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Research Article

The prevalence of helminth eggs in raw vegetables from street markets in Eskişehir, Türkiye

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ABSTRACT

This research was performed on a total of 120 vegetables, with 12 samples taken from each available Eskişehir district markets. In this study, we aimed to determine the presence of contamination from helminth eggs in 10 types of vegetables: carrot, lettuce, parsley, arugula, cress, fresh onion, mint, cucumber, dill, and purslane. 200 g of material from each collected sample was prepared for the helminthological examination. The prepared samples were examined for helminth eggs with a light microscope that could be identified at 40x magnification. The data were analyzed using SPSS 16 software. Helminth eggs were detected in 20 (16.6%) vegetable samples. According to the research, the highest rate of helminth eggs was observed in spring onion (66.6%), while the lowest rate was found in mint (16.6%) and purslane (16.6%). *Ascaris lumbricoides* eggs were found in 11 (9.1%) of the samples, and strongyle type eggs in 9 (7.5%). In this study, we observed that infectious forms of parasites can contaminate many foods and potentially infect people after consumption if these foods are not washed well. The aim of this study was to assess the presence of helminth eggs in raw vegetables, which are commonly consumed produce sold in street markets in Eskişehir, Türkiye.

Keywords: Eskişehir, helminth contamination, street markets

1. INTRODUCTION

The World Health Organisation (WHO) reports that diseases caused by contaminated food are the most common health problems in the modern world [1]. Factors that can cause contamination in food include bacteria, viruses, fungi, and parasites [2]. Parasites are commonly found in freshwater sources contaminated by either human or animal faeces. Consumption of fruits and vegetables grown or washed with water containing infective parasites causes infections [3,4]. The origin of water contamination can be from animals or humans, which can lead to contamination of products during cultivation, collection, transportation, and storage. The rise in organic farming also increases the risk of parasitic contamination of vegetables and fruits [5-7]. Parasitic infections can adversely affect human health in all age groups [8]. Parasites are the main causes of childhood diarrhoea and growth delay, particularly in non-developed countries [9,10]. Appropriate disposal of domestic and animal husbandry waste is a basic strategy to prevent orally transmitted parasitic infections by preventing contamination of food or water. Complete or detailed washing of pre-cooked vegetables and fruits removes parasitic cysts, oocysts, and eggs. However, it can be difficult

to clean leafy vegetables and peeled fruits. Washing hands frequently, using clean utensils and tools, and taking precautions to prevent cross-contamination are important for clean food consumption [3]. Failure to establish an effective washing and hygiene standard in places with high consumption, such as hospitals, schools, restaurants, and hotels, increases the risk of parasite infection transmission to humans [6,11-14]. This study aimed to detection of helminth contamination in various vegetable samples.

2. MATERIALS AND METHODS

2.1. The study area

The study was carried out in the location of Eskişehir. Eskişehir is located in the Northwest of the Central Anatolia Region of Türkiye, at 39° 46′ 60″ North latitude and 30° 31′ 0″ East longitude. It has a hot and dry climate in the summer, while it is cold and snowy in the winter. The weather is hot and rainy in spring and autumn, and the precipitation is mainly in the form of rain. The average annual rainfall of Eskişehir is 336.7 kg/m^3, and the annual temperature is 11°C. Although industry is at the top of the list as a source of income in Eskişehir, agricultural production is significant in some parts. Mihalgazi and Sarıcakaya are two important districts of Eskişehir that have microclimate characteristics. Controlled greenhouse-grown seasonal vegetables are grown in these districts and nearby regions. Apart from these zones, in the province, especially grain and the production of plants such as sugar beet are important. Since most of the cultivated land is dry land and the amount of annual rainfall in the province is low, it is not possible to cultivate all of the owned land every year [15].

2.2. Sample collection

As research material, a total of 120 unwashed vegetable samples (12 samples of each type: carrot, lettuce, parsley, arugula, cress, spring onion, mint, cucumber, dill, and purslane) were collected from Eskişehir district markets (four district markets in total) between March and April in 2017. These samples were transferred to the laboratory in sealed plastic bags. Three of each vegetable were collected from each of the four district market vendors.

2.3. Determination of helminth eggs

All vegetable samples were prepared for helminthological examination with 200 g of each sample. The samples were washed in 1.5 litres of detergent solution (1% sodium dodecyl sulphate and 0.1% Tween 80) and left for 12 hours. Then, the washing solution was transferred to 50 ml polypropylene centrifuge tubes and centrifuged at 1500 g for 15 minutes. Sediments were combined into a single tube and washed twice with PBS. The Fülleborn saturated salt water flotation method was applied to the final sediment and examined for helminth eggs using a light microscope at 40x magnification, which was sufficient for identifying eggs [6,16].

2.4. The statistical analysis

Research data were analyzed with SPSS 16 software. Percentage, Chi-squared, and Fisher's exact tests were used to analyse the data, and the p-value less than 0.05 was considered as significant ($p \leq 0.05$).

3. RESULTS AND DISCUSSION

Helminth eggs were detected in 20 (16.6%) of all 120 samples. *Ascaris lumbricoides* eggs were found in 11 (9.1%) of samples, and strongyle type eggs were found in 9 (7.5%) samples (Table 1). We found that lettuce, arugula, spring onion, mint, and purslane were contaminated with at least one species of helminth egg. There were no helminth eggs found in any dill, cucumber, parsley, cucumber, or carrots. Spring onions had the highest percentage of helminth eggs (66.6%), whereas mint (16.6%) and purslane (16.6%) exhibited the lowest rates. Arugula has the highest percentage of *Ascaris lumbricoides* eggs (33.3%), while spring onions (8.3%) and purslane (8.3%) have the lowest rates. Strongyle type eggs were most prevalent in spring onions (58.3%) and the least in lettuce (8.3%) and purslane (8.3%). Lettuce, spring onion, and purslane (Table 1) contained more than one helminth egg type, including both *Ascaris lumbricoides* egg and strongyle type egg.

Table 1. Distribution of helminth eggs detected in the examined vegetable samples in street markets in Eskişehir

Sample (n)	*Ascaris lumbricoides* eggs		Strongyle type egg		Total	
	n	%	n	%	n	%
Lettuce (12)	3	25	1	8.3	4	33.3
Arugula (12)	4	33.3	0	0.0	4	33.3
Spring onion (12)	1	8.3	7	58.3	8	66.6
Mint (12)	2	16.6	0	0.0	2	16.6
Purslane(12)	1	8.3	1	8.3	2	16.6
Carrot (12)	0	0.0	0	0.0	0	0.0
Parsley (12)	0	0.0	0	0.0	0	0.0
Cress (12)	0	0.0	0	0.0	0	0.0
Cucumber (12)	0	0.0	0	0.0	0	0.0
Dill (12)	0	0.0	0	0.0	0	0.0
Total (120)	11	9.1	9	7.5	20	16.6

Table 2. Distribution of helminth eggs in vegetable samples according to street market

Sample (n)	Gökmeydan Street Market		Visnelik Street Market		Kumlubel Street Market		Seker Street Market	
	*A. l. n (%)	**S. T n (%)	*A. l. n (%)	** S. T n (%)	*A. l. n (%)	** S. T n (%)	*A. l. n (%)	** S. T n (%)
Lettuce(12)	1 (8.3)	0 (0.0)	2 (16.6)	0 (0.0)	0 (0.0)	1 (8.3)	0 (0.0)	0 (0.0)
Arugula (12)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	4 (33.3)	0 (0.0)	0 (0.0)	0 (0.0)
S. Onion (12)	0 (0.0)	0 (0.0)	1 (8.3)	0 (0.0)	0 (0.0)	1 (8.3)	0 (0.0)	6 (50)
Mint (12)	2(16.6)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Purslane (12)	0 (0.0)	0 (0.0)	1 (8.3)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (8.3)
Carrot (12)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Parsley (12)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Cress (12)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Cucumber (12)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Dill (12)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Total (120)	3 (2.5)	0 (0.0)	4 (3.3)	0 (0.0)	4 (3.3)	2(1.6)	0 (0.0)	7 (5.8)

*_Ascaris lumbricoides_. ** Strongyle type.

Helminthological examination methods applied to vegetable samples identified Strongyle type eggs (Figure 1A) and *Ascaris lumbricoides* eggs (Figure 1B).

The number of helminth eggs in vegetable samples examined in the laboratory is shown in Table 1 and 2.

After examining the results of the samples from district markets, we determined that the highest number of infected samples came from the Seker market with seven (5.8%), and the lowest number from the Gökmeydan district market with 3 (2.5%) samples (Table 2).

The number of helminth eggs found in vegetables purchased from the Gökmeydan market was statistically significantly lower than the number of helminth eggs found in samples purchased from the Visnelik market ($p = 0.01$; Table 3). In addition, the same result was observed when comparing samples from the Gökmeydan ($p = 0.03$) and Visnelik ($p<0.01$) markets with the Kumlubel market (Table 3). The number of helminth eggs found in vegetables bought from the Seker market was statistically significantly higher than the number of helminth eggs found in vegetables collected from the Kumlubel market ($p<0.01$; Table 3). In this study, we examined the

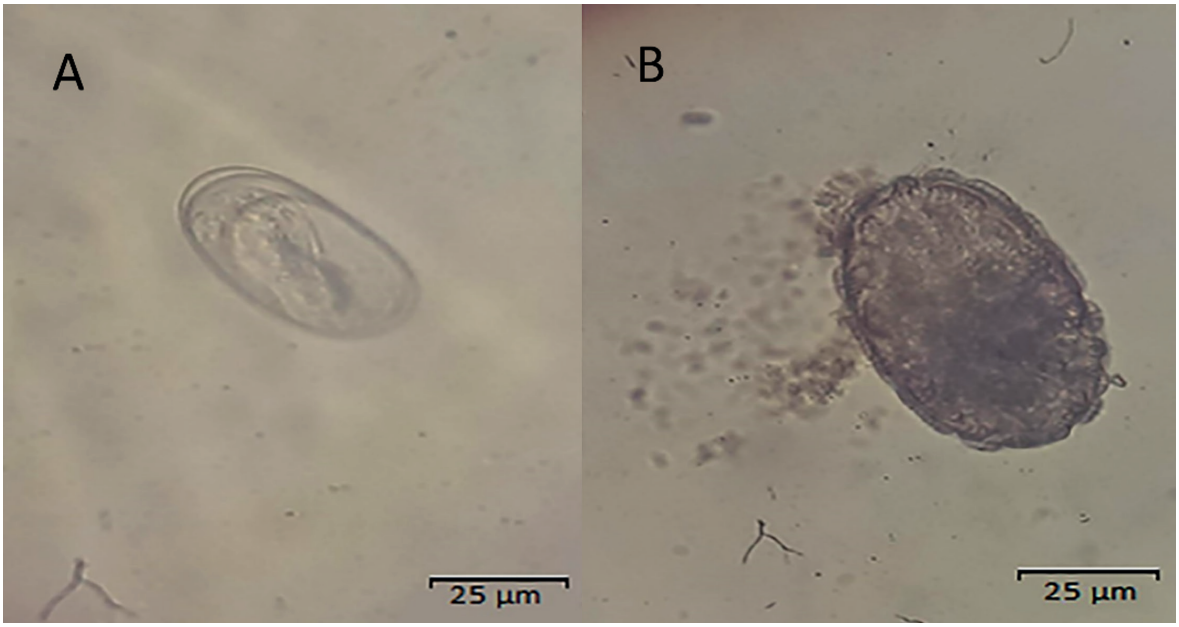

Figure 1. [A] Strongyle type egg and [B] *Ascaris lumbricoides* egg (40x magnification)

Table 3. Significance between the distribution of helminth eggs in food samples according to the street markets

	Visnelik Street Market (chi square /p*)	Kumlubel Street Market (chi square /p*)	Seker Street Market (chi square /p*)
Gökmeydan Street Market	8.000/ 0.01**	6.301/ 0.03**	2.857/ 0.20
Visnelik Street Market		10.355/ <0.01**	4.286/ 0.08
Kumlubel Street Market			7.532/ <0.01**

*Chi-squared test, Fisher's exact test. **p<0.05 was considered statistically significant.

contamination and frequency of helminth eggs in raw vegetable samples collected from district markets.

Ascaris lumbricoides [17,18] can cause infection in healthy people by consuming foods contaminated with the faeces of infected people. In the 120 samples examined in this study, the frequency of *A. lumbricoides* eggs was 9.1%, and that of Strongyle type eggs was 7.5%. *A. lumbricoides* eggs have been reported in numerous studies carried out in Türkiye. It has been reported that *Ascaris lumbricoides* eggs were found in 1% of 203 unwashed samples in a study conducted in Ankara [6], 2% in 199 unwashed samples in Bursa [19], 1.8% in 111 samples in Burdur [20], and 11% [21] in 100 food samples in Şanlıurfa.

The rate of egg detection varies by the number of samples, the country, or the region where the samples were taken. The frequency of *Ascaris lumbricoides* eggs detected in this study was higher than in many previous studies. *Ascaris lumbricoides* eggs were predominantly found in arugula (33.3%), the lowest in scallions (8.3%), and in purslane (8.3%); eggs were not detected in any carrots, parsley, cress, cucumber, or dill.

Erez et al. (2022) conducted a study to determine helminth contamination of 508 vegetable samples, including lettuce, parsley, carrot, spring onion, spinach, cress, arugula, mint, dill, and purslane, in Afyonkarahisar. It was reported that they had detected Taeniid eggs in two (0.39%) vegetable samples, including 1 lettuce and 1 dill; *Toxocara* spp. in 2 (0.39%) samples, including 1 lettuce and 1 mint; *Toxascaris leonina* eggs in 1 (0.2%) arugula sample; hookworm and strongyle type eggs in 58 samples (11.42%), including 4 lettuce, 6 parsley, 3 carrots, 18 onions, 2 spinach, 9 cress, 4 arugula, 6 mint, and 6 purslane; *Dicrocoelium* spp. in 2 (3.63%) carrots,

1 (2.04%); *Moniezia* spp. in 2 (3.63%) carrot samples; and *Fasciola* spp. in 1 (2.08%) spring onion sample [22]. In this study, *Ascaris lumbricoides* eggs and Strongyle type eggs were found in the collected samples. We did not observe any other helminth eggs. The different irrigation methods in the regions where vegetables are grown may explain the absence of other helminth eggs. Avcioglu et al. (2011) detected helminth eggs in lettuce (5.6%) and parsley (4.3%), from 199 unwashed samples. No helminth eggs were found in 199 washed samples [19]. In our study, we found helminth eggs mostly in spring onions (66.6%) and the lowest in mint (16.6%) and purslane (16.6%).

In a study conducted in Burdur, *A. lumbricoides* eggs were mostly found in lettuce (9.09%) and parsley (7.69%) [20]. In contrast, we observed the highest rate of *Ascaris lumbricoides* eggs in arugula (33.3%), lettuce (25%), mint (16.6%), and less frequently in spring onions (8.3%) and purslane (8.3%).

Aydenizöz et al. (2017) observed a total of 9 samples positive for helminth eggs in 900 green leafy vegetable samples from Kırıkkale, also found that 0.44% were determined to be strongyle type eggs [23]. In our study, strongyle type eggs were found in 9 (7.5%) samples.

In many studies, parasitological analysis showed that foods contain both *Ascaris lumbricoides* eggs and Strongyle type helminth eggs. Studies conducted in other countries detected a higher frequency of helminth eggs compared to our study. According to the results of studies conducted around the world, it was easier for helminth eggs to infect multiple layers of vegetables, such as lettuce and spring onions. Green leafy samples taken from markets, grocery stores, and supermarkets in Brazil contained more than one helminth egg in lettuce, scallions, and arugula. Furthermore, Hookworm or *Strongyloides* spp. egg frequency was 12.9% [24]. Compared to our study, Strongyle type eggs were found at a rate of 7.5%.

In a study examining vegetables and fruits collected from four local markets in southern Ethiopia, the frequency of *Ascaris lumbricoides* was 20.8% [25]. Furthermore, in Nigeria, the frequency of *Ascaris lumbricoides* eggs was 41.1% and hookworm eggs (Strongyle type) was 8.9% in 124 vegetable samples [26]. Comparatively, the rate of *Ascaris lumbricoides* eggs (9.1%) was lower than that observed in these studies, while the frequency of Strongyle type eggs (7.5%) was similar to the mentioned studies. Another study in Nigeria of 300 samples found the frequency of *Ascaris lumbricoides* eggs to be 18.3% and hookworm eggs (Strongyle type) to be 1.67% [27]. We observed the frequency of *Ascaris lumbricoides* eggs to be lower but strongyle type eggs higher in comparison. In a study conducted in Nigeria where samples were collected from the market, helminth eggs were not found in carrots; however, *Ascaris lumbricoides* eggs were found in lettuce [28], whereas we found no *Ascaris lumbricoides* eggs in lettuce.

Helminth eggs have been reported in both lettuce and carrots [29]. Furthermore, Adamu et al. (2012) found hookworm (Strongyle type) eggs in 3% of 300 lettuces and 2.3% of 130 cucumbers [30]. Comparatively, we observed strongyle type eggs mostly in scallions (58.3%) and least in lettuce (8.3%) and purslane (8.3%), while we detected none in carrots, parsley, cress, cucumber, and dill.

The findings of the intestinal parasite examination conducted in Eskişehir (1993) reported that the rate of *Ascaris lumbricoides* was found to be 0.15% [31]. In contrast, a study conducted in 2008 did not find any *A. lumbricoides* eggs [32]. By eliminating the infrastructure problem and distributing drinking water in the city instead of tankers, the use of hygienic water bottles has reduced the incidence of this parasitic species. Moreover, actively preventing waste from mixing with the Porsuk River, which could be used for agricultural purposes, significantly contributed to the reduction.

Another study carried out to investigate the presence of intestinal parasites in primary school students in Eskişehir found *A. lumbricoides* in 2% of 124 samples [33]. Compared to previous studies, the latest findings show a higher percentage of observed *Ascaris lumbricoides* eggs. A probable explanation for this difference may be a variation in the ages of the collected samples. The high incidence of *A. lumbricoides* eggs in primary school students

suggests that children are not adequately conforming to hand hygiene along with general hygiene and nutrition rules. *Ascaris lumbricoides* eggs were found in 11 (9.1%) of the samples collected in this study. This rate is significantly higher than the rate observed in people in Eskişehir. One possible reason for this higher rate could be that people in Eskişehir consume vegetables after hygienic washing.

Water sources regularly used for drinking and farming in rural areas without sewage systems can become contaminated by human or animal waste. Furthermore, the use of animal fertilisers in growing vegetables can lead to the contamination of vegetables by zoonotic agents.

When comparing the helminth eggs detected by district markets, we determined the lowest egg frequency to be in the Gökmeydan district market (2.5%) and the highest egg frequency in the Seker district market (5.8%). We also observed that the number of helminth eggs found in vegetables bought from the Gökmeydan market was less than those from Visnelik, Kumlubel, and lastly, Seker markets, in that order. The differences in irrigation and fertilization practices of the soils from which the vegetables are obtained might explain the variation in the frequency of helminth eggs detected, despite the samples bought from the markets being the same in terms of variety and number. Some of the vegetables bought from different markets had no helminth eggs detected, while others had more than one helminth egg.

4. CONCLUSION

According to our findings, parasites can be found on many vegetables and herbs (particularly vegetables with multiple layers, such as lettuce and spring onions), which have the potential to cause parasitic infections in humans. This is likely the result of consuming vegetables without washing them adequately. The types and numbers of parasites observed in vegetables vary according to markets. The occurrence of parasitic infections varies depending on many factors, such as agricultural irrigation, access to healthy water resources, and socioeconomic structure. Considering this variability, it is necessary to develop correct and effective washing and disinfection methods for raw vegetables. In addition, there is a need to educate people with regards to thoroughly washing vegetables before consumption. Restaurants, hospitals, factories, schools, and anywhere such foods are offered for consumption in large quantities should establish effective washing processes. Authorities should manage and conduct thorough inspections of these establishments.

Ethical approval

Not applicable, because this article does not contain any studies with human or animal subjects.

Author contribution

Concept: KK, ME; Design: ME; Supervision: KK, ME; Materials: KK, ME; HG; Data Collection and/or Processing: KK, ME; HG; Analysis and/or Interpretation: HG; Literature Search: KK, ME; HG; Writing: KK, ME; Critical Reviews: ME.

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Conflict of interest

The authors declared that there is no conflict of interest.

REFERENCES

1. World Health Organization (2022, May 19). Food safety. Retrieved February 6, 2024, from https://www.who.int/news-room/fact-sheets/detail/food-safety
2. Muratoğlu K, Çetin Ö, Çolak H. Besin kaynaklı hastalıkların epidemiyolojisi. Türkiye Klinikleri. (2015); 1:1-8.
3. Doyle E. A Review of the scientific literature. Food Research Institute. University of Wisconsin UW Madison WI. FRI Briefings. Foodborne Parasites. (2003); 53706:9-10.
4. Molins RA, Motarjemi Y, Käferstein FK. Irradiation: A critical control point in ensuring the microbiological safety of raw foods. Food Control. (2001);12:347-356. https://doi.org/10.1016/S0956-7135(01)00035-4

5. Erdoğrul Ö, Şener H. The contamination of various fruit and vegetable with *Enterobius vermicularis*, *Ascaris* eggs, *Entamoeba histolytica* cysts, and *Giardia* cysts. Food Control. (2005);16:559-562. https://doi.org/10.1016/j.foodcont.2004.06.016

6. Kozan E, Gönenç B, Sarimehmetoğlu O, Aycicek H. Prevalence of helminth eggs on raw vegetables used for salads. Food Control. (2005);16:239–242. https://doi.org/10.1016/j.foodcont.2004.02.005

7. Robertson LJ, Gjerde B. Occurrence of parasites on fruits and vegetables in Norway. Journal of Food Protection. (2001);64:1793–1798. https://doi.org/10.4315/0362-028X-64.11.1793

8. Cantoray R. Hayvanlardan insanlara geçen bazı paraziter hastalıklar ve bunların önemi. Eurasian Journal of Veterinary Sciences. (1984);1:133-139.

9. Guerrant RL, Kosek M, Moore S, Lorntz B, Brantley R, Lima AA. Magnitude and impact of diarrheal diseases. Archives of Medical Research. (2002);33:351–355. https://doi.org/10.1016/S0188-4409(02)00379-X

10. Roberts T, Murrell KD, Marks S. Economic losses caused by food borne parasitic diseases. Parasitol Today. (1994);10:419-423. https://doi.org/10.1016/0169-4758(94)90171-6

11. Coelho LM, Oliveira SM, Milman MH, Karasawa KA, Santos RD. Detection of transmissible forms of enteroparasites in water and vegetables consumed at schools in Sorocaba, Sao Paulostate, Brazil. Review of Society Brasil Medicine Tropical. (2001);34, 479-482. https://doi.org/10.1590/S0037-86822001000500012

12. Mesquita VC, Serra CM, Bastos OM, Uchoa CM. The enteroparasitic contamination of commercial vegetables in the cities of Niteroiand Rio de Janeiro, Brazil. Review of Society Brasil Medicine Tropical. (1999);32:363–366. http://10.1590/s0037-86821999000400005

13. Takayanagui OM, Febronio LH, Bergamini AM, Okino MH, Silva AA, Santiago R, Capuano DM, Oliveria MA, Takayanagui AM. Monitoring of Lettucecrops of Riberiao Preto, Brazil. Review of Society Brasil Medicine Tropical. (2000);33:169-174. http://doi.org/10.1590/S0037-86822000000200002

14. Vazquez Tsuji O, Martinez Barbarosa I, Tay-Zavala J, Ruiz Hernandez A, Perez-Torres, TA. Vegetables for human consumption as probable source of *Toxocara* spp. infection in man. Bolivian Chileno de Parasitology. (1997);52:47–50.

15. Anonymus. (2023). Retrieved January 11, 2024, from https://eskisehir.tarimorman.gov.tr

16. Bier JW. Isolation of parasites on fruits and vegetables. Southeast Asian Journal of Tropical Medicine Public Health. (1991);22:144-145.

17. Gül C, Nazlıgül C. Helmint enfeksiyonlarına güncel yaklaşım. Dirim Tıp Gazetesi. (2008);83:40-48.

18. Kozan E, Kircali SF, Köse M, Eser M, Cicek H. Afyonkarahisar'da tarımsal amaçlı kullanılan atık suların helmint kontaminasyonu yönünden incelenmesi. Türkiye Parazitoloji Dergisi. (2007);31:197-200.

19. Avcioglu H, Soykan E, Tarakci U. Control of helminth contamination of raw vegetables by washing. Vector Borne and Zoonotic Diseases. (2011);11(2):189-191. https://doi.org/10.1089/vbz.2009.0243

20. Adanir R, Tasci F. Prevalance of helminth eggs in raw vegetables consumed in Burdur, Turkey. Food Control. (2013);31:482-484. https://doi.org/10.1016/j.foodcont.2012.10.032

21. Ulukanligil M, Seyrek A, Aslan G, Ozbilge H, Atay S. Environmental pollution with soil-transmitted helminths in Sanliurfa, Turkey. Memorias do Instituto Oswaldo Cruz. (2001);96(7):903-909. https://doi.org/10.1590/S0074-02762001000700004

22. Erez MS, Kozan E, Göksu A. Detection of helminth egg contamination on raw vegetables in Afyonkarahisar, Turkey. Kocatepe Veterinary Journal. (2022);15(4):374-380. https://10.30607/kvj. 1158402

23. Aydenizöz M, Gökpinar S, Gazyagci AN. Investigation of parasitological contamination in leafy vegetables in Kırıkkale of Turkey. Animal Health Production and Hygiene. (2017);6(1): 463-467.

24. Luz JGG, Barbaso MV, Carvalho AG, Resende SD, Dias JVL, Martins HR. Contamination by intestinal parasites in vegetables marketed in an area of JequitinhonhaValley, Minas Gerais, Brazil. Rev. Nutr. Campinas. (2017);30(1):127-136. https://doi.org/10.1590/1678-98652017000100012

25. Bekele F, Tefera T, Biresaw G, Yohannes T. Parasitic contamination of raw vegetables and fruits collected from selected local markets in Arba Minch Town, Southern Ethiopia. Infectious Diseases of Poverty. (2017);6(19):1-7. https://doi.org/10.1186/s40249-016-0226-6

26. Amuta EU, Obisike VU, Acham NI. Prevalence of helminth eggs on raw vegetables and fruits sold in selected markets in Makurdi. Benue State, Nigeria. ARRB. (2017);19(4):1-6. https://doi.org/10.9734/ARRB/2017/35806

27. Ishaku A, Ishakeku D, Agwale S. Prevalence of parasitic contamination of some edible vegetables sold at Alhamis Market in Lafia Metropolist. Scholarly Journal Biotechnology. (2013);2(2):26-29.

28. Dada EO, Olusola-Makinde OO. Microbial and parasitic contamination on vegetables collected from retailers in main market, Akure, Nigeria. American Journal of Microbiological Research. (2015);3(3):112-117. https://doi: 10.12691/ajmr-3-3-3

29. Idahosa OT. Parasitic Contamination of fresh vegetables sold in Jos Markets, National Veterinary Research Institute (NVRI), Vom, PlateauState, Nigeria. Global Journal of Medical Research. (2011);11(1), Online ISSN: 0975-5888.

30. Adamu NB, Adamu JY, Mohammed D. Prevalence of helminth parasites found on Vegetables Sold in Maiduguri, Northeastern Nigeria. Food Control. (2012);25:23-26. https://doi.org/10.1016/j.foodcont.2011.10.016

31. Doğan N, Kiraz N, Bolatlı T, Durmaz G, Akşit F, Akgün Y. Eskişehir Anadolu Üniversitesi Tıp Fakültesi Hastanesinin 10 yıllık bağırsak parazitleri inceleme sonuçları. Türkiye Parazitoloji Dergisi. (1993);17(1): 36-42

32. Doğan N, Demirüstü C, Aybey A. Eskişehir Osmangazi Üniversitesinin beş yıllık bağırsak paraziti prevalansının türlere ve cinsiyetlere göre dağılımı. Türkiye Parazitoloji Dergisi. (2008);32(2):120-125.

33. Gökler ME, Doğan N, Ayhan E, Koçman, Buğrul N, Işıklı B. İlköğretim çağındaki öğrencilerde bağırsak paraziti sıklığı ve sağlık eğitiminin parazitlilik düzeyine etkisi. Medical Research Reports. (2019);2(1):9-12.