

The isolation of human intestinal parasites from American cockroach: A preliminary study

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ABSTRACT Human intestinal parasitic infection results from the invasion of the human gastrointestinal system by intestinal helminths and protozoan parasites, often facilitated by factors such as mechanical transmission by household insect pests, notably American cockroaches. This study is aimed at isolating parasitic pathogens responsible for human intestinal parasites from the external surfaces of cockroaches collected from both commercial and residential areas in Perak. The findings indicate a higher prevalence of parasitic infections in American cockroaches from residential areas, with a rate of 75%, as compared to commercial areas where the rate was 40%. The isolation process revealed the presence of eggs and cysts of various parasites, including cestodes, nematodes, and protozoans. Predominantly, *Ascaris* sp. and *Entamoeba* sp. were the most common parasites found on the external surfaces of cockroaches in both residential and commercial areas. Our statistical analysis revealed that, there were no significant correlation ($P>0.01$) between local weather conditions (temperature $r=-0.68$; $P=0.32$; rainfall $r=0.77$; $P=0.23$) and the number of isolated parasites in the study areas. This suggest that weather factors do not significantly influence the infectivity rate of these parasites on American cockroaches in the study area.

KEYWORDS: American cockroach; vector host; mechanical transmission; human intestinal parasites

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INTRODUCTION

Human intestinal parasites such as helminths and protozoa remain the most prevalent infectious diseases predominantly in developing countries that are favourable to the disease conditions. Common symptoms caused by infections include abdominal pain, dysentery, diarrhoea, rashes, nausea, vomiting, and tiredness (Johnson, 2023). These infections cause highly significant morbidity for the patients and their family's routine activity (Alum *et al.*, 2010). Children under five years old of age among the group are exceptionally associated with intestinal parasitic infections (Fauziah, 2022). Helminths, such as tapeworms and roundworms, are a diversified class of ubiquitous worm parasites worldwide. *Cryptosporidium*, *Giardia* and *Toxoplasma* are the prevalent group of protozoa in human infections (Rush, 2022).

Typically, the infections are caused by food and water contaminated with faeces which contain the infective stage of the parasites, ova and or cyst. These parasites are transferred to the food through mechanical transmissions of nonbiting vector hosts like cockroaches (Stein & Chirilă, 2017). The American cockroach, *Periplaneta americana* is a concerning vector for diseases caused by parasites due to its filth behaviour and inhabitants posing a significant risk to public health (Donkor, 2020). Scientific research has shed light on the crucial role these roaches play in the transmission of parasites. For instance, a study conducted by Atiokeng Tatang *et al.* (2017) revealed that American cockroaches can carry and transfer the roundworm parasites *Ascaris* sp., *Trichuris* sp., *Capillaria* sp., *Toxocara* sp., and hookworms. These cockroaches can pick up the cysts, and ova on their legs and bodies when they come into contact with contaminated surfaces, and then inadvertently transfer them to food, utensils, or other surfaces, potentially leading to infections in humans.

Therefore, this preliminary study aims to evaluate the potential role of the American cockroach, *P. americana* as a vector host in mechanical transmissions of human intestinal parasites by isolating the

parasites from its outer body. We hypothesized that the role of American cockroaches as vectors for mechanical transmission of parasites may also be influenced by their habitat environments, and weather parameters. Thus, the association between these variables and the number of parasites isolated will be discussed.

METHODOLOGY

Specimens sampling

Cockroaches were sampled in two different localities at commercial and residential areas in Bagan Serai, Perak (5.0108° N; 100.5410° E) from December 2022 until the end of March 2023. These study locations were chosen based on anecdotal conversations from residents, indicating that the American cockroach was the predominant roach species inhabiting these areas. The cockroaches were caught using hand protection with rubber gloves during night time between 10 p.m. to 12 a.m. The time window was selected for sampling, as this corresponds to the period when these cockroaches are most active, as observed through their behaviour. All caught cockroaches were allowed to live and kept in a tight container. The cockroaches were supplied with dry food like crackers and biscuits to ensure they lived until being transported to the laboratory at the School of Biological Sciences, Universiti Sains Pulau Pinang. All cockroaches were identified and labelled according to their localities. There was no animal ethics required as this study involved insects. The ethical committees primarily concern the use of mammals and other higher vertebrate animals.

Sample preparation

In the course of this study, a total of 80 cockroaches were utilized as samples, with 40 specimens collected from commercial areas and an additional 40 collected from residential areas. Cockroaches specimens were killed by placing them in the freezer or refrigerator at 0-4 °C before sample preparation was carried out. The cockroach sample was deposited individually in a Falcon conical tube (15 ml) covered with saline and shaken vigorously for 2-3 minutes. The samples then were centrifuged for five minutes at 2000 rpm (Yusof, 2018). The sediment obtained was pipetted and transferred on a glass slide and labelled for the examination of the parasites under a light microscope.

Staining and microscopic examination

The staining technique used was a Lugol's Iodine wet mount. A drop of the centrifugated sediment was deposited on the glass slide and examined for the presence of parasites. This is followed by a drop of Lugol's Iodine on every examined slide. A coverslip was then placed on the glass slide and examined thoroughly using a light microscope (Olympus, BX43-TPOST) under 100x and 400x magnifications. The verification and confirmation of the parasites were achieved through meticulous reference to the authoritative parasite atlas book (Mohd Isa & Misiran, 2017).

RESULT AND DISCUSSION

Throughout the sampling period, *Periplaneta americana* known as the American cockroach was the predominant species found in the study localities. Table 1 shows the tabulation of isolated parasites from the American cockroaches at the sampling localities. Residential areas exhibited a high number of cockroaches contaminated with 75% parasitic pathogens compared to commercial areas of 40%. Of these, *Ascaris* sp. and *Entamoeba* sp. were the common parasites that can be found in both commercial and residential areas. On the other hand, parasite helminths from order Cyclophyllidea and hookworm were exclusive in residential areas. Pearson Correlation test analysis showed that there

was a correlation between localities and the number of infected-parasites cockroaches ($r= 1.00$; $P < 0.01$).

Table 1. Parasites obtained from American cockroaches at commercial and residential study areas

*Localities	No. of cockroaches	*No. of infected cockroaches	Percentage infected (%)	Isolated parasites
Commercial	40	16	40	<i>Ascaris</i> sp. eggs
				<i>Entamoeba</i> sp. cysts
Residential	40	30	75	<i>Ascaris</i> sp. eggs
				Cyclophyllidea egg
				<i>Entamoeba</i> sp. cysts
				Hookworm eggs

* Correlation is significant at 0.01 level

A similar study done by Martviset *et al.* (2023) in Thailand showed that there was an association between parasite infection and geographic distribution. The infections of parasitic helminths were high in housing areas in which water reservoirs are many. Thus, our study suggested that high human activity with a convenient water supply could lead to an increase in parasite abundance. This is because most parasitic helminth transmission is from contamination of food and water (Alqarni *et al.*, 2023)

Another factor that could be associated with the distribution of parasites is the weather. Malaysia is known to have a typical tropical climate of hot and humid all the year which is favour to the parasitic helminths habitat. To evaluate the relationship between weather and parasite abundance, we collect a sample during the end of wet seasons (December, January and February 2022) and the beginning of dry seasons (end of March 2023). Table 2 shows the weather and number of isolated parasites from December 2022 until the end of March 2023. The results obtained showed that the highest rainfall received in December 2022 (160-700 mm) gave the highest number of isolated parasites, 22 and the lowest rainfall received at the end of March 2023 (90-160 mm) gave the lowest number of isolated parasites, 12.

Table 2. Correlation of Weather and Parasites Abundance during Sampling

Month	Temperature (°C)	Rainfall (mm)	No. of isolated parasites
December 2022	22 - 32	160 - 700	22
January 2023	22 - 32	160 - 500	15
February 2023	22 - 32	50 - 180	16
March 2023	22 - 34	90 - 160	12

To assess the relationship between weather conditions and the prevalence of isolated parasites, we employed the Pearson-Correlation statistic. However, our analysis did not yield statistically significant results ($P>0.01$) for temperature ($r=-0.68$; $P=0.32$) or rainfall ($r=0.77$; $P=0.23$). These findings stand in contrast to previous research, such as Turner *et al.* (2011) and Shearer & Ezenwa (2020), which reported a significant association between rainfall and parasitism. Moreover, a recent study by Bristol *et al.* (2023) noted that increased rainfall had a considerable impact on the total abundance of parasitic nematodes in longer-term investigations. Our study, however, may have been limited by its small sample size and relatively short duration, potentially explaining our contrasting results.

While rainfall does play a significant role in how certain diseases spread, it is essential not to view it as the only or primary factor influencing parasite abundance and distribution. The transmission of parasites is a complex process, shaped by a variety of elements, including how hosts behave, the dynamics of local ecosystems, and human activities. Consequently, it is imperative to adopt a comprehensive and multifaceted approach when investigating and forecasting parasite infections. It is important to acknowledge that rainfall, on its own, may not always be the decisive determinant governing the distribution of these parasites.

Figure 1 shows the percentage and type of the isolated parasites obtained in this study. All detected parasites were at their infective stage in the life cycle, eggs and cyst. Of these, *Ascaris* sp. eggs were the most isolated parasites accounting for 90.8% whilst Cyclophyllidea helminth was found to be the least isolated parasites, 1.54% from the American cockroaches. Similarly, a study done by Atiokeng Tatang *et al.* (2017) in Melong, Cameroon showed that *Ascaris* was the highest parasite identified (33.76%) from the external body of the cockroaches. While a study done by Dokmaikaw & Suntaravitun (2020) showed a high prevalence rate of parasitic infestation on cockroaches was 46.4%. Thus, our study supported that American cockroaches have the potential as mechanical vectors of parasitic pathogens that can infect humans or animals. Furthermore, almost all parasites recovered in this preliminary study were identified to have a role in parasitic zoonosis.

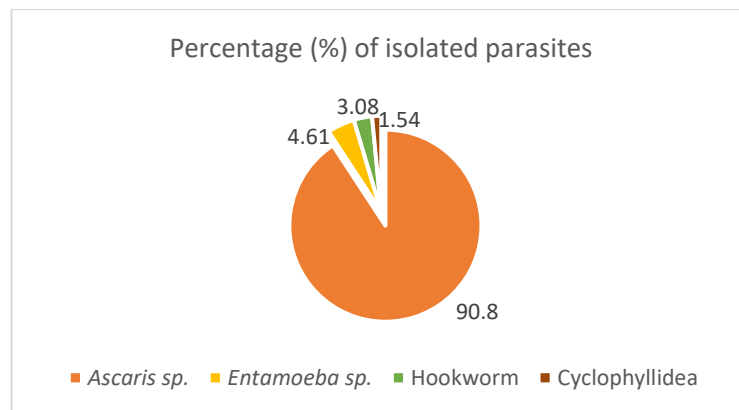


Figure 1. Percentage of isolated helminths parasites from the body of American cockroaches

CONCLUSION

In brief, our study supports the importance of locality and rainfall as the factors influencing the variation and abundance of human intestinal parasites in association with the vector-host, American cockroach. American cockroaches play an important role in the dissemination of parasites through mechanical transmission. It is recommended that to gain a solid confirmation of how locality and rainfall are linked, a future study can be done over a longer time frame which includes a greater variety of locations and considers different types of cockroaches. Data obtained from current and future findings can be used as an educational campaign to develop public health interest in the importance of hygiene and American cockroach prevention. Emphasizing the association between American cockroach infestation and health risks, including possible types of parasites carried to promote behaviour change

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