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Parasitological contamination in salad vegetables in Tripoli-Libya

Amal Khalifa Abougrain [a], Mohamed Hadi Nahaisi [a], Nuri Sahli Madi [a], Mohamed Mohamed Saied [b], Khalifa Sifaw Ghenghesh [c,*]

[a] Faculty of Agriculture, Al-Fateh University, Libya
[b] Faculty of Medical Technology, Al-Fateh University for Medical Sciences, Tripoli, Libya
[c] Faculty of Medicine, Al-Fateh University for Medical Sciences, Tripoli, Libya

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ABSTRACT

Background: Fresh vegetables are an important part of a healthy diet. Raw vegetables can be agent of transmission of intestinal parasites. The aim of the present study was to determine the parasitological contamination of salad vegetables sold at wholesale and retail markets in Tripoli-Libya.
Methods: A total of 126 samples of salad vegetables obtained from wholesale and retail markets were examined for helminth eggs and *Giardia* spp. cysts of using standard methods.
Results: Of the 36 tomato, 36 cucumber, 27 lettuce, and 27 cress samples examined eggs of *Ascaris* spp. were detected in 19%, 75%, 96% and 96%, respectively; eggs of *Toxocara cati* in 11%, 14%, 48% and 41%; eggs of *Toxocara canis* in 3%, 8%, 37% and 33%; and eggs of *Taenia/Echinococcus* spp. in 6%, 25%, 33% and 30%, respectively. Cysts of *Giardia* spp. were detected in 3%, 19%, 4% and 11%, respectively.
Conclusion: Parasitological contamination of raw salad vegetables sold in wholesale and retail markets in Tripoli may pose a health risk to consumers of such products.

1. Introduction

An important ingredient of healthy diet is raw (fresh) vegetables. Vegetables can become contaminated with enteric bacterial, viral and parasitic pathogens through out the process of planting to consumption. The extent of contamination depends on several factors that include, among others, use of untreated wastewater and water supplies contaminated with sewage for irrigation, post-harvest handling, and hygienic conditions of preparation in food service or home settings (Amoah, Drechsel, Abaidoo, & Klutse, 2007; Beuchat, 2002; Simões et al., 2001).

Fresh vegetables can be agents of transmission of protozoa cysts and helminths eggs and larvae (Choi, Ock, & Suh, 1982; Coelho, Oliveira, Milman, Karasawa, & Santos, 2001; Daryani, Ettehad, Sharif, Ghorbani, & Ziaei, 2008; Erdogrul & Sener, 2005) and outbreaks of intestinal parasitic infections epidemiologically associated with raw vegetables have been reported from developed and developing countries (Ortega et al., 1997; Mintz, Hudson-Wragg, Meshar, Carter, & Hadler, 1993).

Information on intestinal parasites prevalence in fresh vegetables sold in Libyan and the neighboring North African countries markets is not available. This information is required to assist the local and health authorities to be able to take the proper actions to improve the quality of such foods. In recent years Libya has been opened to international travel and tourism which makes such information of paramount importance to the international community as a whole. Therefore, the main objective of the present study was to determine the parasitological contamination of fresh salad vegetables sold in wholesale and retail markets in Tripoli city.

2. Materials and methods

A total of 126 samples of fresh salad vegetables were collected during their production seasons (between July 2005 and February 2006) from two wholesale and seven retail markets in Tripoli, Libya were included in the study. These constituted of 8 and 28 samples of tomatoes, 8 and 28 samples of cucumber, 6 and 21 samples of lettuce and 6 and 21 samples of cress from wholesale and retail markets, respectively. Collected fresh vegetables were examined for helminth eggs and *Giardia* cysts as previously reported (Erdogrul & Sener, 2005). Each fresh vegetable sample was weighted (100 g) into sterile plastic bags and washed with physiological saline solution (0.85% NaCl). The washing water was left for 10 h for sedimentation to take place and then the top layer was discarded and the remaining washing water centrifuged at 2164 g for 15 min. The supernatant was discarded, the residue carefully collected and examined in lugol stained slides (three for each sample) through light microscopy. Cysts and eggs of parasites

* Corresponding author. Address: Department of Microbiology and Immunology, Faculty of Medicine, Al-Fateh University of Medical Sciences, P.O. Box 80013, Tripoli, Libya.
E-mail address: ghenghesh_micro@yahoo.com (K.S. Ghenghesh).

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found under the microscope were identified as previously described (Downes & Ito, 2001).

For statistical analysis, the Epi-2000 software (Centers for Disease Control and Prevention [CDC], Atlanta, USA) was employed. *P*-values were calculated using Chi-squares test or Fisher's exact test wherever appropriate. A *P*-value <0.05 was considered statistically significant.

3. Results

Helminth eggs and *Giardia* cysts were detected in 58% (73/126) of fresh salad vegetables examined. These include 14% (5/36) of tomato, 42% (15/36) of cucumber, 96% (26/27) of lettuce and 100% (27/27) of cress samples. Cucumber, lettuce and cress samples were contaminated significantly more often than those of tomato samples with intestinal parasites ($P < 0.009$, Odds ratio = 4.43; $P < 0.0000000$, Odds ratio = 161.20 and $P < 0.0000000$, Odds ratio = undefined, respectively).

Of the 36 tomato, 36 cucumber, 27 lettuce, and 27 cress samples examined eggs of *Ascaris* spp. were detected in 19%, 75%, 96% and 96%, respectively; eggs of *Toxocara cati* in 11%, 14%, 48% and 41%; eggs of *Toxocara canis* in 3%, 8%, 37% and 33%; and eggs of *Taenia/Echinococcus* in 6%, 25%, 33% and 30%, respectively. Cysts of *Giardia* spp. were detected in 3%, 19%, 4% and 11%, respectively. *T*oxocara *cati* and *T. canis* were detected significantly in total lettuce and cress samples than in total tomato and cucumber samples. In addition, eggs of *Taenia*/*Echinococcus* were detected significantly in total lettuce and cress samples than in tomato samples. Table 1 shows the prevalence of intestinal parasites in fresh salad vegetables from wholesale and retail markets in Tripoli.

4. Discussion

In developing countries intestinal parasites are very common. Fresh vegetables are an important route of their transmission. Recently, Daryani et al. (2008) reported the detection of intestinal parasites in 29% (13/45) of native garden vegetables consumed in Ardabil city, Iran. We examined 126 samples of four different types of fresh salad vegetables from wholesale and retail markets in Tripoli, of which 58% were positive for helminth eggs and *Giardia* spp. cysts.

Fresh vegetables like tomatoes and cucumbers are important ingredients of the traditional Libyan summer salad (known locally as "slatha"). Summer salad is a main meal that is eaten by itself and often prepared by the beach for an easy and light lunch after swimming in the sea (http://www.temehu.com/Libyan-food.htm). Inclusion of highly contaminated fresh salad vegetables in traditional and familiar foods certainly will expose consumers of such foods to the risk of acquiring intestinal parasites.

Eggs of *Ascaris* were detected in 68% (85/126) of vegetables examined being the predominant intestinal parasite in the present work. A study from Saudi Arabia reported the detection of *Ascaris lumbricoids* in 16% of leafy vegetables examined (Al-Binali, Bello, El-Shewy, & Abdulla, 2006). Another study from Iran, reported prevalences of 25% and 29% for pathogenic parasites in vegetables of markets and gardens, respectively with *A. lumbricoids* eggs being detected in 2% of samples examined (Daryani et al., 2008).

Reports on the prevalence of *Toxocara* spp. in fresh vegetables in the literature are few. Kozan, Gonenc, Sarimehmetoglu, and Aycicek (2005) detected *Toxocara* spp. in 1.5% of unwashed raw vegetables used for salad. We detected eggs of *T. cati* and *T. canis* in 26% and 18% of fresh salad vegetables studied, respectively.

Erdogrul and Sener (2005) found *Giardia* cysts in 5.5% of different fresh vegetables (lettuce, parsley, cress, and spinach). However, they found *Giardia* only in lettuce samples. In the present investigation, *Giardia* cysts were detected in 10% of the total vegetable samples examined. Contrary to the findings of Erdogrul and Sener (2005) we found *Giardia* cysts in the different vegetables examined with cucumber samples being most contaminated (19%), followed by cress (11%), lettuce (4%) and tomato (3%) samples.

The observed differences in prevalence rates of the different pathogenic intestinal parasites from fresh vegetables reported in the present work and those reported by others is expected. Several factors may contribute to such differences. These may include, among other factors, geographical location, type and number of samples examined, methods used for detection of the intestinal

Table 1
Prevalence of intestinal parasites in fresh salad vegetables from wholesale and retail markets in Tripoli, Libya.

Parasite	No. (%) positive												
	Tomato			Cucumber			Lettuce			Cress			Total ($n = 126$)
	Wholesale ($n = 8$)	Retail ($n = 28$)	Total ($n = 36$)	Wholesale ($n = 8$)	Retail ($n = 28$)	Total ($n = 36$)	Wholesale ($n = 6$)	Retail ($n = 21$)	Total ($n = 27$)	Wholesale ($n = 6$)	Retail ($n = 21$)	Total ($n = 27$)	
Ascaris eggs	3(38)	4(14)	7(19)	7(88)	20(71)	27 (75)[a]	5(83)	21(100)	26(96)[b]	6(100)	20(95)	26(96)[c]	85(68)
Toxocara cati	1(13)	3(11)	4(11)	1(13)	4(14)	5(14)	4(67)	9(43)	13(48)[f]	1(17)	10(48)	11(41)[i]	33(26)
Toxocara canis	0(0)	1(4)	1(3)	1(13)	2(7)	3(8)	3(50)	7(33)	10(37)[g]	3(50)	6(29)	9(33)[j]	23(18)
Taenia/ Echinococcus	0(0)	2(7)	2(6)	2(25)	7(25)	9(25)[d]	2(33)	7(33)	9(33)[h]	2(33)	6(29)	8(30)[k]	28(22)
Giardia cycts	0(0)	1(4)	1(3)	2(25)	5(18)	7(19)[e]	0(0)	1(5)	1(4)	1(17)	2(10)	3(11)	12(10)

[a] *Ascaris* eggs were detected significantly more often in total cucumber samples than in tomato samples ($P < 0.000003$, Odds ratio = 12.43).
[b] *Ascaris* eggs were detected significantly more often in total lettuce samples than in tomato samples ($P < 0.0000000$, Odds ratio = 107.71).
[c] *Ascaris* eggs were detected significantly more often in total cress samples than in tomato samples ($P < 0.0000000$, Odds ratio = 107.71).
[d] *Taenia/Echinococcus* were detected significantly more often in total cucumber samples than in tomato samples ($P < 0.03$, Odds ratio = 5.67).
[e] *Giardia* cysts were detected significantly more often in total cucumber samples than in tomato samples ($P < 0.03$, Odds ratio = 5.48).
[f] *Toxocara cati* was detected significantly more often in total lettuce samples than in tomato and cucumber samples ($P < 0.002$, Odds ratio = 7.43 and $P < 0.003$, Odds ratio = 5.76, respectively).
[g] *Toxocara canis* was detected significantly more often in total lettuce samples than in tomato and cucumber samples ($P < 0.0004$, Odds ratio = 20.59 and $P < 0.006$, Odds ratio = 6.47, respectively).
[h] *Taenia/Echinococcus* were detected significantly more often in total lettuce samples than in tomato samples ($P < 0.005$, Odds ratio = 8.50).
[i] *Toxocara cati* was detected significantly more often in total cress samples than in tomato and cucumber samples ($P < 0.007$, Odds ratio = 5.50 and $P < 0.02$, Odds ratio = 4.26, respectively).
[j] *Toxocara canis* was detected significantly more often in total cress samples than in tomato and cucumber samples ($P < 0.002$, Odds ratio = 17.50 and $P < 0.02$, Odds ratio = 5.50, respectively).
[k] *Taenia/Echinococcus* were detected significantly more often in total cress samples than in tomato samples ($P < 0.01$, Odds ratio = 7.16).

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parasites, type of water used for irrigation, and post-harvesting handling methods of such vegetables.

Yaghan, Bani-Hani, and Heis (2004), in Jordan, interviewed 55 patients with hydatid disease. All patients gave history of contact with dogs since their childhood, and history of lifelong ingestion of raw vegetable food. The ingested vegetables included lettuce, celery, parsley, dill, scallion, mint, and coriander. Hydatid disease due to *Echinococcus granulosus* is a common condition in Libya with an incidence of nearly 12% in children below ten years of age in the eastern region of the country (Kalani, Ojha, Bhargava, & Broadhead, 1984). Shambesh, Macpherson, Beesley, Gusbi, and Elsonosi (1992) screened a total of 4103 people in an ultrasound survey of hydatid disease in five areas of northwestern Libya and reported an overall prevalence of 2.0%. They also reported that Libyan people keep guard dogs however, there is little direct human:dog contact. The investigators of the study suggested that the transmission of hydatid disease in Libya is probably indirect by ingestion of eggs from contaminated vegetables or drinking water (Shambesh et al., 1992). In the present study, eggs of *Tinea/Echinococcus* were detected in 25% or more of cucumber, lettuce and cress samples examined. However, further studies are needed to confirm the role of contaminated salad vegetables in the transmission of hydatid disease in the country.

Use of sewage contaminated water for irrigation of vegetables is a common practice in developing countries including Libya. Ulukanligil, Seyrek, Aslan, Ozbilge, and Atay (2001), in Sanliurfa, Turkey, detected soil-transmitted helminthes (mainly *A. lumbricoides*) in 14% (14/100) of fresh vegetables, in 84% of soil samples where vegetables are cultivated and in 61% of irrigation water. Although we did not examine samples of irrigation water, our findings strongly indicate that the vegetables examined were irrigated with sewage water. Farmers need to be educated on the risk to the public associated with use of sewage contaminated water for irrigation. Also, there is a need to inform the public in general and restaurant owners in particular of importance of properly washing/disinfecting raw vegetables before consumption. Kozan et al. (2005) examined 203 unwashed and 406 washed samples of different vegetables. They detected helminth eggs in 5.9% of unwashed samples and not in any washed samples ($P < 0.05$).

In conclusion, contamination of fresh salad vegetables sold in wholesale and retail markets in Tripoli with pathogenic intestinal parasites may pose a health risk to consumers of such products. The local health and environmental authorities should educate the public on the health hazards of fresh salad vegetables and the importance of washing and disinfecting them before consumption. Furthermore, an adequate treatment of the sewage water and banning wastewater use for irrigation of plants intended for human consumption, among others, should be implemented.

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