PARASITIC CONTAMINATION OF FRESH VEGETABLES AND FRUITS IN EFFURUN, IGBUDU AND AGBARHO MARKETS DELTA STATE, NIGERIA

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Abstract

Fruits and vegetables had been reported to be contaminated with different types of pathogenic organisms. A total of one thousand five hundred (1500) samples, consisting of fruits (750) and vegetable (750) were examined. Of these, 52.4% of fruits and 56.6 % of vegetables were contaminated with 7 parasites. The most common parasites were *Entamoeba coli* 11.9%, *Entamoeba histolytica* 17.9%, *Ascaris lumbricoides* 17.2%, *Giardia lamblia* 12.9%, *Trichuris trichiura* 17.7%, and *Fasciola gigantica* 6.6%, and Hook worm 15.5%. Base on location, the highest prevalence was obtained in Agbarho with a prevalence of 57.6%, followed by Igbudu with a prevalence of 56.4%. The least prevalence was recorded in Effurun with a value of 43.2%. Statistically, there was no significant difference in the prevalence in markets locations (P0.05; P = 0.3167; F = 1.293). The highest prevalence of parasitic contamination in vegetable was recorded for *Telfairia occidentalis* (Fluted pumpkin), with a prevalence of 78%, in Agbarho. Effurun had its prevalence peak for *Talinum fruticosum* (Waterleaf) with 64%. Igbudu had its peak value of 68% for *Brassica oleracea* (cabbage). Statistical ANOVA revealed that, there was no significant difference in the prevalence of vegetable in markets locations (P>0.05; P = 0.9651; F = 0.03564). The data in this study revealed the contamination of pathogens on our fruits and vegetable. There is a need for improved surveillance systems on fruits and vegetable for pathogens to reduce their public health burden.

Keyword: Parasitic contamination, vegetables, fruits, Effurun, Igbudu, Agbarho, Delta state.

Introduction

Background to the study

A healthy and balance diet normally include fruits and vegetables. A lifestyle of reduced consumption of fruits and vegetables has been associated with poor health and increased risk of non-transmissible diseases (WHO, 2004; Moore *et al*., 2013). The consumption of vegetables and fruits has increased in recent years because of their nutritional importance and health benefits (Idahosa, 2011). Vegetables form a key component of a healthy diet, highly beneficial for the maintenance of health and prevention of diseases (Onwordi *et al.,* 2009). Fruits and vegetables are low in calories, fat and sodium, and supply fibre, vitamins, minerals, and other health-promoting phytochemicals (Luke, 2017). The importance of fruits and vegetables in supplying most of the vitamins and minerals such as carotene, ascorbic acid, riboflavin, iron, iodine, calcium cannot be over emphasized. Fruits and vegetables also produce valuable roughages and fibre which promote digestion and help to prevent constipation in humans (Klamsmewyer *et al*., 2004). Consumption of diet rich in vegetables may reduce the risk of stroke, help reduce blood cholesterol levels and lowers the risk of cardiovascular diseases, type 2 diabetes, and certain cancers of the mouth, stomach, colon, and rectum. Potassium in some vegetables may also reduce risk of kidney stones and bone-calcium loss while antioxidants in vegetables help protect the body from oxidant stress, diseases, and cancers by boosting immunity (Gruda, 2005). Fibres absorbed in the colon retain good amount of moisture in faecal matter and aid its smooth passage from the body, thus offering protections against haemorrhoids, colon cancer and chronic constipation. The foliate in vegetables helps in the formation of red blood cells, reduces the risk of neural tube defects, spin bifida and anencephaly during foetal development in pregnancy while the potassium content may help to maintain healthy blood pressure. Consumption of vegetables generally helps to maintain healthy body weight (Steimetz *et al*., 1996).

Fruits, on the other hand, are rich sources of fibre, carbohydrate, and antioxidants. Halvorsen *et al*., (2002) reported that oranges, carrots, garden eggs, tomatoes and cucumber have extremely high antioxidant value. Antioxidants are known to neutralize free radicals which are harmful molecules that damage the body cells and cause inflammation (Aprikian *et al*., 2003).The World Health Organisation and the Food Agriculture Organisation 2004, recommend that a minimum of 400g of fruits and vegetables should be consumed daily (WHO, 2004; Moore *et al.,* 2013). However, recent studies revealed that a higher consumption of fruits and vegetables 400g is required to reduce the risk of cardiovascular diseases, cancer, and premature mortality.

Globally, an estimated 3.9% mortality rate was attributed to inadequate fruit and vegetable consumption in the year 2017 (WHO, 2019). However, vegetables and fruits 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 animal (Idahosa, 2011; Amoros *et al.*, 2010). There has been an increase in the number of reported cases of foodborne illness linked to consuming fresh fruits and vegetables. The consumption of raw vegetables plays a major epidemiological role in the transmission of parasitic food-borne diseases and intestinal parasites which are widely prevalent in developing countries, probably due to poor sanitation and inadequate personal hygiene (Kang *et al*., 1998). Fruits and vegetables can be agents for transmission of protozoan cysts and oocytes of *Giardia lamblia*, *Entamoeba histolytica*, *Toxoplasma gondii*, *Cryptospordium* species, *Cyclospora cayatanensis* and *Isospora* species as well as eggs and larvae of helminthes like *Hymenolepis nana*, *Taenia* species, *Fasciola* species, *Toxocara* species, *Ascaris lumbricoides*, *Trichuris trichiura*, *Strongyloides stercoralis*, *Trichostrongylus* species, *Enterobius vermicularis*, and Hookworms species (Ikpeze and Chima, 2017; Darchenkova, *et al.*, 2006; De Oliveira and Germano, 1992). These intestinal parasitic infections are among the most common infections worldwide. Human Infection by these parasites and can cause various clinical symptoms (Duedu *et al*., 2014), thereby making the control of those parasites in vegetables a public health intervention priority. Fresh produce, including apples, grapes, lettuce, peaches, peppers, spinach, sprouts, and tomatoes, are

known to harbour large parasite populations (Rastogi *et al*., 2012). In developing countries like Nigeria, water supply and toilet facilities are inadequate hence the use of untreated wastewater and manure for irrigation is a common practice (Amoros *et al*., 2010). 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 as contact with flies, rats and domestic animals (Falavigina *et* al., 2005; Takayanagui *et al*., 2006). The consumption of fresh vegetables is common in Delta State, Nigeria. However, there is paucity of epidemiology 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 Effurun, Igbudu and Agbarho market, Nigeria, an invaluable data in the public health importance of fruits and vegetables in epidemiology of some parasitic diseases in the tropics.

Materials and Methods

Description of Study Area.

This study was carried out between the months of June 2022 and February 2023 in Effurun, Igbudu and Agbarho Markets. Effurun, Igbudu and Agbarho Markets are three major towns in Uvwie, Warri South and Ughelli North local Government Area of Delta State, Nigeria. The inhabitants are mainly farmers and traders together with civil servants. Sellers from Effurun, Igbudu and Agbarho markets mostly get their fruits and vegetables supplies directly from the local farmers and traders from Northern Nigeria. People from other Local Government Areas and some nearby States usually come to the three (3) market locations to buy fruits and vegetables. There are absence of toilet facilities in most of the markets, hence traders' resort to the use of open defecation especially for children and disposed within the markets. Sewage disposal is also poor as manifested by heap of refuses where faeces are often deposited in the markets. These sources constitute means of contamination of these farm produces.

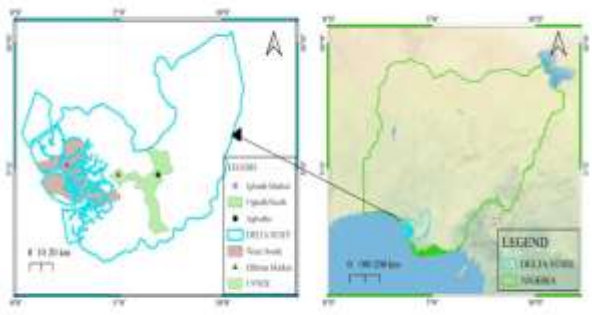

Fig. 1 Map of Delta State Showing the Area of study
Source: Developed using QGIS version 4.2

Sample collection.

Collection of samples was carried out according by Tefera *et al*. (2014). One thousand five hundred (1500) samples of five different types of fruits (750), *Citrus sinensis* (orange), *Citrullus lanatus* (watermelon), *Ananas comosus* (pineapple), *Malu domestica* (apple), *Solanum lycopersicum* (tomatoes) and 750 vegetables *Telfairia occidentalis* (Fluted pumpkin), *Brassica oleracea* (cabbage), *Vernonia amygdalina* (bitter leaf), *Talinum fruticosum* (Waterleaf), *Spinacia oleracea* (Spinach), *Daucus carota* (carrot) were purchased from farmers and vendors in three local markets, namely, Agbarho, Effurun and Igbudu, Delta State, Nigeria. Ten (10) of each sample were collected randomly per week in each market from fifteen (15) pieces randomly selected. The samples were collected separately in a properly labelled plastic or zip lock bag and transported to the laboratories of Animal and Environmental Biology, and Centre for Advance research Delta State University, Abraka for parasitological examinations.

Parasitological examination

Standard parasitological methods namely, direct smear method, Sedimentation, and zinc sulphate floatation technique described by Bekele and Shumbej (2019) were used to examine the fruits and vegetable collected.

Results

The prevalence of parasitic contamination of fruits sold in Agbarho, Effurun, and Igbudu market as shown in Table 1.2. The highest prevalence was obtained in Agbarho with 57.6%, followed by Igbudu with 56.4%, and lastly Effurun with a value of 43.2%. In Agbarho, the highest rates of contamination occurred in *Citrullus lanatus* and *Solanum lycopersicum* with a prevalence of 76% and 54% respectively. The least prevalence value was obtained in *Malu domestica* with a prevalence of 24%. Effurun had its prevalence peak for *Ananas comosus* with 54% with its least values being 34% for *Musa paradisiaca*, *Citrullus lanatus* was not contaminated. The least prevalence in Igbudu was recorded for *Citrus sinensis and Solanum lycopersicum* with prevalence of 36%, while its peak value was 62% for *Citrullus lanatus*. Statistical ANOVA revealed that, there was no significant difference in the prevalence of parasitic contamination of fruits in the market locations ($P>0.05$; $P = 0.389$; $F = 1.006$).

Table 1.2: Prevalence of Parasitic Contamination of Fruits Sold in Agbarho, Effurun, and Igbudu Market.

	Markets						
		Agbarho		Effurun		Igbudu	
Botanical Name	No. Examined	No. contaminated (%)	Overall Prevalence (%)	No. contaminated (%)	Overall Prevalence (%)	No. contaminated (%)	Overall Prevalence (%)
Citrus sinensis (orange)	50	22(44)	8.8	19(38)	7.6	18(36)	7.2
Citrullus lanatus(watermelon)	50	38(76)	15.2	0(0)	0	31(62)	12.4
Ananas comosus (pineapple)	50	25(50)	10	27(54)	10.8	19(38)	7.6
Malu domestica(apple)	50	12(24)	4.8	24(48)	9.6	27(54)	10.8
Solanum lycopersicum(tomatoes)	50	27(54)	10.8	21(42)	8.4	18(36)	7.2
TOTAL	**250**	**144**	**57.6**	**108**	**43.2**	**141**	**56.4**

Table 1.3: Prevalence of Parasitic Contamination of Vegetables Sold in Agbarho, Effurun, and Igbudu Market.

	Market						
		Agbarho		Effurun		Igbudu	
Botanical Name	No. Examined	No. contaminated (%)	Overall Prevalence (%)	No. contaminated (%)	Overall Prevalence (%)	No. contaminated (%)	Overall Prevalence (%)
Telfairia occidentalis (Fluted pumpkin)	50	39(78)	15.6	31(62)	12.4	25(50)	10
Brassica oleracea(cabbage)	50	28(56)	11.2	0(0)	0	34(68)	13.6
Talinum fruticosum (Waterleaf)	50	23(46)	9.2	32(64)	12.8	28(56)	11.2
Spinacia oleracea (Spinach)	50	26(26)	10.4	28(56)	11.2	13(26)	5.2
Daucus carota(carrot)	50	16(32)	6.4	24(48)	9.6	15(30)	4
TOTAL	*250*	*149*	*59.6*	*143*	*57.2*	*133*	*42.5*

Table 1.3 shows the prevalence of parasitic contamination of vegetables sold in Agbarho, Effurun, and Igbudu market. The highest prevalence was obtained in Agbarho with a prevalence of 59.6%, followed by Effurun with a prevalence of 57.2%. The least prevalence based on was recorded in Igbudu with a value of 42.5%.

In Agbarho, the highest prevalence was recorded in for *Telfairia occidentalis*, *Brassica oleracea and Talinum fruticosum (Waterleaf)* with a prevalence of 78%, 56% and 46% respectively. The least prevalence value was obtained in other *Spinacia oleracea (Spinach)* with a prevalence of 26%. Effurun had its prevalence peak for *Talinum fruticosum* with 64% with its least values being 48% for *Daucus carota* (carrot). *Brassica oleracea* was not infected. The least prevalence in Igbudu was recorded for *Daucus carota* (carrot) (3.0%) while its peak value was 68% for *Brassica oleracea* (cabbage). Statistical ANOVA revealed that, there was no significant difference in the prevalence of vegetable in markets locations (P>0.05; P = 0.9651; F = 0.03564).

Table 1.4: Percentage Occurrence of Parasitic ova and cyst found in all the three markets

	Agbarho			**Effurun**			**Igbudu**			
Parasites	**Total Number of parasites (%)**		**% of Parasites isolated**	**Total Number of parasites (%)**		**% of Parasites isolated**	**Total Number of parasites (%)**		**% of Parasites isolate**	**Total**
	Fruits	**Vegetables**		**Fruits**	**Vegetables**		**Fruits**	**Vegetables**		
Entamoeba coli	15(8)	12(6.5)	27(7.29)	20(10.5)	5(5.3)	25(10.7)	35(23.9)	27(13.3)	62(18.28)	114(11.9
Entamoeba histolytica	41(22)	24(13.0)	65(17.56)	27(14.2)	22(23.4)	49(21.1)	23(15.7)	34(16.74)	57(16.81)	171(17.9)
Ascaris lumbricoides	52(27.9)	28(15.2)	80(21.6)	38(20)	11(11.7)	49(21.1)	23(15.7)	12(5.9)	35(10.32)	164(17.2)
Giardia lamblia	13(6.9)	32(17.39)	45(12.1)	10(5.26)	21(22.3)	31(13.36)	13(8.9)	34(16.7)	37(10.9)	123(12.9)
Trichuris trichuria	39(20.9)	51(27.7)	90(24.3)	8(4.2)	4(4.25)	12(5.17)	12(8.2)	55(27.09)	67(12.76)	169(17.7)

Fasciola gigantic	7(3.7)	12(6.5)	19(5.1)	3(1.57)	9(9.57)	12(5.1)	11(7.5)	21(10.34)	32(9.43)	63(6.6)
Hook worm	19(10.2)	25(13.58)	44(11.8)	32(16.8)	22(23.4)	54(23.2)	29(19.86)	20(9.85)	49(14.45)	147(15.5)
Total	186	184	370	190	94	232	146	203	339	951

Percentage Occurrence of Parasitic ova and cyst found in the three markets are presented in Table 1.4. The overall highest prevalence in the three markets was seen in *Entamoeba histolytica* followed by *Trichuris trichiura and Ascaris lumbricoides* with a value of 17.9%, 17.7%, and 17.2%, respectively. The most prevalent parasite in Agbarho was *Trichuris trichuria* (24.3%). In Effurun, Hook worm had its prevalence peak of 23.2% while in Igbudu, *Trichuris trichuria* also had its prevalence peak of 12.76%. ANOVA revealed that, there was no significant difference in the prevalence in markets locations ($P<0.05$; $p=0.9475$; $F = 0.05409$).

Discussion

The findings from this study have shown that parasitic eggs, larva, and cyst can be found in fruits and vegetables in our study area. The overall prevalence of 54.5% depicted high contamination of fruits and vegetables sold in the study areas. This value collaborates with the study of Adogo *et al.,* (2021) who recorded prevalence of 52.5% in Nigeria. This prevalence is higher than reports of Damen *et al*., (2014) and Maysa *et al*., (2014), 36% and 29.6% in Nigeria and Egypt. High prevalence in this study may be attributed to the relatively fewer months of investigation by Adogo *et al* (2021); Damen *et al*., (2014) and Maysa *et al*., (2014) where fewer months of studies were carried out, which could limit the number of organisms collected. Also, exposure of fruits to contaminated environments contaminated and contaminated irrigation water could also be factors. Furthermore, the communities studied lack good toilet facilities, hence open defecation is practiced, and faecal matter may be washed off into irrigation waters.

Also, studies conducted by Tamirat *et al.,* (2014) and Kudah *et al.,* (2014), with prevalence rates of 57.8%, and 57.5% in Ethiopia and Ghana collaborates our investigation. They attributed these patterns to type of water used for irrigation, varying environment factors, sampling technique or methods used for detection of the intestinal parasites.

In this study, *Ananas comosus* (pineapple) had the highest overall prevalence of 28.4% for fruits and *Telfairia occidentalis* (Fluted pumpkin) with the highest overall prevalence of 38% for vegetables. This agrees with Adogo *et al* (2021) where Fluted pumpkin had the highest parasitic contamination of 93%. According to Adogo *et al* (2021), this could be due to the fact that the degree of contamination varies according to the vegetable type. For instance, Fluted pumpkin has uneven surface which can facilitate the attachment of the eggs and ova of parasite, thereby increasing the level of contamination than other vegetables.

The most frequent parasites detected with a prevalence of 17.9%, 17.7% and 17.2% in *Entamoeba histolytica* followed by *Trichuris trichuria* and *Ascaris lumbricoides*, respectively. The predominance of these parasites in this study disagree with the previous reports of other researchers who observed that *Ascaris lumbricoides, Entamoeba coli, Entamoeba histolytica, and Toxocara* sp. were the most abundant parasites detected (Windom *et al*., (2015); Matosinhos *et al*., (2016); Davoud *et al*., (2016); Nazemi *et al*., (2012).

The implication of these parasites among the fruits and vegetables from our study localities are of public health significance and will enrich the existing epidemiological data in contamination of fruits and vegetables by parasites in Nigeria.

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