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Parasitic Contamination of Fresh Vegetables Sold in Open-Aired Markets in White Nile State, Sudan

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Abstract: This was a prospective cross-sectional study conducted in White Nile state, Sudan during September to October 2017 to detect the parasitic contamination in fresh vegetables sold in two markets. Out of a total of 100 fresh vegetable samples and 30 water samples used to sprinkle vegetables, the prevalence of intestinal parasites was 36% (36) whereas, the water samples used to sprinkle vegetables showed 23.3% (7) were positive for parasitic contamination. Remarkably, high level of contamination in fresh vegetable samples was recorded in Watercress 50 % (10) followed by Carrot 45% (9), Tomatoes 35% (7), Green onion 40 % (6) and Cucumber 25 % (4), while green pepper was not contaminated. The identified protozoans and helminthes were *Entamoeba histolytica, Giardia lamblia, Strongyloides stercoralis, Trichuris trichiura, Hymenolepis nana* and nonpathogenic *Entamoeba coli.* The most predominant parasites encountered were *Entamoeba histolytica* 52.8 %, *Giardia lamblia*, nonpathogenic *Entamoeba coli* and *Trichuris trichiura, Strongyloides stercoralis* 5.6 % for both.Contaminated fresh vegetables inthe markets of White Nile state may play a significant role in transmission of intestinal parasitic infections tohumans and the water used by greengrocers to sprinkle vegetable(s) can be implicated in vegetable contamination.

Key words: Parasitic Contamination · Fresh Vegetables · White Nile state · Sudan

INTRODUCTION

Infection with intestinal parasites remains one of the most common health problems in the world mainly in tropical and subtropical countries [1]. Parasitic infection associated with poor hygiene and lack of sanitation is commonly observed in developing countries [2, 3].

Vegetable consumption provides the human body with the necessary diet and protects the body from various diseases including the risk of stroke, cardiovascular diseases and certain types of cancers [4-6]. Fresh vegetables harbor numerous microbial contaminants. Beside their nutritional and health benefits, consumption raw vegetables play roles in outbreaks of human infection [7-10].

Vegetable contamination with microbes can occur before harvesting through soil, feces, water used for cleaning, ice and application of animal manure or sewage [11-13]. Contamination may also take place during harvesting, handling of the product, processing equipment and transportation [14-16]. Moreover, water used for rinsing vegetables and sprinkling to keep them fresh is also a source of contamination [17].

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Intestinal parasitic contamination including protozoa and helminthes is common in raw vegetable [18, 19]. It has been reported that consumption of enteric parasites in contaminated food leads to morbidity and mortality [20]. Several studies reported that there is an association between the food-borne illness and eating fresh vegetables [5, 21, 22].

Poor sanitation conditions in White Nile State, may results in an increased risk of acquiring parasitic infections. Therefore, we designed the current study to determine the level of parasitic contamination in fresh vegetables and associated factors in the White Nile State.

MATERIALS AND METHODS

Study Design and Study Area: This was a prospective cross-sectional study conducted in Kosti and Rabak cities, White Nile state during the period of September 2017 to October 2017. Kosti and Rabak are main cities in White Nile State located in the southern part of Sudan about 270km from Khartoum, with its new map between latitudes 12-13, 30 degrees north and longitudes 31-33, 30 degrees east. Kosti stands on the western bank of the White Nile River opposite Rabak(the capital of the White Nile State)where there is a bridge. TheWhite Nile State has a total area of 39, 701 square kilometers. The White Nile State have dry and semi-dry climates, with an annual rainfall of 300 millimeters in the north of the state and more than 60 millimeters in the south.

Sample Collection and Examination: Fresh vegetable samples were collected randomly from two markets (AlshaabiKosti and Alkabir Rabak Markets). A total of 100 fresh vegetable samples (50/ Market) including six different types that are commonly eaten were collected. In each Market, three sellers were selected randomly and the samples were collected. Samples were collected from the upper, middle and lower shelves of each seller. Moreover, thirty water samples used to sprinkle vegetables were collected (15 samples/Market).

The six types of vegetable samples collected for this study were tomatoes (Solanumlycopersicum), watercress (Nasturtium officinale), carrots (Daucuscarota), cucumber (Cucumssativus), greenonion (Alliumcepa) and green pepper (Capsicup).

The vegetable samples were collected into sterile bags and transported immediately to the laboratory of Parasitology at University of El Imam El Mahdi for parasitic examination. Water samples used to sprinkle vegetable(s) were also collected in sterile universal containers (50 ml).

The samples were processed as described in Mohamed *et al.* [23]. The fresh vegetable samples were washed in 10 % formal saline (150 ml) for detaching the parasitic stages (Ova, larvae, cysts and oocysts) of helminthes and protozoan parasites. The washing formal saline and water samples used to sprinkle vegetables were transferred to 14 ml conical glass centrifuge tubes. For concentrating the parasitic stages, the tubes were centrifuged at 3000 rpm for 5 min. After centrifugation, the supernatant was removed carefully. Then the sediment was mixed and examined under light microscope using 10× and 40× objectives. Two slides were prepared from each sample to increase the chance of parasite detection. Then iodine stained smear was prepared by adding a small drop of Lugol' siodine solution prior to cover slipping to a slide similarly prepared for the unstained smear. The eggs/cysts were identified based on morphological details as described by Soulsby [24].

Data Analysis: All statistical analysis was carried out using Graph Pad prism 5 software. One-way ANOVA and student t-test were employed for analysis of differences between the groups. $P < 0.05$ was considered significant.

RESULTS

This study was conducted in White Nile State (Kosti and Rabak cities) in order to determine parasitic contamination in fresh vegetables sold in open-aired markets.

A total of 100 fresh vegetable samples and 30 water samples used to sprinkle vegetables were examined for the presence or absence of parasitic contamination. The results revealed 36% (36/100) of fresh vegetables examined were contaminated with at least one type of parasite. The most predominant parasites in the vegetable samples in both markets were *E. histolytic* 19%, *G. lamblia*, *E. coli* 3%, *Strongyloides stercoralis* 2%, *T. trichiura* 2% and *H. nana* 2% (Table 1).

Among the six types of vegetables tested, the most contaminated vegetables were Watercress 10% followed by Carrot 9%, Tomatoes 7% Green onion 6%, Cucumber 4% and no parasite was detected in the Green paper 0%, Table 2.

For water samples, protozoan cysts were detected in 23.3% (7/30) of water samples used to sprinkle vegetables. The predominant parasites found in water samples used to sprinkle vegetables were *G. lamblia* 10%, *E. histolytica* 6.65 % and then *E. coli* 6.65% (Table 3).

Table 1: Intestinal parasitic contamination rate in fresh vegetable samples

Parasite	Number of sample infected	Prevalence %
E. histolytica	19	19 %
Giardia lamblia	8	8 %
Entamoeba coli	3	3 %
S. stercoralis	2	2 %
T. trichiura	2	2 %
H.nana	2	2 %
Total	36	36 %

Table 2: Distribution of parasitic contamination in fresh vegetable samples

Vegetables	Number of examined	Number of positive
Watercress	20	10 (10 %)
Carrot	20	9 (9 %)
Green onion	15	6 (6 %)
Tomatoes	20	7 (7 %)
Cucumber	16	4 (4 %)
Green paper	9	0 (0 %)
Total	100	36 (36 %)

Table 3: Frequency of intestinal parasitic contamination in 30 water samples

Parasite	Number of positive
E. histolytic cyst	2 (6.65 %)
G. lamblia cyst	3 (10 %)
E. coli cyst	2 (6.65 %)
Total	7 (23.3 %)

Table 4: Distribution of parasitic contamination in fresh vegetable and water samples according to the markets

Market	Vegetables samples	Prevalence	P. value	Waters samples	Prevalence	P.value
AlkabirRabak	*E.histolytica*	10% (10)	0.0012	1	3.33 %	0.0006
	G.lamblia	5% (5)		3	10 %	
	E.coli	0%		10	3.33 %	
	S.stercoralis	2% (2)		0	0%	
	T.trichiura	0%		0	0%	
	H.nana	0%			0%	
Total		17% (17)		5	16.66	
AlshaabiKosti	*E.histolytica*	9% (9)		1	3.33 %	
	G.lamblia	3% (3)		0%	0%	
	E.coli	3% (3)		1	3.33 %	
	S.stercoralis	0%		0%	0%	
	T.trichiura	2% (2)		0%	0%	
	H.nana	2% (2)		0%	0%	
Total		19%(19)		2	6.66	

The rate of contamination among fresh vegetables examined was significantly higher in Alshaabi Kosti Market 19%, compared with Alkabir Rabak Market 17%, P.value = 0.0012 (Table 4).

Similarly, the parasitic contamination in water samples used to sprinkle vegetables was remarkably higher in Alkabir Rabak Market 16.65 % compared with Alshaabi Kosti Market 6.65 %, P. value 0.0006 (Table 4).

DISCUSSION

The parasitic detection of the vegetables is indicative of fecal contamination during the process of cultivation and post harvesting as well as the unsanitary condition that facilitate parasite dissemination in the entire population [4, 25].

This study was aimed to determine the parasitic contamination of fresh vegetables sold in Open-aired Markets in White Nile State, Sudan. The prevalence rate of contaminated vegetable samples was found to be 36%, which is higher than reports from Syria, Ethiopia, Egypt and Iran, respectively [5, 26-28]. Whereas, lower than the results was obtained from Nigeria and Ethiopia, respectively [6, 29, 30]. This variation of results in vegetable contamination rates may be attributed to geographical location, type and number of samples examined, methods used for detection, different laboratory techniques used, type of water used for irrigation, post harvesting handling methods of such vegetables and even the type of water used to wash vegetables can play an instrumental role in the epidemiology of transmission of parasitic diseases.

Among the types of vegetables tested, the most contaminated vegetables were Watercress 10% followed by Carrot 9%, Tomatoes 7% Green Onion 6%, Cucumber 4% and no parasite was detected in the Green Paper 0%. The variation of parasitic contamination in these vegetables may be in fact that leaves which are capable of harboring parasites in-between and in addition to its uneven surfaces on which parasites are attached more easily than other vegetables with smooth surfaces. The smooth surface of green pepper might reduce the rate of parasitic attachment hence had lower contamination rate [31].

The *E. histolytic* was the most prevalent parasite in the vegetable samples in both markets 19%, this observation is in accordance with Mohamed *et al.* [26, 23, 32, 33]. Various studies support the findings of this study in regards to contamination of the vegetables with *G. lamblia* [32, 33].

The water samples used to sprinkle vegetables were found to be contaminated with different parasitic stages, 23.3 % of water samples were infected in both markets. The greengrocers of the markets buy water for washing and freshening vegetables. The water is brought from outside the market in containers carried by cart because the markets lack healthy piped water form a reservoir. Most of the water samples used to sprinkle vegetables was dirty owing to dust and vegetable debris.

According to the markets, the contamination rate was significantly higher in Alshaabi Kosti Market 19%, compared with Alkabir Rabak Market 17%. This might be associated with the act of washing of the produces before display.

CONCLUSIONS

This study demonstrated obviously that the fresh vegetables and water use to sprinkle the vegetables were highly contaminated with parasites. Human consumption of these contaminated fresh vegetables may results to high risk of infection with amoebiasis, giardiasis, strongyloidiasis, trichuriasis and hymenolepiasis.

Prevention of contamination remains the most effective way of reducing food borne parasitic infection. Washing procedures before eating fresh vegetables regardless of the provider's. Adopting control measures that cover guidelines of sprinkled water quality, strategies to reduce the risk of disease transmission by food-borne parasites.

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