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Parasitic Contamination of Vegetables Consumed Raw in Parts of South East Nigeria: A Challenge to NTDs Elimination

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ABSTRACT

Consumption of raw vegetables has been implicated in the transmission of parasites, hence mitigating efforts geared towards the control and elimination of Neglected Tropical Diseases (NTDs). This study assessed the parasitic contamination of vegetables sold in open markets in Owerri, Imo State, Nigeria. Garden egg leaf (*Solanum macrocarpon*), Okazi leaf (*Gnetum africanum*), and utazi (*Gangronema latifolium*) were purchased from nine vendors, three selected randomly from three different markets namely Afor Enyiogwugwu, Ihiagwa and Eke-Ukwu Owerre. Samples were processed using standard parasitological techniques and data analyzed using descriptive and inferential statistics. A total of 54 vegetable samples were examined out of which 22 (40.7%) were contaminated with parasites. Three parasite species were identified. *Gardia lamblia* recorded the highest prevalence of 20.4% followed by *Entamoeba histolytica* (11.1%) and *Ascaris lumbricoides* (9.3%). *Solanum macrocapon* was the most contaminated vegetable (12, 66.6%) followed by *Gangronema latifolium* (6, 33.3%) and *Gnetum africanum* (4, 22.2%). Highest contamination of vegetables was recorded in Afor Enyiogwugwu (10, 55.5%). However, the results show no significant difference in the distribution of the parasites species across the sampled vegetables and markets ($p>0.05$). This study has shown that consuming raw vegetables is a potential source for the transmission of intestinal parasites in Owerri and this poses a significant challenge to NTDs control and elimination in the country. The status of WASH among households in the study area should be evaluated and improved to reduce environmental contamination with human wastes. Efforts should also be geared towards improving hygiene practices among consumers, vendors and farmers to reduce transmission of parasites through consumption of raw vegetables.

Keywords: Intestinal Parasites, contamination, Vegetables, Markets, NTDs

INTRODUCTION

Vegetables are agricultural crops whose parts like the leaves, flowers, fruits, stalks and roots can be consumed raw or cooked and are either annual plants or perennial plants [1]. They constitute vital parts of a healthy diet of man and remain valuable sources of important minerals, vitamins and fibre [2]. Due to the abundance of bioactive components in vegetables and fruits, they

play a crucial role in the prevention of a range of chronic diseases [3]. A greater variety of green and white vegetables and fruits has been associated with decreased risks of all-cause and cardiovascular disease mortality while the intake of a greater variety of purple/red vegetables and fruits has been associated with reduced risks of all kinds and cancer mortality [4]. Some vegetables consumed raw like utazi leaf (*Gangronema latifolium*), okazi leaf (*Gnetum africanum*), garden egg leaves (*Solanum macrocarpon*), carrot (*Dacus carota*), cucumber (*Cucumis sativus*), cabbage (*Brassica oleracea*) and tomatoes (*Salanum lypoersicum)* have nutrients and non-nutritive phytochemicals [2]. It's often recommended that these vegetables are consumed raw to avoid the destruction of heat liable nutrients, consequently leading to increased transmission of parasites.

Raw consumption of these vegetables has been linked with transmission of intestinal parasites [5,6]. Intestinal parasite infections (IPIs) are among the most critical public health problem worldwide and patients suffer from significant morbidity and mortality [7]. Intestinal parasites include intestinal protozoan and intestinal helminthes. *Giardia lamblia, E.histolytica and Cryptosporidium sp* are the most common intestinal protozoans in developing countries [7]. Soil-transmitted helminthes (STHs) are a group of parasitic worms infecting humans across the globe. STHs are transmitted through contaminated soil [8] and infection occurs through accidental ingestion of parasite eggs in faecally-contaminated food and water or penetration of skin by infective larvae (hookworms). These parasite eggs and larvae survive typically in warm, moist farmlands of both tropical and sub-tropical regions. The roundworms, whipworms and the hookworms are of great public health importance [9]. These infections primarily occur in regions with humid and warm climates where sanitation and hygiene remain inadequate [8].

In Nigeria, especially the Eastern part, vegetables like garden egg leaves (*Solanum sp*), are often used for local delicacies like Abacha, Ngwo-ngwo, Nkwobi and Isiewu [10]. Utazi (*Gangronema latifolium benth*) is used for medicinal purposes [11] and for therapeutic and dietary purposes [12]. Okazi (*Gnetum africanum*) is a perennial climbing wild vegetable [13] and grows through rhizomes or new shoots in the wild all year round [14]. Traditionally, the leaves of *Gnetum africanum* are being used for medicinal purposes, treating conditions including enlarged spleen, high blood pressure, sore throats and piles [14]. The GC-MS analysis of *G. africanum* revealed the presence of fourteen bioactive compounds and thus demonstrates its chemopreventive potential beneficial in minimizing the incidence of new cancers and in the treatment of existing cancers. [13]. These vegetables are often taken raw for their medicinal efficacies as it is believed that the process of cooking of the leaves of vegetables undermines the efficacy of these compounds resulting in diminished bioactivities.

Raw vegetables remain one of the most vital foods in human diet [15] as they protect humans from several diseases [16]. However, these raw vegetables could be contaminated with parasitic eggs and/or larvae owing to poor hygiene procedures during harvesting, packing, transporting, storage, and preparation for sale [16,17]. The consumption of raw vegetables as a way of maintaining healthy lifestyle often acts as a route for the spread and transmission of various parasitic infections [17]. These infections may lead to suppression of the immune system because the resistance of such individuals to other infections become lowered and can also make active immunization procedures to be less effective [8].

Globally, parasitic infections have remained a major public health problem and are classified as neglected diseases especially in tropical regions like Nigeria. Constantly, food borne diseases have been reported and

these have been linked to the consumption of raw vegetables. Notwithstanding the numerous studies reporting contamination of vegetables by parasites in Nigeria, there is dearth of information on the parasitic contamination of the selected vegetables that form a major part of some local delicacies consumed in this part of the country. This study therefore aimed at addressing this gap in information by assessing the parasitic contamination of *Solanum macrocarpon*, *Gangronema latifolium* and *Gnetum africanum* in selected markets in Imo State. The specific objectives include to identify the parasite species contaminating the vegetables, evaluate parasitic contamination among different vegetables and evaluate parasitic contamination in the different markets.

MATERIALS & METHODS

STUDY AREA

The study was conducted in Owerri zone of Imo state. A moderately populated State, located in Eastern part of Nigeria between longitude $6^{0}50^{1}$E and 725^{1}E and latitude $4^{0}45^{1}$N and $7^{0}15^{1}$N with an area roughly 5,100 km2. It is bounded by Abia State, Enugu State, Anambra State and Rivers State on the East, North, West and South respectively. It is located in the tropical rainforest region with maximum temperature and humidity of about 25^{0}C respectively. It has two distinct seasons, the dry season and rainy season. The State has many markets where both imported, and locally sourced goods are sold. However, the goods are from different parts of Nigeria. Figure 3.1 illustrates the map of the study area.

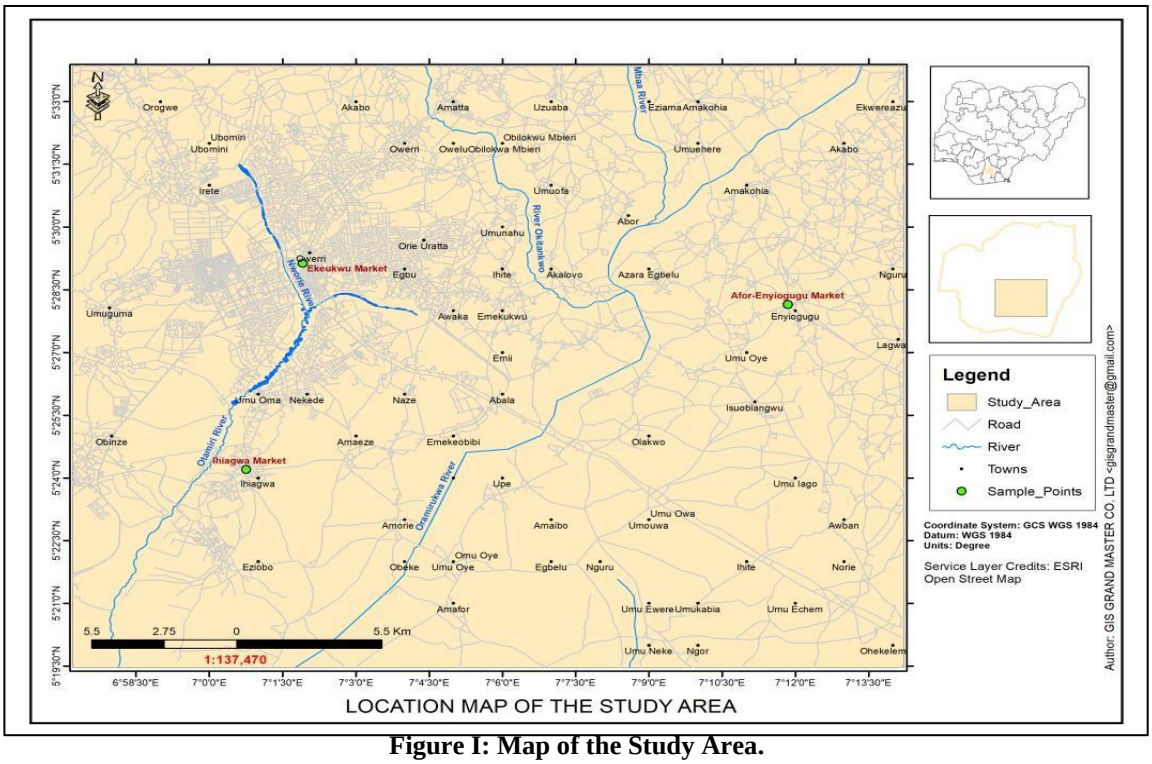

Figure I: Map of the Study Area.

SAMPLE COLLECTION

A total of 54 Samples were collected from three open markets in Owerri Zone of Imo State. The samples were collected once in each market from different vegetable vendors. From each market, two bunches of each vegetable were purchased from three different vendors of the various vegetables, giving a total of 18 bunches from each market. The samples were selected from the top, middle, and bottom layers of the heap of vegetable bunch displayed for sale. Selected vegetables were put in Ziplock bags, labelled with the appropriate

identification numbers and then transported to the laboratory in a cold box within two hours of collection. Vegetable samples were processed using sedimentation techniques and parasites identified using standard morphological details as described by [18].

STATISTICAL ANALYSIS

Statistical analysis was done with SPSS version 20.0. Descriptive statistics (frequencies and percentages) were used to estimate proportions while Pearsons Chi-square (χ^2) was used to compare the difference in contamination among the vegetables and markets. Statistical significance was established with the p-value < 0.05.

RESULT

Prevalence of parasitic contamination in vegetable samples

Table 1 represents the prevalence of the parasite species identified. An overall prevalence of 40.7% was recorded in the study. *Gardia lamblia* had the highest prevalence of 20.4% while *Ascaris lumbricoides* had the least prevalence of 9.3%. However, the variation in the prevalence across parasite species was not statistically significant (p>0.05).

Table 1: Prevalence of parasites identified

S/NO	Parasite	No. examined	No. infected (%)	χ^2	P
1.	*Entamoeba histolytica*	54	6 (11.1)		
2.	*Ascaris lumbricoides*	54	5 (9.3)		
3.	*Gardia lamblia*	54	11(20.4)		
	Total	**54**	**22 (40.7)**	**3.261**	**0.196**

Parasitic contamination of the various vegetables sampled

A total of fifty-four (54) vegetables were sampled. Parasitic contamination was highest in garden egg leaves (*Solanum macrocarpon*) with a prevalence of 66.6% followed by Utazi leaves (*Gongronema latifolium*) (33.3%) and then okazi (*Gnetum africanum*) with the least prevalence of 22.2%. However, the variation in the prevalence across the vegetables was not statistically significant (p>0.05).

Table 2: Prevalence of parasitic contamination across the vegetables sampled

S/NO	Market	No. examined	No. infected (%)	χ^2	P
1.	Garden egg leaves (*Solanum macrocarpon*)	18	12(66.6)		
2.	Utazi leaves (*Gongronema latifolium*)	18	6(33.3)		
3.	Okazi leaves (*Gnetum africanum*)	18	3(22.2)		
	Total	**54**	**22(40.74)**	**3.186**	**0.203**

Parasitic contamination of vegetables in the various markets

Samples were obtained from three (3) different markets. Parasitic contamination was highest in Afor Enyiogwugwu with a prevalence of 55.5% followed by Eke Ukwu (38.8%) and then Ihiagwa market with the least prevalence of 27.7%. However, the variation in the prevalence across the markets was not statistically significant (p>0.05).

Table 3: Prevalence of parasite contamination across the various markets

S/NO	Market	No. examined	No. infected (%)	χ^2	P
1.	Eke Ukwu	18	7(38.8)		
2.	Afor Enyiogwugwu	18	10 (55.5)		
3.	Ihiagwa	18	5(27.7)		
	Total	**54**	**22(40.74)**	**2.915**	**0.233**

DISCUSSION

This study assessed the parasitic contamination status of vegetables across the open markets situated in Owerri Zone, Imo State, Nigeria. The overall prevalence of 40.7% reported is much lower than 73.5% reported by [19] in Abeokuta. The low prevalence could be attributed to the fact that two out of the three species of vegetables sampled are climbers and have little or no contact with the soil except during harvest. However, the prevalence is higher than those reported in Port Harcourt (40.3%) and Ibadan (11.6%) by [20] and [21] respectively.

The differences in the reports of prevalence could be attributed to variations in the number and type of vegetables sampled; the parasitological techniques used in processing the samples and also differences in environmental conditions and hygiene practices employed by the farmers as well as the sellers in the study area. Lack of toilet facilities that are characteristic of most rural areas predisposes people to open defecation habits on farm soils used for planting [22], leading to feacal contamination of soil. This perpetuates the cycle of transmission of these parasites to humans through vegetables which get contaminated during harvest. Consumers should therefore ensure proper washing of these vegetables before consuming them to maximize the benefits of raw consumption while lowering the potential risk of parasitic infection.

Reports have shown that a major medium for transmission of protozoan cysts is the use of contaminated water. Thus, vegetable contamination with protozoan parasites reported in this study could possibly be due to irrigation of vegetables with contaminated water or use of contaminated vegetable refreshing water by vendors in the market. The only helminth identified in this study is *Ascaris lumbricoides* (Table 1). This could be attributed to the sticky nature of the eggshell of *A. lumbricoides* which might enhance the attachment of eggs on vegetables and the durability of *A. lumbricoides* eggs under varying environmental conditions. The presence STHs in vegetables in the food chain is therefore a major public health problem in Nigeria as it will undermine efforts towards elimination of NTDs by 2023.

Solanum macrocarpon (Garden egg leaf) was the most contaminated vegetable (Table 2). This plant is grown closer to the soil than the others which are climbers, and this could account for the higher prevalence recorded. Also, the rough surface of the leaves enables better anchorage for parasites eggs or larva, preventing them from being washed off easily. Furthermore, the leaves are fragile and consequently, vendors minimally wash the vegetables to prevent damaging the leaves. This enhances retention of parasite eggs or larva on the leaves after harvest. Okazi was least contaminated (22.2%) and is in line with the findings of [23] in the NigerDelta Region. This could be attributed to the place of cultivation, the type of plant and the nature and texture of the leaves. This vegetable is usually grown in farmlands distant from residential areas and found growing in the wild. The vegetable is also a climber unlike *Solanum marcrocarpon* that grows very close to the soil. Also, Okazi has a characteristic thick papery glossy texture [24], making attachment and anchorage of parasites difficult.

This study also evaluated parasitic contamination of vegetables sold across different open markets (Table 3). Vegetables from Afor Enyiogwugwu recorded the highest parasitic contamination and this could reflect the suitability of the ecology of farmlands where the sampled vegetables were cultivated. Afor Enyiogwugwu is a rural market and it is also possible that the vegetable vendors are not aware of transmission patterns of these parasites and also do not observe good hygiene practices. Efforts geared towards improving hygienic practices of the farmers, vendors and consumers in these areas is therefore of paramount importance.

As the world gears towards the elimination of NTDs by 2030, the risk of acquiring

parasitic infections through the consumption of raw vegetables remains a major public health problem. The inadequacy or unavailability of basic sanitation resources leads to open defecation and consequent contamination of the environment with human wastes. This perpetuates the cycle of disease transmission and will set back NTDs control and elimination in Nigeria.

CONCLUSION

This study has shown that consuming raw vegetables is a potential source for the transmission of intestinal parasites in Owerri and this poses a significant challenge to NTDs control and elimination in the country. This is an indication that humans in the study area are at risk of infections especially as these vegetables are consumed raw, forming a major part of local delicacies like Abacha, Nkwobi, Isiewu and natural remedies for certain ailments. The status of WASH among households in the study area should be evaluated and improved to reduce environmental contamination with human wastes.

Declaration by Authors

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