

Seasonal Parasitic Contamination of Vegetables Marketed in Bori Central Market, Khana Local Government Area, Rivers State, Nigeria

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ABSTRACT

Seasonal parasitic contamination of vegetables marketed in Bori central market, Khana Local Government Area, Rivers State, Nigeria was investigated. A total of 80 vegetable samples, (40 samples each during the rainy and dry season respectively) were purchased from the Bori central market. The vegetable samples were examined in the laboratory for the presence of intestinal parasites using sedimentation techniques and microscopy. The results revealed that out of 80 vegetable samples (20 samples of each vegetable type and 40 samples each for rainy and dry seasons) examined, an overall prevalence of 41(51.3%) was recorded. Out of the 40 samples of vegetable each examined during the rainy and dry seasons, 23(57.5%) and 18(45.0%) samples were positive for intestinal parasites during the rainy and dry seasons respectively. Across the two seasons, intestinal parasites belonging to four genera were identified. The genera were *Ascaris*, *Giardia*, *Ancylostoma* and *Trichuris*. A total of 23 intestinal parasites were identified during the rainy season (*Ascaris* 13/23(56.3%), *Giardia* 3/23(13.1%), *Ancylostoma* 4/23(17.4%) and *Trichuris* 3/23(13.1%) while a total of 18 parasites were extracted from the vegetables during the dry season (*Ascaris* 9/18(50%), *Giardia* 1/18(5.5%), *Ancylostoma* 3/18(16.7%) and *Trichuris* 5/18(27.8%). Carrot and tomatoes were the most statistically ($P > 0.05$) contaminated vegetables in the rainy and dry seasons respectively. All species of parasites identified have a high relative abundance in the rainy season than in the dry season. *Ascaris* sp. (56.5%) was the most abundant species of parasite in the rainy season, followed by *Ancylostoma* sp. (10.0%), *Giardia* sp. (7.5%) and *Trichuris* sp. (7.5%). In the dry season, *Ascaris* sp. had the most relative abundance (50.0%), followed by *Trichuris* sp. (27.8%), *Ancylostoma* sp. (7.5%) and *Giardia* sp. (2.5%). There was a statistically significant difference ($P < 0.05$) in the relative abundance of parasite species in the rainy and dry seasons. The high level of parasitic contamination of vegetables recorded in the study area is a public health concern and demands serious intervention especially in areas of health education on personal hygiene, sanitation and the danger of consumption of improperly washed vegetables, provision of sanitary facilities, mass deworming, open defecation and use of waste water for fertilizer.

Keywords: Bori Central Market, Contamination, Intestinal Parasites, Vegetables.

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I. INTRODUCTION

Vegetables are fresh edible portion of herbaceous plants roots, stems, leaves, or fruits. (Adejumoke & Morenikeji, 2015). Globally, vegetables are integral part of human diet (Okuy et al., 2004), a major source of vital nutrients including carbohydrates, mineral, vitamins, dietary fiber, and antioxidants, and according to WHO (2003, 2005), daily consumption of at least 400g of fresh fruits and vegetable will provide micro-nutrient for the body and also boost immunity.

Reports indicate that consumption of fresh vegetable lowers the risk of stroke and cardiovascular disease and protects against some malignancies (Alade et al., 2013; Alhabbal, 2015). In Nigeria, consumption of fresh vegetable

is a common nutritional practice among the people. These vegetables are either eaten fresh or prepared in a variety of ways.

Studies have implicated vegetables as veritable epidemiological vehicles for the transmission of food-borne parasitic infections to human especially when not hygienically prepared and when ingested raw (Hassan et al., 2012; Berger et al., 2010). Traditional practices in the cultivation, manuring and harvesting and transportation of vegetables especially in many parts of sub-Saharan Africa remains an area of concern, causing parasitic contamination.

Additionally, the use of sewage and other form of liquid waste during cultivation of crops and as fertilizer are other potential sources of contamination of vegetables with eggs and larvae of parasites (Alade et al., 2013; Nazemi et al.,

2012; Tomass *et al.*, 2012;). Humans become infected when improperly cooked parasite-contaminated vegetables are or eaten raw.

Fresh vegetables have been implicated in the transmission of many gastrointestinal parasitic cysts and oocysts of many parasites including *Entamoeba*, *Ascaris*, *Gardia* and *Cryptosporidium*, and the eggs and larvae of helminths such as *Toxoplasma*, *Taenia*, *Strongyloides* and Hookworm (Al-Megrm, 2010; Anwar & McKenry, 2012; Tefera *et al.*, 2014). The potentiality of vegetables as vehicles for the transmission of intestinal parasites is enhanced by poor agricultural management system, sanitation, personal hygiene and inadequate water supply. Hence, the prevalence of these parasites in poor developing countries of the world.

These parasites are known to cause several species-related gastrointestinal infections in human especially when the vegetables are eaten fresh and raw (Hassen *et al.*, 2012). Infections such as cryptosporidiosis, giardiasis, ascariasis, amoebiasis, strongyloidiasis, taeniasis and hookworm disease have been linked with consumption of contaminated vegetable and fruit (Yusof *et al.*, 2017.; Istifanus & Panda, 2018., Tchounga *et al.*, 2017., Said, 2012., Kuda *et al.*, 2018). The mortality rate associated with these diseases in developing countries is estimated at 2.2million people annually (Kuda *et al.*, 2018). The situation is exacerbated by the prevailing poor personal and sanitary condition, inadequate healthcare system that makes diagnosis of most food-borne infections difficult, hence underestimated (Dorny *et al.*, 2009).

In the United State, 9.4million cases of food-borne infections were reported in 2011 (Scallan *et al.*, 2011), 76million illness and 5,000 mortality in 1999. In Africa, foodborne infections have been implicated in the death of 137,000 people and 91 million illnesses annually, most of which are children below the age of 5years (WHO, 2019).

In Nigeria, several studies have been carried out on the prevalence of gastrointestinal parasites on vegetables (Al-Megrm, 2010; Damen *et al.*, 2007; Uneke, 2007; Ogunleye *et al.*, 2010; Alade *et al.*, 2014; Gboeloh & Sounya, 2021; Tchounga *et al.*, 2017), however, no particular studies in relation to nparasites and vegetable has been conducted in Bori, Khana Local Government Area, Rivers State.

II. MATERIALS AND METHODS

A. Study Area

The study was conducted at the Bori central market located in Khana Local Government Area, Rivers State (Fig. 1.0). The local government area has an area of 560 km² and an estimated population of 294,217 people (NPC, 2006) and an average temperature of 25 °C and an average rainfall of 2900mm per annum. Like other parts of the state, Bori has two seasons that are not well defined, however, the rainy season begins from March to October while the short dry season starts from November to February (Chinago, 2020). Bori is 59 feet above sea level and it is located on Latitude 4°40'34"N, Longitude 7°21'54" (Odunze & Nimaa, 2018).

It shares similar weather condition with other communities in Rivers State. The indigene of the area are predominantly farmers while some involves in fishing and petty trading.

The local government has several markets where variety of commodities, mostly agricultural produce (cassava, vegetables, maize, palm oil, garri, plantain etc.) are sold but the Bori central markets remains the most accessible market due to location in Bori metropolis.



Fig. 1. Map of study area (Bori). Source: Goggle Map (2018).

B. Sample Collection and Preparation

Samples of various vegetables were purchased from Bori central market across the dry and rainy seasons. Forty samples were purchased during the rainy season (March to October) and another set of forty samples were also bought during the dry season (November to February). Each set of the samples was transported to the research laboratory, Department of Biology, Ignatius Ajuru University of Education, Port Harcourt, for laboratory examination. The vegetables examined were Tomatoes (*Lycopersicon esculantum*), Cucumber (*Cucuneropsi manii*) Carrots (*Daucus carota*), Onions (*Alium cepa*). All the vegetables were purchased from the same market. The vegetables were collected and examined from November to February 2020 and March to October 2021.

C. Laboratory Examination

The fresh samples of each vegetable were soaked separately in 10 % formal saline (150 ml) for about two hours, then washed to detach the parasitic ova, larvae, cysts, and oocysts from the vegetables. The water sediment was transferred to 12 ml conical glass centrifuge tubes and centrifuged at 3000 rpm for 5 minutes (Idahosa, 2011). After centrifugation, the supernatant was carefully siphoned off without shaking the content of the tube and the remaining sediment was agitated gently by hand for redistributing the parasitic stages (Ebrahimzadeh *et al.*, 2013). Three slides were prepared to enhance the chances of parasite detection. To prepare wet smear, a drop of the sediment was obtained from the centrifuge tube and placed on clean slide and covered with a clean cover slip for microscopic examination using 10x and 40x objective lens. Iodine stained smears were prepared by adding a small drop of Lugol's iodine solution prior to cover slipping to a slide similarly prepared for the unstained smear, for observation of eggs, cysts and oocysts (El Said Said, 2012). The eggs/cysts were identified based on morphological characteristics. The intensity and abundance of the parasites were determined using the following formulae:

$$\text{Parasite Intensity} = \frac{\text{Number of each parasite counted}}{\text{Number of infected vegetable sample}}$$

Determination Relative Abundance was determined using the following formula:

$$RA = \frac{nss}{tnp} \times 100$$

where

RA = Relative Abundance;

nss = Number of specific species of parasite;

tnp = Total number of parasites.

D. Data Analysis

Statistical analyses of data were done using SPSS software, version 12.0 (SPSS Inc., Chicago, IL, USA). Chi-square was used to compare the rate of contamination of vegetables, vegetable types and between seasons at a significance difference of $p < 0.05$.

III. RESULTS

The results indicated that out of 80 vegetable samples (20 samples of each vegetable type and 40 samples each for rainy and dry seasons) examined, a total of 41(51.3%) samples of different vegetable were contaminated with at least one parasite species (Fig. 2). Out of the 40 samples of vegetable examined during the rainy season, 23(57.5%) samples were positive for intestinal parasites while 18(45.0%) samples were positive for intestinal parasites out of the 40 samples investigated in the dry season (Fig. 3).

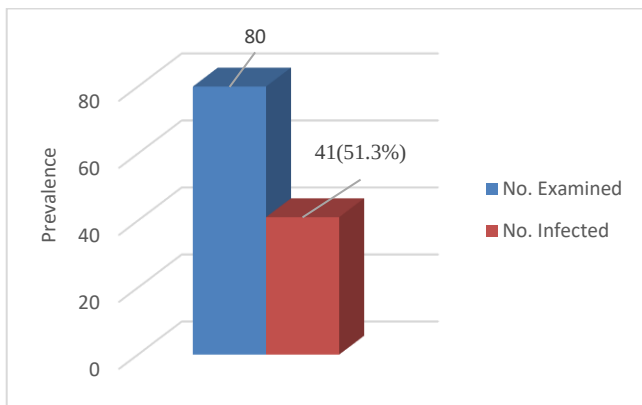


Fig. 2. Overall prevalence of intestinal parasites on vegetables in the study area (n=80).

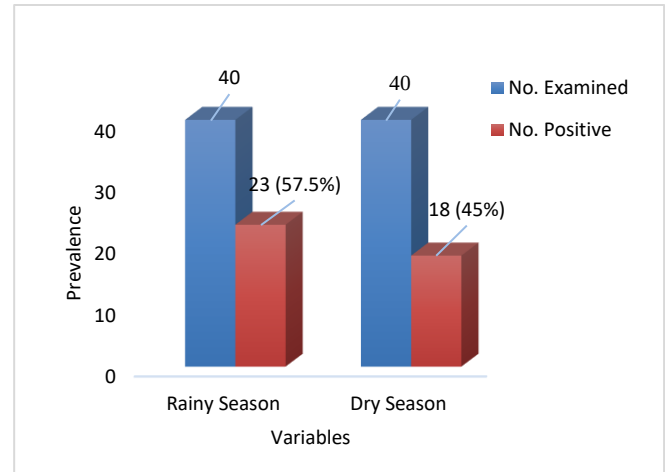


Fig. 3. Seasonal prevalence of intestinal parasites associated with vegetables.

During the rainy and dry seasons, intestinal parasites belonging to four genera were identified. The genera were *Ascaris*, *Giardia*, *Ancylostoma* and *Trichuris*. A total of 23 intestinal parasites were encountered during the rainy season (*Ascaris* 13/23(56.3%), *Giardia* 3/23(13.1%), *Ancylostoma* 4/23(17.4%) and *Trichuris* 3/23(13.1%) while a total of 18 parasites were extracted from the vegetables during the dry season (*Ascaris* 9/18(50%), *Giardia* 1/18(5.5%), *Ancylostoma* 3/18(16.7%) and *Trichuris* 5/18(27.8%) (Table I). Carrot (47.8%) and tomatoes (44.4%) were the most contaminated vegetables in the rainy season and dry seasons respectively. This was statistically significant ($P < 0.05$) when compared to contamination of other vegetables (Table I).

Seasonal Relative Intensity and Relative Abundance of Parasites on vegetables: All species of parasites identified have a high relative abundance in the rainy season than in the dry season. In the rainy season, *Ascaris* sp. (56.5%) was the most abundant species of parasite, followed by *Ancylostoma* sp. (10.0%), *Giardia* sp. (7.5%) and *Trichuris* sp. (7.5%). In the dry season, *Ascaris* sp. had the most relative abundance (50.0%), followed by *Trichuris* sp. (27.8%), *Ancylostoma* sp. (7.5%) and *Giardia* sp. (2.5%) (Table II). There was a statistically significance difference ($P < 0.05$) in the relative abundance of parasite species in the rainy and dry seasons. The intensity of the parasites was high on carrot in the rainy season while tomatoes recorded more parasitic contamination in the dry season than other vegetable types (Table II).

TABLE I: PREVALENCE OF INTESTINAL PARASITE IN RELATION TO SPECIES OF PARASITES

Parasite Genera	Vegetable types				
	Rainy Season (March-October)				Total (%)
	Carrot (%)	Cucumber (%)	Onions (%)	Tomatoes (%)	
<i>Ascaris</i>	6 (46.2)	3 (23.1)	0 (0)	4 (30.7)	13 (56.5)
<i>Giardia</i>	1 (33.3)	1 (33.3)	1 (33.3)	0 (0)	3 (13.1)
<i>Ancylostoma</i>	3 (75)	0 (0)	0 (0)	1 (25)	4 (17.4)
<i>Trichuris</i>	1 (33.3)	0 (0)	1 (33.3)	1 (33.3)	3 (13.1)
Total	11 (47.8)	4 (17.4)	2 (8.7)	6 (26.1)	23
Dry Season (November - February)					
<i>Ascaris</i>	3(33.3)	3(33.3)	0(0)	3(33.3)	9 (50)
<i>Giardia</i>	0(0)	0(0)	0(0)	1(100)	1(5.5)
<i>Ancylostoma</i>	1(33.3)	1(33.3)	0(0)	1(33.3)	3(16.7)
<i>Trichuris</i>	1(20)	1(20)	0(0)	3(60)	5(27.8)
Total	5(27.8)	5(27.8)	0(0)	8(44.4)	18

TABLE II: SEASONAL RELATIVE INTENSITY AND RELATIVE ABUNDANCE OF PARASITES ON VEGETABLES

Parasite Genera	Vegetable types					
	Rainy Season (March-October)					
	Carrot (%)	Cucumber (%)	Onions (%)	Tomatoes (%)	Rel. Ab. (%)	Prev. (%)
<i>Ascaris</i>	6 (46.2)	3 (23.1)	0 (0)	4 (30.7)	13 (56.5)	32.5%
<i>Giardia</i>	1 (33.3)	1 (33.3)	1 (33.3)	0 (0)	3 (13.1)	7.5%
<i>Ancylostoma</i>	3 (75)	0 (0)	0 (0)	1 (25)	4 (17.4)	10%
<i>Trichuris</i>	1 (33.3)	0 (0)	1 (33.3)	1 (33.3)	3 (13.1)	7.5%
Total	11 (47.8)	4 (17.4)	2 (8.7)	6 (26.1)	23 (100)	57.5%
Intensity	3.7	2.4	1.1	2.9		
Parasite Genera	Dry Season (November - February)					
	Carrot (%)	Cucumber (%)	Onions (%)	Tomatoes (%)	Rel. Ab. (%)	Prev. (%)
	Carrot (%)	Cucumber (%)	Onions (%)	Tomatoes (%)	Rel. Ab. (%)	Prev. (%)
<i>Ascaris</i>	3(33.3)	3(33.3)	0(0)	3(33.3)	9 (50)	22.5%
<i>Giardia</i>	0(0)	0(0)	0(0)	1(100)	1(5.5)	2.5%
<i>Ancylostoma</i>	1(33.3)	1(33.3)	0(0)	1(33.3)	3(16.7)	7.5%
<i>Trichuris</i>	1(20)	1(20)	0(0)	3(60)	5(27.8)	12.5%
Total	5(27.8)	5(27.8)	0(0)	8(44.4)	18(100)	45%
Intensity	1.7	1.1	0	2.3		

IV. DISCUSSION

Parasitic contamination of commonly consumed vegetables remains a public health concern especially when not properly cooked. This study revealed the presence of intestinal parasites on vegetables in the study area. An overall prevalence (51.3%) of parasitic contamination was recorded. This result is higher than the 13.8% reported in vegetable in Bauchi by Isifamus & Panda (2018), 29.5% recorded in vegetables sold in some local markets in Port Harcourt by Tchounga *et al.* (2017), 31.7% reported in commonly consumed raw vegetables in Alexandria, Egypt by El Said Said (2012), and the 36% recorded in vegetables sold in urban markets, Ghana by Amoah *et al.* (2006).

The result obtained in this study is also lower than the 44.2%, 32% and 36% reported in India (Gupta *et al.*, 2009), Iran (Daryani *et al.*, 2008) and Vietnam (Uga *et al.*, 2009). The 51.3% recorded in this study is however slightly lower than the 57.5% and 57.8% reported by Kudah *et al.* (2018) and Tefera *et al.* (2012) in vegetables and fruits sold in two markets in Ghana and Jimma town, Southeast Ethiopia respectively. The differences in the results could be attributed to differences in socio-cultural practices in the various study areas (Istifanus & Panda, 2008), handling methods employed the farmers and marketers and level of personal hygiene (Mustafa *et al.*, 2001). Differences in geographical location of the study areas, sample size and techniques used in preparation and identification of the parasites may also be responsible for the variation in results (El Said Said, 2012).

In this study, there was a relatively high prevalence of the parasites during the rainy season (57.5%) than in the dry season (45.0%). However, the difference in prevalence was not statistically significant ($p > 0.05$). The result obtained in this study is contrary to the ones recorded in previous studies by Eraky *et al.* (2014), Yusof *et al.* (2017), El Said Said (2012), Uga *et al.* (2009) and Monge *et al.* (1996). The authors recorded high prevalence of intestinal parasites in vegetables during the rainy season than in dry season. The variation in the results could be attributed to differences in the climatic conditions in the study areas. Rivers State is characterized by moderate high temperature even in the rainy season and it could also be heavy rainfall during the dry season. Temperature is very influential on the development, survival and transmission of many parasites especially trematodes (Mas-Coma *et al.*, 2009; Poulin, 2006).

Intestinal parasites species belonging to four genera were identified in this study. The genera included *Ascaris*, *Giardia*, *Ancylostoma* and *Trichuris*. This agrees with the findings of Gboeloh & Sounya (2021), Obebe *et al.* (2020), Tchounga *et al.* (2017), Yusof *et al.* (2017), Adejumo & Morenikeji (2015). The most relatively abundance parasite in both the rainy and dry season was *Ascaris* sp. Similar result was reported by Isifamus and Panda (2018), Tchounga *et al.* (2017), Adejumo & Morenikeji (2015), Shaf-ul *et al.* (2014), Gupta *et al.* (2009) and Uneke (2007). The high relative abundance of *Ascaris* sp in this study could be attributed to the tolerance ability of the parasitic eggs to survive in the soil for a long period, the environmental temperature and humidity that favour its striving and developmental stages as well as poor personal hygiene of the handlers of vegetable (Isifamus & Panda, 2018).

The high parasitic contamination of carrot and tomatoes recorded in this study could be linked to poor hygienic status of handlers especially during transportation to the market. It is worthy of note that carrot and tomatoes are not cultivated in Ogoni land. These vegetables are cultivated in the north and transported to the south, hence there could be faecal contamination during handling and procession for sales.

V. CONCLUSION

This study revealed a high level of parasitic contamination of vegetables sold in Bori central market. The prevalence of these parasites was significantly high in the rainy season than in dry season. The high level of parasitic contamination of vegetables recorded in the study area is a public health concern and demands serious intervention especially in areas of health education on personal hygiene, sanitation and the danger of consumption of improperly washed vegetables, provision of sanitary facilities, treatment of infected persons (mass deworming), open defecation and use of wastewater for fertilizer. Adequate and functional surveillance system to monitor food-borne infection should be deliberately activated in the study area.

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