



HELMINTH EGGS CONTAMINATION OF COMMONLY CONSUMED LEAFY GREEN VEGETABLES IN KIRŞEHİR PROVINCE, TÜRKİYE

Nuri ERCAN^{1*}

¹Kırşehir Ahi Evran University, Kaman Vocational School, Department of Food Processing, 40300 Kaman, Kırşehir, Türkiye

Abstract: Safe food is crucial for human health and well-being. Fruit and vegetables are essential for human diet as they provide providing vitamins, minerals, phytochemicals, and fibre, which are associated with a lower risk of cardiovascular disease and obesity. However, they are also a potential source of microbial contamination that can lead to food-borne infections. The aim of this study was to reveal the helminth egg contamination of leafy green vegetables for sale to humans in Kırşehir province. A total of 60 fresh leafy green vegetable samples (parsley, rocket, peppermint, purslane, and spinach) obtained from markets and bazaars were examined microscopically. Helminth eggs were detected in 3 (5%) of the 60 vegetables, specifically in rocket (1/12), spinach (1/12), and purslane (1/12) samples. These results highlight that unwashed or poorly washed leafy green vegetables pose a risk of parasite egg exposure and emphasize the importance of consumers adhering to proper hygiene practices before consumption. This study provides the first data on parasitic contamination of leafy green vegetables sold in markets and bazaars in Kırşehir province, Türkiye.

Keywords: Helminth eggs, Vegetables, Public health, Kırşehir

*Corresponding author: Kırşehir Ahi Evran University, Kaman Vocational School, Department of Food Processing, 40300 Kaman, Kırşehir, Türkiye

E mail: nuri.ercan@ahievran.edu.tr (N. ERCAN)

Nuri ERCAN  <https://orcid.org/0000-0001-6039-3510>

Received: May 29, 2025

Accepted: July 22, 2025

Published: September 27, 2025

Cite as: Ercan N. 2025. Helminth eggs contamination of commonly consumed leafy green vegetables in Kırşehir province, Türkiye BSJ Eng Sci, 8(5): 1401-1405.

1. Introduction

Vegetables and fruit are an important part of the human diet all around the globe. They provide important nutrients, such as vitamins, minerals, dietary fiber, and phytochemicals, and offer protection against chronic diseases (Mazzoni et al., 2021; Erol et al., 2023; Irma et al., 2023). A diet rich in vegetables is closely associated with improved gastrointestinal health and vision, as well as a lower risk of heart disease, stroke, diabetes, certain cancers, and protects and promotes mental well-being (Dias, 2012; Fismen et al., 2024). Moreover, the growing demand for easy and quick-to-eat, high-quality, and organic food has led to an increase in raw food consumption of vegetables (Li et al., 2020; Alneyadi et al., 2024). For example, the consumption of lettuce in the USA has increased significantly in the last decade (12.0 kg/person/year) (Esmael et al., 2023).

Food contaminated with harmful levels of pathogens and chemical or physical substances can cause acute or chronic illnesses – including more than 200 diseases (WHO, 2020). Despite all these benefits, fresh leafy green produce is susceptible to contamination throughout the entire process, from production to consumption (Esmael et al., 2023). The main routes of pathogenic contamination during vegetable production include farm and municipal waste, as well as irrigation water sources contaminated with human or animal feces (wild or domestic animals) (Bilgiç et al., 2023). Among these pathogens, several

protozoal cysts (*Entamoeba* spp., *Giardia intestinalis*, *Blastocystis* spp.), oocysts (*Cryptosporidium parvum*, *Cyclospora* spp., *Isospora* spp., *Toxoplasma* spp.), and helminth eggs and larvae (*Strongyloides* spp., *Trichuris trichiura*, *Enterobius vermicularis*, *Fasciola hepatica*, *Ascaris lumbricoides*, *Toxocara* spp., *Taenia* spp.) play an important role in contamination (Balali et al., 2020). Despite the dominance of bacteria in foodborne diseases, neglected parasitic foodborne diseases can be serious and even fatal (Bosch et al., 2018; Robertson, 2018). In addition, helminth-borne diseases affect a quarter of the world's population and cause significant health problems (Jourdan et al., 2018).

To date, the presence of vegetable-borne pathogenic diseases has been reported from many different countries, including Türkiye. However, no study has been conducted to determine the parasitic contamination of vegetables sold in Kırşehir. In this context, the present study aimed to determine the contamination of fresh vegetables with helminth eggs, sampled from local markets and bazaars in the Kırşehir province.

2. Materials and Methods

2.1. Study Area

This study was carried out in Kırşehir province, located in the Central Anatolian Region of Türkiye. Kırşehir province has cold, snowy winters and hot, dry summers. The average annual temperature is +11.3 °C, and the annual



rainfall is less than 400 mm (<http://www.kirsehir.gov.tr>). Agriculture and animal husbandry are the primary economic activities in this region.

2.2. Sample Collection

A total of 60 unwashed and pre-washed vegetables, including parsley (n=12), rocket (n=12), peppermint (n=12), purslane (n=12), and spinach (n=12) samples

(Figure 1) were taken from local markets and bazaars between March to June in 2024 (Table 1). To prevent cross-contamination, each sample was placed in a separate nylon bag and immediately transported to the laboratory for examination. No human or animal ethics approval was required for the completion of this study.

Table 1. Distribution of samples that are obtained from market and bazaar

	Parsley	Rocket	Peppermint	Purslane	Spinach
Market	5	4	4	10	-
Bazaar	7	8	8	2	12
Total	12	12	12	12	12

2.3. Processing samples for helminthological examination

The samples were included in the study as purchased and without prior treatment. A sample of each vegetable was weighed (~200 g) and placed in an Erlenmeyer flask with physiological saline solution (0.9% NaCl). The flask was placed on the orbital shaker plate and shaken for two hours at 130 rpm at room temperature. The vegetable leaves were discarded, and the resulting solution was allowed to settle overnight. The supernatant was then carefully decanted, ensuring minimal disturbance to the

sediment. Approximately 50 mL of the sediment was transferred to a Falcon tube and centrifuged for 10 min at 2500×g (M'rad et al., 2020). After centrifugation, the supernatant was decanted, and a portion of the resulting sediment was then examined for the presence of trematode eggs. The remaining sediment was transferred to a 15 mL glass tube, mixed with a saturated salt solution, and a glass coverslip was placed on top. After 15 minutes, the coverslip was examined at 10x and 40x magnification for the presence of cestode and nematode eggs. To ensure quality, three slides per sample were analysed.



Figure 1. Vegetable Samples. A. Rockets, B. Purslane, C. Parsley, D. Spinach.

3. Results

Helminth egg contamination in the examined vegetables, including parsley, peppermint, rocket, spinach, and purslane is presented in Table 2. Helminth eggs were detected in 3 (5%) of 60 vegetables, including purslane (1/12), rocket (1/12), and spinach (1/12). Morphological

analysis of the detected helminth eggs revealed them to be of the ascarid type (Figure 2). Although other helminth eggs or larvae (e.g., *Toxocara*, *Strongyloides*) have been reported in similar studies, only ascarid-type eggs were observed in our samples.

Table 2. Distribution of helminths eggs contamination in vegetable samples in Kırşehir

Vegetables	No. of Positive (%)	No. of Negative	Total
Parsley	-	12	12
Rocket	1 (8.3)	11	12
Peppermint	-	12	12
Spinach	1 (8.3)	11	12
Purslane	1 (8.3)	11	12
Total	3 (5)	57	60



Figure 2. The identified helminth egg in purslane sample in this study (40X magnification).

4. Discussion

Despite health advances and preventive measures, foodborne diseases remain unexpectedly high in both developed and developing countries. The World Health Organisation (WHO) estimates that 600 million people worldwide fall ill each year after consuming contaminated food (WHO, 2022). While there are many benefits to eating fruit and vegetables, eating raw or insufficiently washed fruit and vegetables carries the risk of contracting pathogen-borne diseases (Tangi et al., 2023). In our study, very few helminth eggs were identified with a low contamination rate (5%). Compared to previous findings in Türkiye, this result is relatively similar to those of Kozan et al. (2005) [5.9%], Avcioglu et al., (2011) [3.0%], Adanir and Tasci (2013) [6.3%] and Erol et al. (2023) [9.1%], but significantly lower than those of Bilgiç et al. (2023) [26.2%], Erez et al., (2022) [13.5%] and Kartal et al. (2024) [16.6%], and slightly higher than that of Aydenizoz et al. (2017) [1.0%]. Ulukanligil et al. (2001) conducted a comprehensive study in Şanlıurfa and found high levels of helminth contamination (59.5%) in fecal samples from farmers, irrigation water, soil samples, and locally grown vegetables. These observations could be due to differences in the sensitivity of the techniques used in the different studies, as well as differences in geographical location, sample size, origin and type of vegetable samples, and the seasons in which the samples were collected. When local climatic conditions are unfavourable, the

demand for green vegetables in Kırşehir is met by imports from other regions. In the late spring and summer, however, locally grown produce from rural areas and villages is sold at local markets and bazaars, alongside imported vegetables. The origin and growing conditions of the samples used in this study are unknown.

Ascarids are widespread nematodes that primarily infect the small intestine of their hosts, which include several domestic animals, wildlife species, and humans. Especially in humans, ascariasis can have acute and chronic manifestations, the latter being associated with significant nutritional and growth deficits (Else et al., 2020). In addition to the physical effects, recent investigations have also indicated that *Ascaris* infections can affect mental processing in some school children (O'lorcain and Holland, 2000; Drake et al., 2020). From this perspective, ascariasis is an important but neglected disease (Holland et al., 2022). The results of our study reinforce the understanding that foodborne pathogens pose a threat to public health, especially for children and immunocompromised individuals.

The contamination of vegetables by microbial agents can occur at any point in the production chain (Balali et al., 2020). Gil et al. (2015) categorised the sources of contamination into two broad groups: pre-harvest and post-harvest. Pre-harvest sources of contamination include the soil in which the vegetables are grown, irrigation water, dust, improperly composted manure, and human interaction with the product. In addition to irrigation water, rain also contaminates leafy vegetables with soil particles (da Costa Dantas et al., 2023). Post-harvest contamination sources include feces, harvesting and packaging equipment, human handling, insect vectors, and rinsing water. All of this information highlights the risks associated with consuming raw fruit and vegetables without proper washing and emphasises the need to strictly adhere to washing procedures.

5. Conclusion

To summarise, this study is the first to reveal parasitic contamination of green vegetables sold in Kırşehir province. It is crucial for producers and consumers to comply with the required maximum hygiene standards. In addition, the relevant state institutions must take the necessary measures to raise public awareness and municipalities should prioritise public health in the disposal of solid and liquid waste.

Author Contributions

The percentages of the author' contributions are presented below. The author reviewed and approved the final version of the manuscript.

	N.E.
C	100
D	100
S	100
DCP	100
DAI	100
L	100
W	100
CR	100
SR	100
PM	100
FA	100

C=Concept, D= design, S= supervision, DCP= data collection and/or processing, DAI= data analysis and/or interpretation, L= literature search, W= writing, CR= critical review, SR= submission and revision, PM= project management, FA= funding acquisition.

Conflict of Interest

The author declared that there is no conflict of interest.

Ethical Consideration

Ethics committee approval was not required for this study because of there was no study on animals or humans.

Acknowledgements

The author would like to thank the editor and blind reviewers for their comments and contributions to the manuscript.

References

- Adanir R, Tasci F. 2013. Prevalence of helminth eggs in raw vegetables consumed in Burdur, Türkiye. *Food Control*, 31(2): 482-484.
- Alneyadi KSS, Almheiri MSB, Tzortzakis N, Di Gioia F, Ahmed Z FR. 2024. Organic-based nutrient solutions for sustainable vegetable production in a zero-runoff soilless growing system. *J Agric Food Res*, 15:101035.
- Avcioglu H, Soykan E, Tarakci U. 2011. Control of helminth contamination of raw vegetables by washing. *Vector-Borne Zoonotic Dis*, 11(2): 189-191.
- Aydenizoz M, Gokpinar S, Gazyagci AN. 2017. Investigation of parasitological contamination in leafy vegetables in Kırıkkale of Türkiye. *Anim Health Prod Hyg*, 6(1): 463-467.
- Balali GI, Yar DD, Afua Dela VG, Adjei-Kusi P. 2020. Microbial contamination, an increasing threat to the consumption of fresh fruits and vegetables in today's world. *Int J Microbiol*, 2020:3029295.
- Bilgiç F, Ozturk E, Babat S, Babaoğlu A, Erdoğan D, Korkmaz M. 2023. Determination of parasitic contamination in vegetables collected from local markets in İzmir province, Türkiye. *Türkiye Parazitoloji Derg*, 47(2).
- Bosch A, Gkogka E, Le Guyader FS, Loisy-Hamon F, Lee A, Van Lieshout L, Phister T. 2018. Foodborne viruses: Detection, risk assessment, and control options in food processing. *Int J Food Microbiol*, 285: 110-128.
- da Costa Dantas LM, de Medeiros Maia CM, da Silva Chaves Damasceno KSF, Mont'Alverne Jucá Seabra L, Chaves G, de Assis CF, de Sousa Júnior FC. 2023. Prevalence of helminths in fresh vegetables: a narrative literature review. *J Sci Food Agric*, 103(8): 3761-3765.
- Dias JS. 2012. Nutritional quality and health benefits of vegetables: A review. *Food Nutr Sci*, 3(10): 1354-1374.
- Drake LJ, Jukes MCH, Sternberg RJ, Bundy DAP. 2000. Geohelminth infections (ascariasis, trichuriasis, and hookworm): cognitive and developmental impacts. *Sem Pediatr Infect Dis*, 11(4): 245-251.
- Else KJ, Keiser J, Holland CV, Grencis RK, Sattelle DB, Fujiwara RT, Cooper PJ. 2020. Whipworm and roundworm infections. *Nat Rev Dis Primers*, 6(1): 44.
- Erez MS, Kozan E, Göksu A. 2022. Detection of helminth egg contamination on raw vegetables in Afyonkarahisar, Türkiye. *Kocatepe Vet J*, 15(4): 374-380.
- Erol U, Altay K, Şahin ÖF, Urhan OF. 2023. Helminth contamination of commonly consumed raw vegetables in sivas province in the central part of Türkiye: First molecular detection of human pathogenic *Toxocara canis* eggs in raw vegetables. *Acta Vet Eurasia*, 49(1).
- Esmael A, Al-Hindi RR, Albiheyri RS, Alharbi MG, Filimban AA, Alseghayer MS, Teklemariam AD. 2023. Fresh produce as a potential vector and reservoir for human bacterial pathogens: Revealing the ambiguity of interaction and transmission. *Microorganisms*, 11(3): 753.
- Fismen AS, Aarø LE, Thorsteinsson E, Ojala K, Samdal O, Helleve A, Eriksson C. 2024. Associations between eating habits and mental health among adolescents in five nordic countries: a cross-sectional survey. *BMC Public Health*, 24(1): 2640.
- Gil MI, Selma MV, Suslow Jacksens L, Uyttendaele M, Allende A. 2015. Pre-and postharvest preventive measures and intervention strategies to control microbial food safety hazards of fresh leafy vegetables. *Crit Rev Food Sci Nutr*, 55(4): 453-468.
- Holland C, Sepidarkish M, Deslyper G, Abdollahi A, Valizadeh S, Mollalo A, Rostami A. 2022. Global prevalence of *Ascaris* infection in humans (2010–2021): a systematic review and meta-analysis. *Infect Dis Poverty*, 11(1): 113.
- Irma KNG, Thierry EBJ, Isaka KN, Vanelle WS, Efietngab AN, Emilie TT, Lucia N. 2023. Parasitological assessment of some fruits and vegetables commonly sold in retail outlets in the Mfoundi Division of Cameroon. *Parasite Epidem Cont*, 22:e00313.
- Jourdan PM, Lamberton PH, Fenwick A, Addiss DG. 2018. Soil-transmitted helminth infections. *Lancet*, 391(10117): 252-265.
- Kartal K, Eser M, Güzel H. 2024. The prevalence of helminth eggs in raw vegetables from street markets in Eskişehir, Türkiye. *Eur J Life Sci*, 3(1): 1-8.
- Kozan E, Gonenc B, Sarimehmetoglu O, Aycicek H. 2005. Prevalence of helminth eggs on raw vegetables used for salads. *Food Control*, 16(3): 239-242.
- Li J, Wang Z, Karim MR, Karim MR, Zhang L. 2020. Detection of human intestinal protozoan parasites in vegetables and fruits: a review. *Parasit Vectors*, 13:380.
- Mazzoni L, Ariza Fernández MT, Capocasa F. 2021. Potential health benefits of fruits and vegetables. *Appl Sci*, 11(19): 8951.
- M'rad S, Chaabane-Banaoues R, Lahmar I, Oumaima H, Mezhoud H, Babba H, Oudni-M'Rad M. 2020. Parasitological contamination of vegetables sold in Tunisian retail markets with helminth eggs and protozoan cysts. *J Food Prot*, 83(7): 1404.

- 1104-1109.
- O'lorcain P, Holland CV. 2000. The public health importance of *Ascaris lumbricoides*. *Parasitology*, 121(S1): S51-S71.
- Robertson LJ. 2018. Parasites in food: from a neglected position to an emerging issue. *Adv Food Nutr Res*, 86: 71-113.
- Tangi FB, Arnauld TGB, Koye B. 2023. Parasitic contamination of commonly consumed fresh fruits sold at Tiko and Limbe Municipality Markets, South West Region of Cameroon. *Food Sci Nutr Res*, 6(1): 1-7.
- Ulukanligil M, Seyrek A, Aslan G, Ozbilge H, Atay S. 2001. Environmental pollution with soil-transmitted helminths in Sanliurfa, Türkiye. *Mem inst osvaldo cruz*, 96: 903-909.
- World Health Organization (WHO). 2020. Key facts: food safety. (accessed date: April 15, 2025).
- World Health Organization (WHO). 2022. WHO global strategy for food safety 2022–2030: towards stronger food safety systems and global cooperation: executive summary. World Health Organization. (accessed date: April 15, 2025).