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Parasites on Vegetables Sold at Masaka Market, Karu, Nasarawa State, Nigeria

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Abstract

The consumption of fresh vegetables serves as source of important nutrients in the body; however, parasitic infection from the consumption of raw fruits and vegetables is on the increase. This study aimed at identifying the parasitic contamination of Vegetables sold at Masaka market New Karu, Nasarawa State. A total of 240 samples of vegetables were examined by sedimentation concentration after washing using normal saline. The overall prevalence of parasitic contamination was 52.5%. Fluted pumpkin (93.3%) was the most contaminated vegetable while cucumber and apple (16.7%) were the least contaminated vegetables (P>0.05). *Strongyloides stercoralis* (28.9%) was the most frequently detected parasite followed by *Taenia* spp (18.8%), *Entamoeba coli* (17.2%), Hookworm (13.3%), *Entamoeba histolytica* (8.6%), *Ascaris lumbricoides* (7.8%) and *Toxocara* spp (5.5%) was the least detected parasite. The parasitic contamination of different vegetables shows that Tomatoes and Lettuce had the highest poly-parasitic contamination of four species of parasites, whereas Apple and Cucumber had the least poly-parasitic contamination of one parasite. *Strongyloides stercoralis* had the highest infestation (37.5%) of the water samples used to refresh the vegetables. Vegetables that were washed before display for selling was significantly associated with reduced parasitic contamination (P>0.05). Vegetables are potential sources of transmission for intestinal parasites in the study area, hence, proper washing of fruits and cooking of vegetables is required to reduce parasitic infections.

Keywords: Vegetables, Parasitic contamination, Masaka, Karu, Nasarawa

Introduction

A healthy diet consists of fruits and vegetables. A lifestyle of reduced consumption of fruits and vegetables has been associated to poor health and increased risk of non-transmissible diseases [1, 2]. The World Health Organization and the Food and Agriculture Organization 2004, recommend that a minimum of 400 g of fruits and vegetables should be consumed daily [1,2]. However, recent studies revealed that a higher consumption of fruits and vegetables than the generally-recommended 400 g is required to reduce the risks of cardiovascular disease, cancer, and premature mortality [3, 4, 5]. Globally, an estimated 3.9% mortality rate was attributed to inadequate fruit and vegetable consumption in the year 2017 [6]. However, vegetables consumed without proper washing and processing can serve as a viable medium for the transmission of parasites which pose a health threat to man and animals [7, 8].

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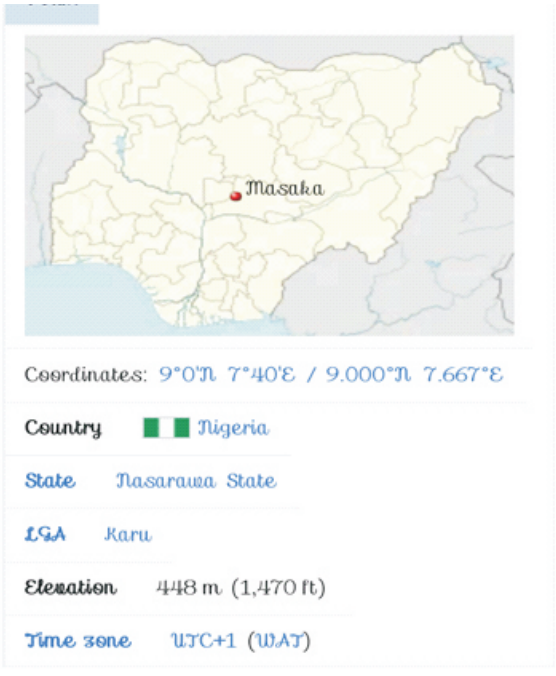
In developing countries like Nigeria, water supply and toilet facilities are inadequate hence the use of untreated waste water and manure for irrigation is a common practice [9]. Parasitic contamination of vegetables may occur at various stages of their production and commercial chain due to quality of water used for irrigation, washing, harvesting, storage, processing, distribution, sales, exhibition and handling by infected individuals, as well contact with flies, rats and domestic animals [10,11].

The consumption of fresh vegetables is common in Karu Local Government. However, there is paucity of epidemiological information about the parasitic contamination of fruits and vegetables in the study area. Hence, this study was designed to determine the prevalence of intestinal parasites isolated from fresh fruits and vegetables sold in Masaka market, Karu in Nasarawa State Nigeria in order to create public health awareness and provide useful data to guide in developing control strategies in the study area.

Material and Methods

Study Area

Masaka is a town that forms the Karu urban area. Masaka is a district of Karu Local Government Area, Nasarawa State. Nasarawa State lies between latitude 9°0' North and longitude 7°40'East, with an elevation of 448m [12]. Masaka market is located along the Abuja-Keffi express way and the traders consist of farmers, whole sellers and retailers who sell various farm produce and other food commodities.



Sample Collections

Eight (8) different vegetables which include lettuce (*Lactuca sativa*), apple (*Malus pumila*), carrot (*Daucus carota*), tomato (*Solanum lycopersicum*), pepper (*Capsicum annuum*), spinach (*Spinacia oleracea*), cucumber (*Cucumis sativus*) and fluted pumpkin (*Telfairia occidentalis*) were purchased from Masaka market. Equal numbers of samples (30 each, totally 240 samples) were collected and sampling was carried out twice a week. The samples were collected and placed in a separate sterile transparent zip lock bag and properly labelled. Twenty (20ml) of water used for sprinkling or refreshing the vegetables were collected. At each collection point, a well-structured questionnaire was administered to the sellers to obtain vital information. The samples were transported to the Microbiology laboratory of Bingham University Karu, Nasarawa State, for parasitological analysis.

Laboratory Examination of Samples

A portion (100g) of each vegetable was measured on a weighing balance and washed in 10% normal saline (500 ml) so as to detach the parasitic stages (ova, larvae, cysts, and oocysts) of helminths and protozoan parasites commonly associated with vegetable contamination.

The normal saline and water samples used to sprinkle the vegetables were left for twelve (12) hours to allow sedimentation. Fifteen (15) mls of the sediment was emptied into centrifuge tubes. The tubes were centrifuged at 3,000 revolutions per minute for 2 minutes after centrifugation, the supernatant was decanted carefully and the sediment was agitated gently to redistribute the parasitic stages. The entire content was used to prepare slides from each sample to increase the chance of parasite detection. The sediment was examined under a light microscope using 10X and 40X objectives. The eggs/cysts were identified based on morphological details [13].

Data Analysis

Data analysis was carried out with SPSS software version 16 (IBM, Chicago, IL, USA). Pearson's chi-square test ($\chi 2$) test was used to determine association between categorical variables. *P*-value equal to or less than 0.05 was considered to be statistically significant.

Results

Of the 240 samples collected from Masaka market and examined for parasitological contamination, 126

samples were identified to be contaminated with at least one type of parasite. The highest contamination was recorded on fluted pumpkin, 28(93.3%) and the least was found on cucumber and apple which were both 5(16.7%) respectively (Table 1).

The study isolated seven parasites as shown on table 2. The result revealed *Strongyloides stercoralis* (28.9%) as the most frequently detected parasite followed by *Taenia* spp (18.8%), *Entamoeba coli* (17.2%), Hookworm (13.3%), *Entamoeba histolytica* (8.6%), *Ascaris lumbricoides* (7.8%) and *Toxocara* spp (5.5%) was the least detected parasite at P>0.05

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The types of parasitic contamination are shown in Table 3. *Entamoeba histolytica* was not encountered on cucumber, lettuce, spinach, carrot and apple. *Taenia* sp. was not encountered on Tomatoes, Pepper, Carrot, and Fluted pumpkin. Hookworm only occurred on tomato, pepper and lettuce. *Stongyloides stercoralis* was recovered on lettuce, spinach, carrot and fluted pumpkin. *Entamoeba coli* only occurred on tomato. *Ascaris lumbricoides* was recovered on lettuce, spinach, and carrot. *Toxocara* sp. was also encountered but only on tomato, pepper and carrot.

Table 4 shows the poly parasitism on vegetables, where Tomatoes and Lettuce was found to have the highest poly-parasitic contamination of four species of parasites, whereas Apple and Cucumber showed the least poly-parasitic contamination of one parasite

Table 5 shows the distribution of parasitic contamination of vegetables after refreshing with water samples. *Strongyloides stercoralis* had the highest infestation of the water followed by *Ascaris lumbricoides* 2(25.0%) and *Entamoeba histolytica* (25.0%). *Entamoeba coli* were the lowest occurring parasite 2(12.5%).

Table 6 shows socio-demographic factors associated with contamination of fruits and vegetables in the study area. The educational status of the vendors was ascertained and the majority (66.7%) of the vendors had no formal education, while 30.8% of the vendors had primary education, only 2.1% had secondary education and 0.4% had tertiary education. Another factor associated with parasitic contamination of fruits and vegetables is the act of washing the produces before they were displayed for sale. According to this study (50.4%) of the farm produce were not washed before display for selling while only (49.5%) of the fruits and vegetables were washed before they were displayed for sale. The sources of water used for washing the produce among the vendors was only borehole water (49.5%) and it was contaminated with at least one parasitic species, respectively.

The method of display for selling was also another factor assessed for association with parasitic contamination of fruits and vegetables. Various methods of display were observed among the vendors as follows: (36.7%) of the produces are displayed on the floor by the road sides, (29.2%) on tables by the road sides, (21.7%) on tray by the road sides and (12.5%) on wheelbarrow walking round the market.

Table 1: Prevalence of parasitic contamination in vegetables at Masaka market

Types of Vegetables	No. of samples Examined	Number Positive (%)	Number Negative (%)	X^2	P- Value
Tomato	30	20 (66.7)	10(33.3)		
Pepper	30	18 (60.0)	12 (40.0)		
Cucumber	30	5 (16.7)	25 (83.3)		
Lettuce	30	15 (50.0)	15 (50.0)	48.000	0.243
Spinach	30	25 (83.3)	5 (15.7)		
Carrot	30	10 (33.3)	20 (66.7)		
Fluted pumpkin	30	28 (93.3)	2 (6.7)		
Apple	30	5 (16.7)	25 (83.3)		
Total	**240**	**126 (52.5)**	**114 (47.5)**		

Table 2: Distribution of intestinal parasites on vegetables sold at Masaka market

Detected parasites	Frequency	Prevalence (%)	X^2	P value
Entamoeba histolytica (cyst)	11	8.6		
Taenia spp	24	18.8		
Hookworm (eggs)	17	13.3		
Strongyloides stercoralis (ova)	37	28.9	30.00	0.224
Entamoeba coli (cyst)	22	17.2		
Ascaris lumbricoides (ova)	10	7.81		
Toxocara spp (ova)	7	5.5		
Total	**128**	**53.3**		

Table 3: Distribution of parasitic contamination according to types of vegetables

Parasites	T	P	C1	L	S	C2	F	A
Entamoeba histolytica	8	8	0	0	0	0	20	0
Taenia spp	0	0	5	6	10	0	0	5
Hookworm	5	6	0	4	0	0	0	0
Strongyloides stercoralis	0	0	0	3	9	5	8	0
Entamoeba coli	5	0	0	0	0	0	0	0
Ascaris lumbricoides	0	0	0	2	6	3	0	0
Toxocara spp	2	4	0	0	0	2	0	0
Total	**20**	**18**	**5**	**15**	**25**	**10**	**28**	**5**

Key; T= Tomatoes, P= Pepper, C1= Cucumber, L= Lettuce, S= Spinach, C2= Carrot, F= Fluted pumpkin

Table 4: Poly-parasitism on Vegetables

Parasites	T	P	C1	L	S	C2	F	A
Entamoeba histolytica	+	+	-	-	-	-	+	-
Taenia spp	-	-	+	+	+	-	-	+
Hookworm	+	+	-	+	-	-	-	-
Strongyloides sterocoralis	-	-	-	+	+	+	+	-
Entamoeba coli	+	-	-	-	-	-	-	-
Ascaris lumbricoides	+	-	-	+	+	+	-	-
Toxocara spp	-	+	-	-	-	+	-	+

Key; T= Tomatoes, P= Pepper, C1= Cucumber, L= Lettuce, S= Spinach, C2= Carrot, F= Fluted pumpkin (Ugu), A= Apple.

Table 5: Distribution of parasitic contamination on vegetables after refreshing with water samples

Detected parasites	Frequency	Prevalence (%)
Entamoeba histolytica (cyst)	2	25.0
Strongyloides stercoralis (ova)	3	37.5
Entamoeba coli (cyst)	1	12.5
Ascaris lumbricoides (ova)	2	25.0
Total	**8**	**100**

Table 6: Factors associated with parasitic contamination of fruits and vegetables

Variables	Positive	X^2	P Value
Sources of water			
Rain	0		
Tap	0		
Borehole	119 (49.5)	8.000	0.238
Well	0		
Total	**240**		
Washed before Display			
Yes	119 (49.5)	2.000	0.157
No	121(50.4)		
Total	**240**		
Point of display			
On tables	70 (29.2)		
On the floor	88 (36.7%)	12.000	0.213
On wheelbarrow	30 (12.5)		
On tray	52 (21.7)		
Total	**240**		
Educational status of Vendor			
No formal education	160 (66.7)		
Primary education	74 (30.8)	12.000	0.213
Secondary education	5 (2.1)		
Tertiary education	1 (0.4)		
Total	**240**		

Discussion

The findings from this study have shown that parasitic eggs, larvae and cysts can be found on vegetables. Of the 240 samples of vegetables and fruits that were collected, processed and examined, 126 of them were contaminated with parasites given an overall prevalence of parasitic contamination of 52.5%. This prevalence is higher than the reports of [14, 15, 16, 17] who recorded prevalence of 29.6%, 36.0%, 35.1% and 42.6% in Egypt, Nigeria, Thailand and Ethiopia respectively. The high prevalence in this study may be attributed to the exposure of the fruits to contaminated environments and contaminated irrigation water. Furthermore, the community lacks good toilet facilities, hence open defecation is practiced and faecal matter may be washed off into irrigation waters. In separate studies conducted by [18, 19,20], higher prevalence rates of 57.8%, 54.4% and 57.5% was reported in Ethiopia and Brazil. This variation may be attributed to type of water used for irrigation, varying environmental factors, sampling technique or methods used for detection of the intestinal parasites.

This study revealed that fluted pumpkin (Ugu) had the highest parasitic contamination (93.3%) while apple (16.7%) and cucumber (16.7%) recorded the least parasitic contamination. This could be due to the fact that the degree of contamination varies according to the vegetable type. Fluted pumpkin,

have uneven surfaces and makes parasitic eggs and larva attach to the surface of the vegetable more easily, either in the farm or when washed with contaminated water, whereas apple, cucumber and tomatoes had the least prevalence which may be because of the smooth and small surface areas which reduces the rate of parasitic attachment.

The most frequent parasite detected with a prevalence of 28.9% was *Strongyloides* parasite. This may be due to the free-living state of the parasite which does not require a host for its proliferation, in addition to its parasitic mode of life. The predominance of *Strongyloides* in this study is similar with the findings reported in Plateau, Kogi and Nasarawa states [8, 21, 22]. However, our findings disagree with the previous reports of other researchers who observed that *Ascaris lumbricoides, Entamoeba coli, Entamoeba histolytica,* and *Toxocara* spp were the most abundant parasites detected [23, 24, 25, 26]. *Toxocara* spp (5.5%) was reported. They can cause toxocariasis, visceral, and ocular larva migrants, in young children. Dogs, cats are responsible for the spreading of eggs in the environment [27].

Tomatoes and Lettuce was found to have the highest poly-parasitic contamination of four species of parasites, whereas Apple and Cucumber showed the least poly-parasitic contamination of one parasite. This disagrees with the findings of [18] who reported the highest poly-parasites contamination in carrot. Contamination with multiple species was observed in all kinds of produce examined in this study. This could be attributed to random defecation by humans and animals infected with these parasites or contamination during transportation.

The water used to sprinkle or refresh the vegetables was found to be contaminated with *Ascaris lumbricoides* (25.0%), *Entamoeba histolytica* (25.0%) and *Entamoeba coli* (12.5%) respectively. This may be due to the use of contaminated water to sprinkle the fruits. This hereby suggest the use of saline water to refresh fruits as several studies have reported the efficacy of saline water in dislodging different stages of parasitic infection [20, 28, 29].

Most of the fruits and vegetables were displayed for sale on the floor (36.7%) where it is exposed to dusts and flies. It is well established that the flies can act as vectors for a number of pathogenic microorganisms including parasites like *Cryptosporidium parvum* and *Toxoplasma gondii* [30].

Conclusion

The consumption of contaminated fruits and vegetables poses a great risk of acquiring parasitic infections in the study area. Consequently, the consumption of fresh fruits and vegetables washed in the market should be avoided while proper washing of fruits and sufficient cooking of vegetables before consumption is recommended. Government and market management authorities should make provision of safe water for washing of fruits, vegetables and other farm produce. In the same vein, public health education on improving hygienic practices for vegetable handlers, and improvements in sanitation of the town and its surrounding may help in preventing parasitic contamination.

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