper. TSO conceived the idea and designed the study, TSO and LI carried out sample collection and questionnaire administration. DOA and LI carried out experimentation. All authors analysed and discussed the results and contributed to the final manuscript.

Conflict of interest

The authors declare that there is no conflict of interest.

Acknowledgments

Special thanks to staff of the Department of Public Health, Nigerian Institute of Medical Research and Mrs. Oluwarotimi of the Department of Cell Biology and Genetics, University of Lagos.

REFERENCES

Alade, G.O., Alade, T.O. and Adewuyi, I.K. (2013). Prevalence of Intestinal Parasites in Vegetables sold in Ilorin, Nigeria. *American-Eurasian Journal of Agricultural and Environmental Science,*13(9):1275-1282.

Akoma, O.N., Gbarabe, C.L. and Aminu, R.F. (2017). Parasitological Assessment of Selected Edible Fruits and Vegetables Sold At Some Markets in Lokoja, North Central Region of Nigeria in the Context of Disease Surveillance. *Microbiology & Infectious Diseases.* 1 (2): 1 – 6.

Amaechi, E. C., Ohaeri, C. C., Ukpai, O. M., & Adegbite, R. A. (2016). Prevalence of Parasitic contamination of salad vegetables in Ilorin, North Central, Nigeria. *Momona Ethiopian Journal of Science,* 8(2): 136-145.

Atayese, O.M., Eigbadon, A.I., Oluwa, K.A. and Adesodun, J.K. (2009). Heavy Metal Contamination of Amaranthus Grown Along Major Highways in Lagos, Nigeria. *African Crop Science Journal,*4(16):225-235.

Damen, J.G., Banwat, E.B., Egah, D.Z. and Allanana, J.A. (2007). Parasitic Contamination of Vegetables in Jos, Nigeria. *Annals of African Medicine,*3(6):115-118.

Hajjami, K., Ennaji, M. M., Amdiouni, H., Fouad, S. and Cohen, N. (2013). Parasitic contamination on fresh vegetables consumed in Casablanca City, Morocco and risk for consumers. *International Journal of Science and Technology,* 2(7): 543-549.

Idahosa O.T. (2011). Parasitic Contamination of fresh Vegetables sold in Jos Market. *Global Journal of Medical Research,*11(1):1-6.

Jasem, S., Reza, A. and Shahram, K. (2013). Prevalence of Intestinal Parasites in Vegetables consumed in Ahvaz, South West of Iran. *Journal of Medical Science,*13(6):488-492.

Kpoda, W.N., Oueda, A., Yelezouomin, S.C.S., Gueladio, C., Amadou, H.M. and Gustave, B.K. (2015). Physicochemical and Parasitological Quality of Vegetables Irrigation Water in Ouagadougou City, Burkina-Faso. *African Journal of Microbiology Research,*9(5):307-317.

Lalonde, F.L. and Gajadher, A.A. (2016). Optimization and Validation of Methods for Isolation and Real-Time PCR Identification of Protozoan Oocysts on Leafy Green Vegetables and Berry Fruits. *Journal of Food and Waterborne Parasitology,*2:1-7.

Omowaye, O.S. and Audu, P.A. (2012). Parasite Contamination and Distribution of Fruits and Vegetables in Kogi, Nigeria. *Journal of Biological Protocols,*1(1):44-47.

Oteri, A. and Ayeni, R. A. (2016). The Lagos Megacity. *Water, Megacities, and Global Change.*

Pam, D.D., Pam, V.A., Ogbu, K.I. and Bot, C.J. (2015). Intensity of Contamination of Vegetables in Different Markets in Jos South Local Government Area of Plateau State. *Greener Journal of Agricultural Sciences,*6(5):217-222.

Prain, G. and Dubbeling, M. (2011). Urban Agriculture: A Sustainable Solution to Alleviating Urban Poverty, Addressing the Food Crisis, and Adapting to Climate Change. Synthesis report on five case studies of the cities of Accra, Nairobi, Lima, and Bangalore prepared for the World Bank. Leusden: RUAF Foundation.

Truant, A. L., Elliott, S. H., Kelly, M. T. and Smith, J. H. (1981). Comparison of formalin-ethyl ether sedimentation, formalin-ethyl acetate sedimentation, and zinc sulfate flotation techniques for detection of intestinal parasites. *Journal of Clinical Microbiology***,**13(5), 882-884.