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PREVALENCE, DIVERSITY, AND INTENSITY OF INTESTINAL PARASITIC CONTAMINATION IN EDIBLE LEAFY VEGETABLES SOLD IN AGO-IWOYE MARKET, OGUN STATE, NIGERIA

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ABSTRACT

Background: Consumption of raw leafy vegetables contaminated with intestinal parasites poses a significant public health risk. In Nigeria, such vegetables are commonly eaten without cooking, yet data on their parasitic contamination remain limited. This study investigated the prevalence, diversity, and intensity of intestinal parasites in vegetables sold at Ago-Iwoye Market, Ogun State, Nigeria.
Methods: A cross-sectional survey was conducted between March and May 2017 on 240 samples of four leafy vegetables: *Talinum triangulare* (waterleaf), *Celosia argentea* (Lagos spinach), *Telfairia occidentalis* (fluted pumpkin), and *Corchorus olitorius* (white jute). Parasites were detected using standard parasitological techniques. Data were analysed for prevalence, species distribution, mixed infections, and mean parasite intensity. Differences among vegetable types were assessed using Chi-square analysis.
Results: Overall, 82 samples (34.2%) were contaminated. *Telfairia occidentalis* exhibited the highest contamination (46.7%), followed by *Talinum triangulare* (38.3%), *Corchorus olitorius* (31.7%), and *Celosia argentea* (20.0%). Six parasite species were identified; *Ascaris lumbricoides* was most prevalent (11.3%), followed by *Entamoeba histolytica* (10.0%) and *Giardia lamblia* (6.3%). Mixed infections were frequent, particularly in *Telfairia occidentalis* (34.1%) and *Talinum triangulare* (28.0%). Mean parasite intensity ranged from 0.20 to 0.47 parasites per sample. The distribution of *Trichuris trichiura* differed significantly among vegetables ($\chi^2 = 11.624$, $p = 0.009$).
Conclusion: Leafy vegetables sold at Ago-Iwoye Market are moderately contaminated with intestinal parasites, including multiple species per sample. These findings provide baseline evidence of public health relevance and underscore the importance of improved hygiene practices, vendor education, and consumer awareness to reduce the risk of food-borne parasitic infections.

Keywords: Vegetables, parasitic contamination, food safety, public health

INTRODUCTION

Vegetables are an indispensable component of human nutrition, supplying vitamins, minerals, antioxidants, and dietary fibre that contribute to the prevention of chronic diseases. In Nigeria, as in many developing countries, they are consumed daily, either raw or cooked, as part of staple diets. Despite their nutritional benefits, vegetables may serve as vehicles for pathogenic microorganisms and parasites. Contamination can occur during cultivation, harvesting, transportation, storage, and marketing, with contributing factors including irrigation with untreated wastewater, application of organic manure, poor sanitation, and unhygienic handling practices **(Yahia et al., 2023).**
At the global level, food-borne parasitic infections remain a major public health concern. The World Health Organization estimates that unsafe food causes 600 million illnesses and 420,000 deaths annually, with intestinal parasites contributing substantially to this burden **(WHO, 2015)**. In Nigeria, soil-transmitted helminths and protozoan infections affect millions of people, particularly in communities reliant on informal food systems, and remain a significant contributor to morbidity and economic loss **(Funso-Aina et al., 2020; Gbonhinbor et al., 2024)**. Fresh produce sold in open markets is often exposed to dust, flies, and unsafe water, while weak enforcement of food safety regulations and the absence of routine monitoring exacerbate contamination risks.
Although parasitic contamination of vegetables has been widely investigated in Nigeria, little is known about its prevalence, diversity, and intensity in Ago-Iwoye, Ogun State. The selected vegetables - *Talinum triangulare* (waterleaf), *Celosia argentea* (Lagos spinach), *Telfairia occidentalis* (fluted pumpkin), and *Corchorus olitorius* (white jute) - were chosen because they represent the most consumed leafy vegetables in the Ago-Iwoye community, with high market turnover and daily use in household diets.

The present study was therefore undertaken with the following objectives:

1. To determine the prevalence of parasitic contamination in selected leafy vegetables sold in Ago-Iwoye Market.
2. To identify the parasite species present.
3. To examine the occurrence of mixed (polyparasitic) contamination.
4. To evaluate parasite, mean intensity across vegetable types.

By addressing these objectives, the study provides baseline evidence relevant to public health authorities, consumers, vendors, and policymakers, thereby contributing to ongoing efforts to strengthen food safety regulation and education in Nigeria.

MATERIAL AND METHODS

Study area

The study was conducted in Ago-Iwoye, a semi-urban town in Ijebu North Local Government Area of Ogun State, southwestern Nigeria. The town hosts the main campus of Olabisi Onabanjo University and has a heterogeneous population of students, traders, farmers, and civil servants. It lies within the tropical rainforest zone, characterised by distinct wet and dry seasons that favour the survival and transmission of intestinal parasites.

Study design and sampling

A cross-sectional survey was carried out between March and May 2017. Sample size was estimated using Cochran's formula for prevalence studies, yielding a minimum of 242 samples; for logistical reasons, 240 samples were collected, which was considered statistically sufficient and consistent with comparable studies (**Isazadeh et al., 2020)**. Ten vegetable vendors were selected using simple random sampling based on stall positions. A total of 240 leafy vegetable samples were obtained, comprising 60 each of *Talinum triangulare* (waterleaf), *Celosia argentea* (Lagos spinach), *Telfairia occidentalis* (fluted pumpkin), and *Corchorus olitorius* (white jute). Samples were placed in sterile labelled bags, transported to the Department of Zoology and Environmental Biology laboratory at Olabisi Onabanjo University, and processed within 24 hours.

Laboratory analysis

Each 100 g vegetable sample was washed in 250 ml of 0.9% sodium chloride solution. The wash solution was divided into two portions and processed independently by sedimentation and flotation methods **(Adenusi et al., 2015; Mohamed et al., 2016).** Sedimentation involved filtration, centrifugation, and staining with Lugol's iodine to enhance protozoan cyst visibility, while flotation used zinc sulphate solution of specific gravity 1.18 to concentrate parasite eggs and cysts at the surface. Microscopic examination was performed at ×10 and ×40 magnifications. Morphological identification of parasite eggs, cysts, and larvae was carried out using identification guide (**Williams, 1992**). Results from both methods were subsequently merged to provide a comprehensive record of parasite detection for each sample.

Quality control and ethical considerations

Each sample was examined independently by two trained laboratory personnel. Discrepancies were resolved by consensus, and parasite stages were confirmed using standard morphological keys. Although no human participants were directly involved, the study protocol was reviewed and approved at departmental level to ensure compliance with institutional standards for biosafety and environmental research.

Statistical analysis

Data entry was performed in Microsoft Excel and analysed using SPSS version 20. Results from sedimentation and flotation were first recorded independently and then merged to provide a comprehensive dataset for each vegetable sample. Descriptive statistics were used to summarise prevalence, species distribution, mixed contamination, and mean parasite intensity, with results presented as frequencies, percentages, and arithmetic means. Prevalence was calculated as the proportion of positive samples among those analysed, while species distribution was expressed as the proportion of detections attributable to each parasite. Mixed (polyparasitic) contamination was expressed as the proportion of contaminated samples harbouring more than one parasite species. Parasite intensity was defined as the mean number of parasite detections per infected sample. Associations between vegetable type and parasitic contamination were examined using Pearson's Chi-square test of independence, with statistical significance set at $p \leq 0.05$. Due to low counts and non-normal distribution, no parametric comparisons (e.g., ANOVA) were applied.

RESULTS AND DISCUSSION

A total of 240 leafy vegetable samples were examined using sedimentation and flotation methods, which were performed independently and subsequently merged to provide a comprehensive dataset. Of these, 82 samples were positive, yielding an overall prevalence of 34.2%. Contamination varied across vegetable types **(Table 1**). *Telfairia occidentalis* (fluted pumpkin) exhibited the highest prevalence, with 28 of 60 samples contaminated (46.7%). This was followed by *Talinum triangulare* (waterleaf) at 38.3% (23/60) and *Corchorus olitorius* (white jute) at 31.7% (19/60). The lowest prevalence was observed in *Celosia argentea* (Lagos spinach), with 12 contaminated samples (20.0%).

Six intestinal parasite species were identified (**Table 2).** *Ascaris lumbricoides*, *Entamoeba histolytica*, *Giardia lamblia*, *Strongyloides stercoralis*, *Trichuris trichiura*, and *Entamoeba coli*. The most frequently detected was *A. lumbricoides* (27 occurrences, 11.3%), followed by *E. histolytica* (24 occurrences, 10.0%) and *G. lamblia* (15 occurrences, 6.3%). Less common parasites included *S. stercoralis* (7 occurrences, 2.9%), *T. trichiura* (6 occurrences, 2.5%), and *E. coli* (3 occurrences, 1.3%). Chi-square analysis indicated that most distributions across vegetable types were not statistically significant ($p > 0.05$). However, the distribution of *T. trichiura* differed significantly ($\chi^2 = 11.624$, $p = 0.009$).

Mean parasite intensity is summarised in **Table 3**. *Telfairia occidentalis* recorded the highest mean intensity (0.47 detections per sample), followed by *Talinum triangulare* (0.38) and *Corchorus olitorius* (0.32). The lowest intensity was observed in *Celosia argentea* (0.20). Across all samples, the overall mean parasite intensity was 0.34 detections per sample.

Evidence of mixed (polyparasitic) contamination was also observed (**Table 4).** *Telfairia occidentalis* harboured the greatest diversity, with six parasite species detected, accounting for 34.1% of contaminated samples. *Corchorus olitorius* likewise contained six species, representing 23.2% of contaminated samples. *Talinum triangulare* carried four species (28.0%), while *Celosia argentea* showed the lowest diversity, with three species (14.6%).

Collectively, these findings demonstrate that the vegetables examined were frequently contaminated with multiple intestinal parasites, underscoring potential public health risks if consumed without adequate washing or cooking.

Table 1 Prevalence of Parasitic Contamination in Selected Edible Vegetables

Vegetable	Number Examined (n)	Number Contaminated	Prevalence (%)
Talinum triangulare (Waterleaf)	60	23	38.3
Celosia argentea (Lagos spinach)	60	12	20.0
Telfairia occidentalis (Fluted pumpkin)	60	28	46.7
Corchorus olitorius (White jute)	60	19	31.7
Total	**240**	**82**	**34.2**

Table 2 Distribution of Parasite Species Detected in the Vegetable Samples

Parasite	***Talinum triangulare*** **n (%)**	***Celosia argentea*** **n (%)**	***Telfairia occidentalis*** **n (%)**	***Corchorus olitorius*** **n (%)**	**Total n (%)**	χ^2	**p-value**
Ascaris lumbricoides	10 (16.7)	6 (10.0)	4 (6.7)	7 (11.7)	27 (11.3)	3.130	0.372
Entamoeba histolytica	7 (11.7)	2 (3.3)	9 (15.0)	6 (10.0)	24 (10.0)	4.815	0.186
Giardia lamblia	4 (6.7)	4 (6.7)	5 (8.3)	2 (3.3)	15 (6.3)	1.351	0.717
Strongyloides stercoralis	2 (3.3)	0 (0.0)	3 (5.0)	2 (3.3)	7 (2.9)	2.796	0.424
Trichuris trichiura	0 (0.0)	0 (0.0)	5 (8.3)	1 (1.7)	6 (2.5)	11.624	0.009*
Entamoeba coli	0 (0.0)	0 (0.0)	2 (3.3)	1 (1.7)	3 (1.3)	3.713	0.294
Column Total	**23**	**12**	**28**	**19**	**82**		

Table 3 Mean Parasite Intensity in Selected Edible Vegetables

Vegetable	Number of Samples Examined (n)	Total Parasite Detections	Mean Parasite Intensity
Talinum triangulare (Waterleaf)	60	23	0.38
Celosia argentea (Lagos spinach)	60	12	0.20
Telfairia occidentalis (Fluted pumpkin)	60	28	0.47
Corchorus olitorius (White jute)	60	19	0.32
Total / Mean	**240**	**82**	**0.34**

Table 4 Occurrence of Mixed (Polyparasitic) Contamination in Edible Vegetable

Vegetable	Parasite Species Detected	Number of Parasite Species	Frequency of Contaminated Samples	Percentage (%)
Talinum triangulare	*Ascaris lumbricoides*, *Entamoeba histolytica*, *Giardia lamblia*, *Strongyloides stercoralis*	4	23	28.0
Celosia argentea	*Ascaris lumbricoides*, *Entamoeba histolytica*, *Giardia lamblia*	3	12	14.6
Telfairia occidentalis	*Ascaris lumbricoides*, *Entamoeba histolytica*, *Entamoeba coli*, *Giardia lamblia*, *Strongyloides stercoralis*, *Trichuris trichiura*	6	28	34.1
Corchorus olitorius	*Ascaris lumbricoides*, *Entamoeba histolytica*, *Entamoeba coli*, *Giardia lamblia*, *Strongyloides stercoralis*, *Trichuris trichiura*	6	19	23.2
Total	–	–	**82**	**100**

This study demonstrated an overall prevalence of parasitic contamination of 34.2% in the leafy vegetables examined, indicating that a substantial proportion of produce sold in Ago Iwoye Market may act as vehicles for intestinal parasite transmission. Although noteworthy, this prevalence is lower than the 43.8% reported by **Umeanaeto et al. (2016)** in Onitsha and the 53.4% observed by **Mogaji et al. (2021)** in Ekiti State. Such variation is plausibly linked to differences in environmental sanitation, irrigation sources, agricultural practices, and hygiene standards across study locations.

Among the vegetables analysed, *Telfairia occidentalis* exhibited the highest contamination rate (46.7%), whereas *Celosia argentea* recorded the lowest (20.0%). The elevated contamination in *T. occidentalis* may be attributable to its broad leaf morphology and growth habit, which facilitate the retention of parasite eggs and cysts from contaminated soil, irrigation water, or handling during harvest and marketing. Comparable findings have been reported elsewhere, reinforcing the susceptibility of fluted pumpkin to parasitic contamination.

Six intestinal parasite species were identified, with *Ascaris lumbricoides* being the most prevalent (11.3%). This predominance is consistent with previous studies, including that of **Amaechi et al. (2016)** in Ilorin, and reflects the resilience of *A. lumbricoides* eggs, which can persist in the environment for extended periods and adhere readily to vegetable surfaces. Mixed (polyparasitic) contamination was also evident, particularly in *Telfairia occidentalis* and *Corchorus olitorius,* both of which harboured the greatest diversity of parasite species.

Limitations of the Study

This investigation was subject to methodological constraints. Sampling was restricted to a single market, reflecting a cross-sectional design that may not capture seasonal variation or broader regional contamination patterns. Parasite detection relied solely on conventional microscopy; although sedimentation and flotation techniques are widely accepted, they may underestimate prevalence compared with molecular approaches capable of identifying low intensity or cryptic infections. Parasite intensity was summarised descriptively rather than subjected to parametric statistical comparison, owing to low counts and non-normal distribution. In addition, consumer practices such as washing or cooking were not assessed, thereby limiting inference regarding actual infection risk. Nevertheless, the study provides robust baseline evidence for Ago-Iwoye and underscores the importance of extending surveillance to other diverse market contexts.

CONCLUSION

This study provides baseline evidence of intestinal parasite contamination in leafy vegetables sold at Ago-Iwoye Market, Ogun State, Nigeria. Medically important species, including *Ascaris lumbricoides* and *Entamoeba histolytica*, were detected, and polyparasitic contamination was observed. The dual application of sedimentation and flotation methods enhanced detection sensitivity, strengthening the reliability of findings. These results add new baseline data for Ago-Iwoye and complement reports from other Nigerian markets, highlighting the influence of sanitation, irrigation practices, and market hygiene on contamination patterns. To address these risks, a multi-level framework is recommended: safe irrigation and composting at the agricultural stage; improved sanitary infrastructure, inspection, and vendor education at markets; and consumer awareness of thorough washing and safe handling. Integration of vegetable safety monitoring into public health surveillance would provide sustained oversight and evidence-based policy guidance. Collectively, these measures support preventive food safety strategies and align with the United Nations Sustainable Development Goals, particularly SDG 3 (Good Health and Well-Being) and SDG 6 (Clean Water and Sanitation), contributing to healthier communities and strengthened public health resilience in Nigeria and the wider region.

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