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PARASITIC CONTAMINATION OF SOME VEGETABLES SOLD AT TWO MAJOR MARKETS IN JOS.

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A.E.A design the study T.T.S. collected the samples A.A.H analysis the data, F.O.K. completed the results, D.A.D. finalized the data.

Key words:
Rate, Vegetables, Parasites, Contamination

ABSTRACT

This study was conducted from November 2017 – February 2018 to evaluate parasitic contamination of common vegetables sold at two major markets in Jos, Plateau State, Nigeria. A total of 300 vegetable samples (30 for each vegetable type from both markets) comprising of lettuce, cabbage, spinach, carrot and tomato were collected using random sampling technique and screened using centrifugation method. 150 (50.00%) of the total sample were positive for different species of parasites. All samples from both markets showed multiple contaminations. Highest contamination rates from both market were recorded. Carrot 73.33% (22/30), lettuce 63.33% (19/30), spinach 56.67% (17/30), cabbage 53.33% (16/30) and tomato 43.33% (13/30). Cysts, ova and larvae of parasites were detected. *Trichiris trichiura* had the highest occurrence 249/452, *Entamoeba coli* 116/452, *Entamoeba histolytica* 69/452 and *Giardia lamblia* 18/452. Contamination rate was higher in Farin-gada market. Using chi square the results indicated a significant difference in the prevalence of parasitic contamination in relation to different vegetables examined and also between both markets ($p<0.05$). High parasitic contamination rates associated with these vegetable samples is an indication of poor farming and sanitary practices. Since vegetables can serve as a source of transmission of intestinal parasites in this study area, consumers should properly and hygienically prepare their vegetables before consumption.

1. INTRODUCTION

Vegetables by being a source of essential nutrients, vitamins, minerals, proteins and fibres play a major role in protecting the human body from a number of diseases. They are essential for good health, and form a major component of human diet in every family [1].

Food safety regardless of the specific food product should be a paramount concern to everyone, with parasites from contaminated vegetables being a potential health risk. Consuming raw and improperly washed vegetables is a major way in which human pathogens are transmitted [2,3]. Because of poor

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hygienic practices related to planting, harvesting, packing, transportation and storage, fruits and vegetables can become easily contaminated with parasites [3]. Vegetables act as a vehicle for transmission of parasitic infections when contaminated as a result of various associated factors related to planting, such as while they are still on the field, harvesting, transportation, storage, market chain, and even at home [4,5,6].

Vegetables may act as passive vehicles for transmission of pathogenic parasites and protozoa that are primarily transmitted through the faecal-oral route [7,8]. The major sources of contamination for foods and water are through contact with human or animal faecal wastes. Untreated or contaminated water used for irrigation, as well as the use of fresh untreated manure seem to be likely sources of contamination. Furthermore many parasitic contaminants are part of the environment and fruits and vegetables may be inadvertently contaminated [9,10,11,12,13,14,15]. Food normally become a potential source of human infection and the sources of zoonotic contamination are usually faeces, faecally contaminated soil or water [16,17,18]. With the increasing global water scarcity and pollution of water bodies, vegetable farmers resort to the practice of using untreated wastewater for irrigating vegetables. Vegetables are reported to habour intestinal parasites such as *Ascaris lumbricoides*, *Taenia* species, *Fasciola hepatica*, *Hymenolepis nana*, *Echinococcus* species, *Trichuris* species, *Enterobius vermicularis*, *Trichostrogylus* species, *Toxocara* species, *Strogyloides stercoralis*, *Giardia intestinalis*, *Entamoeba* species, *Lodamoeba butschlii*, *Blastocystis hominis* and *Crytosporidium parvum* [2,4,19,20]. Unhygienic sewage disposal and absence of its treatment facilities pose potential health hazards through contaminating irrigated food crops with parasites in urban and suburban areas of African countries including Nigeria [18,21,22,23]. Many farmers irrigating their farmlands with wastewater are not aware of the risks or potential harmful environmental consequences. This may be due to limited available information, poor sanitary conditions associated with most farmers and illiteracy. Many studies have been conducted on prevalence of intestinal parasite in humans in Nigeria and Plateau State, information on the source of infection remain limited. Therefore, this studies is aimed at evaluating the degree of intestinal parasitic contaminations of some vegetables that are eaten raw or partially cooked from two major markets in Jos North local Government Area of Plateau State, North Central, Nigeria during the dry season.

2. MATERIALS AND METHODS

2.1 *Study area*

The study was carried out in Jos North Local Government Area of Plateau State Nigeria during the dry season (November 2017 – February 2018). Jos is the capital of Plateau State, a city in the middle belt, north central Nigeria. Located at a latitude of $09^{O}55^{1}00^{11}$N and longitude of $08^{O}53^{1}25^{11}$E, 1238m above sea level. It is a commercial city and most inhabitants are petty traders of low economic status. However, there are a lot of farming activities going on in this area especially along the river banks. The watering of vegetables at this period is by irrigation. It is a common practice that majority of the farmers use human and animal manure to increase crop production and to augment the commercially processed fertilizer to limit cost of farming.

2.2 *Sample collection*

A total of 300 samples comprising of five (5) types of fresh vegetables (lettuce, cabbage, carrot, spinach and tomato) were bought from different sellers from both markets (Terminus and Farin-gada Markets) using a random sampling technique. All purchased vegetables were collected in different clean plastic bags (one sample per bag/seller) labelled with date and transported to the Parasitology Laboratory of the Department of Zoology, University of Jos. Analysis was conducted within 24hours of sample collection.

2.3 *Parasitological screening*

Samples were washed individually with formal saline. The liquid was allowed to stand for several hours for proper sedimentation. The supernatant was discarded with a Pasteur pipette leaving about 15ml at the bottom. 10ml of the deposit mixture was transferred into a centrifuge tube and spun for five minutes at 3,000 rpm. The supernatant was decanted while the deposit was resuspended with 10% formal saline. This was centrifuged, the supernatant was decanted and the deposit was then transfer to a clean glass slide. A drop of iodine solution was added to stain the cysts if any, it was then covered with a cover slip avoiding air bubbles and over floating. 10x

and 40x objectives were used for parasitic examination [6]. Modified stained smears were prepared to detect protozoan oocyst including *Entamoeba histolytica, Entamoeba coli*, *Giardia lamblia* and helminthes including *Trichiuris trichura* and other parasites found [4]. Each parasite eggs, larvae or cyst present in the sample were counted.

3. RESULTS

For each vegetable type studied, a total of 30 samples were collected from each market. The eggs, cysts and larvae of different parasitic organisms (nematode and protozoa) were isolated from in the vegetables sold at the Farin-gada and Terminus Markets. In Farin-gada market more than half of the total samples 86(57.33%) were contaminated with more than one type of parasites. Out of 30 samples for each vegetable, carrot 22(73.33%) had the highest number of contamination, lettuce 19(63.33%), Spinach 16(53.33%), Cabbage 16(53.33%) and Tomatoes 13(43.33%) with the least contamination rate. Vegetables sold at the Terminus market revealed that less than half of the total samples 64(42.7%) were contaminated. Out of 30 samples for each vegetables, Spinach 17(56.67%) had the highest number of contamination, carrot 13(43.33%), lettuce 13(43.3%), Tomatoes with 10(33.33%) and cabbage 9(30.00%) with the least contamination. All positive samples had multiple contamination. Table 2 shows that *Trichuris trichiura* had the highest parasitic prevalence (140) observed in Farin-gada and (109) was from terminus market and the least prevalence of (0) *Gardia lamblia* from Terminus market and (17) from Farin-gada market. From both markets, *Trichuris trichiura* had the highest parasite load on all vegetables (249) and *Giardia lamblia* the least (1). Table 3 shows that the egg of *Trichuris trichiura* was more predominant in both markets in all vegetables types examined. Only three larvae of *Trichuris trichiura* were found from both markets i.e. two from lettuce (Farin-gada market) and one from carrot (Terminus market). Cysts of *E. coli* and *E. histolytica* were also observed in both markets with the highest number of *E. coli* (55) and *E. histolytica* (24) both observed from the Farin-gada market. Using Chi square, $P < 0.05$ for both parasitic contamination of vegetables between the two markets and number of parasitic contamination in relation to vegetables type.

4. DISCUSSION

The occurrence of pathogenic microorganisms in vegetables is an indication of the quality of the overall process of cultivation, irrigation, post-harvest handling and poor sanitation. Detection of intestinal parasitic stages from vegetables is an indicative of fecal contamination of human and/or animal origin. This is also an indication that humans will always be at risk of infection especially as vegetables are naturally popular in the diet of people of all classes [24]. As in many African countries, intestinal parasites are widely distributed in Nigeria, not only because of the favourable climatic conditions for survival and dissemination of parasites but also due to the unsanitary conditions that facilitates fecal pollution of water, food stuffs and soil [25]. This study attempted to evaluate the level of contamination and prevalence of different intestinal parasites in vegetables sold and mostly eaten raw or undercooked from two major markets in Jos, Plateau State, Nigeria. Out of 300 vegetable samples, 150 (50.0%) were positive to intestinal parasites.

The overall prevalence of contamination rate was 50.00% which is in agreement with findings elsewhere [4,6]. However, this was lower (53.30%) and higher (20.0%) than what was reported in similar studies carried out in other areas [6,26].The difference between this finding and previous findings may be attributed to variations in geographical location, climatic and environmental conditions, the kind of sample and sample size examined, sampling techniques method used for detection of parasites and socioeconomic status [1,27,28].

The prevalence of parasites in relation to vegetables as shown in table 2 revealed that carrot was most contaminated with a parasite burden of 143 (31.64%) of the total 452 parasites enumerated. This was followed by lettuce, 96 (21.24%), spinach 92 (20.35%), cabbage 68 (15.04%) and tomato least contaminated 53 (11.73%). In both markets, tomato recorded the least parasitic contamination, this could be due to the fact that the surface of tomato is smooth compared with other vegetables (carrot, cabbage, lettuce and Spinach) with uneven surfaces making parasitic eggs, larva, cyst attached to the surfaces of these vegetables more easily either in the farm or when washed with contaminated water. The water

used in washing the vegetables introduce these parasites, followed by soil transmissible helminthes a sign or indicators of poor sociology economic condition as well as poor environmental and sanitary practices.

Contamination rate variation among the vegetables may be due to the fact that carrot is in direct contact with the contaminated soil and uneven surfaces of lettuce and cabbage, and tomato least contaminated due to its smooth surface. This is in agreement with the findings [28,29] in which recorded low contamination rate in tomato, and stated that the smooth surface might reduce the rate of parasitic attachment hence lower contamination rate.

In this study *Trichuris trichiura* egg was most predominant (249). This may be as a result of the life cycle and the quantity of eggs released daily (3,000-20,000) by the adult female parasite. Okoronkwo [30] reported that some eggs of helminthes were found in water from ponds and rivers used for irrigation in Plateau State; this may serve as a source of contamination of irrigated farm products especially vegetables. The cyst of *Entamoeba coli*, though non-pathogenic was found in high quantity. This is an indicator of fecal contamination and its presence should be given due consideration. *Giardia lamblia* cyst was found in small quantity in Farin-gada market, but this was completely absent in the Terminus market. Contamination rate was significantly different for samples collected from both markets in which samples from Farin-gada market showed higher rate. This may be due to the fact that most vegetables sold at the Farin-gada market were not washed before display as against what was observed at the Terminus market. In Farin-gada market, most vegetables were displayed for sale on the floor where it is exposed to many sources of contamination. This is of great concern since the Farin-gada market serve as the major distributor of vegetable to other places in Jos metropolis and even outside the state. A common practice of eating raw vegetables such as tomato, lettuce, cabbage and carrot is predominant in this study area. Hence this finding of this study is of great public health importance, needing urgent intervention to prevent the transmission of diseases that can be acquired through the consumption of such contaminated food produces.

5. CONCLUSION

This study highlighted the importance of vegetables as a potential source of transmission for intestinal parasites to humans. Vegetables contaminated with pathogenic parasites poses health risk to the consumers when eaten raw or undercooked. The findings of this study indicates a high level of parasitic contamination of vegetables sold at the two major markets in Jos metropolis. Of concern is the high level of contamination in the Farin-gada market; this is because this market serves as the major supplier of vegetables to other smaller markets in Jos-North local government area. The implication is that, these parasites are further disseminated across the metropolis. Prevention of contamination remains the most effective way of reducing food borne parasitic infection. Although the disposal of wastewater on agricultural fields has its benefits, the use of such water without any form of treatment poses a serious public health risk to human.

6. RECOMMENDATION

It is obvious that vegetables consumed by people are quite often contaminated with parasites, more especially by intestinal parasites. Vegetables cannot be excluded from human diet but can be removed from the cycle of transmission of parasites. Simple personal and environmental hygiene by farmers, sellers and consumers should be practices. The use of wastewater for irrigating vegetables should be discouraged. Therefore, a comprehensive health education on the used and implication of wastewater should be given to farmers and vendors of vegetables and the general population on the health risk associated with consumption of raw or undercooked contaminated vegetables. Consumers should be advised to always wash and cook purchased vegetables properly and where possible soak in vinegar for some time before use.

7. CONFLICT OF INTEREST

This work was carried out in collaboration between all authors. All authors read and approved the final

manuscript. The authors wish to state that there is no conflict of interest.

8. ACKNOWLEDGMENT

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Table 1: Frequency Distribution of Parasitic Contamination of vegetables sold in Two Major Markets in Jos, Plateau State.

Vegetable	Parasite Detected	Number Examined		Number Positive (%) FM	Number Examined		Number Positive (%) TM
Lettuce	*Entamoeba coli*	30		09 (30.00)	30		12 (40.00)
	Entamoeba histolytica			06 (20.00)			04 (13.30)
	Trichuris trichiura			19 (63.30)			13 (43.30)
	Giardia lamblia			03 (10.00)			00 (0.00)
Carrot	*Entamoeba coli*	30		22 (20.00)	30		03 (10.00)
	Entamoeba histolytica			17 (56.70)			04 (13.30)
	Trichuris trichiura			11 (36.70)			15 (50.00)
	Giardia lamblia			09 (30.00)			00 (0.00)
Spinach	*Entamoeba coli*	30		06 (20.00)	30		01 (3.30)
	Entamoeba histolytica			01 (3.30)			08 (26.60)
	Trichuris trichiura			16 (53.30)			17 (56.60)
	Giardia lamblia			01 (3.30)			00 (0.00)
Cabbage	*Entamoeba coli*	30		04 (13,30)	30		05 (16.60)
	Entamoeba histolytica			01 (3.30)			09 (30.00)
	Trichuris trichiura			16 (53.30)			09 (30.00)
	Giardia lamblia			00 (0.00)			00 (0.00)
Tomato	*Entamoeba coli*	30		01 (3.30)	30		10 (33.30)
	Entamoeba histolytica			02 (6.60)			06 (20.00)
	Trichuris trichiura			13 (43.40)			09 (30.00)
	Giardia lamblia			00 (0.00)			00 (0.00)
Total		150			150		
Total No. of Positive samples				86 (57.33)			64 (42.67)

Table 2: Prevalence and Distribution of Parasitic Protozoa and helmintheson Vegetables sold in Two Major Markets in Jos, Plateau State.

	Entamoeba coli		*Entamoeba histolytica*		*Trichuris trichiura*		*Giardia lamblia*		
Market	**FM**	**TM**	**FM**	**TM**	**FM**	**TM**	**FM**	**TM**	**Total**
Vegetable									
Lettuce	11	13	06	04	43	16	03	00	96
Carrot	55	02	24	06	15	27	14	00	143
Spinach	09	01	04	06	31	40	01	00	92
Cabbage	04	11	02	09	29	13	00	00	68
Tomato	01	09	02	06	22	13	00	00	53
Subtotal	80	36	38	31	140	109	18	00	452
Grand Total	**116**		**69**		**249**		**18**		**452**

FM = Farin-gada Market, TM = Terminus Market

Table 3: Prevalence and Distribution of Eggs, Cysts, and Larvae of Parasitic Protozoa and Helminthes in Vegatables Sold in Two Major Markets in Jos, Plateau State.

Parasite / Vegetable	*Entamoeba coli*		*Entamoeba histolytica*		*Trichuris trichiura*		*Giardia lamblia*	
	FM	TM	FM	TM	FM	TM	FM	TM
Lettuce								
Egg	-	-	-	-	41	16	-	-
Cyst	11	13	06	04	-	-	03	-
Larva	-	-	-	-	02	-	-	-
Carrot								
Egg	-	-	-	-	15	26	-	-
Cyst	55	02	24	06	-	-	14	-
Larva	-	-	-	-	-	01	-	-
Spinach								
Egg	-	-	-	-	31	40	-	-
Cyst	09	01	04	06	-	-	01	-
Larva	-	-	-	-	-	-	-	-
Cabbage								
Egg	-	-	-	-	29	13	-	-
Cyst	04	11	02	09	-	-	-	-
Larva	-	-	-	-	-	-	-	-
Tomato								
Egg	-	-	-	-	22	13	-	-
Cyst	01	09	02	06	-	-	-	-
Larva	-	-	-	-	-	-	-	-

FM = Farin-gada Market, TM = Terminus Market

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