

Prevalence of Parasites of Medical Importance on Fruits and Vegetables Sold in Markets of Makurdi and Otukpo, Benue State-Nigeria

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Abstract- The recovery of protozoa cysts and helminths ova from fruits and vegetables is of great public health significance. Consumption of improperly washed fresh fruits and vegetables constitutes considerable health risk and is the major route of transmission of intestinal parasites. This study aimed at determining the prevalence of parasites on edible fruits and vegetables sold in Makurdi and Otukpo metropolises, Nigeria. Samples were obtained from 3 markets per location and a total of 9 fruits and vegetables were used for the study. Sediments obtained from washing the fruits and vegetables with normal saline were centrifuged and then viewed under the microscope using x4 and x10 objectives. Eggs, cysts, and larvae of parasites including *Ascaris lumbricoides* (37.60%), *Giardia lamblia* (10.86%), *Entamoeba histolytica* (14.13%), *Fasciola hepatica* (10.86%) and *Strongyloides stercoralis* (22.82%) were found to be prevalent in this study across the sampled locations. There was no statistical significance between infected fruits and vegetables with markets, locations and all sampled variables in this study ($p < 0.05$). The result from this study showed high contamination (40.4%) of fruits and vegetables sold in Makurdi and Otukpo markets in Benue State. All parasites recovered in this study are of public health importance as they have been mostly implicated to cause morbidity in man and animals. Hygienic Practices should be promoted among farmers, vendors and the public through health education, health awareness campaigns, to mitigate contamination of fruits and vegetables.

Keywords- Protozoa, helminths, Fruits, Vegetables, Parasites, Makurdi, Otukpo

I. INTRODUCTION

Fruit and vegetable contamination has gained interest from many researchers across the globe. This may be due to the increasing reports on foodborne illnesses linked with the consumption of fresh vegetables contaminated with parasites [1][2]. The nutritional and economic relevance of edible fruits cannot be overemphasized, especially as they play vital roles in the sustainability of human populations [3]. Fresh vegetables are horticultural products that are regarded as essential parts of a healthy diet. Some fruits and vegetables are consumed uncooked to preserve their normal flavour as well as nutrients. However, epidemiological and laboratory surveys have found this practice unhygienic, especially in some parts of the country where people fail to properly wash their fruits before eating hence leading to transmission of parasitic diseases [3].

Harmful microbes that take up residence in the soil and in the intestines of human beings and livestock have potential to contaminate fruits and vegetables through faeces, untreated irrigation water, sewage or other means, such as during the handling or processing of the produces and transportation [4]. These parasites include a group of soil-transmitted helminthes/geohelminthes such as *Entamoeba*

histolytica, *Giardia duodenale*, *Trichuris trichuria*, *Ascaris lumbricoides* and *Entamoeba vermicularis*.

In Benue State, Central Nigeria, fresh fruits and raw vegetables are consumed daily. This makes the consumption of these fruits and vegetables a chief mode for the transmission of intestinal parasites and consequently leads to the spread of high burdened foodborne diseases of great public health importance [3]. Former studies carried out in Nigeria with well-known parasitic infections included Ilorin (Central Nigeria) by [5]; selected zones of Nigeria by [6]; Southeast Nigeria by [7] all these have revealed that eating of fresh vegetables and fruits without proper washing presents an important prospective for the spread of intestinal parasites.

Benue which is characteristically known for availability of fruits and vegetables all year round is not left out with regards to burden of parasites which can be transmitted via consumption of these produces. The presence of the Benue River and its tributaries support productive practices of the inhabitants such as irrigation farming. However, there is exist reports of open air defecation in Benue State and this creates an opportunity for effective spread of parasites of medical significance. In view of this, this study seeks to

document the parasites of medical importance of fruits and vegetables vended in two main towns in Benue State, Nigeria.

II. RELATED WORK

Quite a number of research works were carried out on the prevalence of parasites on edible fruits and vegetables in many parts of the world. This is because there has been increasing reports on food-borne diseases relating to the consumption of contaminated fresh fruits and vegetables [8], [9], [10], [11], [12] and [13]. For instance, Alli *et al.* reported the ‘‘Prevalence of Intestinal Parasites on Fruits Available in Ibadan Markets, Oyo State, Nigeria.’’ They examined a total of 96 samples of fruits for intestinal parasites where 34(35.4%) were positive for intestinal parasites. The parasites implicated in their report were *Ascaris lumbricoides* 55.9 percent, Hookworm *spp* 32.3 percent and *Stroglyoides stecoralis* 11.8 percent [14].

Endale *et al.* reported the ‘‘Detection of medically Important Parasites in Fruits and Vegetables Collected from Local Markets in Dire, Dawa, Eastern Ethiopia.’’ They examined a total of 376 samples of fruits and vegetables for medically important parasites where the positivity rate was found to be 47.3 percent and the highest contamination was detected from lettuce 61.7 percent while the least from orange 25.3 percent. They also reported protozoan and helminths recovered to include *Giardia lamblia* 9.3 percent, *Entamoeba histolytica* 8.8 percent, *Trichuris trichiura* 1.9 percent, *Stroglyoides spp* 8.0 percent and other parasites. Their findings revealed that almost half of the fruits and vegetables hawked in the local markets of the study area were being contaminated [15].

Santos *et al.* undertook a study of the ‘‘Prevalence of Helminths and Protozoa in Fruits Marketed in Streets Markets in a City inside Bahia.’’ They assessed 40 samples of fruits for helminths and protozoa contamination and observed 70 percent of the fruits presented positivity for some kind of parasites where guava was the most contaminated fruit 90 percent. Helminths recovered were *Ascaris lumbricoides*, *Taenia spp* and *Enterobius vermicularis*, and protozoa which included *Balantidium coli* and *Entamoeba coli* [16].

Gebremariam and Girmay conducted research on ‘‘Parasitic Contamination of Fresh Vegetables in Open Air Markets of Aksum, Ethiopia.’’ They evaluated a random sample of 384, 64 vegetables and reported over all prevalence of parasitic contamination of 57.3 percent. The most contaminated vegetable was cabbage 79.7 percent while the least contaminated vegetable was tomato 31.2 percent. The study reported parasites identified to include *Taenia spp* 41.1 percent, *Enterobius vermicularis* 20.3 percent, Hookworm *spp* 19.5 percent, *Faciola spp* 17.2 percent, *Stroglyoides stecoralis* 12.5 percent, *Ascaris lumbricoides* 9.4 percent and *Cryptosporidium spp* [17].

In addition, Morales-Figuerora *et al.* carried out a study on ‘‘Occurrence of Intestinal Parasites in Fruits and Vegetables from Markets of Northwest Mexico’’ [18]. Similarly, studies were carried out on Geohelminth Contamination of Common Fruits and Vegetables in Ebony State, Nigeria: the Public Health Implication’’ [19]. Equally, research on ‘‘Prevalence of Geohelminths on Edible and Vegetables Cultivated in Rural Villages of Ebony State, South East Nigeria’’ were studied [20]. Furthermore, Bakri *et al.* reported ‘‘Intestinal Parasite detection in assorted vegetables in the United Arab Emirates’’ [21].

III. METHODOLOGY

Study Area

The study was carried out in Makurdi and Otukpo metropolises. Makurdi and Otukpo are two out of the 23 local government areas of Benue State, Nigeria. Makurdi doubles as the state capital while Otukpo is the largest town in the southern part of the state. The two local government areas have a combined population of 261,666 according to the 2006 nationwide census. Makurdi is located on latitudes 7°30’N and 7°45’N longitudes 8°30’E and 8°35’E of the equator and Otukpo is located on latitudes 7°N and 8°E longitude and latitude [22]. The annual temperature of Benue State is between 21.8°C to 32.6°C. The average total rainfall of the state is 1.290mm. The raining season starts in April and ends in October while the dry season starts in November and ends in March.

Sample Collection

Three major markets in Makurdi (Modern market, Wurukum market and Wadata market) and three in Otukpo (Otukpo main market, Tiv market and Omateyi market) were considered for the study. Three types of fruits including tomato (*Lycopersicum esculentum*), Garden egg (*Solanum aethiopicum*), Tiger nut (*Cyperus esculentum* L.) and six (6) vegetables including Fluted pumpkin (*Telfairia occidentalis*), Green pepper (*Piper nigrum*), Green beans (*Phaseolus vulgaris*), Scent leaf (*Ocimum gratissimum*), Carrot (*Daucus carota*), and Amaratthus (*Amaratthus hybridus*) were randomly purchased from traders in the selected markets in Makurdi and Otukpo. Equal number of samples were purchased from these markets between 6:30am to 7:30am just as the traders were arriving from the supply farms. The samples were collected in sterile polythene bags and conveyed to the Department of Biological Sciences, Benue State University, Makurdi for parasitological analysis.

Macroscopic Examination of the Samples

The samples were examined carefully for the presence of macro parasites such as cestodes and adult nematodes with the naked eyes.

Sample Processing

The detection of the presence of parasites on the selected fruits and vegetables was done at the Microbiology Laboratory in the Department of Biological Sciences, Benue State University, Makurdi using the sedimentation

technique. Each sample of fruit and vegetable was washed vigorously with normal saline (containing 0.85% of Sodium Chloride) in a 250ml round bottom clean plastic bowl. The suspension was strained to remove undesirable materials (debris) and allowed to stand on the bench for ten hours to allow for proper sedimentation [20]. The supernatant was discarded leaving about 15ml at the bottom. Ten milliliters of the deposit mixture was transferred into a centrifuge tube and spun at 3000rpm for five minutes. The supernatant was decanted by quickly inverting the tube. The deposit was mixed and examined using direct smear and iodine smear techniques. For the direct smear technique, a drop of sediment was applied on the center of a clean grease-free slide and gently covered with clean cover slip avoiding air bubbles and over flooding. The smear was examined under a light microscope using the x4 and x10 objectives. The whole area under the cover slip was systematically examined. This procedure was repeated until the sediment in each test tube was exhausted [20]. For the iodine smear technique, a drop of the sediment was mixed with a drop of Lugol's iodine solution and examined as in direct smear for detection of parasite eggs, cyst, oocyst and larvae [20].

Identification of Parasites

The eggs, cyst, oocyst and larvae of parasites were identified with the aid of identification key and pictorial guides by [24] and [25].

Data Analysis

The data was analysed using descriptive statistics and simple percentages to determine the prevalence of parasites on the edible fruits and vegetables. Chi square test was also employed to determine the relationship between parasites of ova/larvae and contamination of different fruits and vegetables and location of markets.

IV. RESULTS AND DISCUSSION

A total number of 270 fruits and vegetables from 3 markets each within Makurdi and Otukpo local government areas of Benue State were examined for parasitic contamination. Total number of contaminated samples was 109(40.4%). Highest contamination was observed in pumpkin 15(50.0%) while Green pepper and Amarathus 9(30.0%) had the lowest contamination (Table 1). However, there was no statistical difference between level of contamination among the fruits and vegetables (P> 0.05).

Figure 1 shows a comparison of parasites contamination of fruits and vegetables in Makurdi and Otukpo metropolises. Makurdi metropolis had a total prevalence of 55(50.50%), while Otukpo metropolis had a total prevalence of 54(49.50%). This implies that samples from Makurdi metropolis were most contaminated, however there was no significance difference (P> 0.05).

Table 2 presents prevalence of parasites contamination of fruits and vegetables according to the six markets where sample were purchased. Wadata market in Makurdi metropolis had the highest number of positive samples 22

(48.9%), followed by Omateyi market in Otukpo metropolis 20(44.4%), Tiv market had a prevalence rate of 19(42.2%), while the Wurukum market had the least number of positive samples. No statistical difference (P>0.05) however, exist between markets and the level of contamination.

Table 3 shows types of parasites recovered and their prevalence rates. *Ascaris lumbricooides* had the highest prevalence rate of 45(41.3%), while the least parasites observed were *Giardia lamblia* and *Fasciola hepatica* both had prevalence rate of 12 (11.0%). However, there was no statistical difference (P> 0.05). And the distribution of parasites contamination on fruit and vegetable is contained in Table 4.

Table 1. Prevalence of Parasites Contamination According to Fruits and Vegetable Type Sampled in Benue State, Nigeria

Samples (Fruits and Vegetables)	Number Examined	Number Positive	Prevalence (%)
Garden egg	30	14	46.7
Tomatoes	30	14	46.7
Tiger Nuts	30	11	36.7
Carrot	30	12	40.0
Scent leave	30	13	43.3
Green pepper	30	9	30.0
Green beans	30	12	40.0
Pumpkin	30	15	50.0
Amarathus	30	9	30.0
Grand Total	270	109	40.4

($\chi^2 = 5.108$; df = 8; P= 0.746)

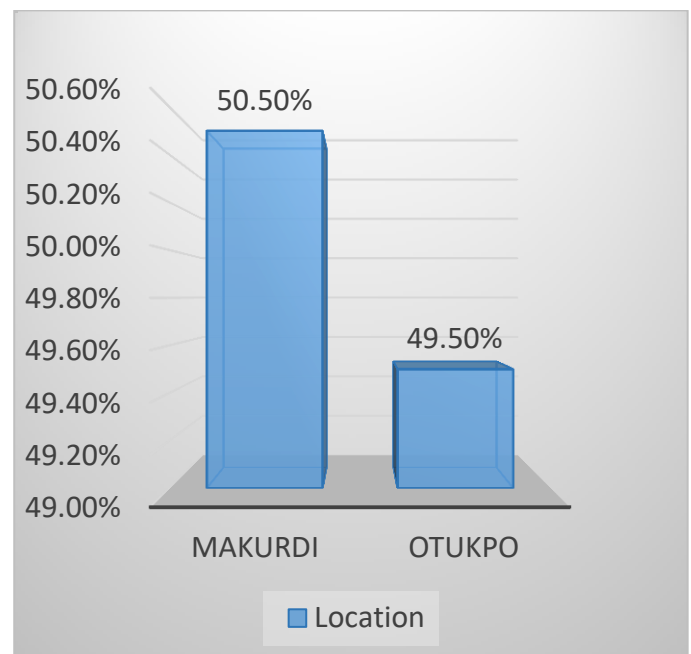


Figure 1. Comparison of parasitic Contamination of Fruits and Vegetables in the study locations

Table 2. Prevalence of Parasites Contamination of Fruits and Vegetables according to Markets

Market	Number	Parasite Load					Total (%)
		<i>Giardia lamblia</i>	<i>Ascaris lumbricoides</i>	<i>Entamoeba histolytica</i>	<i>Fasciola hepatica</i>	<i>Strongyloides stercoralis</i>	
Makurdi Town							
Wurukum Market	45	5	5	1	1	2	14(3.1)
Wadata Market	45	0	10	6	3	3	22(48.9)
Modern Market	45	2	8	3	3	1	17(37.8)
Otukpo Town							
Omateyi Market	45	1	9	2	4	4	20(44.4)
Tiv Market	45	3	6	4	1	5	19(42.2)
Otukpo Main Market	45	1	7	1	0	8	17(37.8)
Total (%)	270(100)	12(1.0)	45(41.3)	17(15.6)	12(1.0)	23(21.1)	109(40.4)

($\chi^2 = 32.471$; df = 5; P=0.145)

Table 3. Prevalence Rates of Parasites Recovered on Fruits and Vegetables Sampled in Benue State, Nigeria

Location	Parasites					Total (%)
	<i>Giardia lamblia</i>	<i>Ascaris lumbricoides</i>	<i>Entamoeba histolytica</i>	<i>Fasciola hepatica</i>	<i>Strongyloides stercoralis</i>	
Makurdi	7	23	10	7	8	55(50.5)
Otukpo	5	22	7	5	15	54(49.5)
Total (%)	12(11.0)	45(41.3)	17(15.6)	12(11.0)	23(21.1)	109(100.0)

($\chi^2 = 43.169$; df = 1; P= 0.337)

Table 4. Distribution of Parasites on Fruits and Vegetables sampled in Benue State, Nigeria

Sample (Fruits and Vegetables)	Parasite Load					Total (%)
	<i>Giardia lamblia</i>	<i>Ascaris lumbricoides</i>	<i>Entamoeba histolytica</i>	<i>Fasciola hepatica</i>	<i>Strongyloides stercoralis</i>	
Garden egg Tomatoes	4	7	1	0	2	14(46.7)
Tiger Nuts	1	6	1	3	3	14(46.7)
Carrot	2	6	1	1	1	11(36.7)
Carrot	0	4	2	1	5	12(40.0)
Scent leave	2	4	4	1	2	13(43.3)
Green pepper	0	5	0	3	1	9(30.0)
Green beans	1	6	0	1	4	12(40.0)
Pumpkin	2	4	5	0	4	15(50.0)
Amaranthus	0	3	3	2	1	9(30.0)
Total (%)	12(11.0)	45(41.3)	17(15.6)	12(11.0)	23(21.1)	109(40.4)

($\chi^2 = 43.169$; df = 8; P=0.337)

DISCUSSION

Recovery of intestinal parasites on fruits and vegetables posed great health risk to the community. Many fruits and vegetables are consumed raw, more so that people usually pick fallen fruits on the ground and eat without proper washing. The water and the soil in which these are cultivated are usually contaminated with human and animal wastes.

The present study reported high prevalence of parasites of medical importance on fruits and vegetables displayed for sale in Makurdi and Otukpo. Elom *et al.* [20] reported that the contamination of fruits and vegetables usually occur on the field due to the application of contaminated water further exacerbated by ineffective hygienic practices. Relatedly, Tchounga *et al.* [26] in their report stated that the risk of infection with intestinal parasites to the populace was fast increasing due to the fact that contaminated fruits and vegetables are sometimes eaten unwashed or undercooked to retain their natural taste and preserve their heat labile nutrients.

The overall prevalence rate of 40.4% recorded in this study was lower than that reported by Morales-Figueroa *et al.* [18], where they reported an overall prevalence rate of 45.0% contamination on fruits and vegetable in Mexico. Also, Dawet *at al.* [8] reported a prevalence rate of 41.9% on fruits and vegetables marketed in Jos-Plateau. However, the prevalence rate of contamination of fruits and vegetables reported in this study was higher than that recorded by Tchounga *et al.* [26], where they reported a prevalence rate of 29.5% in Port-Harcourt. It was again higher than 15.1% prevalence recorded by Bakri *et al.* [21] in United Arab Emirates. The observed differences might be connected to environmental differences in which the vegetables and fruits were cultivated and also, may be due to poor handling of the fruits and vegetables by farmers and vendors.

Five species of parasites were reported in this study (*Ascaris lumbricoides*, *Giardia lamblia*, *Entamoeba histolytica*, *Fasciola hepatica* and *Strongyloides stercoralis*). This agrees with the work of Mohamed *et al.* [10] and Uneke *et al.* [19] where they reported similar number and types of parasites on fruits and vegetables sold in Khartoum and Ebonyi respectively.

Parasitic contamination was high in fluted pumpkin while *Ascaris lumbricoides* was the most prevalent parasite recorded. This could be due to the rough and broad leaf surface in fluted pumpkin which may retain parasitic pathogens from untreated organic manures or waste water used to enhance its growth. This findings corroborates the works of [27] where they recorded the highest parasites contamination in fluted pumpkin.

V. CONCLUSION AND FUTURE SCOPE

The result from this study showed high contamination of fruits and vegetables sold in Makurdi and Otukpo markets in Benue State. Many of the identified parasites are of great

medical significance and veterinary importance, connoting the possibility of zoonosis if left unchecked. The study further revealed that consumption of raw fruits and vegetables is the probable source of transmission for intestinal parasites to man.

Practices that promote contamination of fruits should be discouraged while promoting high hygiene standards. Health education and awareness on the potential health consequences of consuming contaminated food products should be created among the vendors, farmers, and the general public.

This research focused only on assessing parasites of health importance on fruits and vegetables sold in two major town in Benue State, Nigeria. However, further study is needed to cover the entire state to ensure food safety and improve public health. Additionally, research is needed to assess the level of parasitic contamination of the soil and water the farmers used in the cultivation of these produces.

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