Evaluation of Human Parasites Associated with Common Edible Vegetables Sold in Rural Markets in the Niger Delta Region

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Authors' contributions

This work was carried out in collaboration among all authors.author GDA designed the study, performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript. Author BOTC managed the analyses of the study and managed the literature searches. All authors read and approved the final manuscript.

Article Information

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ABSTRACT

A study on evaluation of human intestinal parasite associated with edible vegetables commonly consumed in the Niger Delta region of Nigeria, was carried out to determine parasitic contamination of these daily consumed items. The samples included waterleaf, pumpkin leaf, scent leaf, cucumber, and okazi leaf, sold in the rural markets in Akabuka, Ogbogu, Omoku, Oboburu, and Obirikom, all in Ogba-Egbema Ndoni LGA of the Niger Delta. A total of 250 fresh vegetable samples were purchased and examined for the presence of human intestinal parasites such as *Ascaris lumbricoides, Trichuris trichiura, Strongloides stercoralis*, two primary species of Hookworm namely *Necator americanus* and *Ancylostoma duodenale*, and *Entamoeba histolytica*, using centrifugal floatation and microscopy methods. Results of the findings reveal that, among the vegetable samples examined, Waterleaf (*Talium triangulare)* had higher contamination of 25.0%, followed by Pumpkin leaf (*Telfaria occidentalis*) 11.2%, and the least contamination was observed in Okazi leaf (*Gnetum africanum*). The most frequently observed parasites were *Ascaris lumbricoides* 16(20.2%)

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and *Entamoeba histolytica* 6(14.2%), while the least parasites prevalence was recorded with *Trichuris trichiura* 1(3.1%). The findings of this study showed that vegetables sold in the markets could be potential sources for the transmission of human intestinal infections, due to their cultivation and storage processes, corroborating findings of various studies in Nigeria that human intestinal parasites cause common infections worldwide and are observed to be contacted through their infective eggs and larvae in the soil. There is need for sensitization of consumers on thorough washing and observation of proper hygiene to prevent the public health hazards associated with eating these nutritious vegetables.

1. INTRODUCTION

Food-borne diseases are among the most recent emerging and re-emerging infectious diseases relating to Intestinal Nematode Parasites throughout the world. The emerging and re-emerging disease with these nematode parasites have recently proven in a reasonable doubt to be the highest public health threat in Nigeria, and they contribute between 65% - 80% of health problem in Tropical and Sub-tropical regions of the world [1,2]. These nematode parasite infections are caused mainly by co-infecting parasites *Ascaris lumbricoides* (common roundworm), *Trichuris trichiura* (whipworm), and the two primary species of Hookworm, *Necator americanus* and *Ancylostoma duodenale.*

These intestinal nematode parasites are the most leading causes of diseases in adults and young people especially school-aged children [3,4]. Approximately, millions of people with heavy worm infestations accounts for the highest disability adjusted life years (DALYs), which include years of life lost due to mortality (YLLs) and years lived with disability (YLDs) [5]. The burden of the nematodes infections is most felt in almost all African countries especially in the tropical and sub-tropical areas of the region. In Nigeria, poor waste disposal mechanisms in both urban and rural areas are below satisfactory requirement and are such known to facilitate transmission of intestinal nematode infections. Other habits known to impact on infection and prevalence include open bush defecation, poor personal hygiene and poor access to quality water supply. Lack of awareness of nematode infections related to hygiene practice also contributes to food-borne diseases [6,7]. Humoral and cellular immune responses are generated following infection with these intestinal nematode parasites. Chronic and intense infections with parasitic nematodes can contribute to iron-deficiency anaemia amongst children and pregnant women, cognitive impairment amongst school-aged children and severe morbidity cases. Globally, fruits and vegetables have contributed significantly to the food market due to their high nutrient content of vitamins such as B, C, K, and mineral such as calcium, potassium, magnesium as well as dietary fiber. Their medicinal qualities have been known to play an important role to humans as non-pharmacological prophylaxis against human chronic diseases. Over the years, their importance of protecting human body in boasting immune system to fight diseases has been proven [8,9]. Regular intake of fruits and vegetables reduce the risk of chronic non-infectious diseases such as hypertension, coronary heart diseases, stroke, cancer, type 2 diabetes mellitus, and constipation. However, despite the health benefits, fruits and vegetables, especially, those consumed raw also serve as vehicle for the transmission of parasites of public health importance if not hygienically handled [10]. In Nigeria, poor environmental hygiene, poor personal hygiene, and poor health system commonly observed, makes the prevalence of intestinal infection high amongst the populations [11,12]. Several studies on contamination of fruits and vegetables have shown that soil, in which these edible crops are cultivated, may be contaminated with human and animal feces harboring these intestinal parasites [13,14]. Night soil, which is improperly composted manure used as crop boaster may contribute to contamination of these edible vegetables with parasitic eggs and larvae, as well as human interaction during harvesting, transportation and marketing process with these vegetables at various points [7,15].

Studies on soil and human contamination with intestinal parasitic infections are more common in rural areas of Rivers State than prevalence in fruits and vegetables. To control national and global level of parasitic diseases, there is need for control of it at the local level. This is because disease control is vital to communities as the health of a community fuels economic growth.

Therefore, this study contribute to continuous scanning and monitoring distribution, pattern and spread of disease in our local environments and as such aimed to determined level of parasitic contamination of common vegetables regularly consumed in rural areas.

2. MATERIALS AND METHODS

2.1 Area of Study

The study was conducted in six selected markets namely: Akabuka, Ogbogu, Oboburu, Omoku, and Obirikom, all in Ogba/Egbema Ndoni Local Government Area of Rivers State, Nigeria. The study area lies between coordinate latitude 5° 32' 50'' N, and longitude 6° 34' 42'' East and 139 meters elevation above the sea level. The climate of the area is tropical savanna. Average temperature is between 26-27°C during the raining season and 27-29°C during the dry season. Main occupation of the people is farming at subsistence level and little of trading. Sanitation facilities are grossly inadequate, thus open defecation is a popular practice.

2.2 Sample Period and Collection

Sampling was done between March and August 2019. These months capture both Dry and Wet seasons. Also lots of vegetables are available at this period. Five (5) samples of vegetables namely: Pumpkin leaf (*Telfaria occidentalis*), Water leaf (*Talium triangulare*), Okazi leaf (*Gnetum africanum*), Scent leaf (*Occimum gratussima*), and Cucumber were purchased from five randomly selected markets namely: Oboburu, Ogbogu, Akabuka, Obrikom, and Omoku markets. These vegetables were bought from vendors who come from different rural locations into the selected markets. Each purchased sample was placed in a separate clean white plastic bag, labelled and then transported to University of Port Harcourt Laboratory for Parasitological Analysis.

2.3 Parasitological Examination and Processes

At the laboratory, the samples were soaked separately in a bucket containing 0.8% physiological saline solution for 24 h. After which, the content samples were vigorously shaken for just 5 min and allowed for sedimentation. Twenty minutes after sedimentation, the samples were filtered through fine 0.5 mm mesh size gauze to remove debris. From the filtered sediments 5 mL were measured into a 10 mL test-tube and centrifuged at about 1,500 rpm (revolutions per minute) for 15 min to concentrate parasites stages such as eggs, larvae and cysts. After centrifugation, the supernatant was decanted carefully, and then the sediment was convulsed and finally placed on a clean grease free glass and examined under a light microscope using x10 and x40 objectives of Olympus binocular microscope. Parasites were identified as described by Cheesbrough in 2009 [16].

2.4 Statistical Analysis

Data were entered and analyzed using descriptive statistics, such as percentages and results were presented as tables. Analysis of variance (ANOVA statistical tool) was employed; thus one-way ANOVA was used to test for variation within a factor. Chi-square (χ^2) calculation was also used to analyze the result obtained and to test significance differences.

3. RESULTS

Result of the survey reveals that 38.5% of vegetables sold in the rural markets of Ogba/Egbeme Ndoni LGA of Niger Delta region were contaminated with various human intestinal parasites such as *Ascaris lumbricoides, Trichuris trichiura, Entamoeba histolytica, Strongloides stercoralis, and species of Hookworm,* which are major public health problems more especially in developing regions of the world.

The result (Table 1) showed higher contamination rate of 25.0% observed in Water leaf, followed by Pumpkin leaf 11.2%, Scent leaf 8.5%, Cucumber 3.2% and the least contamination was recorded with Okazi leaf 2.0%.

The most frequently observed parasite in all the vegetable samples was *Ascaris lumbricoides*, recording a higher prevalent rate of 16(20.2%), followed by *Entamoeba histolytica* 6(14.2%), while *Strongloides stercoralis* recorded prevalence rate of 5(13.2%). Hookworm species recorded 2(5.3%) prevalence, and the least prevalence of 1(3.1%) was recorded with *Trichuris trichiura.* The differences was statistically significant (P –value = 0.025< 0.05) (Table 2).

The distribution of parasites recovered from various markets in the study sites (Table 3), showed an overall prevalence of 30(40.2%), of human intestinal parasites recovered from the vegetable samples bought from the market, out of which Akabuka market recorded higher parasite prevalence of 12(15.6%), Omoku recorded 8(11.2%) prevalence, Oboburu recorded 4(8.2%) prevalence and the least was recorded with Ogbogu and Obirikom, having equal prevalence of 3(7.0%).

4. DISCUSSION

It is obvious from the findings of this study that human populations are at risk of infections with human intestinal parasites, *Ascaris lumbricoides, Trichuris trichiura*, species of Hookworm, *Strongloides stercoralis* and *Entamoeba histolytica*. It has been observed that these parasites associated with locally consumed edible vegetables are prevalent in many studies in Nigeria and could serve as indicators of environment pollution of fecal matters [17]. WHO pointed out that their prevalence in tropical countries is due to climatic conditions favorable for their development and transmission and could also be attributed to lack of proper sanitation and hygiene in the rural communities [1,13,11] and [18]. WHO also described these human intestinal parasites to be disease of poverty resulting from poor sanitation, and observed it to have strong correlation between socio-economic status [6,19]. in their work opined that, the unwillingness to treat helminth is a factor of ignorance and low economic profile of the community member and these are typical behaviour in many rural communities. Basically, the endemicity of soil transmitted parasites depends on the presence of the determinants, their behavoural patterns of continuous contamination of the soil, and the frequent contact of a healthy human and the soil. In Nigeria, it has also been reported that human intestinal parasites contaminate edible vegetables and fruits, and consumption of these contaminated vegetables and fruits could play an important role in the transmission of parasitic infections [20,21].

The present study has attempted to ascertain the prevalence of human intestinal parasites in regularly consumed vegetables sold in the Niger Delta region, which are waterleaf, pumpkin leaf, okazi leaf, scent leaf, and cucumber. The result of the study corroborates with findings of Abe [22] and collaborators [23] who demonstrated that water leaf and pumpkin leaves are most contaminated of all edible vegetables. This could be possible, for the fact that, the gardens and farm lands commonly used for growing of water leaf and pumpkin leaf are hidden, there has been a report of spotted human faeces, people defecates indiscriminately around such places. Animal dung and human waste are often used in such gardens as fertilizers for crop boasters. The low degree of contamination in Okazi could be attributed to the place of cultivation. Okazi leaf is usually grown and harvested in distant farmland isolated from residential areas. Low prevalence of parasite contamination could be attributed to the natural growth of okazi leaf, unlike water leaf and pumpkin leaf.

In the study, human intestinal parasites recovered showed *Ascaris lumbricoides*, was the most frequently detected parasite. This therefore, corroborates with the report of [24-26] who also detected *Ascaris lumbricoides* as the most frequently observed parasite. This might be due to the fact that *Ascaris lumbricoides* are acquired by faeco-oral route resulting from poor human and animal waste. Thus, ascaris presence is an indication of poor hygiene and poor sanitary conditions. Higher prevalence could also be attributed to factors including lower temperature within the environment, soil moisture in the region, higher rainfall, thereby increasing the survivability of eggs and oocysts and larvae of parasites in the environment resulting to the contamination of vegetables in the rural region [10]. Open defaecation practices in Nigeria amongst rural dwellers where most vegetables are cultivated, may also explain the higher prevalence of *Ascaris lumbricoides*.

In Nigeria, ascaris are widely distributed [13,17]. Large number of infected persons *(25% of the world's population) who are capable of contaminating the environment, the high fecundity as well as the sticky nature of the egg shell, and durability of the eggs under varying environmental conditions favours their attachment on vegetables. Parasites isolated from the markets in the study sites showed that Akabuka markets had higher prevalence, followed by Omoku. Higher prevalence could be that vegetable items bought may be coming from adjoining villages, where sanitary measures are not observed. It could also be attributed to water used in washing the vegetables and poor hygiene conditions.

Table 1. Prevalence of contamination in vegetables

Vegetable items	No. of samples	Total no. infected	% Total
Pumpkin leaf (*Telfaria occidentalis*)	50	22	11.2%
Scent leaf (*Occimun gratussima*)	50	10	8.5%
Water leaf (*Talium triangulare)*	50	38	25.0%
Okazi *(Gnetum africanum)*	50	4	2.0%
Cucumber	50	5	3.2%
Total =	250	79	38.5%

Table 2. Prevalence of helminthes parasite in vegetables

Vegetable items	A. L	Parasite T.T	Prevalence HK.	En.h	S.S	Total
Pumpkin leaf (*Telfaria occidentalis*)	6	-	-	2	1	9(11.2%)
Scent leaf (*Occimun gratussima*)	2	1	1	1	1	6(8.0%)
Water leaf (*Talium triangulare*)	6	-	1	3	1	11(14.3%)
Okazi *(Gnetum africanum)*	1	-	-	-	1	2(5.2%)
Cucumber	1	-	-	-	1	2(5.2%)
Total =	16(20.2%)	1(3.1%)	2(5.3%)	6(14.2%)	5(13.2%)	30(40.2%)

Keys: A.L= *Ascaris lumbricoides*
T.T= *Trichuris trichiura*
HK= *Hookworm*
En.h=*Entamoeba histolytica*
S.S= *Strongloides stercoralis*

Table 3. Distribution of parasites recovered from various market in the study sites

Markets	Pumpkin leaf	Scent leaf	*Vegetable* Water leaf	*items* Okazi	Cucumber	% total
Ogbogu	1	-	2	-	-	3(7.0%)
Akabuka	3	3	4	1	1	12(15.6%)
Obirikom	2	-	1	-	-	3(7.0%)
Omoku	2	3	2	-	1	8(11.0%)
Oboburu	1	-	2	1	-	4(8.2%)
Total =	9(11.2%)	6(8.0%)-	11(14.3%)	2(5.2%)	2(5.2%)	30(40.2%)

5. CONCLUSION

Findings of this study showed that commonly consumed vegetables sold in the markets are often contaminated with human intestinal parasites, *Ascaris lumbricoides, Trichuris trichiura*, Hookworm species, *Entamoeba histolytica*, and *Strongloides stercoralis.* Contamination arises from the soil due to open or indiscriminate defaecation in the areas where these vegetables (waterleaf, scent leaf, pumpkin leaf, cucumber, and okazi leaf) are cultivated. This study hoped to sensitize the general public on the risk associated with these daily consumed vegetables and the on the need for good hygiene practices.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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