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Contamination Rates of *Strongyloides stercoralis* on some Vegetables from Home-Stead Farms in Two Communities in Abua/Odua Local Government Area, Rivers State, Nigeria

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Abstract

Vegetables are very important parts of our daily meals for healthy living as much as they remain good sources of water and loads of essential nutrients. Vegetables sometimes get contaminated by soil transmitted helminth parasites and become a potential risk health to unsuspecting consumers. A few homestead farms in Ogboloma and Emelogo communities of Odua in the Abua/Odual Local Government Area, Rivers State, Niger Delta, Nigeria, were the study's locations. Vegetables were harvested directly from homestead farms, transported to the Entomology and Parasitology Laboratory, Rivers State University, Port Harcourt, Nigeria, in sterile waterproof bags. 200ml of 0.85% physiological saline solution was used to wash 200g of each sample before it was subjected to the usual sedimentation processes. After centrifugation, the sediment was recovered and placed on a grease-free microscope slide. Lugol's iodine was added to the sediment in little amounts, cover slip was placed over and was screened with an x4 and x10 objectives under a light microscope. The overall prevalence of *Strongyloidis stercoralis* was 67 (27.92%) with Ogboloma more contaminated than Emelogo. *Talinum fruticosum* (Water leaves) were the most contaminated with a prevalence of 48(80%) followed by *Telfairia occidentalis* (Pumpkin leaves) at 19 (31.67%). No helminth was recovered from *Vernonia amygdalina* (Bitter leaves) and *Ocimum grattissimum* (Scent leaves). Chi-square proved that there was a statistically significant difference ($\chi2=127.8$; $p< 0.0001$). One-way Anova also shows that there was a very significant difference in the means when cross compared (F- Value= 82.53; p= <0.0001). The level of *Strongyloides* contamination of vegetables from home stead farms is a pointer to the indiscriminate practice of open defecation and the use of untreated faeces waste as organic fertilizers for cultivation. Vegetables should be washed severally with salt and avoid mere blanching to ensure safety consumption.

Keywords: Strongyloidiasis, Soil Transmitted Helminths, Open defecation, Immunocompromised, Rivers State, Nigeria

Introduction

Vegetables are very important parts of our daily meals for healthy living in as much as they remain good sources of water and loads of essential nutrients (Mohamed *et al*., 2016). Vegetables sometimes get contaminated by soil transmitted helminth parasites (Hall *et al.,* 2008), and become a potential risk health to unsuspecting consumers (Bishop and Yohanna, 2018).

Soils get contaminated due to the practice of open defecation, application of untreated faecal wastes, and the use of faeces-contaminated water bodies for irrigation purposes are the major routes of contamination of vegetables even in home stead farms (Ofor *et al.,* 2009). Vegetable contamination is also most likely in the course of its distribution and handling process in the market (Bishop and Yohanna, 2018).

Vegetables are a very important source of phytonutrients and antioxidants which are vital for healthy living. They provide the body with fibre, vitamins, minerals and phytochemicals which play beneficial roles such as detoxicants in man (Slavin and Lloyd, 2012). A study has shown that vegetables when consumed regularly has the potentials of cancer reduction in so many organs in the body (Steinmetz and Potter, 1991). In many countries, most vegetables are often consumed raw or after mere blanching, hence, infections due to helminth parasite ingestion or by contact may become established (Mba, 2000; Eraky *et al*., 2014; Nyirenda *et al.,* 2021). Utilization of untreated faeces as organic fertilizer or contaminated water during cultivation of vegetables in home-stead or commercial farms could also lead to contamination of farm produce. The consumption or contact with such vegetables is likely to cause intestinal parasitic infections (Faour-Klingbeil *et al*., 2016; Istifanus and Panda, 2018; Nyirenda *et al.,* 2021). Complications such as anaemia, distortions in intestinal morphologies and physiology, loss of weight are associated with these infections (Bishop and Yohanna, 2018). Some commonly encountered helminths in parasitological surveys associated with fresh vegetables are *Ascaris lumbricoides*, *Trichuris trichiura*, *Strongyloides stercoralis*, Hookworm species (*Ancylostoma duodenale* and *Necator americanus*) and *Enterobius vermicularis* (Akoma *et al.,* 2017; Ejike *et al.,* 2018; Agbalaka *et al*., 2019; Okeke *et al.,* 2022; Robert *et al*., 2022).

Strongyloides stercoralis is a soil transmitted helminth parasite of great public health significance most especially in tropics and subtropics (Kassalik and Mönkemüller, 2011; WHO, 2021). It causes intestinal ailment due to its complex life cycle and infectivity patterns which alternates between free living and parasitic phases (Mansfield *et al.,* 1995; Greaves *et al.,* 2013). Strongyloidiasis is mostly asymptomatic but could lead to a deadly hyper-infection syndrome in patients that are immunocompromised or exposed to steroids (Kassalik and Mönkemüller, 2011; WHO, 2021). Moreso, this parasite exhibits very serious levels of autoinfection (WHO, 2021) hence, detection of the eggs in stool becomes tricky and near impossible which allows the infection persist secretly for a longer time (WHO, 2021). Based on the severity of this parasite, the practices of open defecation and use of faeces as organic fertilizers in Emelogo and Ogboloma communities in

Abua/Odua Local Government Area, Rivers State, Nigeria, this study was implemented to determine the contamination rates of four vegetables: Water leaves (*Talinum fruticosum*), Bitter leaves (*Vernonia amygdalina*), Scent leaves (*Ocimum grastissimum*) and Pumpkin leaves (*Telfairia occidentalis*) from home stead farms.

MATERIALS AND METHODS

Study Area

A few homestead farms in Ogboloma and Emelogo of Odua in the Abua/Odual Local Government Area, Rivers State, Niger Delta, Nigeria, were the study's locations. Odua's landmass stretches from the eastern borders of the Orashi River to Sombrero in the north, south, and west. It is situated 4.450–4.490 North of the Equator and 6.300–6.4450 East of Greenwich. The low-lying areas of both settlements are connected by numerous natural water channels that rise to a height of about 48 metres at the northern boundary and begin at about 45 metres in the eastern one. Mangroves and freshwater marshes are the two types of vegetation found in the locations. Its inadequate drainage system contributes to multiple water channels, especially in the rainy season when many of the lakes and creeks overrun their banks (Fig. 1). These communities are vulnerable to annual floods, which halts all activity during that period and raises the degree of poverty and underdevelopment. The indigenous people of these communities mostly engage in subsistence farming, artisanal fishing, and small-scale trading (Amadi and Uttah, 2010).

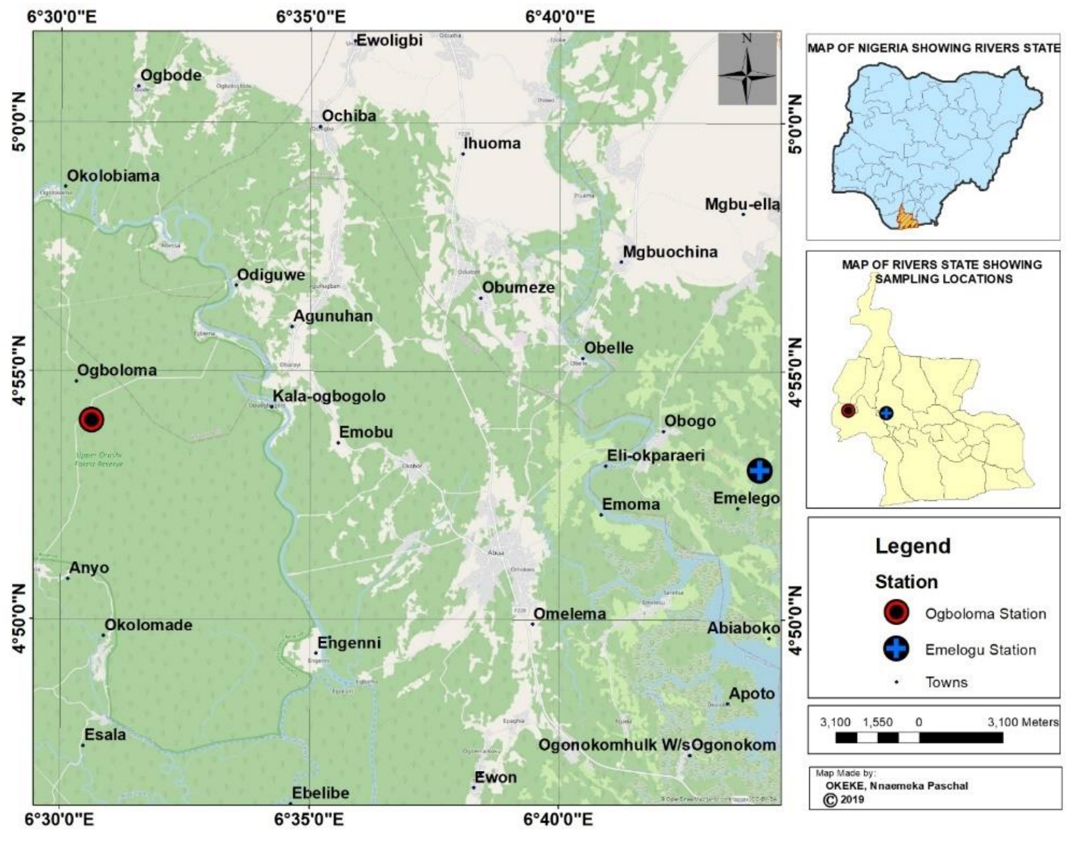

Fig. 1: Map showing Emelogo and Ogboloma Communities, Abua/Odual LGA, Rivers State, Nigeria

Sample Collection

30 homestead farms from the Ogboloma and Emelogo villages provided 120 vegetable samples harvested directly. Over the course of six months, 60 vegetable samples were collected from each study site. The vegetables were fluted pumpkin leaves (*Telfairia occidentalis*), bitter leaves (*Vernonia amygdalina*), scent leaves (*Ocimum gratissimum*), and water leaves (*Talinum fruticosum*).

Parasitological Analyses

Vegetables were transported in sealed, sterile polythene bags to the Parasitology and Entomology Laboratory, Department of Animal and Environmental Biology, Rivers State University, Port Harcourt, Nigeria. 200g for each vegetable type was weighed using an electronic weighing balance (Denver instrument, model TP-512A). Samples were washed in 200ml of 0.85% physiological saline solution. Pieces of the vegetables were removed from the solution with the aid of sterilized forceps, allowed to settle for 24 hours in properly labelled containers (Damen *et al.,* 2007; Arora and Arora, 2010). The following day, the supernatant was decanted from each sample; sediment sieved through a net gauge of mesh size 0.5mm. A test tube was filled with 2ml of the filtrate and centrifuged for 15minutes at 3000rpm in a bucket centrifuge (Cheesebrough, 2006). Excess of the resulting supernatant was decanted, deposit was properly mixed, using a Pasteur's pipette, 1-2 drops was transferred onto a clean grease free glass microscope slide. Equal volume of Lugol's iodine was added and the slide covered with a cover slip ensuring no air bubbles were trapped. Slides were examined microscopically using X 10 and X 40 objectives. This process was repeated twice for each sample. Identification of helminth eggs and larva was done after the protocol of Cheesebrough (2006). Photomicrographs of helminths were taken with the aid of Nikon digital camera attached to the objective lens of the microscope. Prevalence was computed as the result from the division of the number of samples infected by the total number of samples examined expressed as a percentage.

Statistical Analyses

Prevalence was computed as the result from the division of the number of samples infected by the total number of samples examined expressed as a percentage (Bush *et al.,* 1997). T-test was used to check for significant difference between locations, Chi-Square ($\chi 2$) checked for significant associations while Anova was used to test for significant differences between means of variables. Significance was considered at 95% confidence interval.

Results

Strongyloides stercoralis (Plate 1) was recovered from 23 vegetables giving an overall prevalence of 19.17% in Emelogo while in Ogboloma, 44 with a prevalence of 36.67% (Table 1). Chi-square proved that there was an association of significant difference ($\chi 2$=9.131; $p< 0.0025$). The overall prevalence is 67 (27.92%). T-test shows a statistically significant difference in the individual prevalence values of the two study locations (p< 0.0062).

Table 1 Overall Contamination Rate of Vegetables by *Strongyloides stercoralis* in Study Locations, Emelogo and Ogboloma, Abua/Odual LGA, Rivers State, Nigeria

Location	No. Examined	Infected (%)	Uninfected (%)	χ^2	Df	p-value	MI ± SD	p-value
Emelogo	120	23 (19.17)	97 (80.8)	9.131	1	0.0025*	0.41 ± 0.93	0.0062*
Ogboloma	120	44 (36.67)	76 (63.33)				0.79 ± 1.2	
Total	240	67 (27.92)	173 (72.08)					

Key: χ2 = Chi square, Df = degree of freedom, * = Significant at p <0.05.

Talinum fruticosum (Water leaves) were the most contaminated with a prevalence of 48(80%) followed by *Telfairia occidentalis* (Pumpkin leaves) at 19 (31.67%) (Table 2). No helminth was recovered from *Vernonia amygdalina* (Bitter leaves) and *Ocimum grattissimum* (Scent leaves). Chi-square proved that there was a statistically significant difference (χ2=127.8; p< 0.0001). One-way Anova also shows that there was a very significant difference in the means when cross compared (F- Value= 82.53; p= <0.0001)

Table 2: Contamination Rates by *Strongyloides stercoralis* based on Vegetable types, Emelogo and Ogboloma, Abua/Odual LGA, Rivers State, Nigeria

Vegetables	No. examined	positive	negative	χ2	Df	p-value	MI ± SD	F-value	p value
Scent leaf	60	0 (0)	60 (100)	127.8	3	<0.0001	0.0 ± 0.0[a]	82.53	<0.0001
Water leaf	60	48 (80)	12 (20)				1.9 ± 1.3[b]		
Bitter leaf	60	0 (0)	60 (100)				0.0 ± 0.0[a]		
Pumpkin	60	19 (31.67)	41 (68.33)				0.50 ± 0.81[c]		
Total	240	67 (27.92)	173 (72.08)						

Key: χ2 = Chi square, Df = degree of freedom, * = Significant at p <0.05.

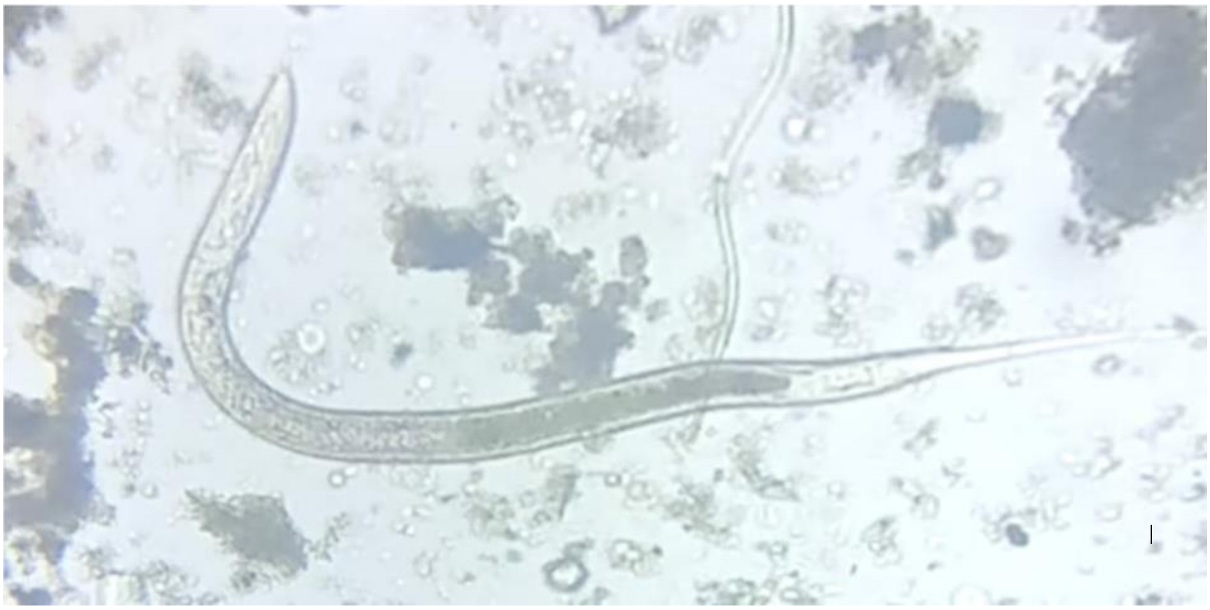

Plate 1. Photomicrograph of unstained larval stage of *Strongyloides stercoralis* isolated from Water leaf (*Talinum fruticosum*) from Ogboloma and Emelego communities, Odua, Abua/Odua Local Government Area, Rivers State, Nigeria (Scale: 0.5mm)

Discussion

According to Bishop and Yohanna (2018), vegetables are essential to a human diet. The year-round high demand for them has made its cultivation a priority without considering the patterns of activities around the farms and possible contaminations by soil transmitted helminths of which *Strongyloides stercoralis* is a notorious player in these events causing asymptomatic illness, making its detection difficult with its complex life cycle (WHO, 2021). With little focus on their safety, the availability of vegetables has received more emphasis throughout time.

Strongyloides stercoralis was screened for in this study using *Talinum fruticosum* (Water leaves), *Telfairia occidentalis* (Pumpkin leaves), *Vernonia amygdalina* (Bitter leaves) and *Ocimum grattissimum* (Scent leaves). Out the 240 vegetables sampled, 67 were contaminated with *S. stercoralis* with a prevalence of 27.92%. This is does not agree with Simon-Oke *et al.* (2014) in Ondo State and Robert *et al*. (2022) who recorded 50.0% from some markets in Port Harcourt Metropolis. The disparity could be linked to the sampled locations and sample sizes (Niang *et al.,* 2022). In their study, vegetable samples were purchased from markets of which it may have been washed before placing for sale, while in the present study, samples were harvested directly from these home stead farms. Moreso, Robert *et al*. (2022) sampled only 18 vegetables while 240 was screen in this study. The 27.92% recorded in this study is in line with the 25% (Bishop and Yohanna, 2018); 26.0% (Yahaya and Bishop, 2022) all in in Samaru-Zaria. This similarity could be as a result of same method of sampling as both studies harvested the vegetables directly from the farms. Vegetables from Ogboloma was significantly more contaminated with *Strongyloides stercoralis* than those from Emelogo. This could be linked to several factors such as the rate of open defecation, behavioural and cultural differences or physico-chemical parameters (Ovutor *et al*., 2017).

This study has showed *Telfairia occidentalis* (Pumpkin Leaves) had the second-highest frequency of *Strongyloides stercoralis* contamination, at 31.67%, behind *Talinum fruticosum* (Water leaves), with a prevalence of 80%. This result is consistent with earlier studies (Obebe *et al*., 2020; Robert *et al.,* 2022) that show some green vegetables are susceptible to helminth infection, underscoring the significance of identifying and removing contamination-causing variables. The observed variations in contamination rates between water leaves and pumpkin leaves could be caused by a number of variables. These variables can affect the adhesion and survival of helminth larvae on the leaves and stalks of these plants. These factors include the surrounding environment, farming methods, water quality, and the surface properties of the vegetables (Robert et al., 2022). Moreso, the high contamination rate of *Strongyloides stercoralis* could have as a result of its complex life cycle that includes a free-living stage in the environment when they do not need a host to proliferate (Bethony *et al.,* 2006; WHO, 2021). Strongyloidiasis may be asymptomatic because of the global population's impaired immune system, there is concern that this parasite could become a serious public health challenge (Kassalik and Mönkemüller, 2011; WHO, 2021). In rural, under developed settings where facilities for proper diagnosis and timely treatment are absent, its acute and hyper-infections are frequently mistaken for other illnesses, hence leading to serious damage to many body organs (Schär et al., 2013). This would be a serious problem (Robert *et al.,* 2022). Therefore, preventing the spread of *S. stercoralis* is crucial for public health, especially in foci areas.

Conclusion and Recommendation

Edible vegetables from homestead farms in Ogboloma and Emelogo communities of Abua/Odual LGA, Rivers State, Nigeria, were infested with *Strongyloides stercoralis*. The most infested vegetable was *Talinum fruticosum* (Water leaves, 80%) followed by *Telfairia occidentalis* (Pumpkin Leaves, 31.67%).

The practice of open defaecation should be discontinued in these communities and this would be achieved by the provision of adequate toilet facilities. Proper plant fertilization practices should be encouraged as well as careful storage and handling of vegetables before consumption.

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