American-Eurasian J. Agric. & Environ. Sci., 13 (9): 1275-1282, 2013
ISSN 1818-6769

DOI: 10.5829/idosi.aejaes.2013.13.09.11040

Prevalence of Intestinal Parasites in Vegetables Sold in Ilorin, Nigeria

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Abstract: The problem of food poisoning especially vegetables is not limited to personal hygiene while cooking but is also widely dependent on the source and handling before it gets to the consumer. To evaluate the rate of the occurrence of intestinal parasites in vegetables that are commonly sold in some markets in Ilorin, Kwara state Nigeria. In the present study, the rate of colonization of intestinal parasites and their prevalence were determined in five common edible vegetables in Ilorin. Three major markets were selected. The vegetables include *Lycopersicum sativus, Talinium triangulare, Celosia argenta, Amaranthus spinosus, Corchorus olitorius*. Each of the vegetables was randomly bought randomly from ten sellers in each of the market. 50 g of each of the samples was rinsed twice with distilled water in a 1 L beaker, it was decanted and centrifuged. The sediment was placed on a slide and observed under a microscope. 41 % of the 150 samples were contaminated with *Celosia argenta* as the most heavily contaminated. Of the eight parasites isolated, *Ascaris lumbricoides* was the most prevalent, while *Entamoeba coli*, *A. lumbricoides* and hookworms were found to be prevalent in all the three markets. Presently, Nigeria has no standard protocol for removal of microorganism or parasites except for the traditional rinsing with water. There is therefore a need for safety practices in planting, harvesting, storage and vendors' proper handling of vegetables.

Key words: Vegetables · Parasites · Microscopy · Contamination

INTRODUCTION

Vegetables are horticultural products having tissues with continuing metabolism and thus subject to respiration, water loss and cell softening throughout the post the post-harvest period [1] they can be consumed raw; others are cooked while some are often used as desserts [2]. They are eaten as part of main meals and as snacks. Their nutritional content varies considerably. Many vegetables are rich sources of small proportion of protein, fat and a relatively high proportion of vitamins (such as vitamins A, C and K), provitamins, including dietary minerals such as calcium, magnesium, potassium and iron), alpha and beta carotene, zea-xanthins, crypto-xanthins, phenolics, flavonoids as well as anthocyanins. They contain fibres known as non-starch polysaccharides such as cellulose, mucilage, hemi-cellulose, gums, pectins etc folic acid and carbohydrates [1, 3, 4]. Many vegetables are also reported to contain phytochemicals which are known to reduce the risk of several diseases like bacterial, fungal, viral and cancer [3, 5]. Eating a diet rich in vegetables as part of an overall healthy diet may reduce the risk of stroke and perhaps other cardiovascular diseases. It may reduce the risk of Type II diabetes, protect against certain cancers such as mouth, stomach and colon-rectum cancer. Vegetables that are rich in potassium may reduce the risk of developing kidney stones and may help decrease bone loss. The antioxidants in vegetables help protect the human body from oxidant stress, diseases and cancers by helping to boost immunity. The fibres absorb water in the colon, retain good amount of moisture in the faecal

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matter and help its smooth passage out of the body, thereby offering protection from conditions like haemorrhoids, colon cancer, chronic constipation, rectal fissures and diverticulosis. It may also help reduce blood cholesterol levels and lower risk of heart diseases. The folate in vegetables helps in the formation of red blood cells and also reduces the risk of neural tube defects, spin bifida and anencephaly during foetal development in pregnant women. While vitamin A keeps eyes healthy and vitamin C aids healing of wounds, keeps teeth and gums healthy and also aids iron absorption, its low calorie property helps to keep the body fit and disease free. Potassium content may help maintain healthy blood pressure. Consumption of vegetables can therefore, help achieve or maintain a healthy body weight [6]. They harbour a wide range of microbial contaminants. That way, they undermine their nutritional and health benefits, thereby increasing outbreaks of human infection associated with the consumption (or minimally processed) vegetables [7-10]. Bacteria, viruses and parasites on vegetables have been linked with illness [2, 11]. Their consumption especially in the raw form has therefore been associated with outbreaks of foodborne disease in many countries [11-13]. These outbreaks range from a few people affected to thousands [11, 14]. Contamination of vegetables may take place before and after harvest [15-16]. Contamination before harvesting can come through soil, faeces (human and animal origin), water (irrigation, cleaning), ice, animals (including insects and birds) and application of animal manures or sewage [17-19]. It can also be introduced during harvesting, handling of the product, processing equipment and transportation [20-27]. Unsafe water used for rinsing the vegetables and sprinkling to keep them fresh is also a source of contamination [28].

Enteric pathogens such as Escherichia coli and Salmonella are among the greatest concerns in food-related outbreaks [4, 29]. Intestinal parasites common to raw vegetable include protozoans, cestodes, nematodes and trematodes [30-31]. Millions of People especially in the developing countries suffer from parasitic infections. About 3.5 billion people are infected with some kinds of intestinal parasites causing diseases like ascariasis, ancylostomiasis, trichuriasis, amoebiasis, schistosomiasis, giardiasis etc. [32] and responsible for about 2-3 million death annually worldwide [32]. Worldwide, it has been found that consumption of enteric parasites infected food leads to morbidity and mortality [33], the resulting diseases also have socio economic impact with respect to the cost of treatment and hospitalization costs [34-35].

MATERIALS AND METHOD

Description of Study Area: Ilorin, the Kwara state capital was used in this study. Kwara state is in North central, Nigeria. Ilorin is situated 306 Km North of Lagos, at 08°30'N and 04°30'E/ 8.500°N 4.550°E and 482 Km South West from Abuja, the federal capital of Nigeria. It is the gateway between the Northern and the Southern parts of the country. The estimated population of about 2.3 million is made up of four main ethnic groups, namely, Yoruba, Nupe, Fulani and Baruba. The state shares boundary with Ekiti, Oyo, Osun, Kogi and Niger states. The climate is tropical, consisting of two main seasons; the dry season, the long wet season with an intervening cold and dry harmattan period. Ilorin has a total population of 847,582 as at 2007 census (Fig.1).

Study Design: Vegetables were sampled from three major markets in Ilorin. Five common vegetables eaten by the people in the area were used for the study.

Fig. 1: Map of Ilorin, Nigeria

Sample Collection: The vegetables used are Tomatoes (*Lycopersicum sativus*), Water leaf (*Talinium triangulare*), Quill grass (*Celosia argenta* L), Spinach (*Amaranthus spinosus*) and White jute (*Corchorus olitorius*). These were chosen because they are the major vegetables eaten by the residents of Ilorin. Five vegetables were picked randomly from ten sellers in each of the open markets selected for the study making a total of 30 samples for each of the vegetables.

Sample Analysis

Macroscopical Examination: Each of the samples was examined carefully for the presence of segment of cestodes and adult nematodes.

Microscopical Examination: A 50 g sample of each vegetable was examined for intestinal parasite profile as described by ……..[36]. The sample was washed in distilled water and the suspension was strained through a sterile sieve to remove undesirable materials [34]. The filtrate was centrifuged at 5000 rpm for 5 minutes and the supernatant discarded while the deposit was suspended in magnesium sulphate floatation fluid of specific gravity 1.3 and re-centrifuged. The floatation fluid was filled to the brim and a cover slip was superimposed, the cover slip was lifted and examined under a light microscope. The cysts and eggs of various parasite species present were identified [37]. Each parasite eggs, larvae or cysts present in the samples were counted.

RESULTS

In all the three markets from which the survey was carried out, only 61 out of the 150 samples which were about 41 % had parasites as indicated in Fig. 2. From Oja Oba market, one of the sample locations, quill grass (*Celosia argenta* L.) had the highest load of intestinal parasites with cyst of *E. hystolytica* as the most prevalent organism, followed by tomato (*Lycopersicum sativum*) while the least affected was water leaf (*Talinum trangulare*) as shown in Table 1. In Oja Tuntun market, both quill grass (*Celosia argenta* L.) and white jute (*Corchorus olitorius* L.) had the highest parasitic load with *Ascaris lumbricoides* as the most prevalent parasites as presented on Table 2. Water leaf had the highest parasitic load in the third market; Ipata market and all the parasites found there were all present in the same amount, this is indicated in Table 3. The number of parasites found in all the three markets was approximately the same (Table 4). Table 5 revealed that quill grass (*Celosia argenta* L.) was the most contaminated with intestinal parasites with 12 samples infected out of 30, while tomato was the least affected with 7 out of the 30 samples tested. The most prevalent parasites were shown to be *A. lumbricoides* as presented in Table 6.

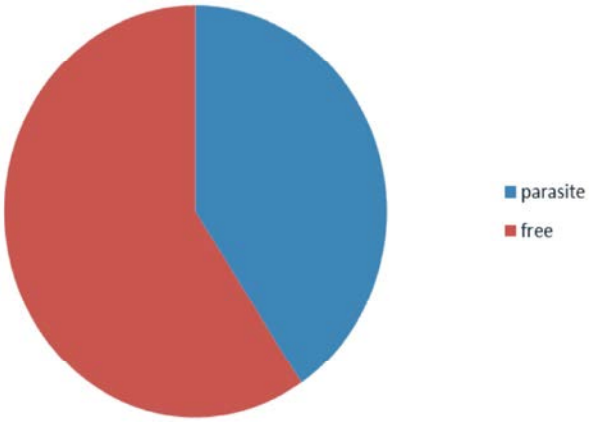

Fig. 2: Prevalence of Intestinal parasites in the vegetables sold in Ilorin

Table 1: Types of Parasites on Vegetables in Oja Oba Market

Vegetables					
Botanical name	Family	Common name	Local name	Type of Parasite	Number of parasites
Lycopersicum sativus		Tomato	Tomati	Cyst of *Entamoeba hystolytica*,	1
				Ova of *Ascaris lumbricoides*,	2
				Ova Hookworm	2
Talinium triangulare (Jacquin) Wildenow	Portulacaceae	Water leaf	Gbure	Ova of *Ascaris lumbricoides*,	2
				Cyst of *Entamoeba coli*	1
Celosia argenta L.	Amaranthaceaeae	Quill grass	Soko yokoto	Ova of *Ascaris lumbricoides*,	2
				Cyst of *Entamoeba histolytica*	4
Amaranthus spinosus L.	Amaranthaceaeae	Spinach	Tete	Ova of *Ascaris lumbricoides*,	2
				Cyst of *Entamoeba histolytica*	2
Corchorus olitorius L.	Tiliaceae	White jute	Ewedu	Ova of *Ascaris lumbricoides*,	2
				Cyst of *Entamoeba histolytica*	1

Table 2: Types of Parasites on Vegetables in Oja Tuntun Market

Vegetables					
Botanical name	Family	Common name	Local name	Type of Parasite	Number of parasites
Lycopersicum sativus		Tomato	Tomati	Cyst of *Entamoeba coli*	1
				Cyst of *Balantidium coli*	1
				Ova *Ascaris lumbricoides*,	2
Talinium triangulare (Jacquin) Wildenow	Portulacaceae	Water leaf	Gbure	Ova of *Ascaris lumbricoides*,	3
				Cyst of *Entamoeba coli*	1
Celosia argenta L.	Amaranthaceaeae	Quill grass	Soko yokoto	Ova of Hookworm Ova of	1
				Ascaris lumbricoides,	4
Amaranthus spinosus L.	Amaranthaceaeae	Spinach	Tete	Ova of *Ascaris lumbricoides*,	2
				Cyst of *Entamoeba coli*	1
				Cyst of *Balantidium coli*	1
Corchorus olitorius L.	Tiliaceae	White jute	Ewedu	Ova of *Ascaris lumbricoides*,	2
				Cyst of *Balantidium coli*	1
				Ova of Hookworm	2

Table 3: Types of Parasites on Vegetables in Ipata Market

Vegetables					
Botanical name	Family	Common name	Local name	Type of Parasite	Number of parasites
Lycopersicum sativus		Tomato	Tomati	Cyst of *Entamoeba coli*	1
Talinium triangulare (Jacquin) Wildenow	Portulacaceae	Water leaf	Gbure	Ova of *Trichuris trichura*	1
				Trophozoite of Giardia	1
				Lambia cyst of Entamoeba coli	1
				Trophozoite of Trichomonas	1
				hominus	1
Celosia argenta L.	Amaranthaceaeae	Quill grass	Soko yokoto	Cyst of *Balantidium coli*	1
				Ova of *Ascaris lumbricoides*,	2
				Cyst of *Entamoeba histolytica*	1
Amaranthus spinosus L.	Amaranthaceaeae	Spinach	Tete	Ova of *Ascaris lumbricoides*,	2
				Cyst of *Balantidium coli*	1
				Ova of Hookworm	2
Corchorus olitorius L.	Tiliaceae	White jute	Ewedu	Ova of *Ascaris lumbricoides*,	2
				Cyst of *Entamoeba coli*	1
				Trophozoite of Trichomonas Huminus	1

Table 4: Comparative Load of Parasites on Vegetables in all the Three Markets

Vegetables				Markets		
Botanical name	Family	Common name	Local name	Oja Oba	Oja Tuntun	Oja Ipata
Lycopersicum sativus		Tomato	Tomati	3 (20.0%)	3 (18.8%)	1 (7.1%)
Talinium triangulare (Jacquin) Wildenow	Portulacaceae	Water leaf	Gbure	2 (13.3%)	3 (18.8%)	4 (28.6%)
Celosia argenta L.	Amaranthaceaeae	Quill grass	Soko yokoto	5 (33.3%)	4 (25.0%)	3 (21.4%)
Amaranthus spinosus L.	Amaranthaceaeae	Spinach	Tete	3 (20.0%)	3 (18.8%)	3 (21.4%)
Corchorus olitorius L.	Tiliaceae	White jute	Ewedu	2 (13.3%)	3 (18.8%)	3 (21.4%)
Total				15	16	14

Table 5: Comparative Load of Parasites on each of the Vegetables in all the Three Markets

Vegetables				Markets			
Botanical name	Family	Common name	Local name	Oja Oba	Oja Tuntun	Oja Ipata	Total
Lycopersicum sativus		Tomato	Tomati	3 (42.8%)	3 (42.8%)	1 (14.3%)	7
Talinium triangulare (Jacquin) Wildenow	Portulacaceae	Water leaf	Gure	2 (22.2%)	3 (33.3%)	4 (44.4%)	9
Celosia argenta L.	Amaranthaceaeae	Quill grass	Soko yokoto	5 (41.7%)	4 (33.3%)	3 (25.0%)	12
Amaranthus spinosus L.	Amaranthaceaeae	Spinach	Tete	3 (33.3%)	3 (33.3%)	3 (33.3%)	9
Corchorus olitorius L.	Tiliaceae	White jute	Ewedu	2 (25.0%)	3 (37.5%)	3 (37.5%)	8

Table 6: Prevalence of Parasites found in all the three markets

Parasites	Total Number of parasites
Ova of *Ascaris lumbricoides*	29 (47.54 %)
Ova of Hookworm	6 (9.83 %)
Cyst of *Entamoeba histolytica*	9 (14.75 %)
Cyst of *Entamoeba coli*	8 (13.11 %)
Cyst of *Balantidium coli*	5 (8.19 %)
Ova of *Trichuris trichiura*	1 (1.63 %)
Trophozoite of *Trichomonas hominis*	2 (3.27 %)
Giardia lambia	1 (1.63 %)
Total	61

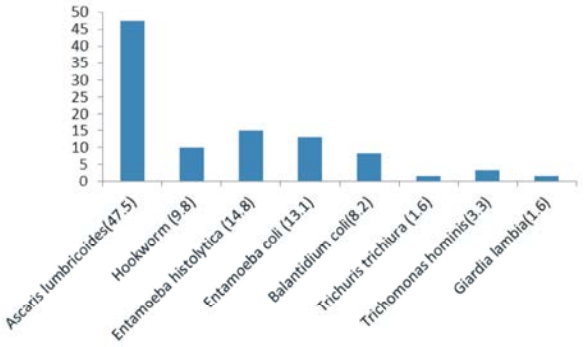

Fig. 3: Percentage Prevalence of Parasites found in all the three markets

DISCUSSION

The occurrence of pathogenic microorganisms in vegetables is an indication of the quality of the overall process of cultivation, irrigation and post-harvest handling [4,38]. Out of 150 samples of vegetables examined, only 61 (40.7 %) (Tables 1,2,3,5, Fig. 3) were positive to intestinal parasite. This shows that approximately one in every two samples of vegetables was contaminated. Although the population in each is not high, it is however a greater indication that much care should be taken in handling vegetables before consumption. It is not also the population that matters but the deleterious harmful effects to human health. Eight (8) different types of intestinal parasites were isolated. The prevalence of the parasites is in the following order, *Ascaris lumbroides* (48 %) = *Entamoeba histolytica* (15 %) = *E. coli* (13 %) = Hookworm (10 %) = *Balantidium coli* (8%) = *Trichomonas hominis* (3 %) = *Trichuris trichiura* (2 %) = *Giardia lambia* (2 %) (Table 6, Fig. 3). Out of these, only *E. coli*, *A. lumbrodes* and hookworms are present in all the three markets. *Ascaris lumbricoides* is the giant roundworm of humans, belonging to the phylum Nematoda. It is responsible for the disease ascariasis in humans and it is the largest and most common parasitic worm in humans. One sixth of the human population is estimated to be infected by *Ascaris lumbricoides* or another roundworm [39]. Ascariasis is prevalent worldwide and more so in tropical and subtropical countries. Infections with these parasites are more common where sanitation is poor [39] and raw human faeces are used as fertilizer. Often, there are no symptoms with an *A. lumbricoides* infection. However, in the case of a particularly bad infection, symptoms may include bloody sputum, cough, fever, abdominal discomfort and passing worms [39]. Infection with *A. lumbricoides* was associated with increased risk of asthma ($p < 0.001$) and atopy in China rural children [40]. The most significant risk of hookworm infection is anaemia, secondary to loss of iron (and protein) in the gut. The worms suck blood voraciously and damage the mucosa. However, the blood loss in the stools is not visibly apparent. Ancylostomiasis, also known by several other names, is the disease caused when *A. duodenale* hookworms, present in large numbers, produce an iron deficiency anemia by sucking blood from the host's intestinal walls. Hookworm is a leading cause of maternal and child morbidity in the developing countries of the tropics and subtropics. In susceptible children, hookworms cause intellectual, cognitive and growth retardation, intrauterine growth retardation, prematurity and low birth weight among newborns born to infected mothers. It is estimated that between 576-740 million

individuals are infected with hookworm today [34] [34]. Of these infected individuals, about 80 million are severely affected [34]. Globally, millions of people suffer from parasitic infections [41-44].

A recently recognized *E. coli* strain was reported to produce high levels of toxins that can cause kidney damage as well as septicaemia, or blood poisoning. Symptoms can include diarrhoea, chills, headaches and high fever and in some cases the infection can lead to death, even with medical intervention [45]. The most heavily contaminated vegetable was *Celosia argenta*, followed by spinach and water leaf while the least contaminated was tomato. Parasites' eggs and trophozoites attach to themselves surface of vegetables more easily while tomatoes had the least because of the smooth surface that reduces the rate of parasites' attachment. The presence of these parasites may be due to lack of modern toilet facilities, inadequate public health enlightenment and illiteracy that make people defeacate indiscriminately resulting in pollution of water and farm land [46]. The risk of infection with intestinal parasites to the population is increased because these contaminated vegetables are sometimes eaten raw, under parboiled to retain the natural taste and preserve heat labile nutrients [26, 47]. Contamination of soil and water sources with human faeces [48] and poor sewage disposal such as use of the soil for fertilizers [49], eggs in the soil can be transferred on to vegetables [48]. These findings are comparable to various studies carried out on vegetables and fruits in some markets in other parts of Nigeria; In Ibadan, only *Ascaris lumbricoides*, hookworm and *Strongyloides stercoralis* were isolated, *Ascaris lumbricoides* was the most prevalent similar to our finding although *Strongyloides stercoralis* was not found in ours [50]. In Ebonyi, only *Ascaris lumbricoides*, hookworm and *Trichuris trichuria* were isolated with *Ascaris lumbricoides* also as the most prevalent [31], this is also similar to our findings and all these three parasites were also isolated in Ilorin markets. In Jos, *Trichomonas hominis* was found to be the most prevalent [46] which is not the case in our findings and in the other two parts of Nigeria aforementioned. In all these findings *Ascaris lumbricoides* is common in all the markets.

Farmers should, therefore, ensure that vegetables are grown hygienically, the use of sewage or waste water with potential risks of transmitting infectious pathogens should be minimized or discouraged. Leafy vegetable sellers and consumers should endeavour to wash all products thoughroughly before selling and consumption. This can be achieved through proper washing in clean chlorinated water.

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