Advances in Bioresearch
Adv. Biores., Vol 9 (2) March 2018: 01-06

Print ISSN 0976-4585; Online ISSN 2277-1573
Journal's URL:http://www.soeagra.com/abr.html
CODEN: ABRDC3
DOI: 10.15515/abr.0976-4585.9.2.16

Advances in Bioresearch

ORIGINAL ARTICLE

Parasitic Contamination of Raw Edible Vegetables in Hail Region, Saudi Arabia

A. Abdel-Muhsin*, Elnour Abdelmageed , Mohamed Y A Babiker
Department of Biology, Faculty of Science, University of Hail, Saudi Arabia.
P.O. Box 2440, Hail 81451, Saudi Arabia
* Correspondence author: E-mail: abdelmuhsin@yahoo.com

ABSTRACT
Food borne diseases continue to be a common and serious threat to public health. Vegetables were widely reported to become contaminated with different parasitic stages in different places of the world. Transmission of intestinal parasites is mainly associated with parasitic contamination of food, drinking water, and hands.The current study aimed to determine the prevalence of parasitic contamination of raw edible vegetables in local vegetables markets of Hail region. The collection of samples was conducted during the whole period of November-December 2016.A total of 105collected vegetable samples were screened using sedimentation method. The overall parasitic contamination percentage was 70.5%.The most contaminated vegetables were Cabbage and beet, followed by Lettuce, Radish, Green onion, Tomato, Watercress and Green pepper, Cucumber, Parsley, and finally Carrot. The most abundant parasite was Giardia trophozoite, followed by larva of Hookworm, then Ascaris ova, Giardia, Diphyllobothrium latum ova, Hookworm ova, Entamoeba histolytica, Trichuris trichiura.The least frequently detected parasite was Hymenolepis nana, Hymenolepisdiminuta and Enterobiusver micularis. Results revealed higher contamination rate among vegetables collected from Al Gaaid market, followed by and Hail City, then Al Gazala market, and finally Al Shinan market. This study revealed a high prevalence of intestinal parasites among vegetables sold at vegetables markets of Hail region. Accordingly, more intensive studies are of great importance to provide more information on the possible sources of vegetable contamination, in addition to using molecular techniques for species identification and genotyping.
***Keywords**: Raw vegetables, Parasitic contamination, Hail, KSA*

Received 04.09.2017 Revised 18.09.2017 Accepted 16.01.2018

How to cite this article:
Abdel-Muhsin A. Abdel-Muhsin, Elnour Abdelmageed , Mohamed Y A Babiker. Parasitic Contamination of Raw Edible Vegetables in Hail Region, Saudi Arabia. Adv. Biores., Vol 9 [2] March 2018.01-06.

INTRODUCTION

Globally, food borne diseases continue to be a common and serious threat to public health. Consumption of raw fruits and vegetables, though it contains essential nutrients, vitamins, minerals, proteins, and fibers that play a major role in protecting the human body from a number of diseases, have led to outbreaks of human infections [8,9,17]. Food-borne parasitic infections are associated with the consumption and eaten raw or without peeling contaminated fresh vegetables [16]. Vegetables become contaminated with different parasitic stages on the farm during harvesting, through contaminated irrigation water used or washing process, and through infected food handlers [22]. Transmission of intestinal parasites is mainly through the contamination with feces in food, contaminated water and untreated wastewater for irrigation, nails and fingers, which indicate the importance of feco-oral human-to-human transmission as well as poor personal hygiene, could be potential sources of infections of many intestinal helminths and protozoa. Post-harvest handling can be another source of contamination in farms and cross contamination during transportation with other food products [4, 20, 25]. Around two billion individuals worldwide are infected with pathogenic and nonpathogenic intestinal parasites [15], 819 million people are infected with *Ascaris lumbricoides* (*A. lumbricoides*), 464.6 million people with *Trichuris trichiura* (*T. trichuira*), 438.9 million people with hookworm infection [26], 500 million people with *Entamoeba histolytica* (*E. histolytica*), and 2.8 million people are infected with *Giardia lamblia* (*G. lamblia*) [11].

High prevalence of intestinal parasitic infections affect the health status of individuals causing malnutrition, anaemia, stunting, cognitive impairment, low educational achievement and interfering with productivity [17, 27]. Hong *et al.*, [19], in a study carried out in Seoul- Korea investigated farm soil and vegetables samples from local grocery markets, found that 32.4% of the locations and 12.5% of vegetable samples were contaminated. Inadequate diagnosis of food-borne pathogens lead to disease outbreaks caused by contaminated vegetables that mostly go undetected [9].

Many studies have been carried in different parts of Saudi Arabia, however, review of literature did not reveal published information on the parasitic contamination of vegetables in Hail region. The study aimed to determine the prevalence of parasitic contamination of raw edible vegetables in local markets of Hail region, with special attention to overall percentage of contamination, the most contaminated vegetables, the most abundant parasites, and the markets with the highest contamination levels Investigation of parasitic contamination of raw edible vegetables in the region can help propagating effective plans for prevention and control of parasitic diseases and reinforce active health education programs.

MATERIALS AND METHODS

Study Area

The present study was carried out in Hail region, KSA.Hail is located in north-western Saudi Arabia at altitude of 27.5114° North and a longitude of 41.7208° East, with an estimated population of 527,033.The region is considered as an agricultural area characterized by rich water resources and fertile soil. Different crops and fruit trees are cultivated in the area, most of which are cultivated in open fields, compared to about 18% grown in green houses [5].

Sample Collection

Samples for 11 different types of raw edible vegetables that are frequently consumed in Hail region were collected from different local markets in Hail city, Al Gazala,Al GaaidandAl Shinan. Vegetables screened for parasitic contamination were Tomato (*Solanum lycopersicum*), Watercress (*Nasturtium officinale*),Green pepper (Capsicum annuum), Green onion (*Allium fistulosum*), Radish (*Raphanusraphanistrum*), Parsley (*Petroselinumcrispum*), Cabbage (*Brassica oleracea)*,Lettuce (*Lactuca sativa*),Cucumber (*Cucumissativus*), Carrot (*Daucuscarota*) and Beat (*Beta vulgaris*). Sampleswereplaced in sterile plastic bags and brought to the laboratory, Biology department, Faculty of Science, University of Hail, KSA.

Screening of parasites

250g of each sample was immersed in 1000 ml physiological saline solution (0.95% NaCI). Each suspension was shaken periodically for 30 minutes, then filtered by a sterile strainer. The filtrate was left overnight to sediment. The top layer was discarded and the remaining wash solution was centrifuged at 5000 rpm for 5 minutes, the supernatant was discarded, and the remaining sediment was transferred to glass slides and examined for parasites under a light microscope, 10× and 40× magnifications.

Data analysis

Statistical analysis was performed using the Statistical Package for Social Sciences (SPSS) software version 16.0.

RESULTS

The study revealed an overall contamination rate of 70.5% in the four selected areas.74 (75.4%) out of 105 samples were found to be contaminated with at least one parasite species. All Cabbage and beet samples tested were found to be contaminated. 83.3% of Lettuce, 80% of Radish, 71.4% of Green onion, 63.6% of Tomato, 60% of Watercress and Green pepper, 54.5% of Cucumber, 50% of Parsley, and 33.3% of Carrot were contaminated. Green onion and beet was contaminated with three species of parasites.Cabbage,Lettuce,Radish, Tomato, Watercress, Green pepper, Cucumber and Parsley were contaminated with two species of parasites and carrot was contaminated with only one species of parasite(Table 1).

The most frequently detected parasite was *Giardia* trophozoite (49. 5%), followed by larva of Hookworm(16.2%), *Ascaris*ova (13.3%), *Giardia* cyst(7.6%),*Diphyllobothrium latum* ova (3.8%), *Hookworm* ova (2.8%),*Entamoeba histolytica* and *Trichuris trichiura* (1.9%).The least frequently detected parasite was *Hymenolepis nana*, *Hymenolepis diminuta* and *Enterobius vermicularis* (0.9%)(Figure1).

Giardia trophozoite was detected on all selected vegetables, whereas larva of *Hook worm* was most frequent on beet followed by green onion, and was less frequent on Watercress, lettuce and Radish .*Ascaris* ova was detected more on Cabbage and lettuce than on Tomato, Watercress, Green pepper and Green onion. *Giardia cyst* was detected on Cabbage, Watercress, Radish, Parsley and Green pepper. *Diphyllobothrium latum* ova was detected on cabbage, radish and Cucumber. *Hook worm* ova was detected

only on Beet. *E. histolytica* was detected only on Cabbage. *T. trichiura* was detected on Tomato and Green pepper.*Hymenolepis nana* was detected only on Cabbage, *Hymenolepisdiminuta* was detected onlyon Watercress and *Enterobius vermicularis* was detected only on Green onion (Table 2).

The distribution of parasitic contamination in the four locations is shown in Table 3.The contamination rate among vegetables collected from Al Gaaid and Ha'ilmarket, (84.6 %) and (84.2%) respectively, was significantly higher compared to vegetables collected from Al Gazala (60.7%)and Al Shinan (59.4%).

Table 1.Number and percentage of parasites-contaminated vegetables in Hail region.

Vegetables examined		Number and percentage(%) of positive samples	Number and percentage(%) of parasites species detected in each vegetable		
Vegetable	Number of samples		One species	Two species	Three species
Cabbage	12	12 (100)	6 (50)	6 (50)	0 (0)
Tomato	11	7 (63.6)	6(54.5)	1(9.1)	0 (0)
Watercress	10	6 (60)	4 (40)	2 (20)	0 (0)
Lettuce	12	10 (83.3)	9 (75)	0 (0)	1 (8.3)
Radish	10	8 (80)	3 (30)	5 (50)	0 (0)
Cucumber	11	6 (54.5)	5 (45.4)	1 (9.1)	0 (0)
Green onion	7	5 (71.4)	3 (42.8)	1 (14.3)	1 (14.3)
Parsley	8	4 (50)	3 (37.5)	1 (12.5)	0 (0)
Green pepper	10	6 (60)	5 (50)	1 (10)	0 (0)
Beet	8	8 (100)	1 (12.5)	4 (50)	3 (37.5)
Carrot	6	2 (33.3)	2 (33.3)	0 (0)	0 (0)
Total	105	74 (70.5)	47 (44.8)	22 (20.9)	5 (4.8)

Table 2: Distribution of parasites on contaminated vegetables in Hail region.

	Parasites species detected											
	Giardia cyst	*Giardia tropho*	*E. histolytica cyst*	*D. latium ova*	*Ascaris ova*	*T. trichiura*	*Hook Worm larva*	*Hook Worm ova*	*H. nana*	*E. vermicu-laris*	*H. Dimenuita*	Totaland percentage (%)
Cabbage	1	8	2	1	5	0	0	0	1	0	0	18 (17.1)
Tomato	0	6	0	0	1	1	0	0	0	0	0	8(7.6)
Watercress	1	3	0	0	1	0	2	0	0	0	1	8(7.6)
Lettuce	0	7	0	0	4	0	1	0	0	0	0	12 (11.4)
Radish	3	5	0	2	0	0	2	0	0	0	0	12 (11.4)
Cucumber	0	6	0	1	0	0	0	0	*0*	0	0	7(6.7)
Green onion	0	2	0	0	1	0	4	0	0	1	0	8(7.6)
Parsley	1	3	0	0	0	0	1	0	0	0	0	5(4.8)
Green pepper	2	2	0	0	2	1	0	0	0	0	0	7(6.7)
Beet	0	8	0	0	0	0	7	3	0	0	0	18 (17.1)
Carrot	0	2	0	0	0	0	0	0	0	0	0	2(1.9)
Total(%)	8 (7.6)	52(49.5)	2(1.9)	4(3.8)	14 (13.3)	2 (1.9)	17 (16.2)	3(2.8)	1 (0.9)	1 (0.9)	1 (0.9)	105 (100)

Figure1:Frequency of parasites in contaminated vegetables in Hail region.

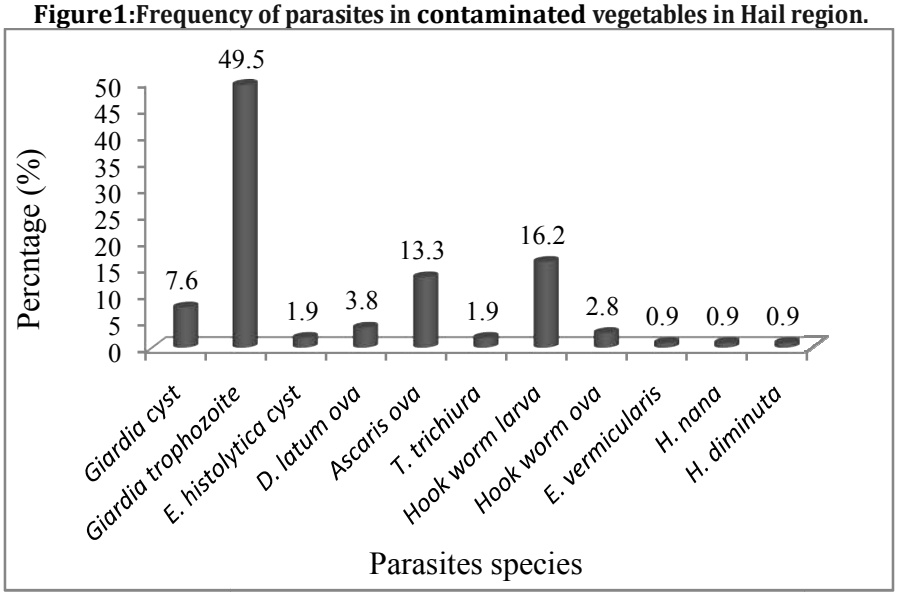

Table 3: Distribution of parasitic contamination in selected vegetables from the four areas of the study.

Vegetables examined	Number and percentage (%) of positive samples			
	Hail market	Al Gaaid	Al Gazala	Al Shinan
Cabbage	3 (100)	3 (100)	3 (100)	3 (100)
Tomato	2(100)	3 (100)	2(66.7)	0 (0)
Watercress	2 (100)	0(0)	2(66.7)	2(66.7)
Lettuce	1 (33.3)	3 (100)	3 (100)	3 (100)
Radish	2 (100)	3 (100)	3 (100)	0 (0)
Cucumber	2 (100)	3 (100)	0(0)	1 (33.3)
Green onion	1 (50)	1 (50)	1(100)	2 (100)
Parsley	1 (100)	1 (50)	0(0)	2 (100)
Green pepper	2 (100)	3 (100)	0(0)	1 (50)
Beet	0 (0)	2 (100)	3 (100)	3 (100)
Carrot	0 (0)	0 (0)	0 (0)	2 (33.3)
Total	16 (84.2)	22(84.6)	17(60.7)	19(59.4)

DISCUSSION

Detection of transmissible pathogenic parasites in raw edible vegetables has important public health implications. The current study was carried to assess the level of contamination of different intestinal parasites in selected vegetables sold at local markets of in Hail region; KSA. The overall parasitic contamination rate was found to be 74.4%, which is higher than what have been reported in previous similar studies in Saudi Arabia. For example Gabre and Shakir [15], reported 46% intestinal parasites contamination rate in consumed vegetables in Tabouk area, A1-Megrin [2] revealed that 16.2% of leafy vegetable samples contained intestinal parasites in Riyadh area, and Alqumber [3] found that 14.4% samples tested in cities of the Sarawat Mountain Range of Saudi Arabia were parasite contaminated. Moreover, The current study revealed a higher contamination rate compared to studies carried in Nigeria [25] with overall contamination rate 68.3%, Ethiopia [29, 5] with parasite rate of 54.4% and32.41% respectively, and Egypt [11, 12],with 31.7% parasite rate. However, The current study revealed a lesser contamination rate compared to a study done by Ezatpour *et al*., [13] in Iran where 79% of the samples were found to be contaminated.

Results obtained from the present study showed that Cabbage and beet were the most frequently contaminated vegetables, and Carrot was the least contaminated. This finding is in dis-agreement with the study done by A1-Megrin [2] in Riyadh, Saudi Arabia which detected no parasite from cabbage samples. The prevalence of *Giardia trophozoite* was (49. 5%) and it was detected on all selected vegetables, this finding supports study from Libya and two studies from Iran revealing prevalence of 10%, 7% and 10%, respectively [1, 7, 22].Our findings regarding hookworm ova prevalence(2.8%), is in dis-agreement with two studies conducted in Ethiopia [6, 28] and another study in Egypt [11, 12] which indicated detection of no ova of hookworm.90.1% (10 out of 11) vegetables were found to be

contaminated with more than one parasite species in this study, which reflects the persistence of intestinal parasitic infections in the area, and may results in multiple parasitic infections in humans [24].
The study revealed that samples collected from Al Shinan area showed the least percentage of contamination (59.4%) followed by Al Gazalla area (60.7%), whereas samples from Hail City and Al Gaaid showed the highest rate of contamination(84.2% and 84.6%) respectively. The variation in parasite rate between the four areas of the study is assumed to be attributed to many factors such as the type and source of water used for irrigation, use of animals excreta as fertilizers in some farms and post harvesting and handling methods of the vegetables. Al Gaaid is an agricultural area with many vegetables farms. Moreover, the nearest town to it for marketing the vegetables is Hail City. The high contamination level of Al Gaaid vegetables might have contribution to the high contamination level of vegetables in Hail City market, which, unfortunately would make many people purchasing vegetables at risk of parasitic infection.

CONCLUSION

This study revealed a high prevalence of intestinal parasites among vegetables in Hail region indicating the high risk of acquiring parasitic infection from the consumption of raw vegetables in the area. These findings raised concern of public health on further action that should be taken to reduce the occurrence of the disease transmission by food-borne parasites by adopting control measures in improving the hygiene, implementing the principles of washing, disinfecting, and peeling or cooking of vegetable before consumption.. There is a need for further investigation in this area in order to provide more information on the possible sources of vegetable contamination, and also using molecular techniques for species identification and genotyping.

ACKNOWLEDGMENTS

The authors express their sincere gratitude and acknowledge the financial support of The University of Hail (Deanship of Scientific Research, PROJECT NO: 0150144).

REFERENCES

1. AbougrainAK,Nahaisi, MH, Madi NS, Saied MM, Ghenghesh KS. (2009) Parasitological contamination in salad vegetables in Tripoli-Libya. Food Control. 2010;21(5):760–2. doi:10.1016/j.foodcont.2009.11.005.
2. A1-Megrin, W, (2010). Prevalence of Intestinal Parasites in Leafy Vegetables in Riyadh, Saudi Arabia. International Jouna1 of Zoological Research 6 (3): 190-195.
3. Alqumber, MA, (2014). Parasitic Contamination in Raw Vegetables in Cities of the Sarawat Mountain Range of Saudi Arabia. Life Science Journal 11(9): 707-711.
4. Andargie G, Kassu A, Moges F, Tiruneh M, Huruy K (2008). Prevalence of Bacteria and Intestinal Parasites among Food-handlers in Gondar town. J. health popul. Nutr. Int. centre for diarrheal dis. res. 26(4):451-5.
5. Asiry, K.A, Hassan, SSM. and AlRashidi, M, (2013). Factors Affecting Agricultural Sustainability–A Case Study of Hail Region, Kingdom of Saudi Arabia. Asian Journal of Agriculture and Rural Development. 3(10): 674-687.
6. Bekele F, Tefera T, Biresaw G and Yohannes T,(2017). Parasitic contamination of raw vegetables and fruits collected from selected local markets in Arba Minch town, Southern Ethiopia. Infectious Diseases of Poverty. 6:19
7. Daryani A, Ettehad GH, Sharif M, Ghorbani L, Ziaei H. (2008). Prevalence of intestinal parasites in vegetables consumed in Ardabil, Iran. Food Control.9:790–4.
8. Blackburn C, Blackburn de W,McClure PJ, (2002). Foodborne pathogens: hazards, risk analysis and control. Washington DC: CRC Press; p. 18–9.
9. Dorny P, Praet N, Deckers N and Gabriel S. (2009). Emerging food-borne parasites. Veterinary Parasitology 163(3): 196–206.
10. Duc PP, Nguyen-Viet H, Hattendorf J, Zinsstag J, Cam PD, Odermatt P. (2011). Risk factors for *Entamoeba histolytica* infection in an agricultural community in Hanam province, Vietnam. Parasit Vectors.4:102–11.
11. ElSaid SD, (2012). Detection of parasites in commonly consumed raw vegetables-Alexandria, Journal of Medicine, 48(4). 345-352.
12. Eraky MA, Rashed S, Nasr M, Azza, El-Hamshary M, El-Ghannam AS. (2014). Parasitic contamination of commonly consumed fresh leafy vegetables in Benha, Egypt. J Parasitol Res.; 613960. doi: 10.1155/2014/613960
13. Ezatpour B, Chegeni AS, Abdollahpour F, Aazami M, and Alirezaei M, (2013). Prevalence of parasitic contamination of raw vegetables in Khorramabad-Iran, Food Control, 34 (1), , 92–95.
14. Gabre, R.M., and Shakir, A, (2016). Prevalence of Some Human Enteroparasites in Commonly Consumed Raw Vegetables in Tabuk, Saudi Arabia. J Food Prot.79(4):655–8
15. Gelaw A, Anagaw B, Nigussie B, Silesh B, Yirga A, Alem M, Endris M and Gelaw B. (2013). Prevalence of intestinal parasitic infections and risk factors among school children at the University of Gondar Community School, Northwest Ethiopia: A cross-sectional study. BMC Public Health 13(304): 1–7.

16. Gharavi MJ, Jahani MR, Rokni MB, (2002). Parasitic contamination of vegetables from farms and markets in Tehran. Iran. J Public Health. 31(4):83–6.
17. GuyattH. (2000). Do intestinal nematodes affect productivity in adulthood? Parasitolology Today.16(4):153–8.
18. Hassan A, Farouk H and Abdul-Ghani R. (2012). Parasitological contamination of freshly eaten vegetables collected from local markets in Alexandria, Egypt: A preliminary study. Food Control 26(2): 500–503.
19. Hong, S.; Kim, K.; Yoon, S. ; Park, W.-Y.; Sim, S. and Yu, J.R. (2014). Detection of *Cryptosporidium parvum* in Environmental Soil and Vegetables. J Korean Med Sci. 29: 1367-1371.
20. Hussain, S. A, Ali, S, Ahmed, K.; Hyder, S.; Akber, M.; Abbas, Q.; Ul- Hassan, S. N.; Ali, S. and Ali, K. (2014). Gastrointestinal parasites and bacteria in vegetables grown in soil treated with organic manure. Journal of Biodiversity and Environmental Sciences. 5(2): 387-393.
21. Ishaku A A, Asheofo D, Habibu T, Sunday T M, Amuta E A and Azua A T. (2013). Prevalence of intestinal parasitic infections among food vendors in Lafia Metropolis of Nasarawa State, Nigeria. Journals of Biotechnology 2(2): 21–25.
22. Joghataei A, Balarak D, Mahdavi Y, Modrek JM. (2016). Prevalence of parasitic contamination of raw vegetables in Ahar, Iran. Int J Analyt Pharmaceut Biomed Sci. 2016;5(1):28–31.
23. Ogbolu DO, Alli OA, Ogunleye VF, Olusoga OF, Olaosun I. (2009). The presence of intestinal parasites in selected vegetables from open markets in south western Nigeria. Afr J Med Med Sci. 38(4):319–24.
24. Omowaye OS, Audu PA, (2012). Parasites contamination and distribution on fruits and vegetables in Kogi, Nigeria. CIBTech J Bio-Protocols.1(1):44–7.
25. Park, S., Szonyi, B., Gautam, R., Nightingale, K., Anciso, J., Ivanek, R., (2012). Risk factors for microbial contamination in fruits and vegetables at the preharvest level: a systematic review. J. Food Prot. 75: 2055-2081.
26. Pullan RL, Smith JL, Jasrasaria R, Brooker SJ, (2010). Global numbers of infection and disease burden of soil transmitted helminth infections in. Parasit Vectors. 2014;7(1):37.
27. Sahlemariam Z, Mekete G. (2001). Examination of finger nail contents and stool for ova, cyst and larva of intestinal parasites from food handlers working instudent cafeterias in three higher institutions in Jimma. Ethiopian J Health Sci.;11(2):131–7.
28. Tefera T, Biruksew A, Mekonnen Z, Eshetu T, (2014). Parasitic contamination of fruitsand vegetables collected from selected local markets of Jimma town, southwest Ethiopia. Int Sch Res Notices.:382715.doi: 10.1155/2014/382715.
29. Tomass Z and Kidane D, (2012). "Parasitological contamination of wastewater irrigated and Raw Manure fertilized vegetables in Mekelle city and its Suburb, Tigray, Ethiopia," Momona Ethiopian Journal of Science, vol. 4, no. 1, pp. 77–89.