



Contents lists available at ScienceDirect

Asian Pacific Journal of Tropical Disease

journal homepage: www.elsevier.com/locate/apjtd



Document heading doi:10.1016/S2222-1808(12)60012-7

## Assessing parasitic infestation of vegetables in selected markets in Metro Manila, Philippines

Glenn L Sia Su<sup>1\*</sup>, Clara Mae R Mariano<sup>2</sup>, Nikki Shayne A Matti<sup>2</sup>, Gliceria B Ramos<sup>2</sup><sup>1</sup>Biology Department, University of the Philippines–Manila, Philippine<sup>2</sup>Biology Department, De La Salle University–Manila, Philippine

## ARTICLE INFO

## Article history:

Received 13 June 2011

Received in revised form 27 July 2011

Accepted 4 September 2011

Available online 28 February 2012

## Keywords:

Parasite

Vegetable

Food safety

Biological hazard

## ABSTRACT

**Objective:** To assess the parasitic infestation of vegetables in selected markets in Metro Manila, Philippines. **Methods:** A total of 80 vegetables were purchased from public and private markets in Munoz, Quezon City, and Alabang, Muntinlupa City. Vegetables were washed, and the washings were collected and examined for parasitic organisms. **Results:** In all vegetables examined, 36 of 80 (45.0%) were infested with parasitic organisms. Vegetables obtained from Muntinlupa City showed that 17 of 40 (42.5%) have parasitic infestation as compared with those obtained from Quezon City with 19 of 40 (47.5%). Significant differences on the parasitic organisms existed between the public and private markets and between the two locations ( $P < 0.05$ ). **Conclusions:** Findings indicate that vegetables can be potential source of parasitic infection. There is a need to be vigilant in ensuring that foodstuffs sold in our market systems are safe and fit for consumption.

### 1. Introduction

Food is one of the basic necessities of every individual. Numerous people worldwide, including the Philippines, often cannot buy food that they need and do not have access to the resource. Years of concerted efforts have enabled Filipinos to produce food resources for the growing consumption demands, but the question of how safe our food resources sold in the market system still remains one of the critical and forefront issues. Over the years, a number of reports have revealed that both chemical and biological hazards have continuously contaminated our food resources. The concern on providing food on every Filipino table is not the only problem that our government system considers, but also the safeness of these foodstuffs.

Vegetables are important food commodities that provide numerous nutrients and serve as the daily sustenance to individuals. However, the consumption of vegetables has been a major way of transmitting contaminants, particularly parasitic organisms, leading to the increase of the number of

food-borne illnesses[1]. Reports have also revealed that the consumption of contaminated food resources, particularly vegetables, have resulted to morbidities and mortalities.

Food-borne diseases have always been one of the prevalent problems affecting the Filipino populace. A study has revealed that the most common cause of food-borne infections from the ingestion of contaminated vegetables have been attributed to infective agents, particularly parasites[2]. This food-borne diseases caused by parasitic organisms have been identified to be the cause of serious debilitations to individuals who ingest contaminated vegetables[3]. In the Philippines, as of 2004, parasitic worms were one of the major agents of food-borne diseases, which have caused at least 78.6 thousand deaths[4]. Millions of people across the world suffer from parasitic infections. These parasitic organisms are commonly transmitted through a fecal oral route to humans due to poor sanitation[5]; use of human feces, animal manure[6], and wastewater in the cultivation of vegetables[7]; and the improper handling, processing, storage, and transport of vegetables, particularly by handlers whose contaminated hands have not been properly washed after defecation[5] or from mechanical vectors transmitting the parasites from the feces to the foodstuff[8]. All of these conditions have contributed greatly to the dilemma of contaminating

\*Corresponding author: Glenn L Sia Su, 12D Cleveland Tower, Asiaworld, Paranaque City.

Tel: +6329946626

E-mail: glss76@yahoo.com

vegetables and making our foodstuffs unfit for consumption. The presence of the parasites in the foodstuffs like vegetables indicates high transmission risks of the parasites to the general public, hence increasing the burden of infection to people who have consumed these contaminated foodstuffs.

This study aims to assess the parasitic infestation of vegetables sold in selected market systems in Metro Manila, Philippines. The assessment of parasitic contamination in our foodstuffs, particularly vegetables, are vital, as these foodstuffs are readily available and affordable. Information obtained from this assessment may help in the development of preventive and control strategies that will raise people's awareness and will safeguard the general public's health and welfare. Likewise, the results of this study are vital in the determination of the safeness of our foodstuffs, particularly vegetables, sold in the market systems in Metro Manila, Philippines.

## 2. Materials and methods

This study was carried out from February 2011 to April 2011 in Munoz, Quezon City, and in Alabang, Muntinlupa City. Fresh vegetables were bought from both public markets (open-air markets) and private markets (supermarkets). A total of 80 vegetable samples, including pechay (*Brassica rapa*) and lettuce (*Lactuca sativa*), were randomly selected. All vegetables purchased were placed in individual plastic bags, transported to the laboratory, and washed, and the washings were collected for examination through the concentration method. The supernatant was discarded, and the filtrate was centrifuged for 10 min at 3200 rpm. The sediment was collected and examined in Lugol-stained slides through light microscopy.

Parasitic infestation on the vegetables were determined. Significant differences in the prevalence of parasitic organisms in the public and private markets and the market system in Munoz, Quezon City, and Alabang, Muntinlupa City, were determined using the paired t test. The null hypothesis for the t test indicated no significant difference, whereas the alternate hypothesis presented a significant difference. The test indicating  $P < 0.05$  could be a reason to conclude that the differences between the markets and locations were significant.

## 3. Results

A total of 80 vegetable samples were assessed for parasitic infestation; 20 samples for each species were collected: lettuce and pechay were from the two public markets and two private markets in Quezon City and Muntinlupa City. In all vegetables examined, 36 of 80 (45.0%) were infested with parasitic organisms. Vegetable samples obtained from Muntinlupa City showed 17 of 40 (42.5%) were with parasitic infestation, whereas 19 of 40 (47.5%) of vegetable samples obtained from Quezon City had parasitic infestation. Vegetable samples purchased from public markets showed 21 of 40 (52%) of parasitic infestation as compared with those

vegetables purchased from private markets showing 15 of 40 (37.5%) had parasitic infestation. Between the two vegetables assessed, pechay showed a higher prevalence of parasites with 22 of 40 (55.0%) whereas lettuce had 14 of 40 (35.0%) of parasitic infestation. Table 1 shows the prevalence of parasites in the public and private markets of Quezon City and Muntinlupa City, Metro Manila.

**Table 1**

Prevalence of parasites in public and private markets of Metro Manila, n(%).

Vegetable samples	Munoz, Quezon City		Alabang, Muntinlupa City		Overall
	Public	Private	Public	Private	
Pechay	7 (70%)	5 (50%)	5 (50%)	5 (50%)	22 (55%)
Lettuce	4 (40%)	3 (30%)	5 (50%)	2 (20%)	14 (35%)
Overall	11(55%)	8 (40%)	10 (50%)	7 (35%)	36 (45%)

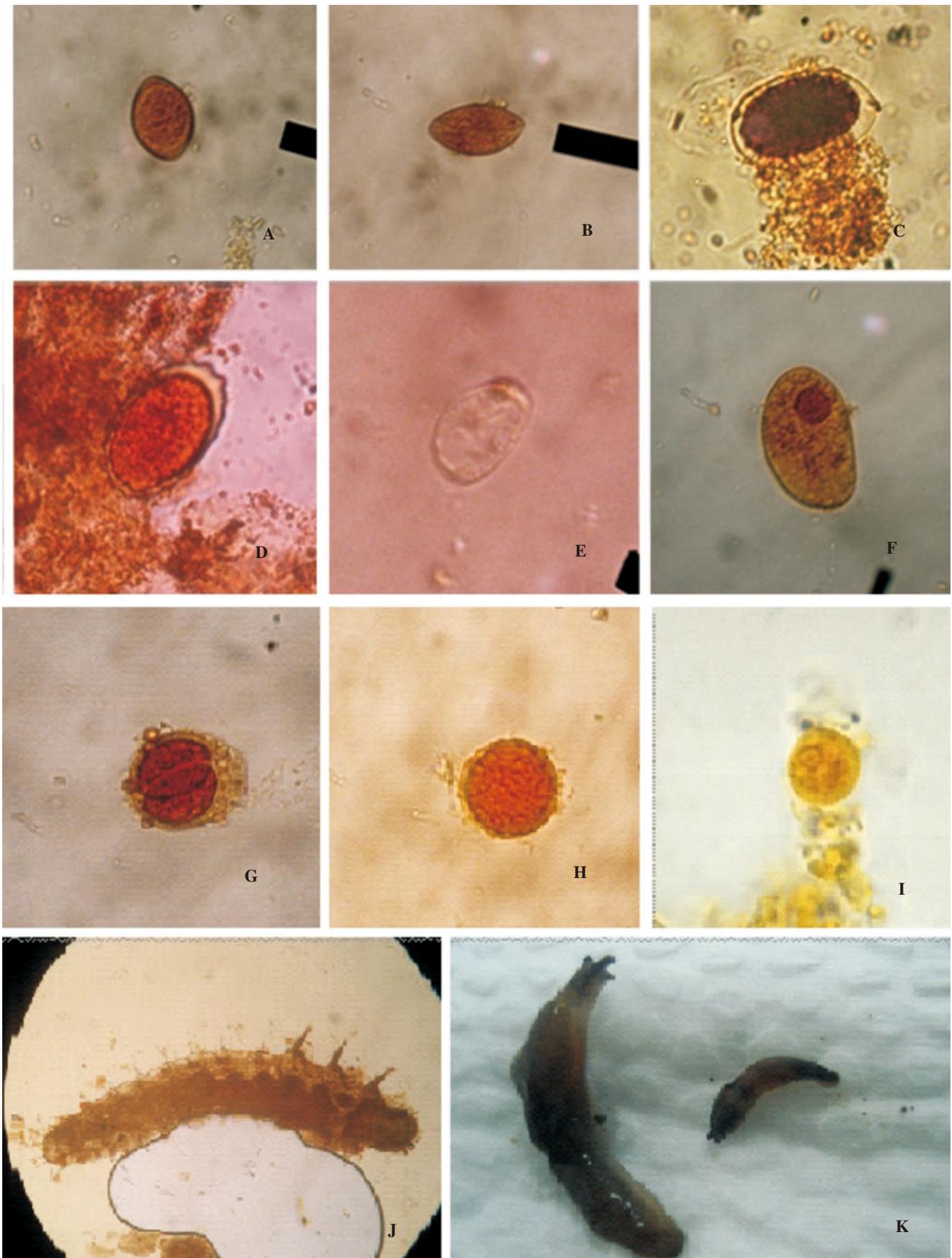
One or more parasites were observed in each of the 36 vegetable samples tested positive for contamination. Among the parasites identified, the *Ascarid* is the most prevalent (23.6%), and the least are intestinal protozoa [*Entamoeba histolytica* (*E. histolytica*), 0.6% and *Giardia lamblia* (*G. lamblia*), 0.6%]. Other parasites observed were *Ascaris lumbricoides* (22.9%), insects (11.5%), *Trichuris trichiura* (*T. trichiura*)(10.8%), *Trichostrongylus* sp. (6.4%), *Enterobius vermicularis* (*E. vermicularis*) (4.5%), *Entamoeba coli* (*E. coli*) (2.5%), hookworm (2.6%), slugs (1.9%), and unidentified parasites (12.1%). Figure 1 shows the different parasites observed from the vegetables. The distribution of parasites detected in the examined vegetables is shown in Table 2.

**Table 2**

Distribution of parasites detected in examined vegetables.

Parasites	Vegetables (n)		Total [n (%)]
	Pechay	Lettuce	
Overall	40	40	80 (100.0%)
<i>Ascarid</i>	26	11	37 (46.25%)
<i>Ascaris</i>	25	11	36 (45.00%)
<i>Entamoeba coli</i>	3	0	3 (3.75%)
<i>E. histolytica</i>	2	0	2 (2.50%)
<i>Giardia lamblia</i>	1	0	1 (1.25%)
Hookworm	4	0	4 (5.00%)
<i>Trichostrongylus</i> sp.	8	2	10 (12.50%)
<i>E. vermicularis</i>	6	1	7 (8.75%)
<i>Trichuris trichiura</i>	16	1	17 (21.25%)
Insect	15	3	18 (22.50%)
Slug	0	3	3 (3.75%)
Unknown specimen	17	0	17 (21.25%)

There was a significant difference between the prevalence of parasitic organisms among the vegetables obtained between the public and private markets of Metro Manila ( $t = 13.577$ ;  $P < 0.05$ ). Likewise, a significant difference between the prevalence of parasitic organisms among the vegetables obtained between the two locations exists ( $t = 12.334$ ;  $P < 0.05$ ).



**Figure 1.** Parasites in vegetables. (A) *T. trichiura* (whipworm) egg, (B) *G. lamblia* cyst, (C) *Trichostrongylus* sp. egg, (D) *Ascaris* (intestinal roundworm) egg, (E) *E. vermicularis* (pinworm) egg, (F) *E. histolytica* trophozoite, (G) unknown specimen, (H) *Ascarid* egg, (I) *E. coli* cyst, (J) insect, (K) slugs.

#### 4. Discussion

This was a cross-sectional study, and its scope is limited to assessing the parasitic infestation among the vegetable samples, lettuce and pechay, purchased from Munoz, Quezon City, and Alabyujujukll, public and private markets during the periods of study. This study showed that the prevalence of parasitic infestation of the vegetables sampled was 45.0%, and significant differences exist. The contamination of the vegetables in both markets and locations may occur in a variety of ways, and this is likely to be the reason behind the differences. It is likely that the poor environmental sanitation and management of wastes in the marketplaces, which were evident at the time of purchase of the vegetables, may have indirectly contaminated the vegetables. Based on interviews from the vendors, vegetables purchased from the Munoz, Quezon City public markets were obtained from other public markets in Metro Manila, particularly in Divisoria, Manila, and Balintawak, Quezon City. This finding has revealed the significance of where the vegetable stocks is. A previous study<sup>[9]</sup> has indicated that a high prevalence of parasitic infestation in vegetables was obtained from the two markets, in Divisoria, Manila, and Balintawak, Quezon City. Vendors in Alabang, Muntinlupa City, have indicated that their vegetables were obtained from Baguio City and were being processed and packed individually before their distribution and selling. Although vegetables in these markets were individually packed, the likelihood of vegetables handled improperly at the pre- and post-harvest stages and/or the workers handling vegetables with contaminated hands may have contributed to the contamination of the vegetables. Overall, vegetables in private markets had lower parasitic infestation as compared to public markets. This may be due to the conditions inside the private markets where vegetables are packed and rotten leaves in the outer coverings are removed and are not exposed to mechanical vectors like flies, unlike in public markets where vegetables were exposed to open air and vendors were handling the vegetables with their bare hands. The cleanliness of the environment in the public and private markets was notably different, particularly in the two locations.

The prevalence of parasitic infestation on the vegetables showed similar results to a previous study<sup>[9–11]</sup>, where the pechay tend to harbor more parasitic infestation compared with the lettuce. Results of the study also showed that, among the parasites observed in the vegetables, the *Ascarid* and *Ascaris* eggs were prominent over the other parasites. Previous researches<sup>[2,9]</sup> agreed with this finding. The presence of the *Ascaris* eggs in the vegetables would indicate that animal manure was used as fertilizer and/or animals were allowed to wander where the vegetables were cultivated<sup>[6]</sup>. It would also indicate that handlers may be infected with the parasites and may have handled the vegetables with contaminated hands and have improperly handled the vegetables. It is also likely that the exposure of the vegetables to poor sanitation environments may have been responsible to the transmission of the parasites from mechanical vectors, given that most vegetables sold in public markets are exposed to numerous possible contaminations.

In conclusion, the study showed that the vegetables were infested with parasitic organisms and the prevalence of parasitic infestation of the vegetables was significantly different from those purchased in public and private markets in the two locations. These findings indicate that there is a need to safeguard the general public on the risks brought about by these parasitic osse of night soil as a common agricultural practice in farms rearing these vegetable foodstuffs must be practiced to ensure that food brought to our home's tables are safe and fit for consumption. Proper personal hygiene of handlers and preparers of the food and proper environmental sanitation must always be observed to reduce the prevalence of parasitic infestation in the foodstuffs sold at the markets.

#### Conflict of interest statement

We declare that we have no conflict of interest.

#### References

- [1] Nyarango RM, Aloo PA, Kabiru EW, Nyanchongi BO. The risk of pathogenic intestinal parasite infections in Kisii Municipality, Kenya. *BMC Public Health* 2008; **8**: 237.
- [2] Robertson LJ, Gjerde B. Isolation and enumeration of *Giardia* cysts, *Cryptosporidium* oocysts, and *Ascaris* eggs from fruits and vegetables. *J Food Protection* 2000; **63**: 775–778.
- [3] Srikanth R, Naik D. Health effects of wastewater reuse for agriculture suburbs of Asmara City, Eritrea. *Int J Occup Environ Health* 2004; **10**: 284–288.
- [4] World Health Organization. *Public health risk assessment and interventions*. Geneva: WHO; 2009. [Online] Available from: [http://www.who.int/diseasecontrol\\_emergencies/publications/philippines\\_20091009\\_en.pdf](http://www.who.int/diseasecontrol_emergencies/publications/philippines_20091009_en.pdf). [Accessed on 18 June 2011]
- [5] Okyay P, Ertug S, Gultekin B, Omen O, Beser E. Intestinal parasites prevalence and related factors in school children, a western city sample – Turkey. *BMC Public Health* 2004; **4**: 64.
- [6] Al-Shawa RM, Mwafy SN. The enteroparasitic contamination of commercial vegetables in Gaza Governorates. *J Infect Dev Ctries* 2007; **1**(1): 62–66.
- [7] Andoh LA, Abaidoo RC, Obiri-Danso K, Drechsel P, Kondrasen F, Klank LT. Helminth contamination of lettuce and associated risk factors at production sites, markets and street food vendor points in urban and peri-urban Kumasi, Ghana. *Res J Microbiol* 2009; **4**(1): 13–22.
- [8] Nichols GL. Food borne protozoa. *Brit Med Bull* 2000; **56**(1): 209–235.
- [9] Malison M, Sia Su GL. Prevalence of intestinal parasites in selected vegetables at major public markets in Metro Manila, Philippines. *Asian Pac J Trop Med* 2009; **2**(6): 37–39.
- [10] Hamdan Ibrahim Al-Mohammed, TT Amin, E Aboulmagd, HR Hablus, BO Zaza. Prevalence of intestinal parasitic infections and its relationship with socio-demographics and hygienic habits among male primary schoolchildren in Al-Ahsa, Saudi Arabia. *Asian Pac J Trop Med* 2009; **3**(11): 906–912.
- [11] Bdir S, G Adwan. Prevalence of intestinal parasitic infections in Jenin Governorate, Palestine: a 10-year retrospective study. *Asian Pac J Trop Med* 2010; **3**(9): 745–747.