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DIVERSITY AND DISTRIBUTION OF PATHOGENIC PARASITES IN FRESH PRODUCE SOLD IN LOCAL MARKETS OF GWAGWALADA AREA COUNCIL, FCT, ABUJA, NIGERIA

By

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Abstract

Fresh produce can harbour diverse parasitic species with varying public health significance. Understanding the composition and distribution of these parasites across different fruits and vegetables is essential for targeted interventions. This study investigated the diversity, prevalence, and distribution of pathogenic parasites in commonly consumed fruits and vegetables sold in local markets of Gwagwalada Area Council, FCT, Abuja, Nigeria. A cross-sectional study was conducted in December 2023 across three markets (Iddo Modern Market, Barko Market, and Fruits Market). A total of 150 samples comprising five fruits (orange, pawpaw, watermelon, pineapple, banana) and five vegetables (cucumber, cabbage, carrot, pumpkin leaf, garden egg leaf) were analysed using sedimentation and flotation techniques with microscopic identification. Parasite species were identified based on morphological criteria, and their distribution across produce types was analysed using descriptive statistics and chi-square tests at $P \leq 0.05$. Eight parasite species belonging to two genera; helminths (Ascaris lumbricoides, Strongyloides stercoralis, Hookworm, Enterobius vermicularis, Trichuris trichiura) and protozoans (Entamoeba histolytica, Cryptosporidium parvum, Giardia lamblia) were detected across 212 total parasitic isolates. A. lumbricoides (21.23%) and S. stercoralis (18.87%) were the most prevalent, while T. trichiura (1.89%) was the least. Cabbage harboured the highest number of parasite isolates (40/212, 18.9%), followed by carrot (36/212, 17.0%), while orange had the fewest (6/212, 2.8%). A significant association was found between parasite species and produce type ($\chi^2 = 90.601$, $df = 63$, $P = .013$). A diverse array of pathogenic parasites contaminates fresh produce in Iddo markets, with helminths predominating in vegetables and protozoans showing relatively higher occurrence in fruits. Cabbage and carrot emerged as the highest risk produce types for parasitic diversity. These findings emphasize the need for species-specific surveillance and targeted food safety interventions.

Keywords: *parasite diversity, Ascaris lumbricoides, Strongyloides stercoralis, helminths, protozoa, fresh produce, Nigeria*

I. INTRODUCTION

Parasitic foodborne infections represent a significant global public health burden, with the World Health Organization categorizing parasites among the six most harmful infectious diseases of humans (Wafaa & Hussein, 2017). Approximately 107 known parasite species can be transmitted through food, including protozoa such as *Cryptosporidium spp., Giardia intestinalis, and Cyclospora cayetanensis,* and helminths such as *Ascaris lumbricoides, Trichuris trichiura, and Enterobius vermicularis* (Wafaa & Hussein, 2017; Slifko *et al.*, 2000). Fresh fruits and vegetables, particularly those consumed raw or minimally processed, serve as important vehicles for the transmission of these parasites (Beuchat, 2002; Daryani *et al.*, 2012).

The diversity of parasites found in fresh produce is influenced by multiple factors including agricultural practices, water quality, soil contamination, and post-harvest handling. The use of untreated human and animal dung as fertilizer in vegetable cultivation is a major driver of parasitic contamination, particularly for soil-transmitted helminths (Luca *et al*., 2000; Adamu *et al*., 2018). Contaminated irrigation water, poor sanitation in farming communities, and inadequate post-harvest hygiene further contribute to the presence of diverse parasitic species on produce (Amahmid *et al*., 2002; Adanir & Tasci, 2013).

Studies across different geographical regions have documented varying parasite profiles in fresh produce. In Nigeria, Adamu *et al*. (2018) identified *Ascaris lumbricoides*, *Entamoeba histolytica*, and *Giardia lamblia* as significant contaminants of fruits and vegetables sold in Sokoto State. In Ghana, Duedu *et al*. (2015) reported *Entamoeba histolytica* and *Giardia lamblia* as commonly detected parasites in fresh produce. In Vietnam, Uga *et al*. (2009) found eggs of *Ascaris*, *Trichuris*, *Toxocara*, *Taenia*, and *Ascaridia galli* in vegetables from suburban markets. These studies collectively highlight the diverse parasitic communities that can contaminate fresh produce, with species composition varying by region, agricultural practices, and produce type.

An important characteristic of many of these parasites is the production of highly resistant cysts and ova that can survive for extended periods in water, soil, and on produce surfaces (Abougrain *et al*., 2010). While mortality from these infections is relatively low, their indirect effects have substantial impacts on health and quality of life, including childhood diarrhoea, malnutrition, stunted growth, and cognitive impairment (Slifko *et al*., 2000). Vulnerable populations such as children, pregnant women, the elderly, and immunocompromised individuals are at heightened risk (Cleaveland *et al*., 2001).

Despite the acknowledged importance of parasitic contamination in fresh produce, there is a lack of data on the diversity and species-level distribution of parasites in fruits and vegetables sold in local markets within the Federal Capital Territory (FCT), Abuja, Nigeria. Understanding which parasite species are present, their relative prevalence, and their distribution across different produce types is essential for developing species-specific surveillance, treatment, and prevention strategies. This study aimed to determine the diversity and distribution of pathogenic parasites in commonly consumed fruits and vegetables sold in local markets of Iddo community, Gwagwalada Area Council, FCT, Abuja, Nigeria.

II. MATERIALS AND METHODS

2.1 Study Area

This study was conducted in Iddo community, Gwagwalada Area Council, approximately 35 km from Abuja, FCT, Nigeria (latitude 8°55′–9°00′N; longitude 7°00′–7°05′E). The climate is tropical, with temperatures of 30–37°C and annual rainfall of approximately 1,650 mm (Balogun, 2011). Residents are primarily small-scale farmers who also engage in livestock rearing and trade (Olayinka & Adewale, 2020).

2.2 Study Design and Sample Collection

A cross-sectional, purposive study was conducted in December 2023 across three markets: Iddo Modern Market, Barko Market, and Fruits Market. Five fruits (orange, pawpaw, watermelon, pineapple, banana) and five vegetables (cucumber, cabbage, carrot, pumpkin leaf, garden egg leaf) were selected based on popularity and local availability. Five samples of each produce type were collected from each market (5 × 10 × 3 = 150 samples). Samples were collected in sterile, labelled plastic bags and transported in insulated containers to the Department of Biological Sciences laboratory, University of Abuja.

2.3 Laboratory Analysis

Sample Preparation. Each sample was washed with sterile distilled water and homogenized in a blender. For each sample, 100 g of material was homogenized with 500 mL of physiological saline (0.9% NaCl) at a 1:5 (w/v) ratio (Nyarango *et al*., 2003).

Sedimentation. A 15-mL aliquot of homogenate was centrifuged at 1,500 rpm for 10 minutes. The supernatant was decanted, and the sediment was washed with physiological saline (Damen *et al*., 2007).

Microscopic Examination. Smears were prepared from washed sediment on glass slides with Lugol's iodine and examined under a compound light microscope at 10× and 40×. For lighter parasites (*Giardia lamblia*, *Cryptosporidium parvum*), a flotation technique using zinc sulphate with centrifugation at 1,000 rpm for 5 minutes was employed. Acid-fast staining (*Cryptosporidium*) and trichrome staining (*Giardia*) were used where necessary. Parasites were identified based on morphological criteria, size, shape, colour, internal structures, and staining patterns as outlined by WHO (2018).

Quality Control. Positive and negative control samples were included in each analytical batch. Qualified laboratory technicians verified parasite identification.

2.4 Statistical Analysis

Data were analysed using SPSS version 27 (IBM Corp., Armonk, NY). Frequencies and percentages were used to describe parasite diversity and distribution. Chi-square tests assessed associations between parasite species and produce types at $P \leq 0.05$.

2.5 Ethical Considerations

This study was approved by the Department of Biological Sciences, University of Abuja, FCT., Abuja, Nigeria.

III. RESULT

3.1 Diversity of Parasitic Species Detected

Eight parasite species belonging to two genera were identified across the 150 samples examined. These comprised five helminth species: *Ascaris lumbricoides*, *Strongyloides stercoralis*, Hookworm, *Enterobius vermicularis*, and *Trichuris trichiura*, and three protozoan species; *Entamoeba histolytica*, *Cryptosporidium parvum*, and *Giardia lamblia*. A

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total of 212 parasitic isolates were recovered from contaminated samples.

3.2 Prevalence of Detected Parasite Species

A. lumbricoides was the most prevalent parasite, accounting for 45 of 212 isolates (21.23%), followed by *S. stercoralis* at 40 isolates (18.87%). *E. histolytica* and *C. parvum* each contributed 30 isolates (14.15%). *G. lamblia* accounted for 24 isolates (11.32%), Hookworm for 23 (10.85%), *E. vermicularis* for 16 (7.55%), and *T. trichiura* was the least prevalent at 4 isolates (1.89%) (Table 1; Figure 1).

Table 1. Occurrence and Distribution of Various Parasitic Contaminants in Fruits and Vegetables at Iddo Markets, Abuja (N = 212 isolates)

Detected Parasite Species	Orange	Pawpaw	Water Melon	Pineapple	Banana	Cucumber	Cabbage	Carrot	Pumpkin Leaf	Garden Egg	Total	%
Ascaris lumbricoides	2	5	4	2	7	7	4	4	5	5	**45**	**21.23**
Entamoeba histolytica	1	2	4	0	5	3	9	6	0	0	**30**	**14.15**
Giardia lamblia	0	4	3	0	6	2	5	4	0	0	**24**	**11.32**
Hookworm	1	1	0	1	2	3	4	5	4	2	**23**	**10.85**
Trichuris trichiura	0	0	0	2	0	0	1	0	1	0	**4**	**1.89**
Enterobius vermicularis	2	2	4	3	2	0	0	2	0	1	**16**	**7.55**
Strongyloides stercoralis	0	1	2	1	2	5	10	9	5	5	**40**	**18.87**
Cryptosporidium parvum	0	0	2	4	2	3	7	6	3	3	**30**	**14.15**
Overall Distribution	6	15	19	13	26	23	40	36	18	16	212	

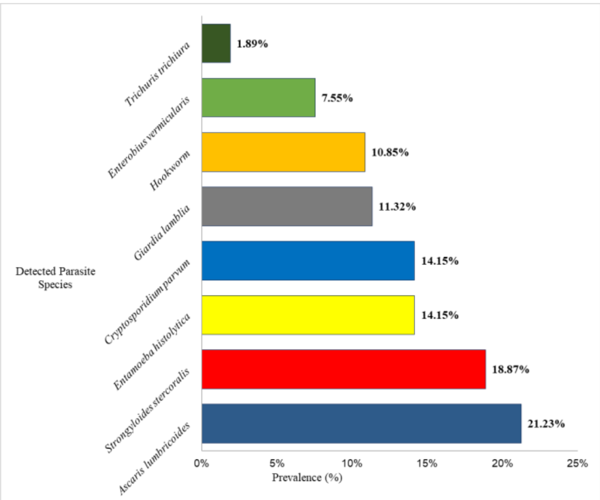

Figure 1. Prevalence of detected parasite species in fruits and vegetables sold at Iddo markets, Abuja.

3.3 Distribution of Parasites Across Produce Types

The distribution of parasitic isolates varied considerably across produce types (Table 1). Cabbage harboured the highest number of isolates (40/212, 18.9%), followed by carrot (36/212, 17.0%), banana (26/212, 12.3%), and cucumber (23/212, 10.8%). Pumpkin leaf (18/212, 8.5%), garden egg leaf (16/212, 7.5%), and watermelon (19/212, 9.0%) showed moderate parasite loads. Orange harboured the fewest isolates (6/212, 2.8%).

3.4 Parasite–Produce Associations

Specific parasite–produce associations were notable. A. lumbricoides was widely distributed, detected in all 10 produce types, with highest counts in banana (7), cucumber (7), carrot (4), and cabbage (4). *S. stercoralis* was concentrated predominantly in vegetables, with the highest counts in cabbage (10) and carrot (9) and was absent from orange. *E. histolytica* was detected in 6 produce types, with peak counts in cabbage (9) and carrot (6), and was absent from pineapple, pumpkin leaf, and garden egg leaf. *C. parvum* was found in 8 produce types, most frequently in cabbage (7) and carrot (6). *G. lamblia* was restricted to 5 produce types (pawpaw, watermelon, banana, cucumber, cabbage, carrot), while *E. vermicularis* was detected in 7 produce types, most in watermelon (4) and pineapple (3). *T. trichiura* was the most restricted, appearing in only 3 produce types: pineapple (2), cabbage (1), and pumpkin leaf (1).

3.5 Statistical Association Between Parasite Species and Produce Type

Chi-square analysis revealed a statistically significant association between parasite species and types of fruits and vegetables (χ^2 = 90.601, df = 63, P = .013). The likelihood

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ratio was also significant (102.740, df = 63, P = .001), confirming that the distribution of parasite species is not independent of produce type (Table 2).

Table 2. Chi-Square Test of Association Between Parasitic Contaminants and Types of Fruits and Vegetables

Test	Value	df	Asymptotic significance (2-sided)
Pearson Chi-Square	90.601[a]	63	.013
Likelihood Ratio	102.740	63	.001
Linear-by-Linear Association	6.189	1	.013
N of Valid Cases	212		

Note. [a] 71 cells (88.8%) have expected count less than 5. The minimum expected count is .11.

IV. DISCUSSION

This study documented a diverse assemblage of eight pathogenic parasite species, five helminths and three protozoans - contaminating fresh fruits and vegetables sold in local markets of Iddo community, Gwagwalada Area Council, FCT, Abuja. The detection of 212 parasitic isolates across 150 samples underscores the extent of parasitic diversity in the local produce supply and highlights the multiplicity of infection risks to which consumers are exposed.

4.1 Dominant Parasite Species

Ascaris lumbricoides (21.23%) and *Strongyloides stercoralis* (18.87%) were the most prevalent parasites, jointly accounting for over 40% of all isolates. This finding is consistent with studies across Nigeria and other tropical regions where soil-transmitted helminths predominate in produce contamination. Adamu *et al*. (2018) similarly identified *A. lumbricoides* as one of the most common parasites in fruits and vegetables sold in Sokoto State, Nigeria. Akinbo *et al*. (2017) reported high prevalence rates of *A. lumbricoides* in vegetables consumed in Benin City. In Vietnam, Uga *et al*. (2009) documented *Ascaris* eggs as the most frequently detected parasite in vegetables from suburban markets.

The dominance of *A. lumbricoides* can be attributed to its remarkable environmental resilience. *Ascaris* eggs possess a thick, chitinous outer shell that enables survival in soil, water, and on produce surfaces for extended periods (Strunz *et al*., 2014). In agricultural settings where untreated human excreta is used as fertilizer, a common practice among small-scale farmers in Nigeria (Luca *et al*., 2000), Ascaris eggs are readily transferred to crops and persist through harvesting, transportation, and marketing.

S. stercoralis, the second most prevalent parasite, is particularly noteworthy given its unique lifecycle involving free-living and parasitic forms. Its high prevalence in cabbage (10 isolates) and carrot (9 isolates) reflects its association with warm, moist soil conditions typical of vegetable cultivation in tropical climates (Adamu *et al*., 2018). *S. stercoralis* can penetrate intact skin, meaning that handling contaminated produce without gloves poses a direct infection risk to vendors and consumers, beyond the oral transmission route.

4.2 Protozoan Parasites

The detection of *E. histolytica* (14.15%), *C. parvum* (14.15%), and *G. lamblia* (11.32%) highlights the protozoan contamination dimension of the produce supply. These three protozoan species are well-documented causes of waterborne and foodborne diarrheal illness worldwide (Xiao, 2010; Slifko *et al*., 2000). Their presence in produce points to contamination of irrigation water sources with human or animal faecal matter (Amahmid *et al*., 2002). *C. parvum* and *G. lamblia* are particularly concerning because of their low infectious dose and resistance to standard chlorination, meaning that simple washing with tap water may not adequately remove them from produce surfaces (Xiao, 2010; Robertson *et al*., 2019).

The relatively higher occurrence of protozoans in certain fruits: *G. lamblia* was found in pawpaw (4), banana (6), and watermelon (3), may reflect contamination through water used for washing or sprinkling produce to maintain freshness in markets. This pattern is consistent with the waterborne transmission routes of these organisms (Xiao, 2010).

4.3 Restricted and Uncommon Parasites

Trichuris trichiura (1.89%) and *Enterobius vermicularis* (7.55%) were the least prevalent parasites. The low detection of *T. trichiura* may relate to the specific soil and climatic conditions of the study area, as whipworm eggs require particular temperature and moisture conditions for embryonation (Strunz *et al*., 2014). The restricted distribution of *T. trichiura* to only three produce types (pineapple, cabbage, pumpkin leaf) further suggests localized contamination events rather than widespread environmental contamination.

E. vermicularis, though detected more widely (7 produce types), had low overall counts. Its presence is often associated with poor personal hygiene among food handlers, as pinworm eggs are transferred via the faecal-oral route through contaminated hands (Robertson *et al*., 2019). The detection of *E. vermicularis* in watermelon (4 isolates) and pineapple (3 isolates) which are fruits typically cut and handled in market settings, supports the hypothesis of handler-mediated contamination.

4.4 Produce-Specific Parasite Diversity

Cabbage and carrot emerged as the produce types harbouring the highest parasite diversity and burden. Cabbage hosted all five helminth species and two of three protozoan species (40 total isolates), while carrot hosted four helminth species and all three protozoan species (36 total isolates). This pattern reflects the inherent biological and structural characteristics of these vegetables. Cabbage, with its multiple tight leaf layers, creates a labyrinth of surfaces and moist microenvironments that can trap and retain parasitic cysts, eggs, and larvae (Abougrain *et al*., 2010; Uga *et al*., 2009). Carrots, as below-ground root vegetables, are in direct contact with soil

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throughout their growth, making them particularly susceptible to soil-transmitted helminths (Luca *et al*., 2000).

The significant association between parasite species and produce type (χ^2 = 90.601, P = .013) confirms that parasite distribution is non-random across produce types. This has practical implications for risk-based surveillance: monitoring and intervention efforts should prioritize cabbage, carrot, banana, and cucumber, which collectively harboured 63.2% of all parasite isolates.

4.5 Public Health Implications

The diversity of parasites detected spanning soil-transmitted helminths, tissue-penetrating helminths, and waterborne protozoans, indicates multiple contamination pathways in the produce supply chain. The co-occurrence of parasites such as *A. lumbricoides* and *S. stercoralis* on the same produce types (e.g., cabbage, carrot) suggests that consumers of these vegetables may be exposed to polyparasitism simultaneous infection with multiple parasite species. Polyparasitism is associated with more severe clinical outcomes, including synergistic effects on malnutrition, anaemia, and growth retardation, particularly in children (Cleaveland *et al*., 2001; Strunz *et al*., 2014).

The presence of *C. parvum* and *E. histolytica* is especially concerning for immunocompromised individuals, in whom these protozoans can cause severe, life-threatening diarrheal illness (Xiao, 2010). Given that HIV prevalence in the FCT region is non-trivial, the foodborne transmission of opportunistic protozoans through fresh produce represents a significant but underrecognized public health threat.

4.6 Limitations

This study was conducted during a single dry-season month (December 2023), and seasonal variation in parasite diversity could not be assessed. Studies have shown that contamination rates are generally higher in warm, wet seasons compared to cold, dry seasons (Ezatpour *et al*., 2013; Olyaei & Hajivandi, 2013). Additionally, molecular characterization was not performed; species-level identification relied on morphological criteria, which may underestimate the true diversity, particularly for morphologically similar species within genera. The cross-sectional design precludes assessment of temporal trends.

V. CONCLUSION AND FUTURE SCOPE

This study revealed a diverse community of eight pathogenic parasite species; five helminths and three protozoans - contaminating fresh fruits and vegetables sold in Iddo markets, Gwagwalada Area Council, FCT, Abuja, Nigeria. *Ascaris lumbricoides* and *Strongyloides stercoralis* were the dominant species, while *Trichuris trichiura* was the least prevalent. Cabbage and carrot harboured the highest parasite diversity and burden, reflecting their structural and growth characteristics. The significant association between parasite species and produce type (P = .013) confirms that parasite distribution is produce-dependent, warranting risk-based surveillance strategies.

These findings emphasize the need for species-specific monitoring programs, improved agricultural practices (particularly regarding fertilizer use and irrigation water quality), and consumer education on thorough washing, peeling, and cooking of high-risk produce. Future studies should incorporate seasonal sampling and molecular characterization to provide a more comprehensive picture of the parasitic contamination landscape in the FCT produce supply.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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DATA AVAILABILITY

The datasets generated and analysed during the current study are available from the corresponding author on reasonable request.

AUTHOR CONTRIBUTIONS

Ebiriekwe, S. C. conceived and designed the study, collected samples, performed laboratory analysis, and drafted the manuscript. Aro V. assisted with laboratory analysis. Waheed L.A., Usman S.M., Iyawa, P., Kaita, S.M., Abubakar, A. and Onyekwere, E.O contributed to data interpretation and manuscript revision. All authors read and approved the final manuscript.

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REFERENCES

1. Abougrain, A. K., Nahaisi, M. H., Madi, N. S., Saied, M. M., Ghenghesh, K. S., & Al Megrin, W. A. (2010). Parasitological contamination of salad

*Corresponding Author: **Ebiriekwe, Chidubem Sabinus.**

vegetables sold in Tripoli, Libya. Food Control, 21(8), 1156–1158.
2. Adamu, N. B., Adamu, J. Y., Mohammed, D., Samaila, A. B., Gidado, S., & Lawal, U. (2018). Parasitic contamination of fruits and vegetables sold in markets in Sokoto State, Northwestern Nigeria: Implications for public health. Journal of Parasitology Research, 2018, 5729391. doi.org
3. Adanir, R., & Tasci, F. (2013). Prevalence of helminth eggs in raw vegetables consumed in Burdur, Turkey. Food Control, 31(2), 482–484.
4. Akinbo, F. O., Omoregie, R., & Okaka, C. E. (2017). Prevalence of intestinal parasites in vegetables consumed in Benin City, Nigeria. Food Control, 86, 55–59.
5. Amahmid, O., Asmama, S., & Bouhoum, K. (2002). Urban wastewater as a vector for the transmission of parasites. Journal of Parasitology, 88(5), 964–969.
6. Balogun, I. I. (2011). Urban environmental problems in Nigeria: Implications for sustainable development. Journal of Sustainable Development in Africa, 13(7), 124–145.
7. Beuchat, L. R. (2002). Ecological factors influencing survival and growth of human pathogens on raw fruits and vegetables. Microbes and Infection, 4(4), 413–423.
8. Cleaveland, S., Laurenson, M. K., & Taylor, L. H. (2001). Diseases of humans and their domestic mammals: Pathogen characteristics, host range, and the risk of emergence. Philosophical Transactions of the Royal Society of London. Series B: Biological Sciences, 356(1411), 991–999.
9. Damen, J. G., Banwat, E. B., Egah, D. Z., & Allanana, J. A. (2007). Parasitic contamination of vegetables in Jos, Nigeria. Annals of African Medicine, 6(4), 157–161.
10. Daryani, A., Ettehad, G. H., Sharif, M., Ghorbani, L., & Ziaei, H. (2012). Prevalence of intestinal parasites in vegetables consumed in Ardabil, Iran. Food Control, 21(8), 1–5.
11. Duedu, K. O., Yarnie, E. A., Tetteh-Quarcoo, P. B., Attah, S. K., & Donkor, E. S. (2015). A comparative survey of the prevalence of human parasites found in fresh vegetables sold in supermarkets and open-aired markets in Accra, Ghana. BMC Research Notes, 8(1), 486.
12. Ezatpour, B., Chegeni, A. S., Abdollahpour, F., Khajavi, M., & Alikhani, M. Y. (2013). Prevalence of parasitic contamination in raw vegetables. Journal of Veterinary Medicine and Hygiene, 65(12), 487–492.
13. Luca, R. C., Ibvan, H. G., & Carmen, C. (2000). Role of waste vegetables for risk of Toxoplasma gondii and Ascaris spp. transmission. Veterinary Parasitology, 93, 153–161.
14. Nyarango, R. M., Aloo, P. A., Kabiru, E. W., Nyanchongi, B. O., & Afandi, S. (2003). Standardized ratio for proper dilution and effective extraction of parasitic material. Journal of Parasitology, 89(3), 538–542.
15. Olayinka, A., & Adewale, B. (2020). Effects of environmental factors on fruit phenology in the rainforests of southwestern Nigeria. Ecological Processes, 9(1), 1–12.
16. Olyaei, A., & Hajivandi, L. (2013). A parasitic contamination in vegetables from markets in Kermanshah, Iran. Journal of Entomology and Zoology Studies, 1(5), 6–9.
17. Robertson, L. J., van der Giessen, J. W. B., Batz, M. B., Kibret, S. N., & Fleming, F. M. (2019). The global burden of foodborne parasitic diseases: An update. Trends in Parasitology, 35(11), 899–901.
18. Slifko, T. R., Smith, H. V., & Rose, J. B. (2000). Emerging parasite zoonoses associated with water and food. International Journal for Parasitology, 30(12–13), 1379–1393.
19. Strunz, E. C., Addiss, D. G., Stocks, M. E., Ogden, S., Utzinger, J., & Freeman, M. C. (2014). Water, sanitation, hygiene, and soil-transmitted helminth infection: A systematic review and meta-analysis. PLoS Medicine, 11(3), e1001620.
20. Uga, S., Hoa, N. T. V., Noda, S., Moji, K., Cong, L., Aoki, Y., & Takakura, Y. (2009). Parasite egg contamination of vegetables from a suburban market in Hanoi, Vietnam. Nepal Medical College Journal, 11(2), 75–78.
21. Wafaa, H., & Hussein, H. S. (2017). Food-borne parasitic zoonoses associated with vegetables in Saudi Arabia. Journal of Veterinary Medical Research, 24(2), 289–301.
22. World Health Organization. (2018). Guidelines for the detection and quantification of foodborne parasites. who.int
23. Xiao, L. (2010). Molecular epidemiology of cryptosporidiosis: An update. Experimental Parasitology, 124(1), 80–89.

*Corresponding Author: **Ebiriekwe, Chidubem Sabinus.**