Influence Of Pre And Post-Harvest Handling Of Vegetables On The Prevalence Of Soil Transmitted Helminths In Iddo Lga, Ibadan, Nigeria

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Abstract: This study investigated the prevalence of intestinal parasites associated with leafy vegetables, the influence of washing of vegetables in reducing the load of soil-transmitted helminths before consumption and the perception of consumers/retailers about contamination of vegetables in Ido Local Government Area, Ibadan, Oyo State, Nigeria. A total of 279 vegetables were sampled from two major farms in Apata area of Ibadan, between March and June, 2017. 300 questionnaires were administered to 300 retailers and consumers on their perception of parasites associated with vegetables. 100g of each collected vegetables was washed with tap-water, saline (0.85%) and 0.0025% tween20. Modified Sedimentation Technique was used in the preparation of wash water assay for microscopic examination under x40. Data obtained were analyzed using IBM SPSS 20.0 version. Associations were ascertained using chi-square analysis $P<0.05$. 156 (55.9%) of sampled vegetables were contaminated with STHs ova or larva. The prevalence of contamination from different type of vegetables range from 62.1% in *Talinum triangulare* followed by 56.8% in *Celosia argentia* 54.5% in *Amaranthus hybridus* and 48.7% in *Cochorus olitorus*, P= 0.0001. All respondent retailers and consumers were ignorant of the possibility of contamination of vegetables with parasites egg or larvae, however, 19.0% of respondents claimed to parboil vegetables before consumption, 3.7% claimed to wash vegetables with chemicals before consumption, also 27.3% wash vegetables with salt water before consumption while 49.3% respondent wash vegetables with tap water before consumption. The high levels of contamination of vegetables observed in the present study confirm the need to reduce/eliminate potential health risk associated with handling of irrigated vegetables, proper enlightenment on the possible contamination of vegetables with helminths infections should be given to vegetable marketers and consumers.

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1. Introduction

Importance of vegetables in human diet includes: supply most of the nutrients that are deficient in other food materials; are acid neutralizers e.g. okra, *Corchorus* spp neutralizes the acid produced from the some fruits; prevent constipation and promote digestion as a result of fibres/roughages obtained from okra, cucumber, amaranthus, lettuce and cabbage; rich sources of carbohydrate e.g. potatoes, sweet corn, carrot etc. Green beans and peas are cheap sources of protein. *Vernonia* (Bitter leaf), *Amaranthus* and *Telfeira* provide some amount of protein in human diet. Vegetables are generally needed to have balanced diets and overcome nutritional deficiencies. Vegetables make our staple food more palatable and enhance their in-take. The practice of cultivating vegetables and spices for food, composite seasoning and medicine is referred to as Olericulture.

Farm vegetables are often contaminated by eggs of human intestinal nematodes where human and animal faeces are extensively used as fertilizers and reused waste water. The indirect reserve of river water contains a substantial percentage of municipal refuse and sewage. This practice is growing prominence in Nigeria as a result of the growing cost of mineral fertilizer and high demand of basic fruits and vegetables as a nutrient diet due to poor socio-economic conditions (Damen *et al.,* 2007). Epidemiological studies have indicated that areas characterized by endemic helminthic diseases are found in population where raw untreated waste water is used for irrigation of fruits and vegetables and consumption of such waste irrigated fruits are generally done unwashed or uncooked (Brooker, 2003; Nock *et al*., 2003; Naish *et al*., 2004).

Eating habits culture, environmental degradation and poverty have also added to the emergence of geohelminth infections worldwide (Phiri *et al*., 2000). Some of these infections are mostly acquired from the food we eat especially raw vegetables, water and animals. Vegetables can become contaminated while growing, during harvesting, postharvest handling or even during distribution and sale at the market (McMahon and Wilson, 2001). Many West African studies have reported high levels of pathogen contamination in irrigation water; and on both farm

and market vegetables (Faruqui, *et al.,*2004; Amoah; *et al.,* 2005) which exceed many of the international standards.

Intestinal parasites such as *Ascaris lumbricoides, Trichuria trichiura*, *Strongyloides stecoralis,* hookworm and *Enterobius vermicularis* have been reported on vegetables in several parts of the Nigeria and outside (Kozan *et al.,* 2007; Ohaeri and Chilaka, 2013; Yakubu *et al.,* 2013). These parasites are known to cause significant morbidity and mortality worldwide, particularly in developing countries (Murray and Lopez, 2010). In Nigeria, approximately 55 million people are infected with ascariasis, 38 million with hookworm infection and 34 million with trichuriasis (Hotez and Kamath, 2009). The widespread habit of consuming contaminated raw or minimally cooked vegetables has increased the chance of hand-to-mouth transmission of these parasites (Mba, 2013). Despite this known fact, majority of studies reporting vegetable contamination with parasites in Nigeria were from the northern part (Yakubu *et al.,* 2013) and eastern part (Ohaeri and Chilaka, 2013) of the country. There are little or no studies reporting the parasites contamination of vegetables grown at different farms in Apata, Ibadan, South-western part of Nigeria. The study was designed to determine the prevalence of intestinal parasites associated with leafy vegetables, the influence of washing of vegetables in reducing the load of soil-transmitted helminthes before consumption and, the perception of consumers/retailers about contamination of vegetables.

2. Material and Methods

The study was carried out between March and June, 2017. Vegetables were sampled from two major farms (Omi-Adio and Akala Farm) in Apata, Ibadan, Oyo State, where majority of the populace depend on the source to buy these products. Though there was poor drainage and sanitation characterized by the presence of River water that flows through the farms, which served as source of irrigation for the farmers and the river is as well used for drinking and domestic purposes for both the farmers and the villagers nearby.

These vegetables were obtained from two major farms (Omi-Adio and Akala Farms) in Apata, Ibadan, Oyo State. These farms were selected because majority of the vegetables sold in the major markets in Ibadan metropolis are from these farms. Market women from different locations within the state always come to these farms to buy vegetables and conveying the farm produce (vegetables) to various markets within Ibadan for sale.

Ethical approval was collected from Oyo State Ministry of Health. Permission to carry out the study was obtained from the Local Government Areas and the communities. Voluntary participation and withdrawal from the study at any time without repercussion was ensured. All data/information from the completed questionnaire was kept confidential to prevent access to information to be provided by study participants by third party.

The vegetables proposed to use in the study are *Celosia argentia*, Jute-leaf, waterleaf and African spinach. Two hundred and seventy two (272) samples of vegetables were picked up to obtain qualitative estimation of parasitic helminthes contamination of these vegetables (Obeng *et al*., 2007). Fresh vegetables were collected into sterile, labeled polythene bags and transported immediately to the laboratory of parasitology, University of Ibadan for parasitic examination. The label was referred to sample type, date of collection and name of farm.

Using, $n=Z^2 P (1-P)/d^2$

where, n - sample size

Z - Confidence level at 95% (standard value of 1.96)

P - Estimated prevalence of intestinal parasite in the study area

d - Degree of precision adopted for the study at 5% (standard value of 0.05)

For the level of confidence of 95%, Z value is 1.96; P which is the expected prevalence falls between 10% and 90%. For this study P is set at 22.78% (0.2278) and d at 0.05, as it follows assumption of normal approximation.

We have, $n = 1.96^2 (0.2278) (1-0.2278)/ 0.05$

A minimum of 272 samples was collected for this study.

Samples were transported to the laboratory in sterile plastic bags. They were divided into four groups and each group was washed with Tap-water, saline (0.85%) and 100ml (0.0025%) Tween-20 or Phosphate buffered saline (PBS) (Cold Spring Harbour Laboratories, 2006). About 100 g to 150 g of material was used for each vegetable. In Ibadan, Oyo State, vegetables were washed either with saline or tap water/ well water, rarely with tap water. Of the two, tap water is the most widely used and involves immersing vegetables in a bowl of tap water and cleaned several times with the hand or by vigorous agitation. Similarly samples were washed in the laboratory immersed in either physiological saline or phosphate buffered saline solutions. About 500 ml of liquid was used to wash all vegetables. The samples were agitated vigorously (manually) in the respective liquids for about three minutes.

The washing solution was transferred into sterile 50mL conical tubes and centrifuged at 3000xg for 15 minutes. The supernatant was discarded and the deposit was examined. Smears were made on grease-

free microscope slides with the deposit from above. Six slides were made for each sample comprising two wet preparations each of unstained and Lugol's iodine stained as well as two cold Ziehl Neelsen stained smears. Slides were prepared and examined repeatedly until deposits were finished in the tubes.

Well-structured questionnaire were used to investigate the perception of randomly selected retailers and consumers about transmission of intestinal parasites, personal and domestic hygiene before sale and consumption of vegetables. Questionnaires were distributed to 300 voluntary respondents (Retailers and Consumers) in the Market. The survey was to determine the level of hygiene practices of retailers and consumers of vegetables and their perception on transmission of parasite. The information solicited includes basic demographical data of both retailers and the consumers, data on education and occupation, as well as knowledge of the parasites, hygiene practices and history of deworming.

Data obtained were inputted using Microsoft excel 2007 and analyzed using IBM SPSS 20.0 version, Armonk, NY: IBM Corp. Associations were ascertained using Pearson chi-square analysis and confidence interval was set at $P \leq 0.05$.

3. Results

A total of 279 vegetables (36 African Spinach, 78 Jute-leaf, 80 Waterleaf and 78 *Celosia argentia*) examined in this study, had 55.9% (156/272) infections with STH's in Apata. The prevalence of *Ascaris lumbricoides, Strongyloides* spp. and Hookworm in collected vegetables in selected location. There were 15.4% of *A. lumbricoides* in Akala, 37.5% in Omi-adio and 27.6% in total in both regions. There were 53.8% of *Strogyloides* spp in Akala, 64.6% in Omi-adio and 52% in total in both regions. There were 25.6% of Hookworm in Akala, 43.8% in Omi-adio and 35.6% in total in both regions, Table 1. Therefore, it could be concluded that there was significant difference in the prevalence of STH's in both locations.

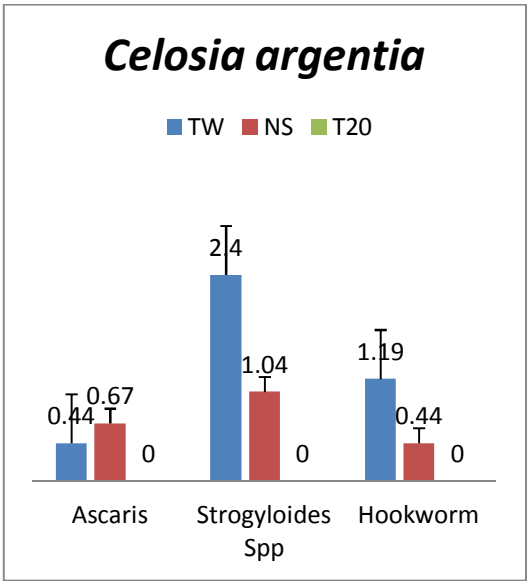
There was total of 29% of *A. lumbricoides* in the vegetables, while the highest prevalence could be seen in *Strogyloides* spp that had 49.1% prevalence, and then followed by Hookworm prevalence of 35.8%. In each vegetable, the prevalence of *A. lumbricoides*, *Strongyloides* and hookworm in *C. argentia* were 28.4%,44.4% and 35.8% respectively where *Strongyloides* had the highest prevalence and *A. lumbricoides* had the lowest; The prevalence of *A. lumbricoides, Strongyloides* and Hookworm in waterleaf were 27.6%,59.8% and 35.6% respectively where *Strongyloides* had the highest prevalence and *A. lumbricoides* had the lowest; The prevalence of *A. lumbricoides*, *Strongyloides* and Hookworm in African spinach were 29.5%,41.0% and 30.8% respectively, where *Strogyloides* had the highest prevalence and *A. lumbricoides* had the lowest; The prevalence *A. lumbricoides, Strongyloides* and Hookworm in Jute-leaf were 29.5%,41.0% and 30.8% respectively where *Strongyloides* had the highest prevalence and *A lumbricoides* had the lowest (Table 2).

Figure 1a-d shows the effectiveness of the several washing methods. There was significant difference in the number of *A. lumbricoides* found in *C. argentia* washed with Tape-water when compared with those washed with tween20 that had no *A. lumbricoides*. In addition, there was significant difference in the number of *A. lumbricoides* when washed with normal saline compared with when washed with tween20. There was significant difference in the number of *Strongyloides* found in *C. argentia* washed with Tape water when compared with those washed with tween20 that had no *Strongyloides*. In addition, there was significant difference in the number of *Strogyloides* when washed with normal saline compared with when washed with tween20. There was also a significant difference in the number of *Strongyloides* in *C. argentia* that was washed with Tape-water and that washed with normal saline where there was significant lower number of *Strongyloides*. There was significant lower number of hookworm in *C. argentia* washed with Tape water when compared with normal saline and also when Tape water was compared with tween20. There was significance difference in the number of *A. lumbricoides* found in water leaf washed with Tape-water when compared with those washed with Tween20 that had no *A. lumbricoides*. In addition there was significant difference in the number of *A. lumbricoides* when washed with normal saline compared with when washed with tween20. There was significant difference (P= 0.0001) in the number of S*trongyloides* found in waterleaf washed with Tap-water compared with those washed with tween20 that had no *Strongyloides*. In addition there was significant difference in the number of *Strongyloides* when washed with normal saline when compared with when washed with tween20.

There was also a significant difference in the number of *Strongyloides* in waterleaf that was washed with Tape-water and that washed with normal saline where there was significant lower number of *Strongyloides spp.* There was significant difference lower number of hookworm in waterleaf washed with Tape-water compared with tween20 and also when normal saline was compared with tween20.

There was significant difference in the number of *A. lumbricoides* found in Jute-leaf washed with Tape-water compared with those washed with

tween20 that had no *A. lumbricoides*. In addition there was significant difference in the number of *A. lumbricoides* when washed with normal saline compared with when washed with tween20. There was significance difference in the number of *Strongyloides* found in Jute-leaf washed with Tape-water compared with those washed with tween20 that had no *Strongyloides*. In addition, there was significant difference in the number of *Strongyloides* when washed with normal saline compared with when washed with tween20. There was also a significant difference in the number of *Strongyloides* in Jute-leaf that was washed with Tape-water and that washed with normal saline where there was significant lower number of *Strongyloides*. There was significant difference lower number of hookworm in Jute-leaf washed with Tape-water when compared with tween20 and also when normal saline was compared with tween20.



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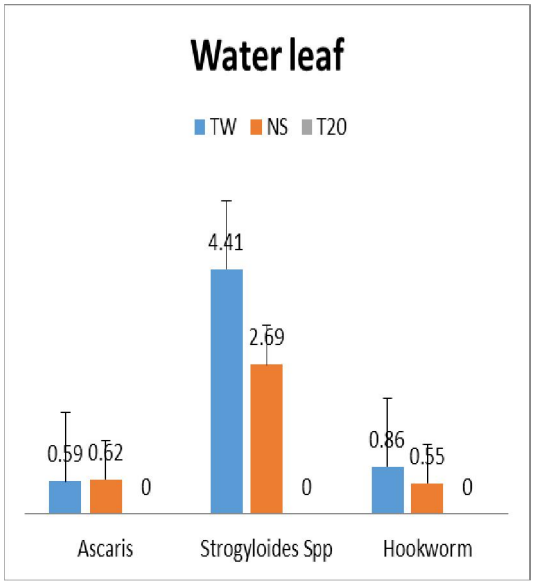

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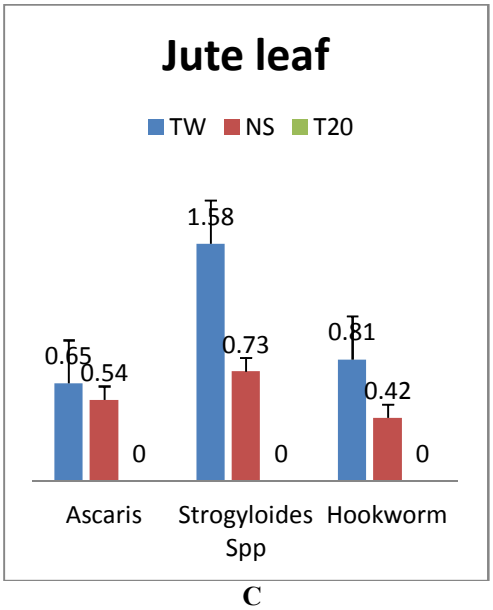

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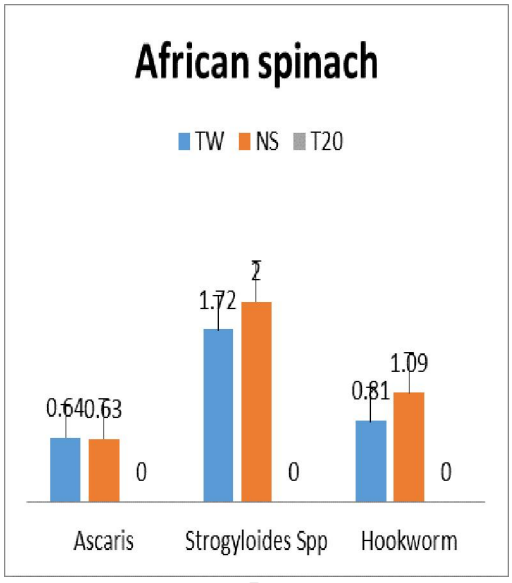

D

Fig. 1A, B, C and D shows the prevalence of parasites by method of washing, *Celosia argentia*, Water-leaf, Jute-leaf and African Spinach respectively with (Tap-water, Saline and Tween20)

Table 1: Prevalence of Parasites Associated with Collected Vegetables

Location	NE	Any helminths (%)	Ascaris (%)	*Strogyloides spp* (%)	Hookworm (%)	*Trichuris trichuria* (%)
Akala	132	65(49.2)	6(15.4)	21(53.8)	10(25.6)	0(0.0)
Omi-adio	147	91(61.9)	18(37.5)	31(64.6)	21(43.80)	0(0.0)
Total	279	156(55.9)	24(27.6)	52(59.8)	31(35.6)	0(0.0)

Table 2: Prevalence of Parasites by type of Vegetables

Vegetables	**NE**	**Any Helminths (%)**	**Ascaris (%)**	***Strogyloides spp (%)***	**Hookworm *(%)***	***Trichuristrichuria* (%)**
Celosia argentia	81	46(56.8)	23(28.4)	36(44.4)	29(35.8)	0(0.0)
Water leaf	87	54(62.1)	24(27.6)	52(59.8)	31(35.6)	0(0.0)
African spinach	33	18(54.5)	11(33.3)	17(51.5)	16(48.5)	0(0.0)
Jute leaf	78	38(48.7)	23(29.5)	32(41.0)	24(30.8)	0(0.0)
Total	279	156(55.9)	81(29.0)	137(49.1)	100(35.8)	0(0.0)

A total of 95(93.1) female and 7(6.9) male retailers were surveyed. However of the 198(100) consumers interviewed 115(58.1) and 83(41.9) were females and males respectively. Majority of the retailers and consumers both belonged to 25-34 years age group. The major occupation group was students with the highest proportion of 18(17.70) retailers and 101(51.0) consumers followed by the trading profession category with 74(72.5) retailers and 13(6.6) consumers. Civil servants were only 3(2.9) retailers and 21(10.6) consumers of the respondents; Artisans and others were 3(2.9) retailers and 12(6.1) consumers, and 4(3.9) retailers and 51(25.8) respectively. There were17% (51/300) illiterate participants, 13.7% (41/300) attended primary, while 14.7% (36/300) and 54.6% (164/300) had secondary and tertiary education respectively (Table 4).

Table 4: Demographic characteristics of retailers and consumers

Variables	Retailer Freq. (%)	Consumer Freq. (%)	P-value
SEX			
Male	7(6.9)	83(41.9)	
Female	95(93.1)	115(58.1)	P<0.05
Total	102(100.0)	198(100.0)	
AGE			
15-24	15(14.7)	42(21.2)	
25-34	28(27.5)	94(47.5)	
35-44	28(27.5)	52(26.3)	
45-54	12(11.8)	5(2.5)	P<0.05
55-64	10(9.8)	4(2.0)	
65-75	9(8.8)	1(0.5)	
Total	102(100)	198(100)	
Educational Qualification			
Primary School	39(38.2)	2(1.0)	P<0.05
SSCE	27(26.5)	17(8.6)	
Tertiary Institution	22(21.6)	142(71.7)	
No Education	14(13.7)	37(18.7)	
Total	102(100.0)	198(100.0)	
Occupation			
Trader	74(72.5)	13(6.6)	
Student	18(17.6)	101(51.0)	
Artisan	3(2.9)	12(6.1)	P<0.05
Civil	3(2.9)	21(10.6)	
Others	4(3.9)	51(25.8)	
Total	102(100.0)	198(100.0)	

Table 5: Hygienic practices and perception of retailers and consumers on transmission of parasites

Variable	Retailer freq. (%)	Consumer freq.(%)	P-value
Do you take vegetables?			
Yes	102(100)	198(100)	p<0.05
No	-	-	
Where do you get it from?			
Market	51(50.0)	173(88.7)	p<0.05
Commercial farm	43(42.2)	11(5.6)	
Backyard	8(7.8)	11(5.6)	
Do you know what parasitic worms are?			
Yes	68(66.7)	135(68.2)	p<0.05
No	34(33.3)	63(31.8)	
If yes, what do you know?			
Intestinal helminths	8(7.8)	47(23.7)	p<0.05
Hookworm	7(6.9)	7(3.5)	
Roundworm	18(17.6)	11(5.6)	
No ideal	69(67.7)	133(67.2)	
Do you know effects worms Have on human health?			
Yes	60(58.8)	128(64.6)	p<0.05
No	19(18.6)	49(24.7)	
Do not know	23(22.5)	21(10.6)	
How can one avoid getting infected?			
Good hygiene	12(11.8)	42(21.2)	p<0.05
Effective cooking	1(1.0)	27(13.6)	
Effective washing	11(10.8)	44(22.2)	
No ideal	78(76.5)	85(42.9)	
How often do you receive treatment for worms?			
Monthly	52(51.5)	42(21.3)	p<0.05
Yearly	19(18.8)	68(34.5)	
Do not know	30(29.7)	87(44.2)	
Do you think parasite can be found on vegetables?			
Yes	47(46.1)	153(77.7)	p<0.05
No	55(53.9)	44(22.3)	
How do you prepare/cook your vegetable?			
Wash with tap water	63(61.8)	85(43.4)	p<0.05
Wash with salt	23(22.5)	59(30.1)	
Wash with chemicals	2(2.0)	14(13.7)	
Parboil it	14(13.7)	43(21.9)	
Do you think vegetable should be packaged in sterile bag?			
Yes	27(26.7)	75(37.9)	p>0.05
No	75(73.3)	123(62.1)	
Have ever be given treatment (Traditional or modern medicine) for intestinal worms?			
Yes	60(58.8)	90(45.5)	p<0.05
No	25(24.5)	79(39.9)	
Do not know	17(16.7)	29(14.6)	
If yes, which one were you given?			
Modern medicine	95(93.1)	182(92.2)	p>0.05
Traditional medicine	7(6.9)	16(7.8)	
When was the last time you were dewormed?			
Months ago	37(36.3)	43(21.7)	p>0.05
Over a year	13(12.7)	24(12.1)	
Do not know	38(37.3)	112(56.6)	
Not applicable	14(13.7)	19(9.6)	

N for Retailers = 102, N for Consumers = 198

Table 5 shows the hygienic practices and perception of retailers and consumers on transmission of parasites. All the retailers and consumers surveyed do consume vegetables when they purchase from either farmers or markets. However, majority of the consumers interviewed 173(88.7) reported market as the source point for the vegetables they consume. Moreover, few number of respondents had little knowledge about the parasite and believed that worms do present in the intestine that can cause adominal pains, vomiting and diarrhoea among others but 202(67.3) had no Knowledge of the parasite therefore, could not cite any symptoms. Many of the respondents could not ascertain how getting infected could be avoided, with about 163(54.3) of the respondents had no idea on how the parasite could be prevented from infecting human, they however, believed that parasitic worm could be prevented by avoiding excessive eating of meat, by keeping vegetables in the refrigerator, avoidance of sugary food/substance, by taking balance diet, some even reported that worm infection could be inborn and so on. Large number of the retailers and consumers 200(66.7) understand the fact that intestinal helminths could be on vegetables.

The attitude and practices of the respondents, show that of the 97(100) retailers surveyed, 72(74.2) reported washing their vegetables before selling to consumers while 8(8.2) reported they do not wash their vegetables at all before selling to consumers, most of the retailers do sell their vegetables within the space of one to two days which might increase the chances of the vegetables being contaminated. The methods of preserving unsold vegetables reported by all the retailers indicate that, there could be high risk of vegetables contamination, these methods include; spread in aerated room, spread on the roof, Sprinkle water on it among others. On the habit of washing vegetables, larger percentage of the respondents 49.7% (148) washed their vegetables with tap water, 27.5% (82) washed their vegetable with salt water (saline), 3.7% (11) washed their vegetables with different chemicals (vinegar) and 19.1% (57) do parboil their vegetable which might denature the protein constituent of the vegetable. In addition, majority of them think vegetables should not be packaged in sterile bag before selling.

In terms of treatment seeking behaviour, 50% (150) of the respondents claimed to have been given treatment for intestinal worms (dewormed) out of this, 92.7%(139) mentioned that they do go to the nearest clinic/hospital for treatment, 7.3%(11) seek treatment from traditional healer. However, the survey also showed that 26.7%(80/300) of the respondents reported to have dewormed few months ago, 12.3%(37/300) of the respondents reported that it's more than over a year they dewormed, 50%(150) of the participants could not say or ascertain if they have dewormed before and 11%(33) of the participants claimed that have not dewormed at all in their life.

4. Discussions

The occurrence of parasites on vegetables is a potential threat of public health significance, most especially to the numerous efforts and resources channeled towards combating food borne related infections. The overall prevalence of 55.9% reported in this study for intestinal helminths on vegetables call for the need of stringent hygienic measures in farms and minimization of water reuse in vegetables farms. The overall prevalence reported in this study was considerably higher than those of (Shahnazi and Jafari-sabet, 2010; Al-mergin, 2010 and Damen *et al*., 2007) where 37.6%,16.2% and 36% were reported respectively and lower than those reported by Ghavari *et al*. (2002) and Fagbenro *et al*. (2016) with 65% and 73.5% prevalence respectively. These inconsistencies in findings might be attributed to varying environmental conditions and hygiene practices of study area. Indiscriminate open defecation habits on farm soils by children and adults, use of organic manures (dung of animals or humans) during planting, and poor personal and domestic hygiene are probable factors aiding the development of parasites on soil and transmission to vegetables.

Furthermore, factors including preference for eating raw or slightly cooked vegetables to protect heat liable nutrients, inadequate washing of farm vegetables and indiscriminate open defecation on farm soil or water bodies among others may increase the risk of infections. These factors should thus be considered when hygiene focused campaigns are planned. The high occurrence of nematodes (*S. stecoralis,* Hookworm and *A. lumbricoides*) reported in this study is in accordance withthat of (Obeng *et al*., 2007; Adamu *et al*., 2012; Ayeh-kum *et al*., 2014; Duedu *et al*., 2014). The high prevalence *S.stercoralis* and hookworm could be associated with contaminated human excreta used as manure or could be associated with contaminated water used for irrigation (Keraita *et al.,* 2002).

There are reports of a wide variation of parasites associated with leafy vegetables which might be due to exposure of the leaves to the soil surface or the nature and appearance of the vegetable (Uga *et al*., 2009). High contamination of Waterleaf might be due to how the vegetable grows (it grows anywhere provided the environment is favourable) on the farms, precisely on the surface of the soil unprotected, due to the soft nature of the leaves. This made it possible for them to be associated with most parasites especially geohelminths such as *S. stercoralis*, hookworm and *T.*

trichiuria which are soil transmitted nematodes (Bethony *et al*., 2006). Also the softness and fragility of the leaves of waterleaf made most retailers ignore washing it, in order to maintain the freshness of their waterleaf thus making them a potential source of parasitic infections. On the other hand, low contamination of Jute-leaf maybe due to the removal of one outer leaf of Jute-leaf priori to washing in this study showed reduction in the level of helminth eggs and larva associated with this vegetable compared with other vegetables.

We found infective stages of some of the parasites in this survey (*S. stercoralis* filariform larva, embryonated *Ascaris* ovum and Hookworm larva). The presence of infective stages poses a greater health risk from handling and consuming the contaminated vegetables. *S. stercoralis* filariform larva could penetrate the skin of both the retailers as well as consumers. Although non-infective stages where also found for these parasites, these life forms could potentially develop into infective stages over time and pose significant health risks.

Variation in the intestinal helminths recorded in this study, might be due to differences in the geographical location of the study. Despite variation in the isolated parasites, Ova of *A. lumbricoides*, Larva of *S. stercoralis* and Larva of Hookworm were common to all vegetables examined in this study, this could be due to the fact that these parasites can withstand a wide variety of adverse environmental conditions which could serve as an indication of water pollution as a result of indiscriminate defecation resulting in pollution of water and farmlands as observed by Damen *et al*. (2007). Faecal contamination of water sources used in crop irrigation is important sources of infection to man, so contamination of fresh vegetables are of greatest concern. It has been reported in recent years that, there has been an increase in the number of reported cases of food-borne illness linked with fresh vegetables due to contamination arising as a consequence of treating soil with organic fertilizers such as manure, sewage sludge and from irrigation water. The consumption of raw vegetables/fruits is a major way in the transmission of parasites of food-borne illness because consumers would want to retain natural taste and preserve heat labile nutrients to be derived from these fresh vegetables (Slifko *et al.,* 2009). This in essence may increase food borne parasitic infections.

To the best of oue knowledge, this study is the first to report the perception of retailers and consumers of vegetables in Ibadan, Oyo State, Nigeria. Post-harvest handling practices at the market indicated that different modes of displaying for sale and modes of preserving unsold vegetable in the markets might contribute to increased contamination levels of vegetables. During marketing, vegetable traders placed their vegetables at one of the three places: bare ground, on old sacks lay on the ground, and on tables.

The poor knowledge of vegetable sellers and consumers about the possibility of transmission of parasites can be a setback in the control of food borne infections. Therefore, educating rural farmers and vegetable traders on the possibility of vegetables carrying these parasites and encouraging safe personal and domestic hygiene in markets and farmlands are important in preventing and controlling food borne infections.

Our study shows that vegetables consumed in Iddo local Government Area, Ibadan, southwestern part of Nigeria are contaminated soil transmitted helminths which have detrimental effects on human health. Moreover, vegetables retailers and consumers are totally ignorant of the possibility that vegetables can carry parasites. Therefore, vegetables consumers easily acquire parasitic infections when appropriate and safe hygienic measures are not put into consideration. However, vegetables thoroughly washed with normal saline significantly reduce helminth larva/eggs counts while those washed with tween20 destroy helminth larva/eggs.

Although wastewater re-use for peri-urban agriculture is encouraged for economic purposes (Keraita *et al.,* 2002; Buechler *et al*., 2006; Kurian *et al*., 2013), significant infection associated dangers are reported (Pham-Duc *et al*., 2013). With the lack of or inadequate treatment systems, wastewater use for agriculture presents a huge public health risk in most developing and underdeveloped countries. Therefore, the farm locations investigated in the present study showed that a vegetable produced from the river that flows through the farm land use as sources of irrigation is also contaminated. The location and environmental quality of the two different farms examined also played a vital role in the contamination of vegetables. The levels of contamination need to be reduced to eliminate potential health risk associated with consumption of wastewater irrigated vegetables. They have also shown that, washing vegetables with just water is not enough to remove any contaminating parasites. It is common to find many people washing vegetables with just water prior to eating. This practice could potentially lead to inadequate washing and thereby cause infection from any contaminating pathogen. The need for washing vegetables with tween20 is strongly encouraged, alternatively saline could also be used to wash vegetables though, and it is not as effective as tween20.

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