

Original article:

**THE MAJORITY OF COCKROACHES FROM
THE SAMUTPRAKARN PROVINCE OF THAILAND ARE CARRIERS
OF PARASITIC ORGANISMS**

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ABSTRACT

We undertook a study of the mechanical transmission of parasitic organisms in cockroaches in the Samutprakarn province of Thailand. In this study, 920 cockroaches were obtained from 18 open-air shopping markets in 5 districts and 1 subdistrict of this province. All cockroaches were captured during their feeding time in their natural habitat. Direct wet smear and modified acid-fast bacilli staining were used to identify the parasites from the external surface or cuticle of the cockroaches. The results show that 498 (54.1 %) of the cockroaches harbored parasitic organisms. Of these, 56.1 % were protozoa and the remaining 43.9 % were helminthes (pathogenic helminthes- 1.4 %, non-pathogenic helminthes- 42.5 %). Of the pathogenic helminthes, the species included *Strongyloides stercoralis* (6 instances of the free-living adult male, 0.8 %), *Ascaris lumbricoides* (2 decorticated eggs, 0.3 %), *Trichuris trichiura* (2, 0.3 %), and *Taenia* spp. (1 egg, 0.1 %). The protozoa types that were identified included *Cyclospora* spp. (10 oocysts, 1.3 %), *Endolimax nana* (10 cysts, 1.3 %), *B. hominis* (9 instances of the vacuolated form, 1.2 %), *Isospora belli* (75 oocysts, 9.6 %), *Entamoeba histolytica/E. dispar* (36 cysts, 4.6 %), *Cryptosporidium* spp. (220 oocysts, 28.1 %), *Chilomastix mesnilli* (2 cysts, 0.3 %), *Entamoeba coli* (31 cysts, 4.0 %), *Balantidium coli* (45 trophozoites, 5.8 %), and *Iodamoeba butschlii* (1 cyst, 0.1 %). These results show that cockroaches isolated from these markets are carriers of several parasitic organisms that cause commonly found symptoms of illness such as diarrhea or bowel disorder.

Keywords: mechanical transmission, cockroaches, parasitic organisms, protozoa, helminthes

INTRODUCTION

Cockroaches have been on earth for about 300 million years, and are the world's most common insects. Today, there are about 4,500 species of cockroaches that can be found in every part of the world. Thirty species are associated with human habitations, but only a few of these species inhabit human dwellings. The most common of these are the American cockroach (*Periplaneta americana*) and the German cockroach (*Blattella germanica*) (Robinson,

2005; Uneke, 2007). Cockroaches are about 10-50 mm in length, and have an oval, flattened shape, long antennae, and are nocturnal in habit. Cockroaches are omnivores; they will eat anything organic but prefer food sources such as sweets, cheese, meat products, starches, and grease. They also feed on plants, vegetables, and fruits. Cockroaches generally like warm, moist environments with abundant food. Sewers and wet, decaying areas are their natural habitat (Jirage, 2011). In Thailand, *Periplaneta*

americana is the dominant cockroach species in the country (Tawatsin et al., 2001; Tungtrongchitr et al., 2004). The habits of living and eating, body structure, and mobility of cockroaches make them well-adapted for mechanically transmitting diseases. Cockroaches are known vectors of human enteropathogens as there are reports of the isolation of various human pathogens from these insects (Fotedar et al., 1991). Several studies have shown that cockroaches can carry disease-causing microorganisms such as *Escherichia coli*, *Enterobacter* spp., *Klebsiella* spp., *Pseudomonas aeruginosa* (Fotedar et al., 1991; Chai-phanawongsaroj et al., 2004; Graczyk et al., 2005; Salehzadeh et al., 2007; Uckay et al., 2009), various fungi (Fotedar et al., 1991; Salehzadeh et al., 2007; Saichua et al., 2008; Bouamama and Sorlozano, 2010), and parasites and their cysts (Fotedar et al., 1991; Graczyk et al., 2005; Salehzadeh et al., 2007). Cockroaches may disseminate these microorganisms in many ways, predominantly by depositing them along with their excrement on human food (Robinson, 2005; Uneke, 2007). Samutprakarn (on the Gulf of Thailand) lies at the mouth of the Chao Phraya River and serves as a lower port of Bangkok. In addition, Hua Chiew University is located in this area. This province has a large number of factories and living areas that are densely populated. Therefore, the open-air shopping markets of Samutprakarn are ideal natural habitats for cockroaches, and for these reasons, six markets here were chosen as sites to sample cockroaches for this study.

MATERIALS AND METHODS

Study description

This study was carried out in 18 open-air shopping markets from 5 districts and 1 subdistrict of the Samutprakarn province in Thailand. Samples were collected in February and March of 2008 between the hours of 8:00 pm and 12:00 am. Analysis was carried out between March and August of 2008.

Sample collection/size

Nine hundred and twenty cockroaches were collected. Fifty cockroaches were collected from each the following markets: 1) In the Bang Bor district: Serm-sook, Saeng-charaen, and Bang-pleenoi; 2) In the Bang Saotong subdistrict: Bang-Saotong, Seesajorakea-noi, and Seesajorakea-yai; 3) In the Bang-Plee district: King-kaew, Kaew-wonn, and Bang-chalong. 4) In the Praphra-daeng district: Praphra-daeng, Bang-pueng, and Nha-wat-karu-nai; 5) In the Prasamutchedi district: Sarm-yaek-chedi, Wat-yai, and Tharaue. Additionally, 55 cockroaches were collected from each of the following markets in the Muang district: Taep-pratarn and Sumrong; and 60 cockroaches were collected from the Pak-narm market in the Muang district.

Sample processing

Each cockroach was caught using methods that have been previously described (Fotedar et al., 1991). Essentially, cockroaches were caught using gloved hands and placed in a plastic bag that had been hole-punched to allow for air flow. Samples were transported alive to the laboratory where they were immobilized by freezing at 0 °C for 10 min. The cockroaches were identified using morphology as well as standard taxonomic keys (Tawatsin et al., 2001). Only adult cockroaches that were caught alive and without missing any body parts were used in this study.

Identification of microorganisms on the external surface of the cockroach

After identification, each cockroach was thoroughly shaken in 5 ml of normal saline in a test tube for 30 sec using a vortex. The cockroach was removed and the solution was centrifuged at 2000 rpm for 5 min. A portion of the sediment was examined using a light microscope and the remaining sediment was stained using modified acid-fast stain for characteristic features of coccidian protozoa such as *Cryptosporidium parvum*, *Isospora belli*, and *Cyclospora cayetanensis*.

RESULTS

In this study, 54.1 % of the 920 cockroaches that were captured from six open-air shopping markets in Thailand had helminthes and protozoa on their external surfaces, indicating that they are carriers that are capable of mechanically transmitting these parasitic organisms (Table 1). The parasitic organisms that were identified included protozoa (56.1 %) and helminthes (43.9 %), of which 1.4 % were pathogenic and 42.5 % were non-pathogenic (Figure 1). The helminthes included *Strongyloides stercoralis* (6 instances of free-living adult males, 0.8 %), *Ascaris lumbricoides* (2 decorticated eggs, 0.3 %), *Trichuris trichiura* (2 samples, 0.3 %), *Taenia* spp. (1 egg sample, 0.1 %), 158 unidentified nematode larva (20.2 %), and 174 unidentified egg samples (22.3 %). Interestingly, most of the protozoa were opportunistic types, and the organisms were identified as follows: *Cyclospora* spp. (10 oocysts, 1.3 %), *Endoli-*

max nana (10 cysts, 1.3 %), *B. hominis* (9 instances of the vacuolated form, 1.2 %), *Isospora belli* (75 oocysts, 9.6 %), *Entamoeba histolytica/E. dispar* (36 cysts, 4.6 %), *Cryptosporidium* spp. (220 oocysts, 28.1 %), *Chilomastix mesnilli* (2 cysts, 0.3 %), *Entamoeba coli* (31 cysts, 4.0 %), *Balantidium coli* (45 trophozoites, 5.8 %), and *Iodamoeba butschlii* (1 cyst form, 0.1 %). Additionally, most of the unidentified rhabditiform larvae showed characteristics of both *Strongyloides stercoralis* (e.g. the short buccal cavity) and hookworm (e.g. the nonprominent genital primodium, unclearly visible). Likewise, most of the unidentified filariform larvae showed characteristics of both *Strongyloides stercoralis* (e.g. the short buccal cavity) and hookworm (the pointed, not notched, tail). Also present on the surface of the cockroaches sampled in this study were unidentified eggs that share no characteristics with eggs from human parasitic organisms.

Table 1: Tabulation of the total number of cockroaches, the number of parasitic carrier cockroaches, and the genus/species of the parasites on cockroaches captured from 18 open-air shopping markets in 5 districts and 1 subdistrict in the Samutprakarn province of Thailand

Name of District	# of cockroaches captured-Total	# of parasitic carriers identified		Genus/species			
				<i>P. americana</i>		<i>P. brunnea</i>	
				#	%	#	%
Bang Bor district	150	85	56.7	146	97.3	4	2.7
Bang Saotong sub-district	150	73	48.7	148	98.7	2	1.3
Bang-Plee district	150	59	39.3	150	100	0	0
Muang district	170	64	37.6	170	100	0	0
Praphra-daeng district	150	111	74	143	95.3	7	4.7
Prasamut-chedi district	150	106	70.7	140	93.3	10	6.7
Total	920	498	54.1	897	97.5	23	2.5

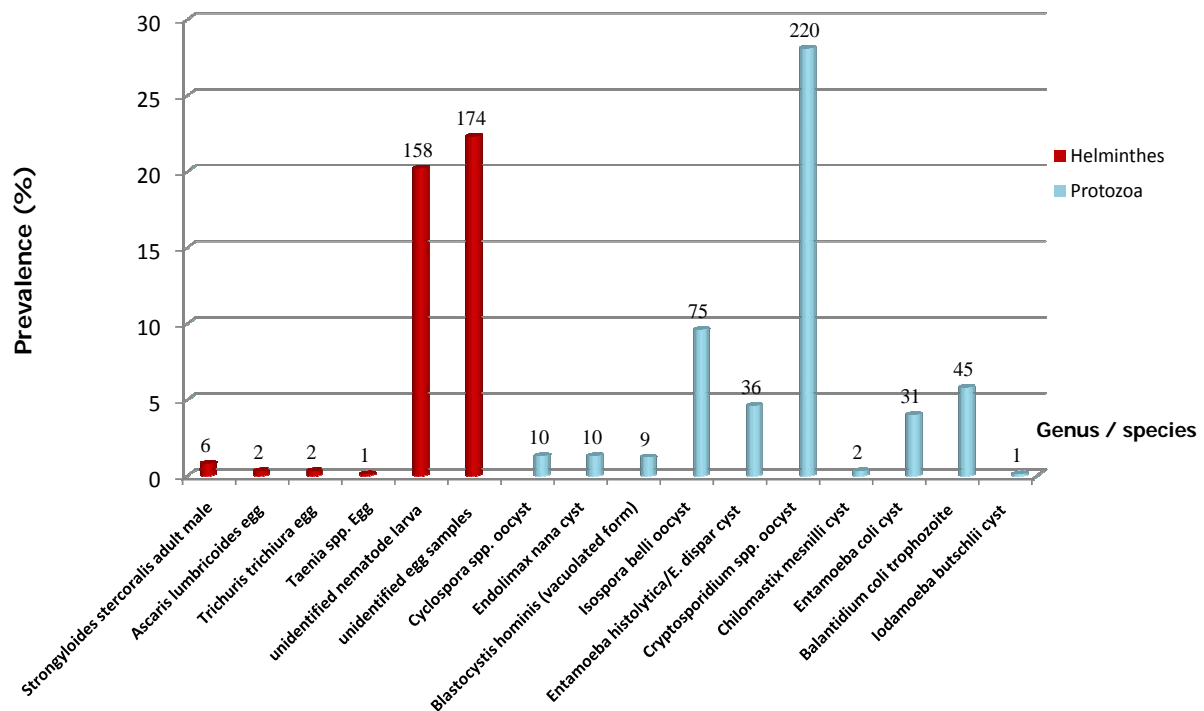


Figure 1: The type, stage, and prevalence of parasites isolated from the external surface of the cockroaches. Parasites were isolated and identified using the procedures described in the Methods section. The genus/species of the parasite is on the X-axis, and the prevalence of each (expressed as a percentage of the entire sample collection) is on the Y-axis, and the actual number of parasites identified is at the top of the bar.

DISCUSSION

As shown here, cockroaches from open-air market environments are potential vectors of medically-important parasites, which is in agreement with previous studies (Fotadar et al., 1991; Graczyk et al., 2005; Salehzadeh et al., 2007; Uckay et al., 2009). *Periplaneta americana* was the predominant cockroach species and encompassed 97.5 % of the cockroaches sampled in this study, which is similar to other studies (Tawatsin et al., 2001; Tungtrongchitr et al., 2004; Saichua et al., 2008). The Muang district had the lowest (37.6 %) percentage of parasitic carrier cockroaches (74 %), while the Praphra-daeng district had the highest. This may be because the Praphra-daeng district is located in a portal area. Various ships, with their unsanitary bathrooms and kitchens, may carry cockroaches from other areas into the zone, and this may add to the high amount of parasitic organisms. Of note is the presence of *Balantidium coli*, a trophozoite that was found on cockroaches

isolated in the markets in this study. This may be present because of the practice of butchers washing out pig intestines right in the markets prior to offering them for sale.

Parasite-related diseases can be managed and prevented by controlling the cockroach population. This can be accomplished at the public level by having the markets put public health regulations in place, as well as on a personal level by maintaining good personal and domestic hygiene.

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