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Journal of Tropical Diseases and Public Health

Research Article

Intestinal Parasites Isolated in Vegetables Sold in most Important Markets within Ilorin Metropolis

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ABSTRACT

The aim of the study was to determine the parasite prevalence of vegetables at three selected major markets in Ilorin metropolis for parasitic incidence. 150 vegetables of different kinds were randomly selected from the three selected markets and processed through both sedimentation and floatation methods. Of the 150 vegetable sampled, 63 (42%) of these vegetables were positive for parasites ranging from Ascaris to Amoeba and hookworm, etc. more parasites were recovered from sedimentation 44 (74.6%) than floatation 15 (25.4%). Spinach "Tete" (*Amaranthus spinosus L*), and Jute mallow "Ewedu" (*Corchorus olitorius*) had the highest parasitic contamination while tomatoes recorded the lowest parasitic contamination, detected were ova of *Ascaris lumbricoides* 19 (42.2%), ova of Hookworm 2 (4.4%), ova of *Trichuris trichiura* 1 (2.2%), cyst of *Entamoeba histolytica* 8 (17.8%), cyst of *Entamoeba coli* 7 (15.5%), cyst of *Balantidium coli* 5 (11.1%), cyst of *Giardia lamblia* and trophozoite of *Trichomonas hominis*. This study identified that vegetables can aids transmission of parasitic infection, avoidance of the use of feaces as manure should be encouraged, whilst vegetables should be properly cooked before consumption to reduce the risk of infection.

Keywords: Selected market; Ilorin; Vegetables; Parasites

INTRODUCTION

Intestinal parasites populate the gastrointestinal tract in humans and other animals. They can live throughout the body, but most prefer the intestinal wall. The mucoid plaque build-up provides an ideal breeding environment for parasites. Means of exposure include ingestion of undercooked meat, drinking infected water, and unwashed vegetables [1].

The major groups of parasites include protozoans and parasitic worms (helminths). Of these, protozoans, including *Cryptosporidium*, *Microsporidia*, and *Isospora* are most common in HIV infected persons. Each of these parasites can infect the digestive tract and sometimes two or more can cause infection at the same time [1].

Parasites can get into the intestine from uncooked or unwashed vegetables contaminated water or hands, or by skin contact with larva infected soils, when the organisms are swallowed, they move into the intestine, where they can reproduce and cause symptoms. Children are particularly susceptible if they are not thoroughly sterilized after coming into contact with infected soil that is present in environments that they may frequently visit such as sandboxes and school playgrounds. People in developing countries are also at particular risk due to eating vegetables from sources that may be contaminated with parasites that colonize the gastrointestinal tract [2].

A "good" or well-adapted parasite does not kill its host because it depends on its host for a steady supply of food over a long period of time. Usually, parasites are smaller than their food

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Received date: September 26, 2019; **Accepted date:** October 11, 2019; **Published date:** January 3, 2020

Citation: Fumilayo AJ, Mosunmola OJ, Kayode AI, Adedokun AR, Zagi HT, Buru AS (2020) Intestinal Parasites Isolated in Vegetables Sold in Most Important Markets within Ilorin Metropolis. J Trop Dis 8:342. doi:10.35248/2329-891X.20.8.342

source. Some parasites live only on one species of animals, but many parasites particularly the worms, spent part of their life in an intermediate host of a different species [3].

The common symptoms are as follows: abdominal pain, myositis, constipation, aneamia, anorexia, B12 deficiency, rectal hemorrhage, blindness, hematochezia, hemoptysis, dysuria, central nervous system impairment, chest pain, chills, chronic fatigue, colitis, coughing, diarrhea, digestive disturbance, dizziness, fever, enlargement of various organs, headaches, vaginitis, jaundice, joint pain, weight loss due to malnutrition, weakness, immunodeficiency, nausea, vomiting, swelling of facial features, sweating, insomnia, skin ulcers, rectal prolapsed, mental problems, lung congestion, memory loss, night sweats and muscle spasms [3,4].

It has been estimated that humans harbor about 300 species of parasitic worm and over 70 species of protozoa [5-7]. Many of these have co-existed with us for thousands of years and have been identified among humans by archeologist [8].

World Health Organization (WHO) estimates that over 3.5 million people are infected with some kind of intestinal parasites in the world suggests that these figures could reach 1/3 of the world's population. The current widespread of infections caused by helminths and protozoan parasites in the digestive tract justify the need for a precise diagnosis in order to implement suitable measures to solve this public health problem [9].

The role of vegetables in nutrition and healthy diets are well recognized. Vegetables are common and are an important source of nourishment and vital ingredient in healthy and balanced diets. Fresh vegetables are highly recommended in diets [10]. In recent years there has been an increase in the number of reported cases of food-borne illness linked to fresh vegetables. The consumption of raw vegetables is a major way in the transmission of parasites [11]. However, the relationship between intestinal parasites, the environment, contamination of food, and human illness is extremely complex. Environmental factor plays a significant role in the transmission of most food-borne parasitic diseases. This impact is particularly apparent with protozoan and helminths, which are readily transported to food by contaminated water [12].

This research seeks to, therefore, determine the parasitic load and public health implication of consuming vegetables sold in the local selected market and precautionary measures to adopt before consumption.

MATERIALS AND METHODS

Description of the study area

Ilorin is the capital of Kwara State and is situated 306 km north of Lagos at 08° 30' N and 04° 30' E and 482 km southwest from Abuja, the federal capital. It is the gateway between the northern and southern part of the country.

The population which is estimated to be around 3 million is made up of four main ethnic groups namely, Yoruba, Nupe, Fulani, and Baruba. Kwara State shares boundaries with Ekiti, Oyo, Osun, Kogi, and the Niger States. Therefore, several Nigerians ethnic groups are well represented in the state capital.

The climate is tropical, consisting of two main seasons (March to November) with an intervening cold and dry harmattan period usually experience from December to January (with an average rainfall of 1,279/mm per annum) [13].

Study design

Vegetables were sampled from three different major markets in Ilorin. Five common vegetables are often eaten by the people of the area used for this study.

Sample collection

The vegetables used in this study were Tomatoes (*Lycopersicum sativus*), Jute mallow (*Carchorus olitorius*), Spinach (*Amaranthus spinosus*), Waterleaf (*Talinium triangulare*), and Quail Grass (*Celosia argentea*). The five varieties of vegetables were chosen because they are the major vegetables eating by the residents of Ilorin. Ten of each of the vegetables was picked randomly from each of the open markets selected for this study.

Sample analysis

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

Sedimentation methods: A 50 g sample of each vegetable was washed in distilled water in a plastic container for the removal of the parasitic ova, larvae, and cysts. The suspension was strained through a sterile sieve to remove undesirable materials [14]. The filtrate was centrifuged at 5000 rpm for 5 minutes and the supernatant discarded into disinfectant jar and the sediment was mixed and a drop was applied in the center of a clean grease-free glass slide, covered with coverslip examined with x10 and x40 objective lens of a microscope. Iodine preparation was made and examined too.

Floatation method: A 50 g of each vegetable was washed in distilled water in a plastic container for the removal of the parasitic ova, larvae, and cysts. The suspension was strained through a sterile sieve to remove undesirable materials [14]. The filtrate was centrifuged at 5000 rpm for 5 minutes and the supernatant discarded into disinfectant jar [14]. The deposit was resuspended in magnesium sulphate floatation fluids and centrifuge. The floatation fluid was superimposed with coverslip and left for 15 minutes and placed on a clean slide and examined under a light microscope using x10 and x40 objectives [14].

RESULTS

In the three most important markets in Ilorin, from which this prevalence study was performed, 63 (42%) out of the 150 vegetables sampled as shown in Table 1 had parasites. Oja Oba market (Table 2) recorded the highest incidences of *Ascaris lumbricoides* in all the three types of vegetables with *Entamoeba histolytica*, while hookworm is the least. Table 3 presented the parasite types found on vegetables in Oja Tutun, with *Ascaris*

lumbricoides having the highest prevalence on all the vegetable types followed by *Entamoeba coli*. In Table 4, the parasites types found on vegetables in Oja Ipata markets, show that *Ascaris lumbricoides* has the highest prevalence and the least *Trichuris trichiura*. Table 5 indicated that out of the three markets, Oja Tutun had the highest number of parasites on the vegetables and the least is the Oja Ipata. The cross-tabulation in Table 6 confirmed the prevalence of the parasites in the various markets and types of vegetables with no statistical significance between parasites prevalence in the Markets. While Table 7 indicated the parasite prevalence on vegetables by both sedimentation and floatation methods in Oja Oba. Table 8 showed parasite prevalence on vegetables by both Sedimentation and floatation methods in Oja Tutun Markets. In Table 9, the parasite prevalence on vegetables by both sedimentation and floatation methods in Oja Ipata markets displayed no statistical significance. Table 10 compared the parasite prevalence on vegetables by both sedimentation and floatation methods in the three markets, there was no statistically significant difference between sedimentation and floatation methods. In Table 11, relating the two methods used for the study, the sedimentation method yielded high percentage of parasites compared to the floatation method in both Oja Oba and Oja Tutun respectively. In summary, looking at the prevalence of parasites found in vegetables in all the markets as shown in Table 12, using both floatation and sedimentation methods, the result indicated that *Ascaris lumbricoides* 33 (52.4%) had the highest prevalence while the least is *Trichuris trichiura* 1 (1.6%) and *Giardia lamblia* 1 (1.6%). In all three markets, there is no statistically significant difference between parasites prevalence in the Markets, $p>0.05$.

Table 1: Different types of vegetables sampled from the three most important markets in Ilorin.

Vegetable (s)	Markets				
	Local Names	Oja Oba	Oja Tutun	Oja Ipata	Total
Tomatoes (*Lycopersicum sativus*)	Tomato	10	10	10	30
Waterleaf (*Talinium triangulare*)	Gbure	10	10	10	30
Quail Grass (*Celosia argentea*)	Soko yokoto	10	10	10	30
Spinach (*Amaranthus spinosus L.*)	Tete	10	10	10	30
Jute mallow (*Corchorus olitarius*)	Ewedu	10	10	10	30
Total		50	50	50	150

Table 1 shows the total number of different types of vegetables collected from the three markets in Ilorin for the prevalence study.

Table 2: Types of parasites on vegetables in Oja Oba market.

Vegetables	Types of parasites	No of parasites by sedimentation method	No of parasites by floatation method
Tomatoes (*Lycopersicum sativus*)	Cyst of *Entamoeba histolytica*	1	Nil
	Ova of *Ascaris lumbricoides*	1	1
	Ova of hookworm	1	1
Waterleaf (*Talinium triangulare*)	Ova of *Ascaris lumbricoides*	1	1
	Cyst of *Entamoeba coli*	1	Nil
Quail Grass (*Celosia argentea*)	Ova of *Ascaris lumbricoides*	1	1
	Cyst of *Entamoeba histolytica*	4	Nil
Spinach (*Amaranthus spinosus L.*)	Cyst of *Entamoeba histolytica*	1	1

	Ova of *Ascaris lumbricoides*	2	Nil
Jute mallow (*Corchorus olitarius*)	Ova of *Ascaris Lumbricoides*	1	1
	Cyst of *Entamoeba histolytica*	1	Nil

Table 2 above shows the parasite types found on vegetables in Oja Oba market, *Ascaris lumbricoides* has the highest prevalence of all the vegetable types, followed by *Entamoeba histolytica*, while the least parasite is Hookworm.

Table 3: Types of parasites on vegetables in Oja Tutun Market.

Vegetables	Types of parasites	No of parasites by sedimentation method	No of parasites by floatation method
Tomatoes (*Lycopersicum sativus*)	Cyst of *Entamoeba coli*	1	Nil
	Cyst of *Balantidium coli*	1	Nil
	Ova of *Ascaris lumbricoides*	1	1
Quail Grass (*Celosia argentea*)	Ova of hookworm	1	Nil
	Ova of *Ascaris lumbricoides*	3	1
Waterleaf (*Talinium triangulare*)	Ova of *Ascaris lumbricoides*	2	1
	Cyst of *Entamoeba coli*	1	Nil
Spinach (*Amaranthus spinosus L.*)	Cyst of *Entamoeba coli*	1	Nil
	Cyst of *Balantidium coli*	1	Nil
	Ova of *Ascaris lumbricoides*	1	Nil
Jute mallow (*Corchorus olitarius*)	Cyst of *Balantidium coli*	1	Nil
	Ova of *Ascaris lumbricoides*	1	1
	Ova of hookworm	1	1

Table 3 shows the parasite types found on vegetables in Oja Tutun, *Ascaris lumbricoides* has the highest prevalence on all the vegetable types followed by *Entamoeba coli* the least.

Table 4: Types of parasites on vegetables in Oja Ipata market.

Vegetables	Types of parasites	No of parasites by sedimentation method	No of parasites by floatation method
Tomatoes (*Lycopersicum sativus*)	Cyst of *Entamoeba coli*	1	Nil
Waterleaf (*Talinium triangulare*)	Ova of *Trichuris trichiura*	1	Nil

	Trophozoite of *Giardia lamblia*	1	Nil
	Cyst of *Entamoeba coli*	1	Nil
	Trophozoites of *Trichomonas hominis*	1	Nil
Quail Grass (*Celosia argentea*)	Cyst of *Balantidium coli*	1	Nil
	Ova of *Ascaris lumbricoides*	1	1
	Cyst of *Entamoeba histolytica*	1	Nil
Spinach (*Amaranthus spinosus L.*)	Cyst of *Balantidium coli*	1	Nil
	Ova of *Ascaris lumbricoides*	1	Nil
	Ova of Hookworm	1	Nil
Jute mallow (*Corchorus olitarius*)	Cyst of *Entamoeba coli*	1	Nil
	Ova of *Ascaris lumbricoides*	1	1
	Trophozoites of *Trichomonas hominis*	1	Nil

Table 4 above shows the parasites types found on vegetables in Oja Ipata markets, *Ascaris lumbricoides* has the highest prevalence and while the least is *Trichuris trichiura*.

Table 5: Number of parasites in the varieties of vegetables by sedimentation method in the market.

Markets			
Vegetables	**Oja Oba**	**Oja Tutun**	**Oja Ipata**
Tomatoes (*Lycopersicum sativus*)	3 (20.0)	3 (18.8)	1 (7.1)
Waterleaf (*Talinium triangulare*)	2 (13.3)	3 (18.8)	4 (28.6)
Quail Grass (Celosia argentea)	5 (33.3)	4 (25.0)	3 (21.4)
Spinach (*Amaranthus spinosus L.*)	3 (20.0)	3 (18.8)	3 (21.4)
Jute mallow (*Corchorus olitarius*)	2 (13.3)	3 (18.8)	3 (21.4)
Total	15	16	14

Table 5 shows that out of the three markets, Oja Tutun had the highest number of parasites on the vegetables and the least is the Oja Ipata.

Table 6: Cross-tabulation of the prevalence of the parasites in the various markets and types of vegetables.

Vegetables	**Oja Oba**	**Oja Tatun**	**Oja Ipata**	**Total**
Tomatoes (*Lycopersicum sativus*)	3 (2.08)	3 (2.46)	1 (2.46)	7

Waterleaf (*Talinium triangulare*)	2 (2.08)	2 (2.46)	3 (2.46)	7
Quail Grass (*Celosia argentea*)	2 (2.08)	2 (2.46)	3 (2.46)	7
Spinach (*Amaranthus spinosus L.*)	2 (2.08)	3 (2.81)	3 (2.81)	8
Jute mallow (*Corchorus olitarius*)	2 (2.38)	3 (2.81)	3 (2.81)	8
Total	11	13	13	37

X2 Cal.=2.0965, df=6 X2 Tab=12.59, since X2 Cal<X2 Tab, we accept the Null hypothesis, there is no statistical significance between parasites prevalence in the Markets, p>0.05.

Table 7: Parasite prevalence on vegetables by both sedimentation and floatation methods in Oja Oba.

Vegetables	Sedimentation (no parasites)	Flotation (no parasites)	Total
Tomatoes (*Lycopersicum sativus*)	3 (3.57)	2 (1.43)	5
Waterleaf (*Talinium triangulare*)	2 (2.14)	1 (0.86)	3
Quail Grass (*Celosia argentea*)	5 (4.28)	1 (1.71)	6
Spinach (*Amaranthus spinosus L.*)	3 (2.85)	1 (1.14)	4
Jute mallow (*Corchorus olitarius*)	2 (2.14)	1 (0.86)	3
Total	15	6	21

X2 Cal=1.0035, df=4, X2 Tab=9.49. Since X2 Cal<X2 Tab we accept the null hypothesis, there is no statistical significance between sedimentation and floatation method in Oja Oba.

Table 8: Parasite prevalence on vegetable by both Sedimentation and floatation methods in Oja Tutun markets.

Vegetables	Sedimentation	Floatation	total
Tomatoes (*Lycopersicum sativus*)	3 (2.84)	1 (1.14)	4
Waterleaf (*Talinium triangulare*)	2 (2.14)	1 (0.86)	3
Quail Grass (*Celosia argentea*)	4 (3.57)	1 (0.43)	5
Spinach (*Amaranthus spinosus L.*)	3 (2.86)	1 (1.14)	4
Jute mallow (*Corchorus olitarius*)	3 (3.57)	2 (1.43)	5
Total	15	6	21

X2 Cal=0.326, df=4 X2 Tab=9.49 Since X2 Cal<X2 Tab we accept the null hypothesis, there is no statistical significance between the methods in Oja Tutun.

Table 9: Parasite prevalence on vegetables by both sedimentation and floatation methods in Oja Ipata markets.

Vegetables	Sedimentation	Floatation	total
Tomatoes (*Lycopersicum sativus*)	1 (0.78)	(0.16)	1
Waterleaf (*Talinium triangulare*)	4 (0.33)	(0.50)	4
Quail Grass (*Celosia argentea*)	3 (3.11)	1 (0.67)	4
Spinach (*Amaranthus spinosus L.*)	3 (3.11)	1 (0.67)	4
Jute mallow (*Corchorus olitarius*)	3 (3.11)	1 (0.67)	4
Total	14	3	17

X2 Cal=0.468, df=4, X2 Tab=9.49 since X2 Cal<X2 tab we accept the null hypothesis, there is no statistical significance.

Table 10: Parasitic prevalence on vegetables by both sedimentation and floatation methods in the three markets.

Vegetables	Sedimentation	Floatation	total
Tomatoes (*Lycopersicum sativus*)	7 (7.46)	3 (2.54)	10
Waterleaf (*Talinium triangulare*)	9 (8.20)	2 (2.79)	11
Quail Grass (*Celosia argentea*)	11 (10.44)	3 (3.56)	14

Spinach (*Amaranthus spinosus L.*)	9 (8.95)	3 (3.05)	12
Jute mallow (*Corchorus olitarius*)	8 (8.95)	4 (3.05)	12
Total	44	15	59

X2 Call=1.0035, df=4 X2 Tab=9.49 since X2 Cal<Tab we accept the Null hypothesis, there is no statistically significant difference between sedimentation and floatation methods, p>0.05.

Table 11: Comparing the two methods in the respective markets.

Methods	Oja Oba	Oja Tutun	Oja Ipata
Sedimentation	15 (33.3%)	15 (33.3%)	14 (31.8%)
Floatation	6 (6.7%)	6 (6.7%)	3 (3.35%)

Comparing the two methods used for the study, the sedimentation method yielded high percentage of parasites compare to the floatation method in both Oja Oba and Oja Tutun respectively.

Table 12: The prevalence of parasites found in vegetables in all the markets, using both floatation and sedimentation methods.

Parasites	No of parasites	% of parasites
Ova of *Ascaris lumbricoides*	33	52.4
Ova of Hookworm	6	9.5
Cyst of *Entamoeba histolytica*	9	14.3
Cyst of *Entamoeba coli*	6	9.5
Cyst of *Balantidium coli*	5	7.9
Ova of *Trichuris trichiura*	1	1.6
Trophozoite of *Trichomonas hominis*	2	3.2
Cyst *Giardia lamblia*	1	1.6
Total	63	100

Table 12 above shows the parasite prevalence using both methods *Ascaris lumbricoides* 33 (52.4%) had the highest prevalence while the least is *Trichuris trichiura* 1 (1.6%) and *Giardia lamblia* 1 (1.6%).

DISCUSSION

Foodborne parasites have received little attention in developing countries. As a rule, these organisms infest vegetables while still in the field and are usually transmitted by contaminated wash water and spread by ineffective hygienic practice [11,15]. In this study, a total of 150 vegetables were sampled from Ilorin major markets, which include Oja Oba, Oja Tutun and Ipata market, and were examined for intestinal parasites contamination. Five vegetables were sampled: Tomatoes (*Lycopersicum sativus*), Waterleaf (*Talinium triangulare*), Quail Grass (*Celosia argentea*), Spinach (*Amaranthus spinonsus*), Jute mallow (*Corchorus olitarius*) while others leaves, tomatoes (*Lycopersicum sativus*) was fruit as shown in Table 1. Out of the 150 samples examined, 63 (42.0%) of the vegetables were positive for intestinal parasites in which Jute mallow (*Corchorus olitorius*) and Spinach (*Amaranthus spinonsus*) recorded the highest 12 (26.6%) parasite contamination while Tomato (*Lycopersium sativus*), Quail Grass (*Celosia argentea*), and Waterleaf (*Talinium triangulare*) recorded the lowest parasites contamination 7 (15.6%) as shown in Table 6. However, according to studies carried out by Damen et al. [16] in Jos Nigeria, 36% parasite contamination was recorded out of 1,250 vegetables examined, with cabbage having the highest parasites contamination (64.0%), while Tomato recorded the less parasites contamination (20.0%), the degree of contamination of vegetables in this study was attributed to the fact that cabbage, lettuce and green vegetables had uneven surface and makes parasites eggs, and trophozoites to attached to the surface of the vegetables more easily, either in the farm or when washed with contaminated water while tomatoes had the least prevalence because of the smooth surface that reduces the rate of parasites attachment. Eight different types of parasites were isolated from 150 vegetables from 3 different markets; these parasites include ova of *Ascaris lumbricoides* 33 (52.4%), cyst of *Entamoeba histolytica* 9 (14.3%), cyst of *Entamoeba coli* 6 (9.5%), cyst of *Balantidium coli* 5 (7.9%), ova of Hookworm 6 (9.5%), Trophozoite of *Trichomonas hominis* 2 (3.2%), ova of *Giardia lamblia* 1 (1.6%). However, the intestinal parasites isolated from this study differ from those isolated from previous studies, Uneke isolated ova of *Ascaris lumbricoides* (36.4%) in Abakaliki, Ebonyi State [17], while Damen et al. [16], isolated *Trichomonas hominis* (24.9%), ova of Hookworm (19.8%), ova of *Ascaris lumbricoides* (17.1%), Strongyloides stercoralis (16.7%), *Entamoeba histolytica* (14.0%), *Trichuris trichiura* (5.1%), and *Hymenolepis nana* (2.4%) in Jos. Despite the variation in the types of parasite isolated, it was observed that ova of *Ascaris lumbricoides* are common to the vegetables examined in all the study area, this could be due to the fact that these parasites can withstand a wide variety of adverse environmental conditions which could also serve as indicator of water pollution [18]. Vegetables in each of the markets selected for this study had almost the same rate of parasitic contamination. The most occurring parasites in the three markets are ova of *Ascaris lumbricoides*, cyst of *Entamoeba histolytica* and *Entamoeba coli*. Although sanitary conditions and the level of education may be the contributing factors for parasite infestations, these factors may not account much in this case because all the people involved are non-educated and their general sanitary conditions can only be assumed. Spinach and Jute mallow have more infestation of the parasites than other vegetables, factors influencing this can be easily deduced, parasites eggs and trophozoites attached to surface of vegetables more easily, while tomatoes had the least infestation because of the smooth surface that reduces the rate of parasite attachment. In further analysis, to determine significance, it was found that, although there was

a difference in the detection of parasites, this difference was not statistically significant. The variation in the various markets also shows that there was no significant difference in parasites detection in various markets. In addition, the presence of protozoa and helminths in this study might be due to lack of modern toilet facilities, inadequate public health enlightenment, and illiteracy that makes people defecate indiscriminately resulting in pollution of water and farmland as observed by Damen et al. [16]. The risk of infection with intestinal parasites to the population is increased because these contaminated vegetables are sometimes eaten raw, undercooked to retain the natural taste and preserve heat-labile nutrients [19]. In this study, more parasites were seen in the sedimentation methods than in the floatation methods. This as reported elsewhere, may be attributed to the density of some parasites which may possibly sink down beyond detection. Comparing the two conventional techniques used in the isolation of parasites in this study, it was observed that sedimentation method had the highest recovery rate of parasites 15 (33.3%), while floatation method recovers 6 (6.7%) (Table 11). In similar study by Daryani et al. [11], had a recovery rate of 36% of parasites using sedimentation method. However, from the study carried out by Nyanrago et al. [14], using floatation methods, a prevalence of 65.5% parasites were recovered. The recovery rate of parasites in this study using sedimentation methods is higher as compared to the floatation method used by Nyanrango et al. [14].

CONCLUSION

From this study, it has been concluded that common parasites are found on vegetables and this may be very good source of infection to man. The presence of these parasites understudy may be applicable to other markets in and around Ilorin metropolis. There is a need for further research work on similar topic. Environmental practices, good sanitary conditions, and general health education messages should be the watchword for these sellers and even the farmers on the implication of these parasites to health. It has finally been recommended from this study that washing the vegetable with salt and vinegar should be encouraged by all so as to reduce the parasites on these vegetables from been eaten by man. Educating the general public on the effects of these parasites will be very much essential for the reduction of the infections of this parasite to man. In the past, community mobilization on sanitation in markets and communities was a tool for keeping to the norms of good sanitary conditions and hygienic practices should be re-introduced to bring about good sanitary conditions to our market generally.

REFERENCES

1. Key TJ, Allen NE, Spencer EA, Travis RC. The effect of diet on risk of cancer. Lancet. 2002;360:861-868.
2. Doyle ME. Food borne parasites: A Review of the scientific literature. 2002.
3. Intestinal Parasites. http://dictionnaire.sensagent.leparisien.fr/Intestinal%20parasite/en-en/
4. Bruchner DA. Helminthic food-borne infections. Clin Chem Lab Med. 2000;19:639-660.
5. Cox FE. History of human parasitology. Clin Microbiol Rev. 2000;15:595-612.
6. Orlandi PA, Chu DMT, Bier JW, Jackson GJ. Parasites and the food Supply. Food Technol-Chicago. 2002;56:72-81.
7. Dittmar K, Teengens WR. The presence of Faciola Hepatica (Liver Fluke) in human and cattle from a 4,500 years old archaeological site in the Saale-Unstut valley, Germany. Men Inst Oswaldo Cruz. 2003;98:141-143.
8. Goncalves ML, Araujo A, Ferreira LF. Human intestinal parasites in the past: New findings and a review. Men Inst Oswaldo Cruz. 2003;98:103-118.
9. World Intellectual Property Organization (WIPO). A system for diagnosing intestinal parasites by computerized image analysis. 2008.
10. Silvia RPS, Silvia EFV, Dariene CP, Aline MS, Marillise BR, Gertrudes C. Microbiological quality of minimally processed vegetables sold in Porto Alegre, Brazil. Braz J Microbiol. 2007;38:594-598.
11. Daryani A, Ettehad GH, Sharif M, Ghorbani L, Ziaei H. Prevalence of intestinal parasites in vegetables consumed in Ardabil, Iran. Food Control. 2008;9:790-794.
12. Maizels RM, Yazdanbaksh M. Immune regulation by helminth parasites: cellular and molecular mechanisms. Nat Rev Immunol. 2003;3:733-744.
13. Geography of Nigeria. https://en.wikipedia.org/wiki/Geography_of_Nigeria
14. Nyarango RM, Aloo PA, Kabiru EW, Nyanchongi BO. The risk of pathogenic intestinal parasites infection in Kisii municipality, Kenya. BMC Public Health. 2008;14:237.
15. Akinseye JF, Ayuba SB, Adewuyi IK, Agunlejika RA. Isolation of intestinal parasites in vegetables sold in major markets in Akure, Ondo State, Nigeria. Int J Health Sci Res. 2017;7:78.
16. Damen JG, Banwat EB, Egah DZ, Allanana JA. Parasitic contamination of vegetables in Jos, Nigeria. Ann Afr Med. 2007;8:115-118.
17. Uneke CJ. Potential for geohelminth parasites transmission by raw fruits and vegetables in Nigeria: implication for a risk profile. J Nutr Environ Med. 2007;16:59-68.
18. Lawal SB, Wada Y, Ifraimu D. Parasitic contamination of commonly consumed fresh fruits and vegetables sold in open-air markets in Zaria Metropolis, Nigeria. J Trop Biosci. 2015;10:68-75.
19. Amawulu E, Sampson A, Henry AI. Fruits consumption pattern and its implication on parasite transmission in Yenagoa Metropolis, Nigeria. J Trop Dis. 2019;7:302.