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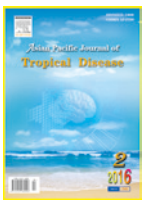

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# Diversity of parasitic contamination in raw vegetables commonly consumed in Shiraz, southwest of Iran

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ABSTRACT

**Objective:** To evaluate the parasitic contamination of row vegetables at farms and retails, separately.
**Methods:** A total of 224 samples from 8 different kinds of vegetables were randomly collected from the retails and farms (retails: 80; farms: 144) in the same area and then were tested for helminth egg, *Giardia* spp. cysts and *Cryptosporidium* spp. oocysts by using sedimentation, floatation and common staining methods.
**Results:** In total, 31.2% (25/80) and 36.8% (53/144) of retails and farms vegetables were contaminated with a variety of parasites, respectively. Parasites detected in retail and farm vegetables were *Giardia* cysts (3.7% and 4.8%), *Taenia* spp. eggs (2.5% and 4.1%), *Trichostrongylus* eggs (2.5% and 2.0%), *Ascaris* eggs (2.5% and 2.0%), *Hymenolepis* egg (1.2% and 0.0%), *Cryptosporidium* spp. (1.2% and 1.3%) and *Trichuris* eggs (0.0% and 1.3%).
**Conclusions:** Based on our results, fresh vegetables can be a source of food-borne parasitic disease in humans. Public educationand awareness, washing vegetables properly and improving of sanitary and irrigation conditions of these kinds of food should be necessary.

## 1. Introduction

Intestinal parasites are among the main public health problems around the world especially in tropical and subtropical countries. Fruits and fresh vegetables are one of the important parts of daily diet. Foods can be contaminated with a variety of microorganisms such as bacteria, parasites and virus which can be pathogen for human. Fruits and vegetables normally are the potential sources of several parasitic infections in human, and may be contaminated from process and preparation from planting to consumption. The sources of zoonotic contamination are usually faeces which environmentally contaminate soil, water and products[1]. Fresh vegetables can be agents of transmission of protozoa cysts and helminths eggs and larvae[2-5]. The outbreaks of parasitic infections associated with fresh fruits and vegetables have been reported epidemiologically from different parts of the world[6,7]. There is an evidence that up to 60% of the world's population is infected with parasites which may be transmitted by oral-fecal/or indirect route, in this way vertebrate and arthropod vectors can have an important role in mechanical transmission and rarely from mother to offspring[8]. Numerous surveys and scientific studies have confirmed that vegetables can be a medium of transmission of protozoan cysts and oocysts, helminth eggs and larvae (*Hymenolepis*, *Taenia*, *Fasciola*, whipworm, *Trichostrongylus*, *Strongyloides* and hookworms) worldwide[2,3,5,9]. This issue causes a serious concern for the immunocompromised people, patients and elderly people. Additionally, contamination of such products affects trade across international borders, and causes policies concerning in food safety[10]. Moreover, trend to eat raw foods traditionally may be an important cause in food-borne parasitic infectious diseases[5], Also, in some areas using sewage in agricultural farms results in transmission of pathogenic organisms from irrigated soil to products and finally human[11,12]. The high occurrence of intestinal parasites including *Giardia*, *Blastocystis hominis*, *Ascaris lumbricoides*, *Hymenolepis nana* and *Taenia* spp. have been reported in Iran by Daryani and Ezatpour[13,14]. Probably major causes of this kind of infection can be sanitation issues, poor hygiene and eating raw foods. The parasitic contamination of fruits and vegetables still need to be estimated. Based on our knowledge, there are a few studies on freshly eaten vegetables in Iran, and referring to existing scientific literature, a few previous surveys have been conducted to evaluate the parasitic contamination of fresh vegetables in Shiraz area. This study was conducted to detect the parasitic contamination of some fresh vegetables which commonly used in Shiraz, Iran.

## 2. Materials and methods

### 2.1. The study area

A cross-sectional study was carried out on raw vegetables

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consumed in Shiraz, the capital of Fars Province, in Spring 2014. The city, with an estimated population of 1 460 665, is located in the southwest of Iran and the northwest of Fars Province. The climate is distinct, and is overall classed as a hot semi-arid climate. Summers are hot, with an average high of 38.8 ℃ (101.8 F) in July and winters are cool with average low temperatures below freezing point in December and January. Around 300 mm of rain falls in each year, almost entirely in the winter months.

### 2.2. Sample collection and laboratory examination

A total of 224 vegetable samples (retails: 80; farms: 144) from 8 different vegetables were collected for this survey: spinach, radish, leek, parsley, basil, dill, coriander and spearmint. These fresh vegetables were collected randomly from different retails and farms. Vegetables were weighed (200 g for each case) and put into sterile plastic bags separately, then washed with physiological saline solution (0.95% NaCl) and the washing water/saline was left for about 5 h for sedimentation. The supernatant was discarded and 5 mL of the remaining sediment washing water centrifuged at 1 500 g for 3 min. The supernatant water was discarded and the residue was carefully collected. All the samples were tested for the presence of oocysts and cysts of *Cryptosporidium* spp. and *Giardia* spp. by using the Ziehl-neelsen and Giemsa staining techniques, respectively. Moreover, samples were examined by Lugol stained slides through light microscopy to detecte eggs of parasites. Cysts and eggs of parasites found under the microscope were identified as described previously[15].

## 3. Results

A total of 31.2% (25/80) of retail vegetables and 36.8% (53/144) of farm vegetables were contaminated with different pathogen parasites. The data in Table 1 shows parasitological contaminations in vegetables. In most cases the diversity of parasites was more than one in each sample ($P < 0.05$). Prevalence of pathogenic parasites in farm vegetables was higher than that of retail ones. The most common parasites in retail and farm vegetables were *Giardia lamblia* (*G. lamblia*) (3.7% and 4.8%) ($P < 0.05$) and *Taenia* eggs (2.5% and 4.1%), respectively. Also parasitic contaminations according to different types of vegetables in retail and farm vegetables are showed in Table 2, separately. Leek (7/10) and radish (5/10) were the two most commonly contaminated vegetables in retails, significantly ($P < 0.05$). Overall, the most common parasite which was found in the retail and farm samples was *G. lamblia*.

**Table 1**

The number and percentage of different intestinal parasites in some raw vegetables. *n* (%).

| Parasites infection status | | Market vegetable (80) | Farm vegetable (144) |
|---|---|---|---|
| Polyparasitism | One parasite | 0 (0.0) | 1 (0.6) |
| | Two parasites | 4 (5.0) | 8 (5.5) |
| | Three parasites | 6 (7.5) | 11 (7.6) |
| Parasite name | *G. lamblia* | 3 (3.7) | 7 (4.8) |
| | *Taenia* spp. egg | 2 (2.5) | 6 (4.1) |
| | *Trichostrongylus* egg | 2 (2.5) | 3 (2.0) |
| | *Hymenolepis* egg | 1 (1.2) | 0 (0.0) |
| | *Ascaris* | 2 (2.5) | 3 (2.0) |
| | *Cryptosporidium* spp. | 1 (1.2) | 2 (1.3) |
| | *Trichuris* egg | 0 (0.0) | 2 (1.3) |
| Total | | 11 (13.6) | 15 (15.5) |

**Table 2**

The number and percentage of intestinal parasites in vegetables based on different raw vegetables. *n* (%).

| Name of vegetables | No. | Market vegetable | No. | Farm vegetable |
|---|---|---|---|---|
| Spinach | 10 | 2 (20) | 18 | 4 (22) |
| Radish | 10 | 5 (50) | 18 | 9 (50) |
| Leek | 10 | 7 (70) | 18 | 15 (83) |
| Parsley | 10 | 1 (10) | 18 | 3 (16) |
| Basil | 10 | 3 (30) | 18 | 8 (44) |
| Dill | 10 | 1 (10) | 18 | 2 (11) |
| Coriander | 10 | 2 (20) | 18 | 5 (27) |
| Spearmint | 10 | 4 (40) | 18 | 7 (38) |
| Total | 80 | 25 (31.2) | 144 | 53 (36.8) |

## 4. Discussion

Gastrointestinal parasites have a wide distribution. Fresh vegetables, and especially salads made by various raw vegetables, are an important route of transmission of intestinal parasites and have been shown to be an important source of food-borne outbreaks, especially in developing countries. Our study showed a considerable level of parasitic contamination of fresh vegetables in Shiraz (31.2%). Several studies on parasites from vegetables have been conducted in Iran. Our data in the present study was in agreement with the other study in Ardabil City, which reported 29% parasitic contamination of the vegetables, previously[4]. Recently, a 29% parasitic contamination of consumed native garden vegetables was reported from Ardabil City, Iran[4]. A higher rate of contamination (58% positive samples) of fresh vegetables was detected in wholesale and retail markets in Tripoli, Libya by Abougrain[16]. Also in Kenya, examination of vegetable samples revealed a high rate (75.9%) of intestinal parasitic contamination[17]. There were many studies on parasitic contaminations of native vegetables associated with unethical irrigation[18-20]. In the present study, eight types of common consumed raw vegetables in Shiraz were examined: spinach, radish, leek, parsley, basil, dill, coriander and spearmint. The highest rate of contamination among retail and farm vegetables was detected in leek samples (70% and 83%, respectively). This could be due to the fact that the degree of contamination varies according to the shape and surface of vegetables. Leek which has a long cylinder-like bundled leaf sheaths was most commonly contaminated, but in other study leek had the least contamination[14,20]. Crops with broad leaf would have large contact with the soil and would be more exposed to the contaminants[21]. The most common parasite which was found in the retail and farm samples in the present study was *G. lamblia* (3.7% and 4.8%) which was also in agreement with other studies in different areas[19,22]. Prevalence of *Giardia* spp. in other cities of Iran was as follow: Ahwaz 15.5%[23], Yasouj 11%[24], Hamadan 5%[25], Ardabil 8.9%[4,20], and Jiruft 14%[20,22,26]. In Norway and Costa Rica, the contamination rate of vegetables with *Giardia* was low (2% and 5%, respectively)[26,27]. Based on previous investigations in Shiraz, 10% of fresh vegetable was contaminated with *Giardia* cysts[16]. In this survey, 3.8% of retail vegetable and 2.7% of those cultivated in Shiraz farms were contaminated with *Taenia* eggs. This prevalence was low versus 16% which was recorded by Daryani[4]. Although *Taenia saginata* eggs are not infective for human, *Echinococcus* spp. eggs excreted by dogs are remarkable and can increase the risk of infection

with hydatid cyst in consumers. Thus it seems that in Shiraz areas dogs are commonly infected with adult *Taenia* spp. through contaminated crops and environment by excretion of *Taenia* and *Echinococcus* eggs, which increases the risk of human infection. Our results clearly show that raw vegetables consumed by people are quite often contaminated with different parasites. With regard to the role of vegetables in the transmission of pathogens to humans, especially parasites, the local and environmental authorities should improve the sanitary conditions in the areas where the vegetables are cultivated and consumed. Proper treatment of wastewater used for irrigation of vegetables should be implemented. Also media programs should be useful to the consumers, and will significantly reduce food-borne infectious disease among consumers.

## Conflict of interest statement

We declare that we have no conflict of interest.

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