

Prevalence of parasitic ova/cysts on fruits and vegetables sold in Afikpo North Local Government Area, Ebonyi State, Nigeria

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Received 4th October, 2017; Accepted 31st October, 2017

ABSTRACT: Fruits and vegetables are good sources of vitamin C, carotene, mineral elements, iron and fiber. Most fruits and vegetables are eaten raw without being cooked. This attitude has led to the development of some parasitic diseases caused by the ova/cysts of intestinal parasites. These parasitic diseases affect the normal health conditions of the body and its development. Hence the need to investigate the prevalence of ova/cysts on fruits and vegetables sold in Afikpo North Local Government Area, Ebonyi State, Nigeria. Out of 2,800 fruits sampled, 28.36% were contaminated with different species of ova/cysts of intestinal parasites. Of the fruits sampled, mango (*Mangifera indica*) was the most contaminated (35.75%), while the least fruits contaminated were apple (*Malus domestica*) (22.25%) and water melon (*Citrus vulgaris*) (22.25%). Also, of the 2,240 vegetables sampled, 44.87% were contaminated with various species of ova/cysts of intestinal parasites. Water leaf (*Talinum triangulare*) was the most contaminated (50.00%), while okro (*Abelmoscous esculentum*) was the least contaminated (38.13%). Fruits sampled from Enohia market were the most contaminated with ova/cysts of intestinal parasites (29.25%) while fruits sampled from Eke market Afikpo were the least contaminated (18.50%). Also, vegetables sampled from Akpoha market were the most contaminated with ova/cysts of intestinal parasites (45.00%), while vegetables from Eke market Afikpo were the least contaminated (31.56%). Of all the parasitic ova/cysts of intestinal parasites recovered, *Ascaris lumbricoides* was the most common in both fruits and vegetables sampled (6.54%) and (9.95%) respectively. While *Balantidium coli* was the least common in both fruits and vegetables sampled (3.75%) and (5.45%) respectively. Poor handling of fruits and vegetables were the major reasons for the high rate of contamination of fruits and vegetables in the study area. Building of shopping malls and proper washing of the fruits and vegetables are some safe practices that will help to checkmate the high incidence rate of contamination with parasitic ova/cysts.

Key words: Afikpo, fruits, intestinal parasites, ova/cysts, vegetables.

INTRODUCTION

Fruits and vegetables are of great importance in human health and development for normal balanced diet. They are important and must be included in our daily diets. Fruits and vegetables such as water leaf, lettuce, water melon, and cucumber have high water contents (Akprikian et al., 2003). Vegetables and fruits are good sources of vitamin C, carotene, mineral elements iron and fiber (Akprikian et al., 2003).

Regular consumption of fruits is associated with reduced risks of cancer, cardiovascular diseases such as coronary heart disease, stroke, cataracts and some of the functional declines associated with ageing (CDC, 2010). Diets that include a sufficient amount of potassium from fruits and vegetables also help to reduce the chances of developing kidney stones and the effect of bone loss (Simon-Oke et al., 2014).

Fruits are good sources of fibers and carbohydrates. Some fruits have high caloric values and glycemic index and should be taken in moderation (Center for Disease Control, 2010). Fruits such as carrots, tomatoes, oranges, garden eggs are good antioxidants, neutralizes free radicals which are harmful molecules that damage the body cells and cause inflammation. They are commonly measured as oxygen radical absorbance capacity (ORAC) (Akprikian et al., 2003; Simon-Oke et al., 2014).

The nutritional values of vegetables vary. Vegetables have low protein and fat contents. They contain varying proportions of vitamins such as vitamin A, K, B6, C and D. Vegetables (such as fluted pumpkin, *Amaranthus* spp., water leaf) also contain phytochemicals which act as antioxidants, antibacterial, and have anti-viral and anti-carcinogenic properties (Olrandi et al., 2002; Gruda, 2005).

Parasites may be transmitted from animals to humans, from humans to humans, food to humans or even humans to animals. Several parasites have emerged as significant cause of food borne and water borne diseases in the world. This is achieved through the consumption of contaminated food, and water or by eating raw fruits and vegetables that are contaminated with parasites ova or cysts (Cheesbrough, 2003).

Parasitic ova include ova of *Ascaris lumbricoides*, *Trichuris trichuria*, *Ancylostoma duodenale*, and cysts include cysts of *Balantidium coli*, *Entamoeba histolytica*, *Giardia intestinalis* (Oliveirra and Germano, 199; WHO, 2003; Anh et al., 2007).

Fruits and vegetables can become contaminated while growing in the fields or during harvesting, handling processes, distribution and use (Beuchat, 1999; Nicholas and Smith, 2002). They are most times consumed raw. Consumption of such contaminated fruits and vegetables are considered as risk factors for the transmission of parasitic ova/cysts in humans (Cheesbrough, 2003).

In Africa, Nigeria precisely, the use of human feces and animal dung in enriching the soil for cultivation of crops mainly fruits and vegetables are on the increase. This medium helps in the transmission of parasitic ova/cysts causing several parasitic diseases (Lucas et al., 2000).

The peasant farmers in Nigeria who are mainly in charge of the cultivation of fruits and vegetables depend on irrigation when there is no rainfall for the cultivation of their crops all year round. Many of them use untreated human feces and animal dung as manure, which contain various species of cysts/ova of intestinal parasites that are of medical and veterinary importance (Okonkwo, 1998; Lucas et al., 2000).

However, the climate, vegetation and topography of Afikpo North Local Government Area in Ebonyi State, Nigeria are suitable for the cultivation of fruits and vegetables using rain during wet season and irrigation during dry season. It is a known fact that the use of

untreated feces/animal dung, polluted irrigation water, are of great health risk to farmers and consumers of such crops produced with the contaminated irrigation water (Lucas et al., 2000; Cheesbrough, 2003). Raw waste water mostly contains high number of eggs (ova) and cysts of parasitic origin.

Thus, this study was aimed at investigating the parasitic ova/cysts on fruits and vegetables sold in Afikpo North Local Government Area, Ebonyi State, Nigeria.

MATERIALS AND METHODS

Background of the study area

The study was carried out in Afikpo North Local Government Area, Ebonyi State, Nigeria. Afikpo is located between latitudes 5° 4' and 6° 3' N and longitudes 7° 5' E and 7° 55' E. There are two main seasons in this area that is rainy season which is between April to October and dry season which lasts between November to March. The annual rainfall is about 160 to 220mm with maximum precipitation occurring between July to September. The temperature ranges between 23.4 and 29.9°C. The relative humidity is between 60 to 80% (National Population Census, 2006). Afikpo is bounded in the North by Ohaozara Local Government Area of Ebonyi State. By the East is Afikpo South Local Government Area, in the South by Cross River State and also in the West by Abia State (National Population Census, 2006). According to the 2006 National Population Census, the population of Afikpo is about 672,000 persons. The area is hilly with undulating plains. The people are predominantly farmers producing rice, cassava, yam, vegetables, palm oil and coco yam. They are also fishermen, hunters and a good number of them deal on timbers. They are hospitable and accommodating.

Sample collection

The study was carried out between October, 2014 and September, 2015. Seven different types of fruits which include garden eggs (*Solanum aethiopicum*) (Anghara), apple (*Mallus domestica*), orange (*Citrus sinensis*) (Oroma), water melon (*Citrullus vulgaris*), banana (*Musa aethiopicum*) (Ukom), paw paw (*Carica papaya*) (Mgbimghi) and mango (*Magnifera indica*) (Maringo) were sampled from the study area. Also seven different types of vegetables, commonly consumed by the people, were sampled. The vegetables include; fluted pumpkin (*Telfania occidentalis*) (Ugu), water leaf (*Talinum triangulare*) (Moimoi ikong), African salad *Ukazi* (*Alfalfa* spp.), okro (*Abelmoscous esculentus*) (Okwuru), African spinach (*Amaranthus spinosus*) (*Inini ogwu*), tomatoes (*Lyperisicon esculentum*) (*Tumato*) and pepper (*Capsicum annum*) (Ose). Fifty fruits and forty bundles

Table 1. Prevalence of parasitic ova on fruits and vegetables from different markets in Afikpo North Local Government Area.

Fruits/vegetables	No examined	No infected	% prevalence
Fruits	2800	794	28.36
Vegetables	2240	1005	44.87
Total	5040	1799	35.69

of vegetables were collected at random from each of the markets, making it a total of 2,800 fruits and 2,240 bundles of vegetables sampled. Eight different markets were sampled from Afikpo North Local Government Area. They include; Eke, Oziza, Akpoha, Kpogrikpo, Unwana, Enohia, Ibii and Amasiri markets.

Parasitological examination of specimens

The specimens were transported to the Science Laboratory Technology Department, Akanu Ibiam Federal Polytechnic Unwana for parasitological analysis. Sedimentation and floatation techniques were used in analyzing the samples (Cheesbrough, 2003).

Floatation techniques

The concentrated sodium chloride floatation technique was used for concentrating the cysts and ova of the parasites (2.1 gravity). Fruits and vegetables were weighed and washed in distilled water. The washings were centrifuged at 2500 rpm for 5 minutes and the supernatant was decanted. Two (2 mL) of the sediment was placed in a 15 mL test tube which was filled with 2 mL concentrated sodium chloride solution to the brim. A cover slip was used to cover the test tube, and the preparation was allowed to stand for about 6 hours, giving enough time for the ova/cysts of the parasites to float on top of the test-tube and attach at the cover slip. The cover slip was placed face downwards on a slide and was viewed under x10 and x40 objectives with a drop of iodine under the cover slip for easy identification of the parasite (Cheesbrough, 2003; Arora and Arora, 2008).

Sedimentation techniques

About 25 g of the samples (fruits and vegetables) were weighed and washed in distilled water for the removal of parasitic ova/cysts. The suspension was strained through a sterile sieve to remove undesirable materials. The filtrate was centrifuged at 3000 rpm for 15 minutes. The supernatant was discarded into a disinfectant container. The sediment was mixed up and a drop of it was placed on the centre of a clean grease free microscope slide and a clean cover slip was placed gently on the slide to avoid air bubbles. Iodine was added through the cover slip into

the preparation for easy identification of the parasite. The preparation was examined under the microscope for parasitic ova/cysts using x10 and x40 objectives (Cheesbrough, 2003; Damen et al., 2007; Arora and Arora 2008).

Statistical analysis

Chi square test was used in testing for the level of significance between the fruits and the vegetables.

RESULTS

Study on the parasitic ova/cysts of intestinal parasites contaminating fruits and vegetables sold in some selected markets in Afikpo North Local Government Area, Ebonyi State, Nigeria were carried out between October, 2014 and September, 2015. Out of 2,800 fruits sampled, (28.36%) were contaminated with different species of ova/cysts of intestinal parasites. Also, of the 2,240 vegetables sampled, (44.87%) were contaminated with various species of ova/cysts of intestinal parasites. The total prevalence of parasitic ova/cysts that contaminates the fruits and vegetables sampled was (35.69%) (Table 1).

Table 2 shows the distribution of parasitic ova/cysts in relation to fruits sampled from the study area. Of the fruits sampled, mango (*Magnifera indica*) was the most contaminated (35.75%), while the least fruits contaminated were apple (*Mallus domestica*) (22.25%) and water melon (*Citrus vulgaris*) (22.25%). Other fruits sampled include; garden egg (*Solanum aethiopicum*) (31.50%), orange (*Citrus cinensis*) (30.75%), pawpaw (*Carica papaya*) (30.00%) and banana (*Musa acuminata*) (26.00%). The total prevalence of contamination was (28.36%).

Table 3 also shows the distribution of ova/cysts of parasites recovered from vegetables. Water leaf (*Talinum triangulare*) was the most contaminated (50.00%), while okro (*Abelmoscous esculentum*) was the least contaminated (38.13%). Other vegetables sampled include; fluted pumpkin (*Telfaria occidentalis*) (49.69%), Alfalfa (*Ukazi*) (42.50%), African spinach (*Amaranthus spinosus*) (46.25%). Others were tomatoes (*Lycopersicon esculentum*) (41.88%) and pepper (*Capsicum annum*) (45.63%) (Table 3). Vegetables were more contaminated with ova/cysts of parasites than fruits ($p < 0.05$).

Table 2. Distribution of parasitic ova/cysts on fruits sampled from Afikpo North Local Government Area.

Fruits	No examined	No infected	% prevalence
Garden egg	400	126	31.50
Apple	400	89	22.25
Orange	400	123	30.75
Water melon	400	89	22.25
Pawpaw	400	120	30.00
Banana	400	104	26.00
Mango	400	143	35.75
Total	2,800	794	28.36%

Table 3. Shows parasitic ova/cysts in relation to vegetables sampled from the markets in Afikpo North Local Government Area.

Vegetables	No examined	No infected	% prevalence
Fluted pumpkin	320	159	49.69
Water leaf	320	160	50.00
<i>Alfalfa (ukazi)</i>	320	136	42.50
Okro	320	122	38.13
<i>Amaranthus spinosus</i>	320	148	46.25
Tomatoes	320	134	41.88
Pepper	320	146	45.63
Total	2240	1005	44.87

Table 4. Distribution of ova/cysts of intestinal parasites recovered from fruits in relation to markets sampled in Afikpo North Local Government Area.

Markets (n=400)	No. infected	% prevalence
Eke	74	(18.50)
Ozizza	105	(26.25)
Akpoha	113	(28.20)
Kpogirikpo	98	(24.50)
Unwana	81	(20.25)
Enohia	119	(29.75)
Ibii	100	(25.00)
Amasiri	104	(26.00)
Total	794	(28.36%)

Table 5. Distribution of ova/cysts of intestinal parasites recovered from vegetables in relation to markets sampled in Afikpo North Local Government Area.

Markets (n=320)	Number infected	% Prevalence
Eke	101	(31.56)
Ozizza	126	(39.38)
Akpoha	144	(45.00)
Kpogirikpo	136	(42.50)
Unwana	113	(35.31)
Enohia	140	(43.75)
Ibii	126	(39.38)
Amasiri	119	(37.19)
Total	1005	(44.87)

Table 4 shows the distribution of ova/cysts of intestinal parasites recovered from the fruits in relation to markets sampled in Afikpo North Local Government Area. Fruits from Eke market were the least contaminated with intestinal parasites (18.50%) while fruits from Enohia market were the most contaminated with ova/cysts of intestinal parasites (29.75%).

The ova/cysts of intestinal parasites recovered from the vegetables sold in different markets in Afikpo North Local Government Area are shown in Table 5. Vegetables sampled from Eke market were the least contaminated with ova/cysts of intestinal parasites (31.56%) while

vegetables sampled from Akpoha market were the most contaminated (45.00%).

Different species of ova/cysts of intestinal parasites recovered from fruits sampled in Afikpo North Local Government Area are shown in Table 6. *Ascaris lumbricoides* had the highest prevalence 183 (6.54%) while *Balantidium coli* had the least prevalence (3.75%) and a total prevalence of 105 (28.36%).

Different species of ova/cysts of intestinal parasites recovered from vegetables sampled in Afikpo North Local Government Area are shown in Table 7. *Ascaris lumbricoides* had the highest prevalence 223 (9.95%),

Table 6. Different species of parasites ova/cysts recovered from fruits sampled and their percentage intensities (n =2800).

Fruits	<i>Ascaris umbricodes</i>		<i>Entamoeba histolytica</i>		<i>Balanutidium Coli</i>		<i>Giardia lamblia</i>		Hookworm ova		<i>Strongyloides stercoralis</i>		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Garden egg	31	1.11	18	0.64	14	0.50	20	0.71	22	0.79	21	0.75	126	4.50
Apple	20	0.71	13	0.46	10	0.36	14	0.50	15	0.54	17	0.61	89	3.18
Orange	29	1.04	20	0.71	18	0.64	17	0.61	20	0.71	19	0.68	123	4.39
Water melon	19	0.68	15	0.54	12	0.43	13	0.46	16	0.57	14	0.50	89	3.18
Paw paw	26	0.93	19	0.68	16	0.57	18	0.64	20	0.71	21	0.75	120	4.29
Banana	22	0.79	15	0.54	14	0.50	19	0.68	16	0.57	18	0.64	104	3.71
Mango	36	1.29	23	0.82	21	0.75	25	0.89	20	0.71	18	0.64	143	5.11
Total	183	(6.54)	123	(4.39)	105	(3.75)	126	(4.5)	129	(4.61)	128	(4.57)	794	(28.36%)

Table 7. Different species of parasites ova/cysts recovered from vegetables sampled and their percentage intensities (n =2240).

Vegetables	<i>Ascaris umbricodes</i>		<i>Entamoeba histolytica</i>		<i>Balanutidium Coli</i>		<i>Giardia lamblia</i>		Hookworm ova		<i>Strongyloides stercoralis</i>		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Fluted pumpkin	32	1.43	26	1.16	22	0.98	28	1.25	27	1.21	24	1.07	159	7.09
Water leaf	40	1.78	28	1.25	18	0.80	25	1.12	27	1.21	22	0.98	160	7.14
Alfalfa (ukazi)	28	1.25	23	1.03	16	0.71	26	1.16	24	1.07	19	0.85	136	6.07
Okro	26	1.16	20	0.89	13	0.58	21	0.94	23	1.03	19	0.85	122	5.45
African spinach	33	1.47	23	1.03	19	0.85	25	1.12	26	1.16	22	0.98	148	6.61
Tomatoes	29	1.29	20	0.89	16	0.71	24	1.07	27	1.21	18	0.80	134	5.98
Pepper	35	1.56	22	0.98	18	0.80	27	1.21	24	1.07	20	0.89	146	6.52
Total	223	(9.95)	162	(7.23)	122	(5.45)	176	(7.8)	178	(7.95)	144	(6.43)	1005	(44.87%)

while *Balanutidium coli* had the least prevalence (5.45%). There is significant difference ($p < 0.05$) with regards to parasitic distribution on fruits and vegetables sampled.

DISCUSSION

Out of the 2,800 fruits sampled from eight markets in Afikpo North Local Government Area, (28.36%) were contaminated with different species of ova/cysts of different intestinal parasites. Also, out of 2,240 vegetables sampled from eight markets

selected at random, (44.87%) were contaminated with different ova/cysts of intestinal parasites. Vegetables were more contaminated with parasitic ova/cysts than fruits (44.87%) and (28.36%) respectively. However, there is a level of significance between the vegetables and the fruits sampled ($p > 0.05$). The results of this study on the prevalence of parasitic ova/cysts on fruits and vegetables are supported by the works of Shahnazi and Jafari-sabet (2010) in Saudi Arabia and Hassan et al., (2012) in Egypt. The results of this study agreed with the findings of Leon (1992) and Damen et al., (2007) who carried out their

research works in Manila, Philippines and Jos, Nigeria on fruits and vegetables respectively.

Of the vegetables sampled, water leaf was the most contaminated with ova/cysts of parasites. These findings are in line with the results of Ohaeri et al. (2011) and Dauda et al. (2011). This is because water leaf stem is short, and it does not grow tall. This predisposes it to contamination by parasitic ova/cysts during flooding, as well as heavy rain splashes from the soil. Mango was the most contaminated with ova/cysts of intestinal parasites. Mango usually has an odor that attracts flies that mostly carry the ova/cysts on its body

and deposit it on mango while perching on it. In rural areas, people are fond of picking mango from the soil which is contaminated with different parasitic ova/cysts and eat without washing, but may wipe it with their bare dirty hands or cloths which are contaminated. This is a very common method of contacting ova/cysts of intestinal parasites (Cheesbrough, 2003; Al-shawa and Mwafy, 2007; Ngele, 2011; Ngele, 2012). Fruits sampled from Enohia market were the most contaminated (29.75%) while fruits sampled from Eke market Afikpo were the least contaminated (18.50%). Also vegetables sampled from Akpoha market were the most contaminated with cysts/ova of intestinal parasites (45.00%), while vegetables sampled from Eke market Afikpo were the least contaminated 101 (31.56%). The reason for the differences in the rates of contamination of fruits and vegetables from the markets sampled may be as a result of the sources of water used for irrigation and also the exposure of the items to open environment. That is, the poor filthy environment, coupled with heaps of refuse dumps within and around the markets contributed to the high rates contamination of ova/cysts of intestinal parasites on the fruits/vegetables as recorded in this study (Geruda, 2005; Simon-oke et al., 2014).

Ascaris lumbricoides was the commonest intestinal parasite recovered during the study, while the least intestinal parasite recovered was *Balantidium coli*. Other intestinal parasites recovered include; *Entamoeba histolytica*, *Giardia lamblia*, Hookworm ova, *Strongyloides stercoralis*. Shuval et al. (1984), Stephenson (1987), Ohaeri et al. (2011), Dauda et al. (2011), Simon-oke et al. (2014) also maintained that *A. lumbricoides* was the commonest intestinal parasite recovered from their different studies.

In conclusion, the research work has shown that fruits and vegetables sold in Afikpo North Local Government Area were contaminated with ova/cysts of intestinal parasites. Dirty environments and improper or poor handling of fruits and vegetables are some major causes of contamination with ova/cysts of intestinal parasites. It is therefore recommend that proper hygiene should be practiced in handling fruits and vegetables to avoid its contamination with parasitic ova/cysts of intestinal parasites. Also, Government should make it as a standing order by insisting that fruits and vegetables should be sold in enclosed shopping malls only, and no longer in open places to avoid its contamination. There should equally be public enlightenment and awareness campaign on the dangers associated with intestinal parasites.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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