Contamination of Fresh Vegetables with Soil-transmitted Helminths in Selected Markets in Albay, Philippines

Jereme Ll. Astaño¹, Jose Randolph C. Almonte², Daile Meek Salvador – Membreve²∗
¹Washington International School, F. Aquende Drive, Legazpi City, Philippines
²Graduate School, Bicol University, Legazpi City, Philippines
∗Corresponding author: dmsmembreve@bicol-u.edu.ph

Abstract

Soil-transmitted helminths (STH) are foodborne parasites associated with fresh vegetables. In this study, the occurrence of STH were assessed in selected open air markets and hypermarkets in Legazpi and Daraga, Albay, Philippines. A total of 96 of six various vegetables were collected which includes carrot (Daucus carota), camote (Ipomoea batatas), potato (Solanum tuberosum), cabbage (Brassica oleracea), water spinach (Ipomea aquatica), and pechay (Brassica rapa). After washing and sedimentation, microscopic observations were performed for identification of the parasite. Ascaris sp., Ancyclostoma sp./Strongyloides sp., Toxocara sp., Trichuris sp. and Trichostrongylus sp. were the detected parasites on vegetables. Ascaris sp. was the frequently detected parasite (40.643%). Majority of the vegetables (66.66%) were presented with STH. Among the vegetables, the leafy vegetable pechay had 100% detection rate followed by carrots (76.19%). The parasite load in supermarket were significant lower in supermarket (66.66%) in comparison with public market (80.43%). Further, the market type, washing and wrapping before display of vegetables showed statistically significant association with STH prevalence. Findings indicate that vegetables may be a potential source of STH infection and proper handling and washing should be observed in order to diminish the risk of contracting STH. To date, this is the first report of STH recovered from vegetables sourced from selected markets in Albay, Philippines.

Keywords: foodborne parasites, washing, open air market, crops, Legazpi, Daraga

Introduction

In tropical countries, cases of soil-transmitted helminths (STH) infections are still highly reported. Globally, it was reported that one-sixth of the population is infected with STH and approximately one-fourth of the population in the Philippines (Paller & Babia-Abion, 2019). On selected parts of Albay, one of the three children examined was found to be infected with the parasite Enterobius vermicularis (Mirandilla et al., 2013). And recently, the Department of Health (DOH) reported that the Bicol region had the highest number of STH infections in the country, having an infection rate of about 67% (Arguelles, 2019).

The four known nematode species of human STHs are the Ascaris lumbricoides, Trichuris trichiura, Ancylostoma duodenale, and Necator americanus (Paller & Babia-Abion, 2019). Infections with STHs were commonly associated with adverse health outcomes which include diarrhea, anemia, fatigue, mental, and developmental retardation (Alemu et al., 2020). These STHs could bring about asymptomatic to mild cases and could compromise human health in chronic infections or in immunocompromised individuals (Zuccherato et al., 2018). The transmission of these parasites includes ingestion of ova or cysts or through contact with contaminated soil, water, or food (Amoah et al., 2017).

Vegetables have become passive carriers of transmission of pathogens which includes parasitic STH (Abourain et al., 2010; Beiromvard et al., 2013). Previous works on vegetables collected in different local markets in the Philippines reported the occurrence of parasites. About 42.5% of the vegetables samples were positive for foodborne parasites in Metro Manila (Sia Su et al., 2012) and about 40.28% of the vegetables collected from Nueva Ecija, Philippines (Vizon et al., 2019). In this work, prevalence of STH on
vegetables from selected markets in Albay, Philippines were documented. Also, risk factors associated with prevalence of STH were also assessed.

In sampling, vegetables were collected from two open air markets (Daraga and Legazpi Public Markets) and supermarkets A and B. Vegetable samples were selected on frequently consumed vegetables and were categorized into leafy or crop vegetables. The leafy vegetables consisted of cabbage (*Brassica oleracea*), water spinach (*Ipomea aquatica*), and petchay (*Brassica rapa*), while crop vegetables includes carrots (*Daucus carota*), camote (*Ipomoea batatas*), and potato (*Solanum tuberosum*). Approximately 1 kilogram of pooled vegetables for each vegetable were randomly sampled in the morning and were individually packed and immediately transported to Natural Science Laboratories in College of Science, Bicol University, Legazpi City, Albay for immediate examination.

The vegetable samples were washed thrice with physiological saline solution (0.95% NaCl) and centrifuge at 3000 rpm for 5 mins (Damen et al., 2007). After centrifugation, sediments were collected to prepare the slides. The prepared slides were then examined using a compound light microscope (OPTIKA®) and the sizes of the ova were measured using MICAM Software version 1.6. The STH and other parasites were identified morphologically referring to a guide by Cuomo and colleagues (2009) and published literatures (Ordoñez et al., 2018; Vizon et al., 2019). The shape, sizes, thickness of the walls and presence of embryo were noted for the identification of ova. Also, the morphology of the tail, bucal cavity and internal structures were taken in consideration for the identification of larva. For further identification and authentication, the images of detected soil-transmitted helminths were sent to the Regional Animal Disease Diagnostic Laboratory Cabangan, Camalig, Albay.

The prevalence of soil-transmitted helminths in vegetables were calculated and Pearson’s Chi-square was performed using IBM SPSS software version 20 to analyze the association of wrapping, type of vegetables, and markets with STH contamination. Also, one-way analysis of variance (ANOVA) followed by Tukey HSD was used to compare the effect of washing regardless of market and vegetable type. Statistical significance was set to a *P*-value less than 0.05.

In this study, from the ninety-six (96) vegetables examined, sixty-four (64) were found positive for STH. A total of five (5) species of soil-transmitted helminths were identified which includes *Ascaris* sp., *Ancylostoma* sp./*Strongyloides* sp., *Toxocara* sp., *Trichuris* sp., *Trichostrongylus* sp. and some unidentified eggs (Figure 1, 2).

Collectively, *Ascaris* sp. was the most prevalent (40.63%) STH recovered from the vegetables, followed by *Ancylostoma/Strongyloides* sp. (hookworm) (Figure 1). Also, *Ascaris* sp. was the most frequent STH reported in these studies (Ordoñez et al., 2018; Sia Su et al., 2012). One possible reason for the frequency of *Ascaris* sp. in the present study might be attributed to having a resistant ova. It is known that *Ascaris* sp. ova can withstand dehydration for 2-3 weeks and can survive in anaerobic and extreme (5°C-70°C) environment (Roberts, 2009; Maya et al., 2012).

![Figure 1](image_url) Prevalence of soil-transmitted helminths on sampled from different (A) vegetable type and (B) markets. AN/ST indicates *Ancylostoma/Strongyloides* spp.
In this work, zoonotic roundworms such as *Toxocara* sp. (4.17%) and *Trichostrongylus* sp. (1.04%) were also recovered on vegetables (Figure 1), which suggest that the vegetables were in contact with fecal droppings of animal origins. The farms where the vegetables were sourced possibly might have domesticated animals. *Toxocara* species are well-distributed roundworms of dogs and cats (Bowman, 2020), while the *Trichostrongylus* species are nematodes of herbivorous livestock that are capable of infecting human (Sharifdini *et al*., 2017; Ashrafi *et al*., 2020).

In addition, infective stages such as ova of *Ascaris* sp. (Figure 2B) and embryonated eggs (Figure 2A) and larval stages of hookworm were recovered in the study (Figure 2 G-I). The infective stages of helminths are either the free-living third larval stage or an egg containing a third larval stage helminths (Hernandez *et al*., 2018). It was mentioned that the occurrence of infectious stages presents a higher potential for an active transmission, most especially the filariform larva of hookworms that are capable of penetrating the skin (Adenusi *et al*., 2015; Duedu *et al*., 2014).

In this study, zoonotic roundworms such as *Toxocara* sp. (4.17%) and *Trichostrongylus* sp. (1.04%) were also recovered on vegetables (Figure 1), which suggest that the vegetables were in contact with fecal droppings of animal origins. The farms where the vegetables were sourced possibly might have domesticated animals. *Toxocara* species are well-distributed roundworms of dogs and cats (Bowman, 2020), while the *Trichostrongylus* species are nematodes of herbivorous livestock that are capable of infecting human (Sharifdini *et al*., 2017; Ashrafi *et al*., 2020).

In addition, infective stages such as ova of *Ascaris* sp. (Figure 2B) and embryonated eggs (Figure 2A) and larval stages of hookworm were recovered in the study (Figure 2 G-I). The infective stages of helminths are either the free-living third larval stage or an egg containing a third larval stage helminths (Hernandez *et al*., 2018). It was mentioned that the occurrence of infectious stages presents a higher potential for an active transmission, most especially the filariform larva of hookworms that are capable of penetrating the skin (Adenusi *et al*., 2015; Duedu *et al*., 2014).

In terms of type of vegetables, the prevalence of STH recovery was independent of the type of vegetables ($P=0.198$), though a slightly higher number of STH was observed in leafy vegetables in comparison to vegetable crops (Table 2). A 100% detection rate were observed on petchay while among the crops, carrots were found to contain the frequent number of STH (Table 2). The variations in contamination rates on vegetables could be attributed to texture and distance from the ground soil (Ordoñez *et al*., 2018; Kudah *et al*., 2018). In this study, except for water spinach, both petchay and cabbage though leafy vegetables are ground plants, growing few inches above the ground. Also, these vegetables have leaves of high surface area that would favour more attachment of contaminated soil, resulting to the slightly higher number of parasites compared to crop vegetables.

Polyparasitism or the presence of multiple parasites in each vegetables were also observed in this study. Alarmingly, majority of the vegetables were contaminated with at least two parasites and more than four parasites were recovered in petchay (Table 2). These results are a concern as multiple species contamination in vegetables might result to infection of various parasites that would compromise human health (Tefera *et al*., 2014).
Expectedly, the prevalence of STH sold in supermarkets was significantly lower compared to the open air markets (Table 2). Among those observed, the Public market A has the highest prevalence of STH contamination (Table 2). Previous studies have shown similar results of higher number of parasite infestation from samples collected from open public markets (Luz et al., 2017; Deuda et al., 2014). Further, statistically higher parasite infestation was observed in unwrapped vegetables (Table 2). These results confirmed that food practices observed in supermarket such as washing, removing rotten leaves and wrapping or less exposure to parasites vectors are effective measures to reduce parasite number in vegetables (Vizon et al., 2019; Sia Su et al., 2012). However, in this study, Trichuris sp. and Trichostrongylus sp. were found in supermarket but not on open air markets (Figure 1B). Although, it was not determined in this study, the probable reasons for the variability in results might be the handling measures during transport and differences of geographic location of where the vegetables were sourced (Luz et al., 2017; Deuda et al., 2014).

The effects of washing were also tested to see if it can diminish or possibly remove altogether the soil transmitted helminths present in the vegetable samples. Our results show that washing with saline significantly diminish the presence of parasites on the vegetables \((P=0.0001)\), however parasites were still recovered after the third wash (Figure 3). Our result provided additional evidence that washing is an important factor to minimize parasites on vegetables, but further study is recommended to establish the number of washings for the complete removal of parasites on vegetables.

This study provided additional evidences of the potential of fresh vegetables as a source of foodborne pathogens such as STH. Majority of the crops and leafy vegetables sampled were found to harbor STH. Infective stages and multiple parasitism were also observed, suggesting a high contamination of parasites in the area of study. The type of market, wrapping and

---

### Table 1: Prevalence of soil-transmitted helminths on different vegetables collected in selected markets sampled in Daraga and Legazpi City, Albay

<table>
<thead>
<tr>
<th>Type of Vegetable</th>
<th>Number of Positive (%)</th>
<th>Polyparasitism of Soil-Transmitted Helminths</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>One (%)</td>
<td>Two (%)</td>
</tr>
<tr>
<td><strong>Crop</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carrot</td>
<td>16 (76.2%)</td>
<td>8 (38.1%)</td>
</tr>
<tr>
<td>Potato</td>
<td>10 (55.6%)</td>
<td>9 (50%)</td>
</tr>
<tr>
<td>Camote</td>
<td>12 (54.6%)</td>
<td>8 (36.7%)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>38 (62.29%)</td>
<td></td>
</tr>
<tr>
<td><strong>Leafy</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cabbage</td>
<td>4 (57.1%)</td>
<td>3 (42.9%)</td>
</tr>
<tr>
<td>Water Spinach</td>
<td>15 (71.4%)</td>
<td>12 (57.1%)</td>
</tr>
<tr>
<td>Petchay</td>
<td>7 (100%)</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>26 (74.28%)</td>
<td></td>
</tr>
</tbody>
</table>

---

### Table 2: Statistical result of factors associated with STH infections of vegetables recovered from selected markets in Legazpi and Daraga, Albay.

<table>
<thead>
<tr>
<th>Sampling Area</th>
<th>Prevalence*</th>
<th>P value</th>
<th>Washed and wrapped*</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number of positives (%)</td>
<td>Total</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Public Market A</td>
<td>15 (83.88%)</td>
<td>0.006</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Public Market B</td>
<td>22 (78.57%)</td>
<td>80.43</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Supermarket A</td>
<td>14 (70%)</td>
<td>46.15</td>
<td>80.7</td>
<td></td>
</tr>
<tr>
<td>Supermarket B</td>
<td>13(43.33%)</td>
<td>66.67</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*significant at P <0.05
washing of vegetables were some factors associated with parasite contamination in this study. Wrapping vegetables and repeated washing (more than three washes) are suggested practices to remove or reduce parasite contamination. Our data reinforce the importance of sanitary measures for food safety.

Acknowledgement

The researchers would like to extend their appreciation to staff of Regional Animal Disease Diagnostic Laboratory and Professor Ahmed Dyab of Assiut University, who has several publications on parasites, for the confirmation of the species. In addition, the authors are grateful of the assistance of Prof. Jocelyn E. Serrano, Prof. Raymond S. Regalia, Prof. Phil V. Morano.

References


Recommended Citation: