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Parasite Contamination of Common Fruits and Vegetables from Selected Markets in Awka-North and Awka-South Local Government Areas, Anambra State, Nigeria

Pauline Ukamaka Umeanaeto[1], Queenette Eberechukwu Chukwuma[1], Goodness Nkiru Itemba[1], Kindness Chidi Irikannu[1*], Joseph Uche Anumba[2], Chukwudinma Chigozie Okoli[3] and Justina Chimezie Akulue[4]

[1]Department of Parasitology and Entomology, Nnamdi Azikiwe University, Awka, Nigeria.
[2]Federal Ministry of Health, National Arbovirus and Vectors Research Centre, Enugu, Nigeria.
[3]Hospital Management Board, Laboratory Unit, Kuje General Hospital, FCTA, Abuja, Nigeria.
[4]Department of Medical Laboratory Science, Nnamdi Azikiwe University, Nnewi Campus, Nigeria.

Authors' contributions

This work was carried out in collaboration among all authors. Authors PUU, QEC, GNI and JCA designed the study. Authors PUU, JUA and KCI performed the statistical analysis. Authors PUU, KCI and CCO wrote the protocol. Authors PUU, JUA and JCA managed the analyses of the study. Authors QEC, GNI, CCO and KCI managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Background: The practice of eating raw fruits and vegetables has led to infection with various parasitic diseases. Some flies species has been reported as mechanical transmitters of parasites and so contribute to the spread of the disease-causing organisms on fruits and vegetables. Edible vegetables and fruits sold in selected markets in Awka-North and Awka-South LGAs, Anambra State, Nigeria were examined for parasites between April and August 2018.

**Corresponding author: E-mail: kc.irikannu@unizik.edu.ng;*

Materials and Methods: Three different fruits (Garden egg: *Solanium macrocarpon*, Local Pear: *Dacryodes edulis* and Orange: *Citrus sinensis*) and four different vegetables (Spinach: *Amaranthus cruentus*, Fluted pumpkin: *Telfairia occidentalis*, Scent leaf: *Ocimum grattissumum*, Garden egg leaf: *Solanium macrocarpon*) were collected. One hundred grams (100g) of each sample was washed separately in beakers containing 100 ml of normal saline. The resulting suspension was sieved to remove debris. Each filtrate was then transferred to a clean labelled specimen bottle and was examined for parasites using floatation and sedimentation techniques.

Results: Of 303 vegetables and fruits samples examined, 167(55.1%) were contaminated [Fruits: 58/135=41.4%; Vegetables: 109/168=64.9%]. Of 90 fruits and 108 vegetables examined in Awka-North markets, 41(45.6%) and 83(76.9%) were contaminated respectively. Of 45 fruits and 60 vegetables examined in Awka-South markets, 17(37.8%) and 26(43.3%) were contaminated respectively. There was higher contamination of fruits and vegetables in Awka-North, 124(62.6%) than Awka-South, 43(41.0%). The overall prevalence was statistically significant ($p < 0.05$) using χ^2. Orange 22(16.3%) was the highest contaminated fruit while Fluted pumpkin 29(17.2%) was the highest contaminated vegetable although not significant ($p > 0.05$). *Ascaris lumbricoides* was the most prevalent parasite recovered on Fruits, 22(16.3%) and vegetables, 41(24.4%).

Conclusion: This investigation has revealed that some fruits and vegetables in the study areas were contaminated with parasites. Therefore, fruits and vegetables should be properly washed and vegetables cooked before consumption to avoid parasite transmission.

Keywords: Parasite; contamination; fruits; vegetables; Ascaris lumbricoides.

1. INTRODUCTION

Vegetables are portions of roots, stems and leaves of some plants [1] while fruits are fleshy seeds of plants that are edible in the raw state [2]. Vegetables are an important ingredient of a healthy diet [3,4] which supply man with essential supplements, but could also become vehicles for soil-transmitted helminth (STH) parasites [5]. Observation has revealed that vegetable consumption can also be a means of transmitting other parasitic diseases to man [6].

Some cyclorrhaphan flies has been reported as mechanical transmitters of parasites and so contribute to the spread of the disease causing organisms among fruits and vegetable sellers [7]. Hookworm ova, *A. lumbricoides* ova, *Trichuris trichiura* ova, *Strongyloides stercoralis* larvae and a protozoan parasite *Entamoeba histolytica* cyst, have all been isolated from the external body surfaces of flies, fruits and vegetables and *Musca domestica* was reported as the highest carrier of the helminthes and protozoan parasites [7,8,9,10,11,12]. Therefore, consumption of these fruits and vegetables when inadequately washed or undercooked may lead to ingestion of eggs, cysts and larvae of these parasites [13,14].

Poor sanitation, lack of good water, inadequate facilities and poor hygienic cultures encourage the transmission of the parasites. Contamination of vegetables depends on some factors such as the use of water supplies contaminated with sewage for irrigation, post-harvest handling, transportation and unhygienic practices in fruit and vegetable delivery [15]. The purpose of this study was to investigate the extent of parasite contamination of fruits and vegetables sold in selected markets in the study area.

2. MATERIALS AND METHODS

2.1 Study Area

The study was conducted in selected markets in Awka-North and Awka-South LGAs. Awka-North and Awka-South have a population of 148,400 and 301,657 respectively [16]. The LGAs are located in the tropical rainforest zone of Nigeria. The study area lies between the coordinates of $6^0$10N and $7^0$04E. The annual rainfall is about 2000-3000mm. Temperature ranges from 23.4^0C to 29.9^0C while relative humidity is between 60 to 80% [16]. The majority of the inhabitants of the area are farmers, others are traders dealing of vegetables, fruits and other farm produce. A few are civil servants and artisans, while others are blacksmiths producing farming equipment.

2.2 Specimen Collection

The fruits and vegetables were randomly selected from different selling points in 3 markets (Orie Amansea, Orie Urum and Orie Achalla) in Awka-North and 3 markets (Eke Awka, Nkwo Amaenyi and Ifite market) in Awka-South. A total of 303 specimens (135 fruits specimens and 168

vegetables) were sampled. The vegetables obtained were Fluted pumpkin (*T. occidentalis*), Spinach (*A. cruentus*), Scent leaf (*O. grattissumum*) and Garden egg leaves (*S. macrocarpon*) while the fruits include Garden egg fruit (*S. macrocarpon*), African pear (*D. edulis*) and Orange (*C. sinensis).* They were purchased in the morning between 8.00 and 10.00hrs to ensure their freshness. The fruits and vegetables were collected into properly labelled polythene bags and transported to the laboratory of the Department of Parasitology and Entomology, Nnamdi Azikiwe University, Awka, for examination.

2.3 Examination of Specimens

One hundred grams (100g) of each sample was washed separately in beakers containing 100ml of normal saline. The resulting suspension was sieved to remove debris. Each filtrate was then transferred to a clean specimen bottle and labelled. Floatation and sedimentation techniques were used for the examination [17].

2.3.1 Floatation techniques

Zinc sulphate solution (1.18-1.20 specific gravity) was used for the study. The specific gravity of the solutions was determined using hydrometer. A test tube half-filled with the suspension resulting from the washing of the fruits and vegetable was then filled to the brim with 5ml of zinc sulphate solution. A clean, grease-free coverslip was placed on top of the tube with care to avoid trapping air bubbles. The test tube was then allowed to stand for 20 minutes, then coverslip carefully removed and placed face-downwards on a slide and was examined microscopically using a 10X objective. After a drop of Lugol's iodine was dropped through the edge of the coverslip, it was then examined with a 40X objective to identify the eggs of helminths.

2.3.2 Sedimentation techniques

This method was employed for the detection of eggs of helminths and cysts of protozoa. A clean, sterile centrifuge tube half-filled with the suspension from the washing of the fruits and vegetable was centrifuged at 1,006 ×g for one minute. The supernatant was decanted and about 1gram of the sediments was placed on a clean glass slide, covered with a coverslip and examined under a 10X objective of the microscope. After, a drop of Lugol's iodine was dropped through the edge of the coverslip, then re-examined under 40X objective lens to identify the protozoa cysts and eggs of helminths.

2.4 Data Analysis

The data were subjected to statistical analysis using the SPSS version 16.0 computer package. T-test and Chi-square test were used to compare the significant differences.

3. RESULTS

Of the 303 vegetables and fruits samples collected, 167(55.1%) were contaminated with parasites. In Awka-North, fruits 41(45.6%) and vegetables 83(76.9%) were contaminated, while in Awka-South, fruits 17(37.8%) and vegetables 26(43.3%) were also contaminated with parasites. Parasites contamination of fruits and vegetables was highest in Awka-North 124(62.6%) while the least 43(41.0%) was observed in Awka-South. There was a significant difference ($p < 0.05$) using χ^2 (Table 1).

Cumulatively, Orange 22(16.3%) was the highest parasite contaminated fruit in the entire study area while Garden egg fruit and Local pear were the least having equal numbers of 17(12.6%) each (Table 2). Fluted pumpkin and Scent leaf were the highest contaminated vegetables also in equal numbers of 29(17.2%) each, while Garden egg leaf 26(15.5%) was the least. Parasite contaminated Spinach was 27(16.1%). There was no significant difference in the level of contamination between the fruits and the vegetables ($p > 0.05$).

In the markets in Awka-North, Orie Achalla had the highest contaminated fruits 24(26.7%) and vegetables 35(32.4%). Others were fruits 16(17.7%) and vegetables 24(22.2%) from Orie Amansea, and fruits 10(11.1%) and vegetables 15(13.9%) from Orie Urum (Table 3).

In the markets in Awka-South, Eke Awka had the highest contaminated fruits 7(15.6%) and vegetables 11(18.3%). Others were fruits 4(8.9%) and vegetables 6(10.0%) from Nkwo Amaenyi, and fruits 6(13.3%) and vegetables 9(15.0%) from Ifite market (Table 4). There was no significant difference in parasite contamination between the fruits and vegetable across the markets ($p > 0.05$).

Fruits 22(16.3%) and vegetables 41(24.4%) were contaminated more with *A. lumbricoides* than

other parasites (Table 5). Other parasite contaminations were fruits 7(5.2%) and vegetables 10(6.0%) by *S. stercoralis*, fruits 9(6.7%) and vegetables 16(9.5%) by Hookworm, fruits 8(5.9%) and vegetables 21(12.5%) by *T. trichiura*, fruits 10(1.5%) and vegetables 23(5.4%) by cyst of *E. hystolytica*. The distribution of parasites among fruits and vegetables was not significant ($p > 0.05$).

4. DISCUSSION

The overall parasitic contamination of 55.1% recorded in this study was slightly lower than 57.8% reported in fruits and vegetables from selected local markets of Jimma Town, Southwest Ethiopia [18], but higher than 37.5% reported in Lafia markets, Nasarawa State [14], 11.87% in Kogi, Nigeria [19] and 16.33% in Akure metropolis, Ondo State, Nigeria [12]. The contamination could have resulted from lack of modern toilet facilities, inadequate public health enlightenment and ignorance that make people defaecate indiscriminately resulting in pollution of water bodies and farmland. *Ascaris lumbricoides* was the most prevalent parasite, followed by hookworm and *T. trichiura.* This study observed that these parasites thrive on fruits and vegetables because they are cultivated in the tropics and tropical climate which provides a conducive atmosphere for the development of helminth parasites. This observation is in line with previous reports [1,2,9,20,21].

Table 1. Prevalence of parasites of edible fruits and vegetables in Awka-North and Awka-South LGAs

Items	Awka-North		Awka-South	
	No. examined	No. positive (%)	No. examined	No. positive (%)
Fruits	90	41(45.6)	45	17(37.8)
Vegetables	108	83(76.9)	60	26(43.3)
Total	198	124(62.6)	105	43(41.0)

p value= .027639 ($p < 0.05$)

Table 2. Different fruits and vegetables contaminated with parasites in Awka-North and Awka-South LGAs

Items	Number examined	Awka-North Number positive (%)	Awka-South Number positive (%)	Total
Fruits				
Garden egg fruit	45	15(33.3)	2(4.4)	17(12.6)
Local Pear	45	9(20.0)	8(17.8)	17(12.6)
Orange	45	15(33.3)	7(15.6)	22(16.3)
Subtotal	135	39(28.9)	17(12.6)	56(41.4)
Vegetables				
Spinach	42	21(50.0)	4(9.5)	27(16.1)
Fluted pumpkin	42	25(59.5)	4(9.5)	29(17.2)
Scent leaf	42	17(40.5)	12(28.6)	29(17.2)
Garden egg leaf	42	20(47.6)	6(14.2)	26(15.5)
Subtotal	168	83(49.4)	26(15.5)	109(64.9)
Total	303	124(40.9)	43(14.2)	167(55.1)

p value =.254358 ($p > 0.05$)

Table 3. Contaminated fruits and vegetables in selected markets of Awka-North LGA

Items	No. examined	Orie Amansea No. positive (%)	Orie Urum No. positive (%)	Orie Achalla No. positive (%)	Total
Fruits					
Garden egg fruit	30	7(23.3)	0	8(26.7)	15(16.7)
Local Pear	30	4(13.3)	5(16.7)	10(33.3)	19(21.1)
Orange	30	5(16.7)	5(16.7)	6(20.0)	16(17.7)
Subtotal	90	16(17.7)	10(11.1)	24(26.7)	50(55.6)
Vegetables					
Spinach	27	3(11.1)	4(14.8)	10(37.0)	17(15.7)
Fluted pumpkin	27	7(25.9)	0	11(40.7)	18(16.7)
Scent leaf	27	9(33.3)	4(14.8)	11(40.7)	24(22.2)
Garden egg leaf	27	5(18.5)	3(11.1)	3(11.1)	11(10.2)
Subtotal	108	24(22.2)	15(13.9)	35(32.4)	74(68.5)
Total	198	40(20.2)	25(12.6)	59(29.7)	124(62.6)

p value =.157879 (p > 0.05)

Table 4. Contaminated fruits and vegetables in selected markets of Awka-South LGA

Items	No. examined	Eke Awka No. positive (%)	Nkwo Amaenyi No. positive (%)	Ifite Market No. positive (%)	Total
Fruits					
Garden egg fruit	15	1(6.7)	0	1(6.7)	2(4.4)
Local Pear	15	3(20.0)	2(13.3)	3(20.0)	8(17.8)
Orange	15	3(20.0)	2(13.3)	2(13.3)	7(15.6)
Subtotal	45	7(15.6)	4(8.9)	6(13.3)	17(37.8)
Vegetables					
Spinach	15	2(13.3)	1(6.7)	1(6.7)	4(6.7)
Fluted pumpkin	15	1(6.7)	1(6.7)	2(13.3)	4(6.7)
Scent leaf	15	6(40.0)	3(20.0)	3(20.0)	12(20.0)
Garden egg leaf	15	2(13.3)	1(6.7)	3(20.0)	6(10.0)
Subtotal	60	11(18.3)	6(10.0)	9(15.0)	26(43.3)
Total	105	18(17.1)	10(9.5)	15(14.3)	43(41.0)

p value = .20283 (p > 0.059)

Orange was the highest contaminated fruit while Fluted pumpkin was the highest contaminated vegetable. Low growth vegetables seem to be more exposed to contamination with parasite stages during high rainfall and floods, unlike high growth vegetables. The tendency of fluted pumpkin growing near the soil and trailing on the soil predisposes them to contamination with various types of parasites which normally undergo part of their development in the soil. Soil contaminated as such may through rain splashing or flooding cause geohelminths ova/larvae in faeces to be lifted above the soil surface. Orange has infoldings that can retain parasites even after washing. These findings are also in agreement with previous observations in other studies [9,20,22]. There was higher contamination of fruits and vegetables in Awka-North than Awka-South. The level of sanitation of the market premises may play a role since Awka-North is more rural than Awka-South and environmental sanitation is more effective in Awka-South.

Table 5. Species of parasites recovered from contaminated fruits and vegetables in Awka-North and Awka-South LGA

Items	No. examined	*Ascaris lumbricoides* (%)	*Strongyloides stercoralis* (%)	Hookwom (%)	*Trichuris trichiura* (%)	Cyst of *Entamoeba histolytica* (%)	Total (%)
Fruits							
Garden egg fruit	45	7(15.6)	1(2.2)	0	0	3(6.7)	11(8.1)
Local Pear	45	9(20.0)	3(6.7)	4(8.9)	3(6.7)	7(15.6)	26(57.8)
Orange	45	6(13.3)	4(8.9)	4(8.9)	5(11.1)	0	19(42.2)
Subtotal	135	22(16.3)	7(5.2)	9(6.7)	8(5.9)	10(1.5)	56(41.5)
Vegetables							
Spinach	42	12(28.6)	1(2.4)	3(7.1)	4(9.5)	5(4.8)	25(14.8)
Fluted pumpkin	42	12(28.6)	2(4.8)	4(9.5)	13(31.0)	5(4.8)	36(21.4)
Scent leaf	42	10(23.8)	5(11.9)	6(14.3)	2(4.8)	6(7.1)	29(17.3)
Garden egg leaf	42	7(16.7)	2(4.8)	3(7.1)	2(4.8)	7(4.8)	12(12.5)
Subtotal	168	41(24.4)	10(6.0)	16(9.5)	21(12.5)	23(5.4)	111(66.1)
Total	303	63(20.8)	17(5.6)	25(8.3)	29(9.6)	33(3.6)	167(55.1)

p value=.278602 (p > 0.05)

5. CONCLUSION

The recovery of protozoan cysts, helminthes eggs and larvae from the local vegetables meant for consumption is of great public health significance. The potential risk of contracting intestinal parasite infections remain the ingestion of locally grown unwashed fruits and vegetables. Proper washing of vegetables and fruits should always be performed to avoid the transmission of intestinal parasites. An adequate treatment of water used for the irrigation of plants should be implemented.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Amaechi EC, Ohaeri CC, Ukpai OM, Adegbite RA. Prevalence of parasitic contamination of salad vegetables in Ilorin, North Central, Nigeria. Momona Ethiopian Journal of Science. 2016;8(2):136-145.
2. Yoila DM, Utitofon IT. The prevalence of intestinal parasites on fruits sold in markets around Gwagwalada area council, F.C.T. Abuja. American Association for Science and Technology Communications. 2016; 3(2):107-11.
3. Micheal HJ. High prevalence of positive culture and parasites in stool samples of food handlers in a Thai hospital setting. Med Gen Med. 2009;4(8):1-3.
4. Abougrain AK, Nahasi MH, Madi NS, Saied MM, Ghenghesh KS. Parasitological contamination in salad vegetables in Tripoli-Libya. Journal of Food Control. 2010;21(5): 760-762.
5. Ikpeze OO, Chima SC. Soil-transmitted Helminth Parasites contaminating Edible Raw Vegetables and Fruits sold at Nkwo-Edo Market Nnewi, Nigeria. The Bioscientist. 2017;5(1):65-72.
6. World Health Organization (WHO). Surface decontamination of fruits and vegetables eaten raw. Food Safety. WHO/FSF/FOSI/ 98.2; 2012.
7. Umeanaeto PU, Igbokwe CC, Onyido AE. Irikannu KC, Ifeanyichukwu MO. Parasites associated with cyclorrhaphan flies caught in selected abattoirs in Awka North and Awka South local Government areas, Anambra state, South Eastern Nigeria. New York Science Journal. 2017;10(8):62-67.
8. Ngele Kk, Ali AN, Aligwe EN, Ujaa ME, Ujum CI. Prevalence of parasitic ova/cysts on fruits and vegetables sold in Afikpo North Local Government Area, Ebonyi State, Nigeria. Journal of Bioscience and Biotechnology Discovery. 2017;2:104-109.
9. Umeanaeto PU, Nwofor OF, Iwueze MO, Ugwuanyi IK, Egbuche CM, Igbodika CM. Parasite contamination of edible vegetables sold in Onitsha markets. The Bioscientist Journal. 2016;4(1):21-31.
10. Akinseye JF, Ayuba SB, Adewuyi IK, Agunlejika RA. Isolation of intestinal parasites in vegetables sold in major markets in Akure, Ondo State, Nigeria. International Journal of Health Sciences and Research. 2017;7(6): 78-83.
11. Center for Disease Control Prevention (CDC). Epidemiological information 4th Edition, Atlanta, and U.S.A. 2010;50-55.
12. Simon-Oke IA, Afolabi OJ, Obasola OP. ParasiticContamination of Fruits and Vegetables sold at Akure Metropolis, Ondo State, Nigeria. Researcher. 2014;6(12):30-35.
13. Fitsum B, Tamirat T, Gelila B, Tsegaye Y. Parasitic contamination of raw vegetables and fruits collected from selected local markets in Arba Minch town, Southern Ethiopia. Infectious Diseases of Poverty. 2017;6(24):123-128.
14. Abe EM, Ajah LJ, Ayuba SO, Mogaji H, Ekpo UF. Geohelminths contamination of fruits and vegetables sold in Lafia markets. Annual Research & Review in Biology. 2006;11(2):1-8.
15. Wegayehu T, Tsalla T, Seifu B, Teklu T. Prevalence of intestinal parasitic infections among highland and lowland dwellers in Gamo area, South Ethiopia. Substance Abuse Treatment Prevention and Policy. 2013;4(13):151.
16. National Population Commission of Nigeria (NPC). Population distribution in local Government areas by sex and number of households. legal notices on publication of the details of the breakdown of the national and state provisional population census totals. Official Gazette. 2006;94(24).

17. Cheesbrough M. Examination of blood for malaria parasite. District Laboratory Practice in Tropical Parasite Contamination. Countries Part 1. Cambridge Low Price Edition. 2006:239-258.
18. Tamirat T, Abdissa B, Zeleke M, Teferi E. Parasitic contamination of fruits and vegetables collected from selected local markets of Jimma Town Southwest Ethiopia. International Scholarly Research Notices. 2014;10:2-7.
19. Omowaye OS, Audu PA. Parasites contamination and distribution on fruits and vegetables in Kogi, Nigeria, CIBTech Journal of Bio-Protocols. 2012;1(1):44-47.
20. Oranusi S, Braide W, Etinosa-Okankan OJ. Prevalence of geohelminths on selected fruits and vegetables sold in Owerri, Imo State Nigeria. African Journal of Food Science and Technology. 2013;4(2):35-43.
21. Nasiru M, Auta T, Bawa JA. Geohelminth contamination of fruits and vegetables cultivated on land irrigated with waste water in Gusau Local Government Area, Zamfara State, Nigeria. The Zoologist. 2015;13:7-10.
22. Wafa A. Prevalence intestinal parasites in leafy vegetables in Riyadh, Saudi Arabia International Journal of Tropical Medicine. 2010;5(2):20-23.

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