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Parasitic contamination of fresh vegetables collected from local markets in Taif: a preliminary study

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Although fresh vegetables are considered as essential part of our diet, raw vegetables consumption represent the main route of transmission for intestinal parasites. The present study aimed to determine the prevalence of vegetable contamination in Taif city. Specifically, there was a need to determine the types of parasites contaminating the vegetables obtained from the hypermarkets, mini markets, farms and street vendors. A total of 200 vegetables samples were collected from hypermarkets, mini markets, farms, and street vendors. Samples were examined for the presence of parasites.The study was conducted from January 2019 to March 2019. A total of 200 samples of vegetables were examined. The sample wash was taken from sedimentation concentrations and examined microscopically.Parasites were observed in 82 samples (41%). *Ascaris lumbricoides* were found most in 17 samples (20.7%), followed by *Giardia lambliaat* cyst 17.1%, and *Entamoeba coli* cyst at 14.6%. The parasite with the lowest frequency were *Taenia sp. at* 6.1% and *Hymenolepis sp.* at 3.7%.. There was a significant correlation between the source of vegetables and parasite contamination (χ^2 =22.23, P = .0001). The types of vegetables were also significantly positively associated (χ^2 =35.23, P = 0.0012) with parasite contamination. Thus, though parasitic infections are not common in Taif city, raw and unclean vegetables can still cause disease by spreading and transmitting intestinal parasites. Consumers and vendors should take extra care to ensure the consumption of parasite-free vegetables. Extensive health education should be provided to ensure that farmers, vendors, and consumers of edible vegetables are educated on minimizing the contamination of parasites on vegetables.

Keywords: Parasite, Contamination, Vegetables, Intestinal, Laboratory Analysis

INTRODUCTION

The consumption of raw vegetables has become an integral part of peoples' diets in many countries. Fresh leafy vegetables and herbs are excellent sources of fiber, protein, minerals, vitamins, and water. During their production, harvesting, shipping, or preparation, fresh vegetables can be contaminated with intestinal contaminants such as viruses, bacteria, and parasites (Punsawad et al. 2019) The spread of intestinal parasites depends on several factors. These factors include economic and social conditions, such as the use of untreated water during washing or irrigation of the crops, and the preservation and consumption of raw vegetables without proper washing. Several parasites, including protozoa and helminths, are transmitted through fresh vegetables. Furthermore, outbreaks of protozoal infections in humans have been associated with the consumption of fresh

vegetables. Statistics on parasitic infections indicate that over 40 million people yearly are affected worldwide, with 10% of the world's population at risk of infection associated with vegetables (Theophilus Idahosa, 2011.).

Numerous studies have been performed in different parts of the world showed that the vegetables can be a main source for transmitting protozoan cysts (*Giardia lamblia*; *E. coli*; *E. histolytica*; *Balantidium coli*), oocysts (*Cryptosporidium* spp; *Isospora belli*.) and helminthes' eggs and larvae (*T. trichiura*; *Strongyloides stercoralis*; *Enterobius vermicularis*; *A. lumbricoides*; *Fasciola hepatica*; *Toxocara spp.*; *Hymenolepis nana*; *Hymenolepis diminuta*; *Taenia* spp.) (Theophilus Idahosa, 2011). These parasites can be ingested by consuming raw meat, drinking sullied water, eating unwashed vegetables or by skin contact with soil contaminated with hatchlings. Once the parasites are inside the humans'' bodies, they multiply and start to cause side effects (Khan et al. 2017). Each of these parasites can cause gastrointestinal sickness alone or in presence of other.

Children are highly prone to infection since they do not effectively sanitize their hands after touching contaminated soil in playing areas (e.g., sandboxes and school grounds). Likewise, adults are exposed to the same hazards when they handle or eat raw vegetables from sources contaminated with parasites that inhabit the gastrointestinal tract (Alemu et al. 2019) . in fact, parasites do not kill the host since they depend on the host for quite a while to provide food. Parasites are typically tinier than a grain of salt. Regular side effects of parasite infection include stomach torment, myositis, obstruction, iron deficiency, anorexia, and nutrient B12 deficiency, among others(Alade, Alade, and Adewuyi 2013; Haq 2014.).

Moreover,the World Health Organization (WHO) affirms that these parasites are present in millions individuals around the world. Many persons are infected with intestinal parasites, and these figures can reach one-third of the total world population (Moustafa et al. 2018).The current prevalence of contamination brought about by helminths and parasitic protozoa points to the need to introduce suitable measures to address this medical issue (Eraky et al. 2014).

From a local perspective, a study has been conducted in the capital of Saudi Arabia regarding the prevalence of intestinal parasites on leafy vegetables. The study screened leafy vegetables commonly consumed by the community to detect contamination rates. The results showed that parasites in different life cycle stages were found only in 16% of the screened samples. At the same time, lettuce was the most contaminated vegetable among all other types of leafy vegetables included in the study (Tefera et al. 2014; Siyadatpanah et al. 2013). In Tabuk city of Saudi Arabia. The prevalence of human endoparasite contamination in vegetables was 20.7% in cucumbers, 15.8% in onions, 14.7% in peas, 14.1% in cress, and 13% in lettuce, 10.3% in carrots, 8.7% in green onions, and 2.7% in tomatoes. However, *Entamoeba* species contamination was shown to be statistically significant (Ngulube, 2015). The present study aims to examine the prevalence of parasitic contamination of raw vegetables in Taif city

MATERIALS AND METHODS

A cross-sectional study was conducted in Taif from January 2019 to March 2019. Fresh and raw vegetable samples were collected randomly from farms, street vendors, hypermarket, and mini markets. These markets were considered fundamental, as most fresh vegetables were brought from different farms and agricultural schemes in different parts of Taif and other parts of the Kingdom of Saudi Arabia and sold in these markets. A total of 200 fresh vegetable samples, including various types and those frequently consumed, were selected randomly. Approval to conduct the study were obtaiend from the review committee at the college of applied medical sciences, tiaf university. 50 samples were collected from each market (hypermarkets, farms, mini markets, and street vendors). Samples were collected randomly from the upper, middle, and lower shelves of each seller. The fresh vegetable samples collected in this study were radish (*Raphanus sativus*), lettuce (*Lactuca sativa*), potatoes (*Solanum tuberosum*), purslane (*Portulaca oleracea*), parsley (*Petroselinum crispum*), mint (*Mentha*), onion (*Brassica oleracea var. capitata*), spinach (*Spinacia oleracea*), and carrots (*Daucus carota*). Fresh vegetables were collected into labeled polyethylene bags and transported immediately to the parasitology laboratory at the College of Applied Medical Sciences, Taif University. The label details included sample type, collection date, and market name. Samples were cut into pieces to fit into 50 ml conical tubes and washed with normal saline with 10% formaldehyde. After vigorous shaking, the wash was filtered through filter paper and

centrifuged for 5 minutes at 1500 cycles. The supernatant was carefully discarded, and sediment was resuspended in 1 ml of 10% formal saline. One drop of each sample resuspension was added to the slide and covered with a coverslip. Finally, the slide was examined under a light microscope using 10x and 40x objectives. To confirm the parasite, sedimentation and flotation methods were used. The data were entered and analyzed using SPSS version 25.

Pearson's chi-square test was applied to determine the difference between the prevalence of intestinal parasites and the different categories. Before the research commenced, the researchers sought ethical clearance from the Taif College of Applied Medical Sciences. Consent was obtained from the collection sites before samples were obtained, and supervisors and vendors were assured of confidentiality and anonymity to safeguard their businesses.

RESULTS

A total of 200 vegetable samples were collected from farms, mini markets, hypermarkets, and street vendors. The results demonstrate that n = 41% (82) of the total samples were positive for one or more types of parasites. As shown in Table 1, lettuce samples had the highest number of positive cases at 6.5% (13), according to the total samples investigated. Purslane , onions, and potatoes all had positivity rates of 5.5% (11). Carrot and parsley samples were positive at a rate of 4% (8), while the radish samples proved to have the least positive cases at 1.5% (3). The study further examined the number of parasites detected in the samples collected. Moreover, while determining the positive cases, some samples appeared to carry mor than one type of parasites as seen in table 1. The results showed that three kinds of vegitables had 3 types of different spesies of parasite, while the majority of the samples had only one kind of parasite.

From the results attained, it was found that the highest frequency of parasites were helminths, which were detected at high rates in samples of onions and lettuce. Furthermore, carrots, mint and radish samples had the lowest rates of parasites. The ova of *Ascaris lumbricoides* was found in purslane rout samples (*Portulaca oleracea*) and potatoes at moderately higher frequencies. Pictures from some positive samples are illustrated below (Figure1).

Table 2 shows the prevalence of intestinal parasites in the samples collected in Taif city. The table shows that *Ascaris lumbricoides* ova comprised the majority of parasites at 20.7%, followed by *Giardia lamblia*at cyst 17.1%, and *Entamoeba coli* cyst at 14.6%. The parasite with the lowest frequency were *Taenia sp. at* 6.1% and *Hymenolepis sp.* at 3.7%.To gain a clearer understanding of the contamination, a correlation test was conducted on the test factors that were associated with the contamination of parasites in the sampled vegetables collected.

A further chi-square test was conducted to determine the correlation and significance of the sources of the vegetable samples collected and the parasitology. For the sources in hypermarkets, 7.31% (6) of the samples tested positive. Samples from farms accounted for 35.3% (29) of the positive samples, and mini markets had 19.51% (16) of the positive samples. In comparison, street vendors had the highest number of positive samples at 37.8% (31). The sources of the samples were positively correlated and significant (χ^2 =22.23, P = .0001). The types of vegetables were also positively correlated and significant (χ^2 =35.23, P = .0012).

Table 1: Distribution of polyparasitic contaminations in sampled vegetables sold in selected markets of Taif city from February 2019 to March 2019

Type of vegetable	No. examined (N)	Positive cases (n [%])		No. of parasitic spp identified.	
			One	Two	Three
Purslane	22	11 (5.5)	8	2	1
Onion	22	11 (5.5)	11	0	0
Lettuce	22	13 (6.5)	7	5	1
Parsley	22	8 (4)	8	0	0
Mint	22	5 (2.5)	5	0	0
Carrot	23	8 (4)	5	3	0
Potato	23	11 (5.5)	6	5	0
Radish	22	3 (1.5)	3	0	0
Spinach	22	12 (6)	9	2	1
Total	200	82 (41.0)	62	17	3

Table 2: Prevalence of intestinal parasites in samples collected at Taif city markets from February 2019 to March 2019.

Detected parasite	Frequency	Prevalence (%)
Giardia lamblia	14	17.1
Trichuris trichiura	7	8.5
Blastocystes hominis	9	11.0
Ascaris lumbricoides	17	20.7
Ancylostoma duodenale	5	6.1
Entamoeba coli	12	14.6
Taenia spp.	5	6.1
Hymenolepis spp.	3	3.7
Cryptosporidium spp.	10	12.2
Total sample (n = 82)	82	100

Table 3: Chi-square test of sources, types of vegetables, and parasitic contamination of samples collected from markets at Taif city from February 2019 to March 2019

Variables	Review of parasitology		$\chi 2$	P value
	Pos (%)	Total		
Sources of samples hypermarkets	6 (7.31)	50		
Farms **mini markets**	29 (35.36) 16 (19.51)	50 50	22.23	0.0001
Street vendors	31 (37.8)	50		
Total	82 (41)	200		
Type of vegetable				
Purslane	11 (5.5)	22		
Onion	11 (5.5)	22		
Lettuce	13 (6.5)	22		
Parsley	8 (4)	22		
Mint	5 (2.5)	22	35.23	0.0012
Carrot	8 (4)	23		
Potato	11 (5.5)	23		
Radish	3 (1.5)	22		
Spinach	12 (6)	22		
Total	82 (41.0)	200		

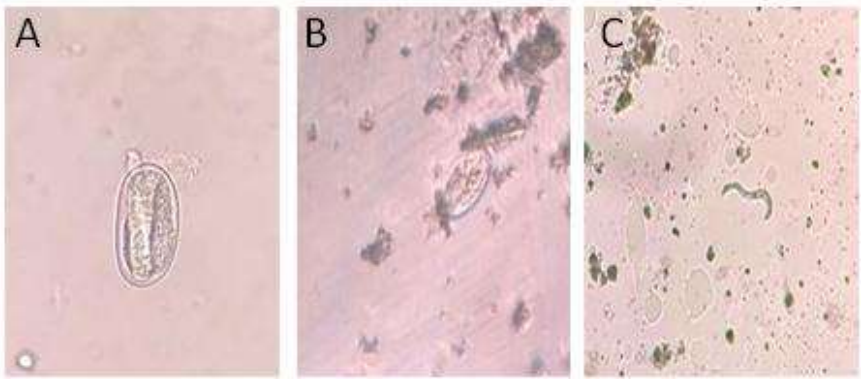

Figure 1: *Anclystoma duodenale* egg found on radish (wet mount x40). B) *Trichuris trichiura* egg found in lettuce (wet mount ×10). C) Non- specified helminth larvae found in Radish (wet mount ×10).

DISCUSSION

A total of 200 vegetable samples were examined for the presence of parasite contamination. Our findings indicated that 41% of the fresh vegetables examined were contaminated with helminthic eggs. The most frequently observed helminthic eggs in the obtaind sedementations were *Ascaris lumbricoides* and *Gardia lamblia* . The parasitic contamination varied among root vegetables vs. leafy vegetables. Although some of the collected vegetable samples seemed to be clean of dirt, they were still contaminated with parasites. Additionally, while larvae were detected in radish samples, other stages of the parasite were excluded due to their phenotypic characteristics that had a resemblanced to non-pathogens found in human body.

These findings are consistent with those of other studies undertaken that show the presence of parasitic contamination on vegetables sampled from marketplaces (Punsawad et al. 2019; Bakri et al. 2020; Khan et al. 2017; Tefera et al. 2014; Bekele et al. 2020; Ashrafi Hafez et al. 2008). Epidemiological investigations have indicated that countless parasitic illnesses are caused by the use of untreated water or re-runs on the water system framework. Vegetables, particularly lettuce, onion, and other expensive leafy vegetables, are prone to spread intestinal parasites (Etewa et al. 2017). The present study has shown that both pathogenic and non-pathogenic parasites were found in crude vegetable samples. The pathogenic parasites included *Giardia lamblia*, *Ascaris lumbricoides*, *Hymenolepis spp., Ancylostoma duodenale,* and *Trichuris trichiura*. The non-pathogenic parasites were *Entamoeba coli*, *Blastocystes hominis, Cryptosporidium spp*. And *Taenia spp.*. These findings are consistant with those of other studies conducted to investigate the types of parasites found in vegetables (Mohamed et al. 2016; Alemu, Nega, and Alemu 2020)

The contamination of edible plants by parasites poses a higher health risk due to the vegetables' pathogens. As a result, consumers should be vigilant to ensure that vegetables are properly washed and cooked to avoid ingesting parasites. The use of preventive methods has proven to be the most effective way of minimizing vegetable parasite infections. Public health education should be offered to communities, including farmers, vendors, and consumers of vegetables, on the possible health risks of ingesting contaminated vegetables. More knowledge should be disseminated on handling vegetables at all stages, from the farm to consumption by the community. Such guidance should include instruction on the primary ways of handling plants that are to be consumed by humans (e.g., washing the vegetables and practicing good hand hygiene when handling vegetables).

Vendors of vegetables should endeavor to avoid the contamination of plants with soil when selling or during transportation of the produce from the farm to the stores. In addition, imported vegetables from other parts of the country and other countries should be subjected to standardization by health officials. Standardization aims at ensuring that vegetables on shelves are free from contamination.

Although this study has highlighted parasites' presence in vegetables, more studies should be conducted to determine those practices that contribute to parasite contamination in vegetables. Furthermore, a broader target area and population should be chosen to ensure that the data acquired's generalizability is possible.

CONCLUSION

The article provides several recommendations guided by the findings. First, vegetables should be dispensed with indications showing when they are expected to expire. This ensures that customers can evaluate the safety of the ingested herbs. Although the consumption of raw vegetables is on the rise, public health officials should advise the public on alternative ways of preparing vegetables, e.g., through canning or packaging of vegetables. To ensure that vegetables' quality is maintained, vendors and sellers should be advised to refrigerate vegetables and natural products at temperatures below 5°C. Hygiene protocols should be adhered to by the vendors and handlers of vegetables at the stores.

Further instructions should be attached to the vegetables' packaging to advise the customers to wash cutting sheets, utensils, and tabletops with cleaning agents and water when preparing vegetables and other products. Before consuming soil-based vegetables, customers should ensure that they are cleaned with running clean water to remove soil that may harbor parasites. All ruined parts of fruits should be removed and discarded to avoid contamination..

CONFLICT OF INTEREST

The authors declared that present study was performed in absence of any conflict of interest.

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AUTHOR CONTRIBUTIONS

Hamsa Banjer conceptualized the study, wrote the manuscript and supervised the project and carried out the experiments with support and contribution from Abdulrahem almalki. Ghadi Alsaedi, Ameerah Almalki, Raghad Alsugair, Afrah Alghamdi, Atheer Aljaeid collected the samples and carried out the experiments.

REFERENCES

Alade, G O, T O Alade, and I K Adewuyi. 2013. "Prevalence of Intestinal Parasites in Vegetables Sold in Ilorin, Nigeria." *J. Agric. & Environ. Sci* 13 (9): 1275–82. https://doi.org/10.5829/idosi.aejaes.2013.13.09.11040.

Alemu, Getaneh, Mezgebu Nega, and Megbaru Alemu. 2020. "Parasitic Contamination of Fruits and Vegetables Collected from Local Markets of Bahir Dar City, Northwest Ethiopia." *Research and Reports in Tropical Medicine* Volume 11 (March): 17–25. https://doi.org/10.2147/rrtm.s244737.

Alemu, Getaneh, Mohammedaman Mama, Direslgne Misker, and Desta Haftu. 2019. "Parasitic Contamination of Vegetables Marketed in Arba Minch Town, Southern Ethiopia." *BMC Infectious Diseases* 19 (1): 410. https://doi.org/10.1186/s12879-019-4020-5.

Ashrafi Hafez, Asghar, Eghbaleh Asadolahi, Mohamadreza Havasian, Jafar Panahi, Abdollah Davoudian, Mona Lotfikar, and Afra Khosravi. 2008. "Study on the Parasitic and Microbial Contamination of Vegetables, and the Effect of Washing Procedures on Their Elimination in Ilam City." *Journal of Paramedical Sciences (JPS)* 4 (4). https://doi.org/10.22037/jps.v4i4.4881.

Bakri, Ali El, Nabila M. Hussein, Zeinab Abdallah Ibrahim, Hayder Hasan, and Raed Abuodeh. 2020. "Intestinal Parasite Detection in Assorted Vegetables in the United Arab Emirates." *Oman Medical Journal* 35 (3): 1. https://doi.org/10.5001/omj.2020.46.

Bekele, Fitsum, Teha Shumbej, Andamlak Dendir, Dereje Mesfin, and Absra Solomon. 2020. "Contamination Rate of Commonly Consumed Fresh Vegetables and Fruits with Parasites of Medically Importance in Wolkite and Butajira Towns of Gurage Zone, Southern Ethiopia." *International Journal of Public Health Science (IJPHS)* 9 (3): 211. https://doi.org/10.11591/ijphs.v9i3.20395.

Eraky, Maysa Ahmad, Samia Mostafa Rashed, Mona El Sayed Nasr, Azza Mohammed Salah El-Hamshary, and Amera Salah El-Ghannam. 2014. "Parasitic Contamination of Commonly Consumed Fresh Leafy Vegetables in Benha, Egypt." *Journal of Parasitology Research* 2014. https://doi.org/10.1155/2014/613960.

Etewa, Samia, Sara Abdel-Rahman, Ghada Fathy, Dalia Abo El-Maaty, and Mohamed Sarhan. 2017. "Parasitic Contamination of Commonly Consumed Fresh Vegetables and Fruits in Some Rural Areas of Sharkyia Governorate, Egypt." *Afro-Egyptian Journal of Infectious and Endemic Diseases* 7 (4): 192–202. https://doi.org/10.21608/aeji.2017.17804.

Haq, Shifa Ul. 2014. "Parasitic Contamination of Vegetables Eaten Raw in Lahore, Pakistan." Pakistan Journal of Zoology 2014; 46:1303-9.

Khan, Wali, Ghazal Mumtaz, Saima Bibi, and Salma Afzal. 2017. "Parasitic Contamination of Fresh Vegetables Sold at Upper and Lower Dir Districts, Khyber Pakhtunkhwa, Pakistan." *Pakistan Journal of Zoology* 49 (3): 1115–18. https://doi.org/10.17582/journal.pjz/2017.49.3.sc3.

Mohamed, Mona Ali, Emmanuel Edwar Siddig,

Arwa Hassan Elaagip, Ali Mahmoud Mohammed Edris, and Awad Ahmed Nasr. 2016. “Parasitic Contamination of Fresh Vegetables Sold at Central Markets in Khartoum State, Sudan.” *Annals of Clinical Microbiology and Antimicrobials* 15 (1): 17. https://doi.org/10.1186/s12941-016-0133-5.

Moustafa, Hemat Z, Heba Al Shater, and Heba Yousef. 2018. “International Journal of Advanced Research in Biological Sciences Toxicity of Nerium Oleander Extracts against Pectinophora Gossypiella (Saunders) (Lepidoptera: Gelechiidae).” *Int. J. Adv. Res. Biol. Sci* 5 (3): 163–68. https://doi.org/10.22192/ijarbs.

Ngulube, Patrick. 2015. “Qualitative Data Analysis and Interpretation: Systematic Search for Meaning.” In Mathipa, E. R. and Gumbo, M. T, (eds.), Addressing Research Challenges: Making Headway for Developing Researchers. Noordwyk: Mosala-MASEDI Publishers and Booksellers cc., pp. 134-153.

Punsawad, Chuchard, Nonthapan Phasuk, Kanjana Thongtup, Surasak Nagavirochana, and Parnpen Viriyavejakul. 2019. “Prevalence of Parasitic Contamination of Raw Vegetables in Nakhon Si Thammarat Province, Southern Thailand 11 Medical and Health Sciences 1117 Public Health and Health Services.” *BMC Public Health* 19 (1). https://doi.org/10.1186/s12889-018-6358-9.

Siyadatpanah, Abolghasem, Fatemeh Tabatabaei, Amir Emami Zeydi, Adel Spotin, Vahid Fallah-Omrani, Mehrdad Assadi, Sepideh Moradi, Ali Rostami, Fatemeh Memari, and Fateme Hajialiani. 2013. “Parasitic Contamination of Raw Vegetables in Amol, North of Iran.” *Archives of Clinical Infectious Diseases* 8 (2). https://doi.org/10.5812/archcid.15983.

Tefera, Tamirat, Abdissa Biruksew, Zeleke Mekonnen, and Teferi Eshetu. 2014. “Parasitic Contamination of Fruits and Vegetables Collected from Selected Local Markets of Jimma Town, Southwest Ethiopia.” *International Scholarly Research Notices* 2014 (August): 1–7. https://doi.org/10.1155/2014/382715.

Theophilus Idahosa, Ojemudia. 2011 “Parasitic Contamination of Fresh Vegetables Sold in Jos Markets Parasitic Contamination of Fresh Vegetables Sold in Jos Markets Parasitic Contamination of Fresh Vegetables Sold in Jos Markets.” *Double Blind Peer Reviewed International Research Journal Publisher: Global Journals Inc*. Vol. 11.