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Parasitological Assessment of Some Selected Vegetables Commonly Consumed Raw in Ankpa Local Government, Kogi State North Central Nigeria

Joshua Idakwo^{1*}, Munirat Eleojo Usman¹, Emmanuel Taiwo Idowu², Bashir Alabi Ali³, and Queen Pheobe Akoh⁴

¹Department of Animal & Environmental Biology, Kogi State University, Anyigba, Kogi State, Nigeria.

²Department of Zoology, University of Lagos, Lagos State Nigeria

³Department of Plant Science and Biotechnology, Kogi State University, Anyigba, Kogi State, Nigeria.

⁴Department of Microbiology, Kogi State University, Anyigba, Kogi State, Nigeria.

*Correspondence should be addressed to Joshua Idakwo: jodakwo@gmail.com

Received 18th February 2021; Revised 3rd April 2021; Accepted 17th April 2021

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Abstract

Background: Consumption of raw vegetables without proper washing can act as a potential route of transmission of some infectious and parasitic diseases. This study determined the parasitic contamination of vegetables sold in some markets in Ankpa Local Government Area, Kogi State.

Methodology: Vegetables was purchased from selected markets in Ankpa Local Government Area, North Central of Nigeria. Two hundred and forty samples of six different vegetable types - Carrot, Spinach, Pumpkin, Tomatoes, Cucumber and Garden egg were purchased from three different markets. The vegetables were examined microscopically for the presence of parasites using standardized parasitological techniques for protozoans and helminths.

Results: Remarkable level of intestinal protozoa and helminthes contaminations of different life stages were recovered. Out of the 240 samples, 34 (14.2%) were positive for different species of parasites. *Entamoeba histolytica* 15 (6.3%) had the highest occurrence while *Strongyloides stercoralis*(0.4%) had the least. Other parasites recovered include Hookworm eggs (2.1%), *Giardia lamblia* (1.7%), *Fasciola hepatica* (0.8%), *Trichuris trichiura* (1.3%), *Ascaris lumbricoides* (0.8%), and *Taenia* spp (0.8%). A significant difference was observed in the prevalence of the identified parasites ($p \leq 0.05$). Spinach contamination had the highest parasitic load of 20.0%, while Garden egg had the least with 10.0%. Prevalence of parasites varied across markets, with Ankpa main market having the highest with 15.9% compared to Afor (12.5%) and Ukwo (10.3%) located in the interior. No significant difference was observed among the markets and the vegetables ($p \leq 0.05$)

Conclusion: Raw vegetables investigated are contaminated with pathogenic parasites. Therefore, consumers need to ensure necessary hygiene practices before consuming vegetables purchased from markets to reduce the risk of infection by parasites associated with vegetables.

Keywords: Intestinal parasites, Protozoa, Helminthes, Vegetables, Ankpa, Nigeria

1. INTRODUCTION

Vegetables are a palatable food source that improve appetite and are essential for human health and well-being and form a major component of a healthy diet. They are highly essential for maintenance of health and prevention of diseases [1]. Vegetables are an important part of a healthy and balanced meal, providing vitamins, minerals, and phytonutrients [2]. Many vegetables are sources of protein, fat, and a proportion of vitamins, provitamins, dietary minerals, alpha and beta carotene, zeaxanthins, flavonoids, and anthocyanins. These body nutrients help reduce the risk of cardiovascular diseases such as stroke, diabetes, cancer, kidney stones, and bone loss [3]. The foliage in vegetables improves the formation of red blood cells while the vitamins in vegetables keep the eyes healthy, heal wounds, aid iron absorption, promote healthy teeth and gums [4]. They also help prevent constipation, hemorrhoids, and rectal fissures [5].

Some vegetables are mostly consumed raw as a salad to retain the natural taste and preserve heat-labile nutrients, while others are consumed cooked. Vegetables often consumed cooked include leafy vegetables such as pumpkin leaves, scent leaves, and bitter leaves. Vegetables usually consumed raw include cabbage, cucumber, lettuce, and the like. However, certain vegetables can either be consumed raw or cooked. Such vegetables include carrots, garden eggs, and the like. Consuming cooked vegetables is healthy, but it is more beneficial to consume raw vegetables [6].

Despite the nutritional values of vegetables to human health, they are major carriers of infective parasites. They act as a passive vehicle for the transmission of helminths through the fecal-oral route [7]. The consumption of raw vegetables without proper washing is an important route in the transmission of parasitic diseases. Intestinal parasites associated with raw vegetables belong to protozoan, cestodes, nematodes, and trematodes [8]. The incidence and distribution of human intestinal parasites are traced to the consumption of raw vegetables, which play a major role in transmitting food-borne parasitic diseases [9].

The processes involved in vegetable cultivation, harvesting, transportation, and processing have made them a potential source of human infections due to their contamination by disease pathogens of different kinds [3,10]. Vegetables can be contaminated while growing in fields by organic fertilizer or contaminated irrigation

water or during harvesting, processing, distribution, sales, and consumption [11]. Fresh vegetables are notable hosts of several epiphytic microorganisms, which are mostly nonpathogenic. However, during the movement of the produce from the field to consumers especially in the open field cultivation, fresh vegetables are exposed to environmental conditions or factors that enhance the introduction of pathogenic microorganisms and parasites [12,13,14].

Many outbreaks of protozoan infections in humans have been linked to raw fruits and vegetables. In Nigeria, approximately 55 million people are infected with ascariasis, 38 million with hookworm infection, while 34 million are infected with trichuriasis [15]. Although few studies have already reported that vegetables grown and marketed in some parts of Nigeria present poor parasitological quality [12,16], there are no data in Ankpa Local Government. Therefore, the present study assessed the presence and intensity of parasite contaminants in commercial vegetables in different markets in Ankpa Local Government.

2. METHODS AND MATERIALS

2.1 Study Area

This study was conducted in Ankpa Local Government, Kogi state, Nigeria. Ankpa is situated in the Middle East of Nigeria with Longitude $7^{\circ}30'0''$ - $7^{\circ}50'0''$ E and Latitude $7^{\circ}20'0''$ - $7^{\circ}30'0''$ N. It has an area of 1,200km² and a population of 359,300 based on the 2016 National Population census (17) (Fig. 1). Ankpa has a tropical climate with an average temperature of 25.50C. About 1392 mm of precipitation falls annually. The warmest month of the year is March, with a temperature of 29.0C to 30.0C and a lowest annual temperature of 23.90C occurs in August. The majority of the inhabitants of the Area are peasant farmers and petty traders with low economic status.

2.2 Study Design

This study design was randomized, involving a random selection of 240 samples of six vegetable species purchased from different vendors in three selected markets in Ankpa Local Government Area, Kogi State, which were examined for the presence of parasites.

2.3 Sample Collection

Samples were randomly purchased from different vendors within Ankpa township market, Afor and Ukwo

Figure 1: Map of the Study Area

markets strategically located and known for a high level of commercial activities weekly. Forty samples each of *Daucus carota* (carrot), *Cucumis sativus* (cucumber), *Solanum macrocarpon* (garden egg), *Telfairia occidentalis* (pumpkin), *Solanum lycopersicum* (Tomato) and *spinacia oleracea* (Spinach) were purchased and transported to the Microbiology laboratory of Kogi State University, Anyigba each in a well-labeled sterile polythene bags. Taxonomic identification of the various vegetable types was done by plant taxonomists in the Department of Plant and Biotechnology, Kogi State University, Anyigba, which were deposited in the Departmental herbarium with specific localized identification numbers.

2.4 Laboratory Analysis

Vegetable samples were removed from the polythene bags with gloved hands and placed on well-sterilized platforms. Each of the samples was carefully examined macroscopically for the presence of segments of cestodes and adult nematodes. Three hundred grams of each sample was weighed and placed in a clean bowl containing 600ml of sterile physiological normal saline (0.95/ NaCl) to detach the parasitic stages (ova, larvae, cysts, and oocysts) of helminths from the surface of the samples. The samples were washed thoroughly, and the water was left overnight for proper sedimentation, and then the supernatant was decanted. The deposit was resuspended with 10% formal saline and centrifuged at 4000rpm for 12 minutes, the supernatant was decanted carefully without shaking, and the residue was collected. A drop of the res-

idue was placed on a clean and grease-free slide with a drop of iodine to enhance the proper view of the parasites. The slide was covered with a coverslip avoiding air bubbles and over floating and examined for parasitic stages under the microscope using the X10 and X40 objective lenses [18].

2.5 Data Analysis

Data obtained were subjected to descriptive statistics, and chi-square tests were performed for the various categories of infection using Statistical Package for Social Sciences (SPSS) version 21.0 at $p \leq 0.05$ level of significance.

3. RESULTS

Out of the 240 samples of the six vegetable types, 34 were positive for at least one intestinal parasite with a percentage of 14.20%. The parasites recorded in this study include *Ascaris lumbricoides*, Hookworm, *Entamoeba histolytica*, *Giardia lamblia*, *Fasciola hepatica*, *Trichuris trichiura*, *Taeniaspp*, and *Strongyloides stercoralis*. The results of parasitic contamination of vegetables are shown in Table 1. The parasite prevalence in Carrot, Spinach, Pumpkin, Tomatoes, Cucumber, Garden egg sample groups are 12.50%, 20.00%, 15.00%, 15.00%, 12.50%, and 10.00%, respectively. Table 3 shows various parasite prevalence for each market. The most prevalent parasite was *Entamoeba histolytica* with a prevalence of 15 (6.30%), while the least was *Strongyloides stercoralis* larva with a prevalence of 1 (0.40%). These findings imply that the presence of parasites varies with the type of vegetable, with Spinach having the highest prevalence (20.00%), while Garden egg had the least prevalence of 10.00%. There was no significant difference between parasites present and vegetable type ($p > 0.05$). Parasitic contamination of vegetables with respect to markets is shown in Table 5 with Ankpa main market recording the highest prevalence (18.89%), followed by Afor market (12.50%), while the least was Ukwo market with a prevalence of 10.25%.

4. DISCUSSION

The result of this study shows the presence of eight different species of parasites in the selected vegetables. They include Hookworm egg, *Entamoeba histolytica* cyst, *Giardia lamblia* cyst, *Fasciola hepatica* egg, *Trichuris trichiura* egg, *Ascaris lumbricoides* egg, *Taenia spp*

Table 1: Parasitic Contamination of Vegetables with Respect to Vegetable Type

	Carrot (n=40)	Cucumber (n=40)	Spinach (n=40)	Pumpkin (n=40)	Garden egg (n=40)	Tomatoes (n= 40)	Total (n=240)	p-value
Hookworms	1(2.50)	2(5.00)	0	0	0	2(5.00)	5(2.10)	0.314
<i>E. histolytica</i>	2(5.00)	2(5.00)	3(7.50)	3(7.50)	2(5.00)	3(7.50)	15(6.30)	0.986
<i>Giardia lamblia</i>	1(2.50)	0	2(5.00)	0	0	1(2.50)	4(1.70)	0.406
<i>Fasciola hepatica</i>	0	0	1(2.50)	1(2.50)	0	0	2(0.80)	0.545
<i>Trichuris trichiura</i>	0	0	2(5.00)	1(2.50)	0	0	3(1.30)	0.214
<i>Ascaris lumbricoides</i>	0	1(2.50)	0	0	1(2.50)	0	2(0.80)	0.545
<i>Strongyloides stercoralis</i>	0	0	0	1(2.50)	0	0	1(0.40)	0.413
<i>Taenia spp</i>	1(2.50)	0	0	0	1(2.50)	0	2(0.80)	0.545

n= number of vegetable examined

Table 2: Parasite Prevalence for Various Vegetables

Vegetables	Number	Number	Preva-	p- value
Carrot	40	5	12.50	0.238
Spinach	40	8	20.00	
Pumpkin	40	6	15.00	
Tomatoes	40	6	15.00	
Cucumber	40	5	12.50	
Garden egg	40	4	10.00	
	240	34	14.20	

egg and *Strongyloides stercoralis* larva. The recovered parasites are similar to those isolated by other researchers across the country [16,19]. The multiple contamination of vegetables by different parasites in this study indicates that Vegetable crops are vehicles of transmission for different parasites.

The findings of this study reveal a high prevalence of *Entamoeba histolytica* cyst, 15(6.3%), which conforms to the findings of Leon *et al.* (1992) [20] who reported *Entamoeba histolytica* as the most prevalent parasite in some markets in Asia. This could be as a result of the unhygienic practices among the handlers from farm to market. This, however, contradicts the reports from researchers in

Table 3: Various Parasites' Prevalence for Each Market.

Parasites	Ankpa main market (n=90)	Ukwo Market (n= 78)	Afor Market (n=72)	Total (n=240)	p-value
<i>Hookworms</i>	2(2.22)	1(1.28)	2(2.78)	5(2.10)	0.809
<i>E. histolytica</i>	6(6.67)	4(5.13)	5(6.94)	15(6.30)	0.881
<i>Giardia lamblia</i>	3(3.33)	1(1.28)	0	4(1.70)	0.245
<i>Fasciola hepatica</i>	1(1.11)	1(1.28)	0	2(0.80)	0.644
<i>Trichuris trichiura</i>	2(2.22)	1(1.28)	0	3(1.30)	0.449
<i>Ascaris lumbricoides</i>	1(1.11)	0	1(1.49)	2(0.80)	0.604
<i>Strongyloides stercoralis</i>	1(1.11)	0	0	1(0.40)	0.433
<i>Taenia spp</i>	1(1.11)	0	1(1.49)	2(0.80)	0.604

n= number of vegetables sampled per market

Table 4: Cumulative Parasites Prevalence for the Market Locations

Parasites	Number of sample	Number positive	Prevalence (%)	P- value
Hookworm	240	5	2.10	0.000*
<i>Entamoeba histolytica</i>	240	15	6.30	
<i>Gardia lamblia</i>	240	4	1.70	
<i>Fasciola hepatica</i>	240	2	0.80	
<i>Trichuris trichiura</i>	240	3	1.30	
<i>Ascaris lumbricoides</i>	240	2	0.80	
<i>Strongyloides stercoralis</i>	240	2	0.80	
<i>Taenia</i> spp	240	1	0.40	
		34	1.80	

* = significant at $p \leq 0.05$.

Table 5: Parasitic Contamination of Vegetables by Market locations

Markets	Number of vegetables screened	Number contaminated	Prevalence (%)	p-value
Ankpa main market	90	17	15.89	0.797
Afor Market	72	9	12.50	
Ukwo Market	78	8	10.25	
Total	240	34	14.20	

other parts of the country where a low prevalence of *E. histolytica* was reported [16,21]. The prevalence of *Strongyloides stercoralis* (0.4%) was the least among other parasites identified in this study, which does not agree with an earlier study [16]. These differences might be due to different climatic conditions and variations in geographical locations of the study area. However, in other studies across the globe, occurrence of *Strongyloides stercoralis* larva was traced to its free living nature and does not always require a host for its proliferation, in addition to its parasitic mode of life [22].

The overall low prevalence (14.2%) reported in this study is not consistent with the findings of Damen *et al.* (2007) [23] and Said (2012) [6] who recorded a higher prevalence of 36.0% and 31.7% in Jos, Nigeria and Alexander, Egypt respectively. However, the total parasite prevalence in this study agrees with the reports from Kaduna [24] and Zaria [25] where low prevalence was reported. This could be attributed to poor hygiene and sanitary handling of vegetables, poor transport and packaging of vegetables, waste and contaminated water for irrigation, washing of vegetables, and other conditions of cultivation.

Although the investigation of the present study revealed parasite contamination of the vegetables at different rates, it is statistically not significant ($p > 0.05$) which is consistent with previous report [26].

The findings of this present study show variations across market locations. The prevalence at Ankpa main market 17 (15.89%) is not significantly higher than that of Afor market 9 (12.50%) and Ukwo market 8 (10.25%). These findings agree with those of Shinkafi *et al.* (2016) [27]; Akoma *et al.* (2017) [19], and Iyaji and Agahiu (2016) [28], who reported that there were significant differences in the rate of contamination of vegetables sampled from different markets in Katsina, Lokoja, and Anyigba respectively.

The differences in the contamination rates observed in the three locations could be because vegetables from Afor and Ukwo markets found in the interiors were directly from the farm with minimal contact with humans and other contaminants. Ankpa main market with the highest prevalence of parasite contamination might probably be due to poor hygiene and handling of the vegetables, poor means of transportation and packaging of the vegetables, and the type of water used for washing the vegetables before selling in the market. Similar findings were reported by other researchers who also attributed the prevalence to the level of education of the vegetable vendors, among others [29].

Spinach recorded the highest parasite contamination while Garden egg had the lowest prevalence probably because Spinach is a leafy vegetable with a wide surface area for contacts and attachment of parasites infective

stages.

The small sample size and unavailability of information on the background and personal hygiene of the vegetable markers may have been a major contributing factor to the results obtained in this study.

The findings of this present study have revealed that vegetables consumed raw in Ankpa Local Government are carriers of infective parasites which cause various diseases in humans and domestic animals. A single vegetable species can be contaminated by multiple parasites and vegetables that have passed through various forms of transportation and handled by different vendors tend to have high parasitic contamination than those supplied by farmers directly to the market. This indicates that humans are always at risk of infection, especially as vegetables are essentials in the diet of people of all ages. The importance of vegetables in the diet cannot be over-emphasized. Therefore, consumers need to thoroughly wash all fresh vegetables purchased from the market using clean water and salt before consumption to reduce the risk of infection by parasites associated with vegetables.

Acknowledgments

We acknowledge the Department of Microbiology, Kogi State University, Anyigba for providing the laboratory space for parasitological examinations. We also appreciate the laboratory technologists for their technical assistance.

Declarations

The authors declare that there is no conflict of interest.

Authors' contributions

JJ: conceived and designed the study, contributed to data and analysis and wrote the paper. **MEU:** Collected samples from the field, contributed to manuscript writing. **ETI:** Reviewed the Manuscript. **BAA:** Identify the vegetables. **QPA:** Carry out the microbiological analysis and parasite identification

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