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Research Article

Prevalence of Contamination of Fresh Vegetables Consumed at The Vegetable Markets in Khartoum locality, Sudan

Abrar A Haron[1], Eman M Abakar[1], Hamda A Hamid[1], Marwa S Abdelrhman[1], Omnia E Abdallah[1], Yagoub H Mahmoud[1], Sababil S Ali[2], Yousof S Yousof[3] and Elsadig A Hag[2]*

[1]Department of Parasitology and Medical Entomology, Faculty of Medical Laboratory Sciences, Elrazi University, Khartoum, Sudan

[2]Department of Parasitology and Medical Entomology, Faculty of Medical Laboratory Sciences, International University of Africa, Khartoum, Sudan

[3]Department of Medical Microbiology, Faculty of Medical Laboratory Sciences, Elrazi University, Khartoum, Sudan

***Corresponding Author:** Elsadig A Haj, Department of Parasitology and Medical Entomology, Faculty of Medical Laboratory Sciences, National University, Khartoum, Sudan.

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Abstract

Background: The consumption of raw vegetables is a major way for bacteria and parasites to travel from one person to another. Fresh vegetables are considered essential. nutrients of a healthy diet as they provide the body with essential supplements. Intestinal parasites are transmitted primarily through the consumption of raw vegetables.

Aim: The purpose of this study was to detect parasitic contamination in fresh vegetables consumed at three open-air markets in Khartoum, Sudan.

Methods: A prospective cross-sectional study consisted of collecting 120 samples of fresh vegetables from three open-air markets (Elshaabi, Central markets, and Mayo) from Augustus to December 2020. Using standardized parasitological techniques for protozoans and helminths worms, we screened these samples for parasitic life forms using microscopy.

Results: A total of 120 water samples were used in Khartoum state, Sudan, to wash vegetables routinely used before human consumption. The most common parasites found were *T. Hominis* (43%), *E. coli* (20%), *G. lamblia* (80%) *Strongyloides* larva(12%), *B. coli* (35%), *E. histolytic* (17%), *I. but chili* (12%). our study showed that the most contaminated vegetable are watercress ((25%) followed by Eggplant (10%) and cucumber (1%).

Conclusion: The results of our study indicate that raw vegetables, especially leafy ones, could be a cause of food-borne illness outbreaks.

Keywords: *Contamination; Fresh Vegetable Consumed; Vegetable Markets*

Introduction

Green vegetables, in particular, are among the most popular foods in families as they provide vitamins and minerals. Many doctors prescribe them to their patients who suffer from chronic diseases such as diabetes and heart disease. They are also useful for pregnant wom-

en and help them to lose weight. They are also considered one of the main elements for strengthening immunity [1]. Vegetables are often beneficial to the health, reducing the risk of strokes, cardiovascular diseases, and certain types of cancer [2,3]. Moreover, vegetables are considered a basic source of energy and the only alternative to meat for vegetarians [4]. Water, vitamin C, carotene, mineral elements such as iron, and vitamins such as thiamine (vitamin B12), niacin, and riboflavin significantly improve food quality [5-7]. Vegetables are often eaten raw or very lightly cooked in many countries to preserve flavor, and this can increase the likelihood of parasitic infections from food [8,9]. The production, collection, transportation, preparation, and/or processing of vegetables can lead to the spread of enteric bacterial, viral, and parasitic pathogens that can infect humans [2,3,10]. Furthermore, soil, feces (human and animal), and water (irrigation, cleaning) are the most frequent sources of contamination [3,5,11]. Additionally, contamination can also be caused when fresh vegetables are rinsed with contaminated water and sprinkled with it [3,12]. Recent reports have indicated that eating fresh vegetables has a significant impact on food-borne illness cases [2,9,12]. About 200,000 people die from parasitic infections in developing countries, which account for about 300 million illnesses [7]. In developed as well as developing countries, enormous outbreaks of intestinal parasitic infections have been reported associated with raw vegetables [5,10], Poor sanitation and inadequate personal hygiene probably contributed to these situations [13]. There have been several surveys conducted in different parts of the world on the causes of protozoan cysts transmission from vegetables, such as in Syria [2]; Ghana [7]; India [9]; Pakistan [10]; Iran [5,6,12]; Nigeria [1,3,4,14]; Vietnam [15,16]; Ethiopia [11,13,17]; Egypt [8,18]. Species such as *Entamoeba histolytica*, *Giardia lamblia, E. coli, Balantidiumcoli*, and *oocysts (Isospora Belli, Cryptosporidium species*.) The following helminth species were found to be present: *Strongyloides stercoralis; Trichiura trichiura; Enterobius vermicularis; Fasciola hepatica; A. lumbricoides; and Toxocara species: Hymenolepis nana, Hymenolepis diminuta, and Taenia species.)* Salads and raw vegetables are the most common foods eaten in Sudanese society. Accordingly, intestinal parasites are especially susceptible to infection when not adequately cleaned. It is for this reason that the present study seeks to detect parasites in fresh vegetables, as it is not enough to rely on chemotherapeutic intervention for cases that have been identified; it is necessary to take steps to reduce and eliminate potential sources of infection in Sudanese communities. These factors have led to the conduct of this study to determine whether fresh vegetables sold at open-air markets in Khartoum, Sudan, are parasitological contaminated.

Rationale

We conducted this study to determine whether vegetables eaten at the market could be parasitological contaminated.

Objectives

General objective

The prevalence of contamination of fresh vegetables consumed in Khartoum locality Markets in Sudan.

Specific objectives

- To detect the intestinal parasite in the fresh vegetables.
- To assess the pathogens of intestinal parasites.
- To determine which vegetables are most contaminated with parasites.
- To indicate the quality of the overall process of cultivation.
- Assess what the market is more highly contaminated than others.

Martial and Methods

Study area

Fresh vegetable samples were collected randomly from three central open-aired markets in the Khartoum locality.

Study design

In September 2020, a cross-sectional study was conducted in Khartoum.

Sample size

A total of 120 water sample used to wash 8 vegetables (Tomato, cucumber1, Eggplant, Cucumber2, Peppers, portulaca) was washed and collected in clean universal containers 60 ml.

Inclusion criteria

Any water used to wash selected consumed diet vegetables.

Exclusion criteria

water that is not used in washing or not selected consumed vegetables.

Ethical consideration

Ethical consideration Was taken from Elrazi University's department of parasitology and Medical entomology head.

Laboratory method

Concentration technique

After washing in 10% formal saline (150 ml), the fresh vegetable samples were processed to pull out the parasitic stages (ova, larvas, cysts, and oocysts) of helminths and protozoa commonly associated with vegetable contamination. Selected samples of the washing saline and the water used to sprinkle the vegetable(s) were transferred to a conical glass centrifuge tube. During centrifugation at 3000 rpm for 5 minutes, the parasitic stages were concentrated [1]. Centrifugation was followed by delicate siphoning of the supernatant without shaking. The sediment was then gently agitated by hand to re-distribute the parasites. Last but not least, sediment was examined under a light microscope using 10× and 40× objectives

To increase the chance of detecting parasites, three slides were prepared from each sample.

Sample analysis

- Using wet preparation methods
- Concentration (Sedimentation) technique.

Statistical analysis

Excel statistical analysis programs.

Results

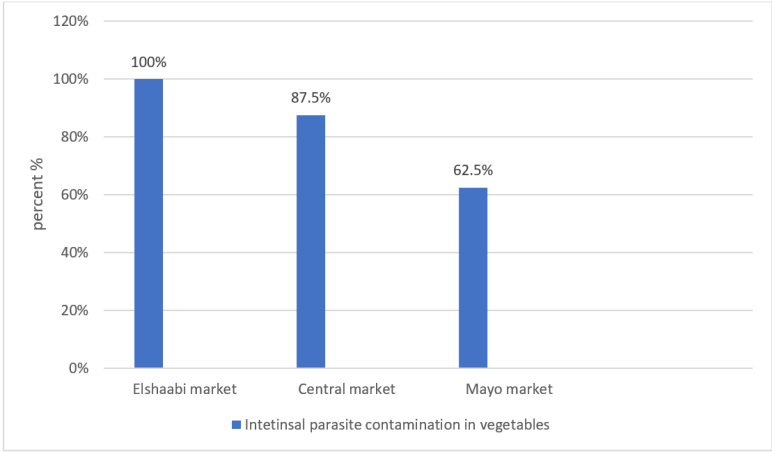

Figure 1: *Intestinal parasites Contamination in Consumed Vegetables.*

Vegetables	Troph of T.homonis	Cyst of E.coli	Troph of G.lambila	Cyst of G.lambila	Larvae of Strongyloides	Troph of B. coli
Watercress	**6**		**6**			**1**
Cucumber[1]						
Pepper	**17**				**2**	
Potato	**6**					**1**
Cucumber[2]			**1**	**1**		
Tomato						**1**
Eggplant	**6**					
Portulaca	**20**	**6**	**2**	**2**		
ToT						**69**

Table 1: *Overall parasites were detected in selected vegetables from the Elshaabi market.*

Vegetables	Troph of T. homonis	Troph and Cyst of E. coli	Troph and Cyst of G.lambila	Larvae of Strongyloide	Troph of B. coli	Cyst of E. histolytica	Cyst of I.butschlii
Watercress	**20**		**5**	**3**	**5**	**2**	**3**
Cucumber	**-**	**2**	**3**	**-**	**-**	**2**	**-**
Pepper	**17**	**-**	**1**	**-**	**3**	**-**	**-**
Potato	**6**	**-**	**-**	**-**	**-**	**-**	**-**
Cucumber	**-**	**-**	**-**	**-**	**-**	**-**	**1**
Tomato	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Eggplant	**1**	**-**	**-**	**-**	**-**	**-**	**-**
Portulaca	-	-	-	-	-	-	-
TOT	-	-	-	-	-	-	**77**

Table 2: *Overall parasite detected in selected vegetables from Central market.*

Subscales	No of items	Mean score ± SD
Working conditions	5	2.25 ± 0.70
Autonomy	3	3.26 ± 0.99
Recognition	3	2.31 ± 0.98
Professional training	6	2.77 ± 0.81
Nature of work itself	4	2.67 ± 0.85
Salary and other benefits	7	1.96 ± 0.63
Promotion	3	1.71 ± 0.80
Co-workers	3	3.39 ± 0.99
Supervision	5	2.74 ± 0.97
Policy and procedures	6	2.18 ± 0.73
Overall satisfaction	45	2.53 ± 0.50

Table 3: *Job satisfaction subscales and their mean scores of HEWs in South Gondar Zone, Northwest Ethiopia, 2020.*

NB. 8/10= Dissatisfied.

Subscales	Satisfied number of HEWs (%)	Dissatisfied number of HEWs (%)
Working conditions	46 (13.0)	308 (87.0)
Autonomy*	208 (58.8)	146 (41.2)
Recognition	79 (22.3)	275 (77.7)
Professional training	129 (36.4)	225 (63.6)
Nature of work itself	114 (32.2)	240 (67.8)
Salary and other benefits	13 (3.7)	341 (96.3)
Promotion	22 (6.2)	332 (93.8)
Co-workers*	226 (63.8)	128 (36.2)
Supervision	144 (40.7)	210 (59.3)
Policy and procedures	43 (12)	311 (88)
Overall job satisfaction	67 (19)	287 (81)

Table 4: *Job satisfaction of HEWs based on job satisfaction subscales in South Gondar Zone, Northwest Ethiopia, 2020.*

**HEWs have better job satisfaction on these two job satisfaction subscales.*

Discussion

It has been found that habitual consumption of raw vegetables plays a significant role in transmitting parasitic foodborne diseases. According to the present study, 120 water samples from Khartoum state that are used to wash vegetables before human consumption was tested for heavy metals *T. Hominis* (43%), *E. coli* (20%), *G. Lambilia* (80%) *Strongyloides larva* (12%), *B. coli* (35%), *E. Histolytica* (17%), *I. Butchilli* (12%). most contaminated vegetables were watercress (67%), followed by Eggplant (10%) and less contaminated cucumber 2 (3%), Total number of the parasite in all, markets was 180 (non-pathogen 63%, pathogen 37%) Markets contain high contaminated parasite was center market (43%), and less contaminated parasite Myo market (19%), but it contains high contaminated pathogen parasites (62%) and low contaminated pathogen detected in Alshaabi market (21%), market contain high contaminated non-pathogen Alshaabi

market (79%) and low was Myo market (38%). Furthermore study conducted in Sudan (2016) by Mona Ali Mohamed., *et al*. Out of 260 vegetables water samples, The most detected parasite in the vegetable sample in both markets central and El shaabl markets were *E. histolytica* and *dispar* (42.9%), *G. lamblia* (22.9%), *E. coli* (14.3%). In their study, eggplant was the most contaminated vegetable (36.4%) Watercress (30.4%)) was the next most common, while cucumbers did not show any parasites. Comparing the previously published study and our study with a greater number of participants [260;120], Several factors may contribute to variations in contamination, including the location, the laboratory technique used, or the type of irrigation water used. comparing this result with other study's. The results were lower than those of Ali El Bakri., *et al.* conducted in the United Arab Emirates. out of 218 vegetable water samples, the presence of parasitic contamination by protozoan cysts and helminths egg. Entamoeba complexes were the most commonly detected parasites *(E. Histolytical E. dispar/E. moshkovskii)* (30.3%), *Entamoebacoli* (18.2%), and *Strongyloides stercoralis* (12.1%) Fennel, green pepper, rocket, and carrots (0.0%) were all free of parasites. Comparing the previous study and our study in the sample type we use water to wash vegetables. Girdialambila (48.2%) accounted for the highest percentage of parasite detections, *E. histolytica* (13.1%), *E. coli* (12.70%), and strongyloids (43.7%) This variation in contamination may be attributed to type and number of sample examined method used for detection.

Conclusion

In Khartoum, Sudan, large vegetable markets may be causing food-borne disease outbreaks because of the prevalence of highly pathogenic parasites on raw vegetables, especially the leafy varieties.

Recommendations

- The results of our study emphasize the urgent need to educate the public on the safe and proper handling of fresh vegetables, such as educating them on how to properly disinfect vegetables before eating them.
    - We recommend washing with vinegar and running tap water as well.
    - Currently, the market is close to the restrooms and must be relocated.
    - It is important to keep vegetable markets away from crowded areas.
    - Tables above the ground are preferred for displaying vegetables.

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