Veterinary World, EISSN: 2231-0916
Available at www.veterinaryworld.org/Vol.7/April-2014/13.pdf

RESEARCH ARTICLE
Open Access

Assessment of parasitic contamination of raw vegetables in Mannuthy, Kerala state, India

B. Sunil, Divya Rani Thomas, C. Latha and H. Shameem

Department of Veterinary Public Health,
College of Veterinary and Animal Sciences, Kerala Veterinary and Animal Sciences University,
Mannuthy, Thrissur-680 651, Kerala, India
Corresponding author: Divya Rani Thomas, email: divyaranithomas@gmail.com
Received: 31-12-2013, Revised: 17-03-2014, Accepted: 25-03-2014, Published online: 20-04-2014

doi: 10.14202/vetworld.2014.253-256
How to cite this article: Sunil B, Thomas DR, Latha C and Shameem H (2014) Assessment of parasitic contamination of raw vegetables in Mannuthy, Kerala state, India, *Veterinary World* 7(4): 253-256.

Abstract

Aim: To assess the parasitic contamination of raw vegetables retailed at Mannuthy in Thrissur district of Kerala state, India.

Materials and Methods: A total of 112 samples, viz. cabbage (17), mint (11), coriander leaves (11), spinach (15), onion (10), carrot (10), potato (10), ginger (15), beet root (7) and tomato (6) were collected from retail market at Mannuthy, Kerala. Collected samples were washed with physiological saline solution. The washings were collected and examined under light microscopy.

Results: Helminthic eggs were detected in three (2.7%) of 112 samples. Two samples of cabbage (1.8%) and one sample of onion (0.9%) was positive for ova of *Ascaris* spp.

Conclusion: Vegetables can act as potential source of gastrointestinal parasitic infections. The study emphasizes the need for proper washing of vegetables before they are consumed or cooked.

Keywords: helminthic eggs, parasitic contamination, public health, raw vegetables.

Introduction

Vegetables are essential for human health and well-being, and they form a major component of healthy diet. They are highly beneficial for maintenance of health and prevention of diseases [1]. Vegetables contain valuable nutritional factors, which can be successfully utilized to build up and repair the body. They are valued mainly for their high carbohydrate, vitamins, minerals, and fibre contents. Joint FAO/WHO Expert Consultation on diet, nutrition and the prevention of chronic diseases, has recommended the intake of a minimum of 400g of vegetables and fruits per day for the prevention of chronic diseases such as heart disease, cancer, diabetes and obesity, as well as for the prevention and alleviation of several micronutrient deficiencies, especially in less developed countries [2]. Consumption of raw vegetables and salads is a common practice, as they retain natural flavor and preserve heat labile nutrients.

On the other hand, vegetables can act as potential source for the spread of various infectious and parasitic diseases [3]. Parasitic diseases can be considered among the most common diseases on earth, which are transmitted to humans through water, soil, and foodstuffs such as vegetables [4]. Vegetables, especially salads, are an important route of transmission of intestinal parasites and have been shown to be an important source of food borne outbreaks in developing countries [5]. Consumption of unwashed, raw, and unhygienically prepared vegetables is considered a risk factor for human parasitic infections. There has been an increase in the number of reported cases of food-borne illness linked to fresh vegetables [6].

Keeping these facts in mind, the present study was conducted to assess the parasitic contamination of raw vegetables, retailed at Mannuthy in Thrissur district of Kerala state, India. The findings could lead to better practices in handling, washing, and preparation of vegetables to protect the consumers against gastro-intestinal parasitic infections.

Materials and Methods

A total of 112 raw vegetable samples (n=112), *viz.* cabbage (17), mint (11), coriander leaves (11), spinach (15), onion (10), carrot (10), potato (10), ginger (15), beet root (7) and tomato (6) were collected randomly from retail market at Mannuthy during January-March, 2012. The samples (approximately 100 g) were collected in sterile plastic bags (30 x 20 cm) and examined for helminthic eggs as described previously [7]. Samples were washed with physiological saline solution (0.85% NaCl). The washing water was left for 10h for sedimentation to take place and then the top layer was discarded and the remaining was centrifuged at 2164 g for 15 min. The supernatant was discarded, the residue was carefully collected and examined in lugol stained slides (three for each sample) through light microscopy and eggs were identified.

Table-1: Distribution of parasitic ova on vegetables in the study

Vegetables	No. examined	No. (%) positive
Cabbage	17	2 (1.80)
Mint leaves	11	-
Coriander leaves	11	-
Spinach	15	-
Onion	10	1 (0.90)
Potato	10	-
Ginger	15	-
Beet root	7	-
Carrot	10	-
Tomato	6	-
Total	**112**	**3 (2.7)**

Results

Distribution of parasitic ova on vegetables in the study is presented in Table-1. Of the 112 samples screened, three were positive for helminthic ova, all for *Ascaris* spp. ova. Two samples of cabbage (1.8%) and one sample of onion (0.9%) was positive for *Ascaris* spp. ova.

Discussion

Detection of helminthic ova on raw vegetables in the present study has significant public health implication. Vegetables may act as passive vehicles for transmission of pathogenic parasites and protozoa that are primarily transmitted through the fecal-oral route [8]. Worldwide, parasites infect millions of people. In some regions, there are a major cause of childhood diarrhoea and stunting of growth and cause significant economic losses related to human and animal health and to agriculture [9]. Intestinal parasites are widely prevalent in developing countries, probably due to poor sanitation and inadequate personal hygiene [10]. Studies conducted in both developed and developing countries have shown that helminthic diseases caused by *Ascaris* spp. and *Trichuris* spp. and bacterial diseases such as cholera are endemic in populations that consume salad vegetables irrigated with raw or untreated sewage [11]. Biologically, the highest health risk is for helminthic infections compared with other pathogens because helminthes persist for longer periods in the environment and the infective dose is small [12]. Continued use of untreated wastewater and human and animal excreta as fertilizer for production of fruits and vegetables is a major contributing factor for contamination that causes numerous food-borne disease outbreaks [13]. *Ascaris* spp. ova are found in insufficiently treated sewage-fertilizer and in soils where they may contaminate crops grown in soil or fertilized with sewage. The eggs of these roundworms are 'sticky' and may be carried to the mouth by hands, inanimate objects or foods, transmission may also be caused by contamination of a wide variety of foods by infected food-handlers [14]. Contamination of soil with animal wastes and increased application of improperly composted manures and improperly treated waste-water to soil in which vegetables are grown also play a role in parasite contamination to green vegetables [15]. Bad hygienic practice during production, transport, processing, and preparation by handlers including consumers also contribute in vegetable contaminations [16].

In the present study, it was found that cabbage and onion are contaminated with parasitic ova. These vegetables are commonly consumed raw and are important components of salads. Therefore, the study points to the need for proper washing and disinfection of all vegetables, particularly salad vegetables and those that are consumed raw. In a study conducted in West Bengal, India, 44.2% of vegetables in the study were positive for helminthic ova. *Ascaris* spp. eggs were the most predominant parasitic ova observed and was detected in 36 per cent of the samples examined [17]. In another study, conducted in Morocco, 50% of vegetables from farmland were contaminated by helminthic eggs [18]. Adamu *et al.* conducted a study in Northeastern Nigeria and found that 3.5% vegetables were contaminated with helminthic parasites [19]. Kozan, *et al.* [20], reported zero percent prevalence of helminthic eggs in washed vegetables in Turkey [20]. Garedaghi *et al.* [21], reported a parasitic prevalence of 40 per cent and 76% in markets vegetables and gardens vegetables respectively in Tabriz, Iran. Olyaei and Hajivandi [22] reported parasitic contamination of 38.5 and 48.9% in markets vegetables and gardens vegetables respectively in Southern Iran [22]. Saki *et al.* [23] reported that 15.5% of studied vegetables in Ahvaz, southwest of Iran, were contaminated with various parasite stages [23]. Geographical location, type, and number of samples examined, methods used for detection of the intestinal parasites, type of water used for irrigation, and post-harvesting handling methods of vegetables are different from country to country and region to region. This could be the reason for variation in prevalence in different parts of world [24].

Enquiry with the retailers revealed that the vegetables are not cultivated in the same locality, but are imported from other nearby states. In such vegetable gardens, there are possibilities for the use of night soil or untreated sewage as fertilizers, which might have contributed to the presence of *Ascaris* spp. ova in 2.7% of examined vegetables. *Ascaris* spp. (roundworm) is among the resistant enteric pathogens and it is often used as a parasitological indicator [25] and affects about a quarter of the world's population but

more prevalent in the developing world [26]. Samples of cabbage revealed a prevalence of 1.8% and onion samples recorded a prevalence of 0.9%. Variation in prevalence rates of parasitic contamination among the different vegetables could arise due to differences in plant foliage [19]. Vegetables like cabbage have broad leaves and large surface areas, which are in direct contact with the sewage contaminated soil surface [27]. Cabbage also has rough uneven surfaces that make parasitic eggs attach themselves easily to the surfaces of the vegetables either on the farm or when washed with contaminated water [28]. These could be the reasons for detection of parasitic ova in samples of cabbage. Vegetables like tomatoes have smooth leathery surfaces that tend to reduce the rate of parasitic attachment [29].

Vegetables pass through several hands on their way from farm to the table. During this period, they can become contaminated with enteric bacterial, viral, and parasitic pathogens throughout the process of planting to consumption [24]. Contamination can occur on field during growth, harvesting, transportation, processing, distribution, and marketing or in home by food handlers. Once harvested, vegetables may be washed in nearby canals, which may also add parasitic contamination. Such water bodies may carry parasitic ova excreted through feces of infected animals and human beings. According to Ebrahimzadeh et al, in most cases, contamination of raw vegetables is associated with the water used for irrigation [30]. Mahvi *et al.* [31], reported that use of insufficiently treated wastewater to irrigate vegetables is responsible for the high rates of contamination with pathogenic parasites in many developing countries.

The maximum and minimum atmospheric temperature during sampling period was in the range of 29-37°C and 17-26°C. Average relative humidity during the period was around 70%. These conditions favour the survivability of parasitic ova and pose threat to the consumers. Kim *et al*, [32], reported that, temperature in the range of 25-35 °C accelerates the development and embryonation of *Ascaris* spp. eggs. *Ascaris* spp. eggs are of particular interest in that the presence of a thick cell wall makes them resistant to adverse environmental conditions and provide them a long life span in the soil [33]. Temperature, relative humidity and light affect the viability of eggs which, in temperate climates (10-15°C) can be retained for two to three years and in tropical climates (20-30ºC) for ten to twelve months [34]. Discussion with retailers revealed that vegetables remain for about two to three days in their shops. During this period, there are chances that the vegetables may be contaminated due to handling by worm carriers or cross contamination from other vegetables. In the wholesale market, vegetables come in close contact with soil, which may also add to parasitic contamination.

Conclusion

The result of this study has indicated that vegetables at retail markets in Mannuthy, are contaminated with pathogenic helminthic parasites and may pose a health risk to consumers of raw vegetables. The present study emphasizes the importance of raw vegetables in threatening public health by transmission of intestinal parasites to humans. The findings of the study may have important implications in food safety and points to the need for further investigation in this area.

Prevention of contamination is the most efficient way to ensure food safety and prevent foodborne illness. Thus, every effort should be made to protect food from primary sources of contamination. Prevention of infection can be achieved by thorough washing of vegetables, improved hygienic practices of vegetable handlers and improvement in standards of sanitation. The local health authorities should take necessary actions to improve the sanitary conditions in the areas where the vegetables are cultivated. Construction of sanitary toilets for farm workers and provision of safe and wholesome water is also recommended. Passage of animals across vegetable farms must be restricted through proper farm fencing. Use of properly treated manure and proper treatment of wastewater used for irrigation of vegetables should be implemented. There is also an urgent need for the improvement of sanitary facilities in our markets and vegetable vendors.

However, this may not be possible always and raw foodstuffs, particularly fruits and vegetables grown close to the soil, may be contaminated with various pathogens. In such cases, efforts should be made to establish critical control points to reduce contamination to safe levels, by applying the Hazard Analysis and Critical Control Point system. Awareness on potential health consequences of consumption of contaminated foodstuffs must be created among public through various media. Education of public on steps to be taken for prevention and control of food borne illness is also vital.

Authors' contributions

BS (Principal Investigator of the project) and CL designed the study. DRT and HS: collection of samples and laboratory analysis. All authors have contributed in drafting and revision of the manuscript. All authors read and approved the final manuscript.

Acknowledgements

This study is a part of Indian Council of Agricultural Research (ICAR) network project entitled 'Outreach Programme on Zoonotic Diseases'. The financial assistance received from ICAR, New Delhi, for this study is duly acknowledged.

Competing interests

The authors declare that they have no competing interests.

References

1. Hanif, R., Iqbal, Z., Iqbal, M., Hanif, M. S. and Rasheed, M. (2006) Use of vegetables as nutritional food: role in human

health. *J. Agric. Bio. Sci*., 1(1): 18-22.
2. WHO. (2003) *Diet, nutrition and the prevention of chronic diseases. Report of a joint FAO/WHO expert consultation.* Geneva, World Health Organization, WHO Technical Report Series, No. 916.
3. Izadi, S.H., Abedi, S., Ahmadian, S. and Mahmoodi, M. (2006) Study of the current parasitic contamination of the edible vegetables in Isfahan in order to identify preventive measures. *Sci. J. Kurdistan Univ. Med. Sci.,* 11(2): 51-58.
4. Nazemi, S., Raei, M., Amiri, M. and Chaman, R. (2012) Parasitic contamination of raw vegetables in shahroud, semnan. Zahedan. *J. Res. Med. Sci*. 14(8): 84-86.
5. Pires, S. M., Vieira, A. R., Perez, E., Fo, L., Wong, D. and Hald, T. (2012) Attributing human foodborne illness to food sources and water in Latin America and the Caribbean using data from outbreak investigations. *Int. J. Food. Microbiol*. 152(3): 129–38.
6. Said, D. (2012) Detection of parasites in commonly consumed raw vegetables. *Alexandria J. Med*., 48(4) 345–352.
7. Erdogrul, O. R. and Sener, H. (2005) The contamination of various fruit and vegetable with *Enterobius vermicularis*, Ascaris eggs, *Entamoeba histolytica* cysts and *Giardia lamblia* cysts. *Food Control*, 16(6): 557–560.
8. Beiromvand, M., Akhlaghi, L., Massom, S.H., Meamar, A.R., Motevalian, A., Oormazdi, H. and Razmjou, E. (2013) Prevalence of zoonotic intestinal parasites in domestic and stray dogs in a rural area of Iran. *Prev. Vet. Med*., 109(1-2): 162-167.
9. Omowaye, O. S. and Falola, O.O. (2012) Prevalence of helminthic and protozoal cyst and ova on vegetables and fruits sold in middle-belt Nigeria. *Cibtech J. Bio-Protocols*, 1(1): 37-43.
10. Ashtiani, M.T., Monajemzadeh, M., Saghi, B., Shams, S., Mortazavi, S.H. and Khaki, S. (2011) Prevalence of intestinal parasites among children referred to children's medical center during 18 years (1991-2008), Tehran, Iran. *Ann. Trop. Med. Parasitol*., 105(7): 507-512.
11. Shuval, H. I., Yekutiel, P. and Fattal, B. (1985) Epidemiological evidence for helminth and cholera transmission by vegetables irrigated with wastewater: Jerusalem - A case study. *Water Sci. Tech*., 17(2): 433 - 442.
12. Gaspard, P., Wiart, J. and Schwartzbrod, J. (1997) Parasitological contamination of urban sludge used for agricultural purposes. *Waste Manage. Res*., 15(2): 429–436.
13. James, I. M. and Ogochukwu, O. (2006) Food-borne disease outbreaks. *J. Environ. Hlth*. 3: 2-3.
14. Clewes, C.A.N. and Shaw, C. (2000) Parasites. *Br. Med. Bull*., 56(1): 193-208.
15. Beuchat, L.R. (2002) Ecological factors influencing survival and growth of human pathogens on raw fruits and vegetables. *Microbes Infect*., 4(4): 413–423.
16. Gupta, S., Satpati, S., Nayek, S. and Garai, D. (2010) Effect of wastewater irrigation on vegetables in relation to bioaccumulation of heavy metals and biochemical changes. *Environ. Monit. Assess.*, 165(1-4): 169–177.
17. Gupta, N., Khan, D.K. and Santra, S.C. (2009) Prevalence of intestinal helminth eggs on vegetables grown in wastewater–irrigated areas of Titagarh, West Bengal, India. *Food Control*, 20(10): 942–945.
18. Hajjami, K., Ennaji, M.M., Fouad, S., Oubrim, N. and Cohen, N. (2013) Wastewater reuse for irrigation in Morocco: Helminth eggs contamination level of irrigated crops and sanitary risk (a case study of Settat and Soualem regions). *J. Bacteriol. Parasitol*. 4(1):1-5.
19. Adamu, N. B., Adamu, J. B. and Mohammed, D. (2012) Prevalence of helminth parasites found on vegetables sold in Maiduguri, Northeastern Nigeria. *Food Control*. 25(1): 23-26.
20. Kozan, E., Gonenc, B., Sarimehmetoglu, O. and Aycicek, H. (2005) Prevalence of helminth eggs on raw vegetables used for salads. *Food Control*, 16(3): 239-242.
21. Garedaghi, Y., Farhang, H. and Pooryagoobi, S. (2011). Parasitic contamination of fresh vegetables consumed in Tabriz, Iran. *Res. J. Biol. Sci*., 6(10): 518-522.
22. Olyaei, A. and Hajivand, L. (2013) Parasitological contamination of markets and farms in vegetables consumed in southern Iran. *Global Veterinaria*, 10(3): 327-331.
23. Saki, J., Asadpoori, R. and Khademvatan, S. (2013) Prevalence of intestinal parasites in vegetables consumed in Ahvaz, South West of Iran. *J. Med. Sci.* 13(3): 488-492.
24. Abougrain, A. K., Nahasi, M. H., Madi, N. S., Saied, M. M., and Ghenghesh, K. S. (2010) Parasitological contamination in salad vegetables in Tripoli-Libya. *Food Control*., 21(5): 760-762.
25. Watson, D. C., Satchwell, M. and Jones, C. E. (1983) A study of the prevalence of parasitic helminth eggs and cysts in sewage sludges disposed to agricultural land. Study of eggs and cysts in sewage. *Water Pollut. Control*. 82(3): 285-289.
26. Blumenthal, U. J., Strauss, M., Mara, D. D. and Cairncross, S. (1989) Generalized model of the effect of different control measures in reducing health risks from wastewater reuse. *Water Sci. Tech*., 78(9): 1104-1116.
27. Larkin, E. P., Tieney, J. T., Lovett, J., Van Donsel, D., Francis, D. and Jackson, G. J. (1978) Land application of sewage waste: potential for contamination of foodstuffs and agricultural soils by viruses, bacterial pathogens and parasites. In H. L. Mc Kim (Ed.), State of knowledge in land treatment of wastewater, Vol. 2 (pp. 215-223). Hanover, NH: US army Corps of Engineers, CRREL.
28. Mara, D., and Cairncross, C. S. (1989) Guidelines for the safe use of wastewater and excreta in agriculture and aquaculture, measures for public health protection. Water and Sanitation Health (WSH), WHO. pp. 21-187.
29. Mba, O. O. (2000) Detection and enumeration of parasite eggs in irrigated vegetables and salad crops in Plateau State, Nigeria. *J. Med. Lab. Sci*., 9(2): 30-36.
30. Ebrahimzadeh, A. Jamshidi, A. and Mohammadi, S. (2013) The parasitic contamination of raw vegetables consumed in Zahedan, Iran. *Hlth. Scope*., 1(1): 205-209.
31. Mahvi, A. H. and Kia, E.B. (2006) Helminth eggs in raw and treated wastewater in the Islamic Republic of Iran. *East Mediterr. Hlth. J.*, 12 (½): 137–143.
32. Kim, M. K., Pyo, K. H., Hwang, Y. S., Park, K. H., Hwang, I. G., Chai, J. Y. and Shin, E. H. **(**2012) Effect of temperature on embryonation of *Ascaris suum* eggs in an environmental chamber. *Korean J. Parasitol*., 50(3): 239–242.
33. Fripp, P.J. (2004) An introduction to human parasitology with reference to southern Africa. Edition 4. Tropical Diseases Research Unit, South African Institute for Medical Research, Johannesburg, South Africa. p196.
34. Strauss, M., Heinss, U., Montangero, A. (2000). On-site sanitation: when the pits are full – planning for resource protection in faecal sludge management. In: Proceedings, International Conference on Resolving Conflicts between drinking Water Demand and Pressures from Society's Wastes (Chorus et al., editors). Bad Elster, Germany, 24-28 November. p105.

****