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Research Article

Contamination of some Vegetables with parasites in Amedi District – Kurdistan Region

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Abstract

The current study investigated the presence of parasitic infective stages, such as ova, oocysts, and cysts, in infected raw vegetables in Amedi District. Out of 700 fresh vegetable samples were obtained from various locations, including home gardens, vegetable fields, and local markets. Various types of vegetables were examined, such as Lettuces (127), Cabbage (106), Celery (130), Parsley (165), Carrot (64), and Radish (108). Helminth ova, cysts, and oocysts of different parasites were found in 593 (84.71%) samples. *E. granulosus* ova were found in 117 (16.71%), followed by *E. histolytica* cysts in 107 (15.28%), *Giardia* cysts in 106 (15.14%), *Toxoplasma gondii* oocysts in 95 (13.57%), *Ascaris* ova in 71 (10.14%), *Hymenolepis nana* in 51 (7.28%), and *Toxocarra* ova in 46 (6.57%). The contamination rates of *T. gondii*, *Hymenolepis nana* ova, *Toxocarra* ova, and *E. histolytica* cysts were significantly higher ($P < 0.05$) compared to other helminths and protozoans such as *E. granulosus* ova, *Giardia* cyst, and *Ascaris* ova. In conclusion, eating raw and unwashed vegetables may be contaminated with ova, oocysts, or cysts of parasites, and contamination might be greatly underestimated, particularly in areas with inadequate sanitation. Vegetables can become contaminated with parasites in a variety of ways, such as during production, processing, storage, and sales. Therefore, contamination may be eliminated by implementing sanitary measures at every stage of production and consumption.

Keywords: vegetables, ova, oocyst, cyst, Amedi

Introduction

Fresh vegetable consumption has been connected to an increase in foodborne illness cases reported in recent years (Herman et al., 2015). One important epidemiological factor in the spread of parasitic food-borne illnesses is the intake of raw or unwashed vegetables (Duedu et al., 2014; Mahmood et al., 2011). The high prevalence of intestinal parasites in poorer nations is likely caused by inadequate personal hygiene and poor sanitation (Bouzid et al., 2018; Julian, 2016). Humans require a variety of critical vitamins, minerals, and fibers, all of which are found in vegetables (Olza et al., 2017; Abdullah, 2021). Consuming fruits and vegetables that are raw or unwashed seems to increase the chance of infection (Fathailah, 1988). If contaminated, these fresh veggies may serve as a significant reservoir for certain food-borne pathogenic microbes (Dawson, 2005; Utaaker et al., 2017; Guirges & Al-Mofti, 2005). The process of producing is handled by several microbes. Diarrheal illnesses can be caused by a variety of infections, with intestinal protozoan parasites being one of the main causes that can be spread by contaminated food consumption (Ryan et al., 2018; Fletcher et al., 2012). Chronic to severe diarrhea, occasionally accompanied by nausea, vomiting, anorexia, exhaustion, low-grade fever, and weight loss, are the hallmarks of intestinal protozoan infections (Ryan et al., 2017; Giangaspero & Gasser, 2019). The objective of this study was to investigate how contaminated vegetables contribute to the transmission of various species of parasites that can potentially infect humans in the designated area.

Materials and methods

A total of 700 fresh vegetable samples were obtained from various locations in the Amedi district throughout the year 2023, encompassing Lettuce, Cabbage, Celery, Carrot, Parsley, and Radish. These six types of fresh vegetables were collected from different sites within the Amedi district, such as private gardens, vegetable fields, and local markets. For parasitological investigation, the vegetable samples were collected into sterile plastic bags, labeled, and put in a cool box, then transferred to the Medical Laboratory Department's Microbiology and Parasitology Laboratory at Amedi Technical Institute. With a sterile knife and wood pad, each vegetable weighing about 200 grams was collected. All samples were soaked with 500 mL of normal saline (0.85% NaCl) for 20 minutes in a clean beaker. After removing the samples from the beaker, the washing solution was kept for 30 minutes to ensure that the parasite stages were properly sedimented. The supernatant was discarded, and 15 ml of the sediment was examined under the microscope, a drop of Lugol's iodine added for each slide to identify parasitic ova and cysts. To find oocysts of *Cryptosporidium*, the amount of sediment was processed and examined using the Modified Ziehl-Neelsen staining method.

Statistical Analysis

The data was examined utilizing the Statistical Package for Social Science (SPSS). The chi-square test and T test were employed to assess statistically noteworthy distinctions, with P-values < 0.05 denoting significant variances between the two groups.

Results

Out of 700 fresh vegetable samples examined, for helminthes ova, cysts and oocysts of parasites were found in 593 (84.71%) samples. The results revealed 4 types of helminths and 2 types of protozoa. The ova of *E. granulosus* was the highest rate in 117 (16.71%) samples, followed by *E. histolytica* cyst in 107 (15.28%), *Giardia* cyst in 106 (15.14%), *Toxoplasma gondii* oocyst in 95 (13.57%), *Ascaris* ova in 71 (10.14%), *Hymenolepis nana* ova in 51 (7.28%), and *Toxocara* ova in 46 (6.57%) as shown in (Table 1).

Table 1. Number and Percentage of Contamination of Vegetables with different parasites in the Amedi District (n=700*)*.

Types of Parasites	Parasitic stages	Number of Contaminated Vegetable Samples	Percentage
Echinococcus granulosus	Ova	117	16.71%
E. histolytica	*Cyst*	107	15.28%
Giardia	cyst	106	15.14%
Toxoplasma gondii	Oocyst	95	13.57%
Ascaris	Ova	71	10.14%
Hymenolepis nana	Ova	51	7.28%
Toxocara	Ova	46	6.57%
Total		593	84.71%

Table (2) indicates that *E. granulosus* ova were detected in 17/130 (13.07%) samples of Celery, 20/127 (15.74%) in Lettuce, 25/106 (23.58%) in Cabbage, 15/165 (9.09%) in Parsley, 29/64 (45.31%) in Carrot, and 11/108 (10.18%) in Radish. These proportions did not show statistically significant differences (p=0.033) when compared to other helminths.

On the other hand, *T. gondii* oocysts were found in 5/130 (3.84%) Celery samples, 16/127 (12.59%) in Lettuce, 34/106 (22.07%) in Cabbage, 20/165 (12.12%) in Parsley, 2/64 (3.12%) in Carrot, and 30/108 (27.77%) in Radish. These percentages revealed highly significant differences (p=0.00) when compared with other helminths.

Hymenolepis nana ova were present in 30/130 (23.07%) Celery samples, 13/127 (10.23%) in Lettuce, 15/106 (14.15%) in Cabbage, 28/165 (16.96%) in Parsley, 9/64 (14.06%) in Carrot, and 11/108 (10.18%) in Radish. These findings also demonstrated highly significant differences (p=0.00) compared to other helminths.

Regarding *Ascaris* ova, they were identified in 13/130 (10.0%) Celery samples, 15/127 (11.81%) in Lettuce, 28/106 (26.41%) in Cabbage, 7/165 (4.24%) in Parsley, 12/64 (18.75%) in Carrot, and 20/108 (18.51%) in Radish. However, these proportions did not show statistically significant differences (p=0.115) when compared with other helminths. *Giardia* cysts were identified in 4/130 (3.07%) Celery samples, 15/127 (11.81%) in Lettuce, 21/106 (19.81%) in Cabbage, 11/165 (6.66%) in Parsley, 15/64 (23.43%) in Carrot, and 5/108 (4.62%) in Radish. These percentages did not exhibit statistically significant differences (p=0.083) when compared with other helminths. *Toxocara* ova were present in 1/130 (0.76%) Celery samples, 10/127 (7.87%) in Lettuce, 15/106 (14.15%) in Cabbage, 15/165 (9.09%) in Parsley, 3/64 (4.68%) in Carrot, and 7/108 (6.48%) in Radish. These proportions showed highly significant differences (p=0.002) when compared with other helminths. *E. histolytica* cysts were detected in 2/130 (1.53%) Celery samples, 8/127 (6.29%) in Lettuce, 21/106 (19.81%) in Cabbage, 3/165 (1.81%) in Parsley, 5/64 (7.81%) in Carrot, and 7/108 (6.48%) in Radish. These findings also demonstrated statistically highly significant differences (p=0.008) when compared with other helminths.

Table 2. Number and percentage of contaminated different vegetable samples with parasites in Amedi District (n=700).

Types and number of vegetables samples	Number and percentage of contaminated vegetables samples with different parasites						
	E.granulosus	*T.gondii*	*Hymenolepis nana*	*Ascaris*	*Giardia*	*Toxocara*	*E.histolytica*
Celery (130)	17 (13.07)	5 (3.84)	30 (23.07)	13 (10.0)	4 (3.07)	1 (0.76)	2 (1.53)
Lettuce (127)	20 (15.74)	16 (12.59)	13 (10.23)	15 (11.81)	15 (11.81)	10 (7.87)	8 (6.29)
Cabbage (106)	25 (23.58)	34 (32.07)	15 (14.15)	28 (26.41)	21 (19.81)	15 (14.15)	21 (19.81)
Parsley (165)	15 (9.09)	20 (12.12)	28 (16.96)	7 (4.24)	11 (6.66)	15 (9.09)	3 (1.81)
Carrot (64)	29 (45.31)	2 (3.12)	9 (14.06)	12 (18.75)	15 (23.43)	3 (4.68)	5 (7.81)
Radish (108)	11 (10.18)	30 (27.77)	11 (10.18)	20 (18.51)	5 (4.62)	7 (6.48)	7 (6.48)
Total (700)	117 (16.71)	107 (15.28)	106 (15.14)	95 (13.57)	71 (10.14)	51 (7.28)	46 (6.57)
P value ($p < 0.01$)	0.033 NS.	0.00 HS.	0.005 S.	0.115 NS.	0.083 NS.	0.002 HS.	0.008 HS.

Discussion

A toral of 700 vegetable samples analyzed, 593 (84.7%) tested positive for various types of helminth ova and protozoan cysts. The investigation highlighted substantial contamination of vegetables by parasites. These findings align with research conducted in numerous cities globally, indicating widespread contamination of vegetables with helminth egg ova, cysts, and protozoan oocysts.

In the current study, the distribution of *E. granulosus* ova was 16.71%. These results agree with the results of Saida and Nouraddin (2011) in Mosul, who showed that 22.4% of vegetables were found contaminated with the eggs of dog worm (*E. granulosus*), which suggests that stray dogs, the definitive hosts, are still highly infected with this parasite. *T. gondii* oocysts were positive in 15.28% of vegetable samples, agreeing with findings from Faraj (2000) in Erbil city, who reported 18.3% contamination with *T. gondii* oocysts. This is similar to what was reported by Al-Niaeemi et al. (2022) in Erbil city, who found a significant relationship between vegetable contamination and washing practices. This may be due to the abundance of stray cats in the area, increased environmental humidity which aids oocyst survival and possible contamination of water sources, including spring water, with cat feces containing oocysts.

Hymenolepis nana ova were present in 15.14% of the six vegetable types examined, which aligns with the results of Faraj (2000) in Erbil city, who reported 4.08% contamination with *H. diminuta* and 10.20% with *H. nana*. Another study by Mirzaei et al. (2021) in Mosul City also supports these findings, reporting an 11% contamination rate with *H. nana*. The current study results are consistent with several studies conducted in Baghdad and other Iraqi provinces (Dawson, 2005; Guirges & Al-Mofti, 2005).

Ascaris ova were found in 13.57% of contaminated vegetable samples in this study, which is in agreement with the findings of Mirzaei et al. (2021) in Soran city, who reported 12% contamination with *Ascaris* ova. *Giardia* cysts were detected in 10.14% of vegetable samples, aligning with Abdullah (2021) in Duhok City (4.2%) and Mirzaei et al. (2021) in Soran City (10.6%). Regarding *Toxocara*, the present study recorded a contamination rate of 7.28%, which is consistent with Mirzaei et al. (2021) in Soran City (6.6%). Higher contamination (12.2%) with *Toxocara* eggs was reported by Utaaker et al. (2017) in Erbil city. *E. histolytica* cysts were found in 6.57% of examined vegetables, which is in agreement with Abdullah (2021) in Duhok City (5.4%), and a high level of contamination was also reported by Mirzaei et al. (2021) in Mosul City (45%).

The variations observed across studies can be attributed to several factors, including climatic and environmental conditions, dog and cat population densities, soil composition, sample sizes, seasons of sample collection, vegetable storage practices, and examination methods. Moreover, the sampling locations, defecation behavior of animals in sampled areas, egg recovery techniques, and high prevalence of certain helminths may be linked to the use of human and animal feces as fertilizer, which remains a common practice on Iraqi farms.

Soil contamination can result from poor environmental sanitation, especially where stray dog populations are high. These dogs tend to frequent such areas, and the persistent humidity allows helminth eggs to remain viable in moist soil for extended periods. In contrast, prolonged sun exposure in arid, sparsely vegetated areas accelerates egg degradation. Climatic factors such as temperature, humidity, rainfall, soil pH, and soil type critically influence egg viability and development. Consequently, differences in climate across locations or seasons can cause fluctuations in soil contamination rates throughout the year or over successive years. In Iraq, contamination peaks in winter and spring, when favorable conditions like mild temperatures, humidity, and rainfall dominate.

Conclusion

The current research always suggests the need for increased attention towards enhancing personal and food hygiene practices to prevent the transmission of infective stages of parasites to humans through contaminated vegetables. Eating raw and unwashed vegetables may be contaminated with parasitic stages and might be greatly underestimated, particularly in areas with inadequate sanitation. Vegetables can become contaminated with parasites in a variety of ways, such as during production, processing, storage, and sales. Therefore, contamination may be eliminated by implementing sanitary measures at every stage of production and consumption.

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