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A Study of Cow Dung Diptera in Sentul Timur, Kuala Lumpur, Malaysia

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Abstract

A survey of cow dung dipteran diversity was conducted at a cattle farm in Sentul Timur, Kuala Lumpur, Malaysia. Five surveys were made to a cattle farm during November-December 2009. We examined 50 cow dung samples for fly larvae and other dung associated arthropods. Adult flies were collected around the dung using a sweeping net or plastic bag while the larvae were collected using forceps. Some of the collected larvae were preserved in 70% alcohol and the rest were raised to adult stages for identification. We collected 321 dipterans from 16 families: Sepsidae, Muscidae, Calliphoridae, Sarcophagidae, Psychodidae, Ephydridae, Sphaeroceridae, Dolichopodidae, Lauxaniidae, Stratiomyiidae, Chloropidae, Neriidae, Tabanidae, Tephritidae, Chironomidae and Aphididae. Other than Diptera, we also collected ants (Formicidae), the nymph of a praying mantis (Acromantinae), a leaf hopper (Cicadellidae), adult coleopterans (Scarabidae, Hydrophilidae), a carabid larva, a centipede (Chilopoda), an earth worm (*Lumbricus terrestris*), a Symphyla (Myriapoda), an earwig (Dermaptera: Forticulidae), a firebrat (Thysanura), a spider and a tiny frog. The Sepsidae were the most abundant diptera, followed by Muscidae, such as *Musca inferior* and *Stomoxys calcitrans*. Most muscid flies are bloodsuckers while the sepsid and other families are scavengers on the cow dung. We also raised the larvae found in the dung to adult stages and subsequently identified them as *Allosepsis indica* (Sepsidae) and *Psychoda* sp (Psychodidae). Blood sucking flies play a vital role in zoonosis transmission. It is important to investigate disease vectors associated with cow dung for implementation of future control measures in Malaysia.

Keywords: cow dung Diptera, biodiversity, Muscidae, abundance, Malaysia

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Introduction

Diptera, or two-winged insects, constitute one of the largest orders of Insecta; its members are abundant almost everywhere on the earth [1,2].

Flies, especially the suborder Cyclorrhapha, are important vectors for disease transmission [3,4]. Non-biting cyclorrhaphan flies, such as house flies, blow flies and flesh flies, are known to carry human intestinal parasites [5,6], human protozoa [7] and animal metazoan parasites [8]. Other than parasites, pathogenic bacteria [7], antibiotic resistant enterococci and staphylococci [9], fungi [10], viral pathogens such as H5N1 virus [11] and Bovine Papillomavirus [12] have been isolated from synantrophic flies in various part of the world. In Malaysia, medically important bacteria, parasites and rotavirus have also been isolated from house flies and cyclorrhaphan flies [13-16].

Information on dung arthropods is important not only to biological and integrated control programs, but also for the implementation of programs controlling pests that breed in cattle droppings [17]. However, little is known of veterinary important dipteran in Malaysia, especially about cow dung Diptera.

The objective of this study was to investigate on the type and abundance of dipteran associated with cow dung in Sentul Timur, Kuala Lumpur. Other arthropods associated with cow dung are also reported in this paper.

Materials and methods

Study site and sample collection

A total of five surveys at a cattle farm were carried out during November-December 2009. The cattle farm is located in Sentul Timur (3°11' N 101°41' E) about 10 km from Kuala Lumpur. Fly collection was carried out from 9 AM until 1 PM. We examined 50 cow dung samples using a spreader. Sweeping nets and plastic bags were used to collect the adult flies around the cow dung while the fly larvae were collected using forceps. Most of the larvae were preserved in 70% alcohol, but some were raised to the adult stage for identification.

Larva processing

The preserved larvae were placed on slides to determine morphology. The larvae were processed as follows: the posterior part of larvae were cut partially without being separated from the main body, and then the larvae were placed in 10% KOH for 24 hours. After overnight immersion, the larvae were placed in 10% acetic acid for 5 minutes to neutralize the remaining KOH. The larvae were then transferred to bottles in a series of ascending concentrations of alcohol at 50%, 70% and 100% for 30 minutes each. After dehydration, the larvae were immersed in clove oil for 30 minutes and then xylene for another 30 minutes. The larvae were finally transferred onto slides, covered with a few drops of Canada Balsam, then cover slips were placed on top. The internal larval structures were examined under a compound light microscope.

Larva rearing

The live larvae were raised in a modified plastic container (height = 10.0 cm; diameter 4.0 cm) with several punctured holes on the screwed cap for air. A small quantity of cattle dung collected from the study site was placed in the plastic container to serve as food source. The plastic container were then stored at room temperature until the emergence of adult flies. Fly identification was based on several references [2,18,19].

Results

Three hundred twenty-one dipterans from 16 families were collected; 12 species from the family Muscidae, four species from Sarcophagidae, two species from Sepsidae, two species from Calliphoridae and two species from Dolichopodidae. The other families were comprised of single unidentified species (Table 1).

The larvae raised to adult stage were subsequently identified as *Allosepsis indica* (Diptera: Sepsidae) and *Psychoda* sp (Diptera: Psychodidae). The third instar larval morphology of *A. indica* is described in this study. The cephalopharyngeal skeleton was stout, without an accessory sclerite on the denticle, dorsal part of dorsal cornu with pale sclerotization and ventral cornu with pharyngeal ridges (Fig 1a). The anterior spiracle had 12 papillae each arranged

Table 1 Biodiversity of cow dung Dipteran collected from Sentul Timur, Kuala Lumpur.

Family	Species
Sepsidae	*Allosepsis indica* Wiedemann, 1824
	Sepsis sp
Muscidae	*Haematobia* sp
	Musca crassirostris Stein, 1903
	M. domestica Linnaeus, 1758
	M. inferior Stein, 1909
	M. sorbens Wiedemann, 1830
	M. ventrosa (Wiedemann, 1830)
	Myospila bina bina (Wiedemann, 1830)
	M. lenticeps Thomson, 1869
	Neomyia indica Robineau-Desvoidy, 1830
	N. lauta Wiedemann, 1830
	Ophyra chalcogaster Wiedemann, 1830
	Stomoxys calcitrans (Linnaeus, 1758)
Calliphoridae	*Chrysomya megacephala* (Fabricius, 1794)
	Hemipyrellia ligurriens (Wiedemann, 1830)
Sarcophagidae	*Boettcherisca peregrina* (Robineau-Desvoidy, 1830)
	Liopygia ruficornis (Fabricius, 1794)
	Parasarcophaga dux (Thomson, 1869)
	Seniorwhitea princeps (Wiedemann, 1830)
Dolichopodidae	*Dolichopus* sp
	Sciapus sp
Psychodidae	*Psychoda* sp
Stratiomyiidae	*Sargus* sp
Neriidae	*Telostylinus lineolatus* (Wiedemann, 1830)
Chironomidae	
Tephritidae	
Chloropidae	
Lauxaniidae	Unidentified species
Sphaeroceridae	
Aphididae	
Tabanidae	
Ephydridae	

in a regular row (Fig 1b). The posterior spiracles were well sclerotized. The peritreme was complete with a thick chitinized wall that was D-shaped and plano-convexed. The spiracular slits were worm-like with 8-14 folds. Spiracular button was chitinized and centrally located within the peritreme (Fig 1c).

The most numerous family was Sepsidae (43.8%) followed by Muscidae (36.1%) and Psychodidae (5.2%) (Fig 2). One hundred sixteen specimens collected belonged to the family Muscidae; this had a diverse group of cow dung Diptera with 12 species: *Musca inferior* (37%), *Ophyra chalcogaster* (12.0%), *Stomoxys calcitrans*

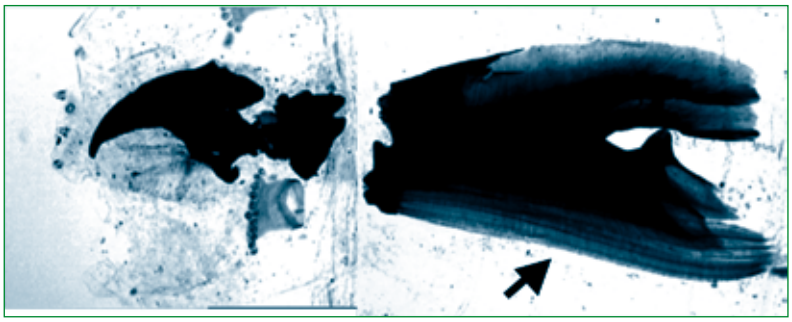

Fig 1a Cephalopharyngeal skeleton of *Allosepsis indica* (Diptera: Sepsidae). Note the ventral cornu with pharyngeal ridges (arrow).

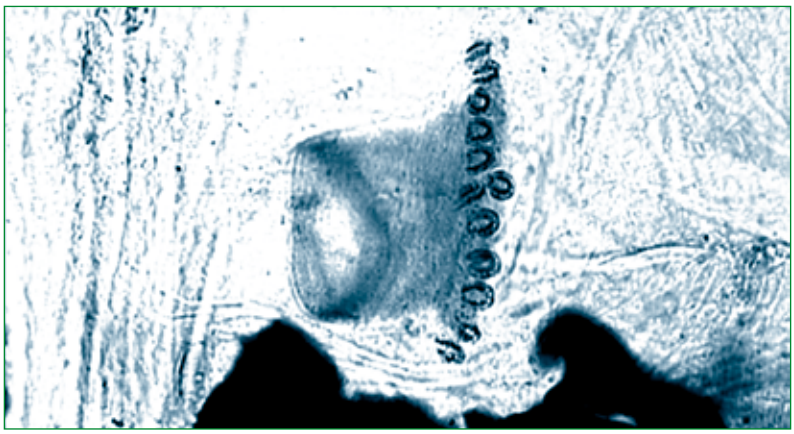

Fig 1b Anterior spiracle consisted of 12 papillae.

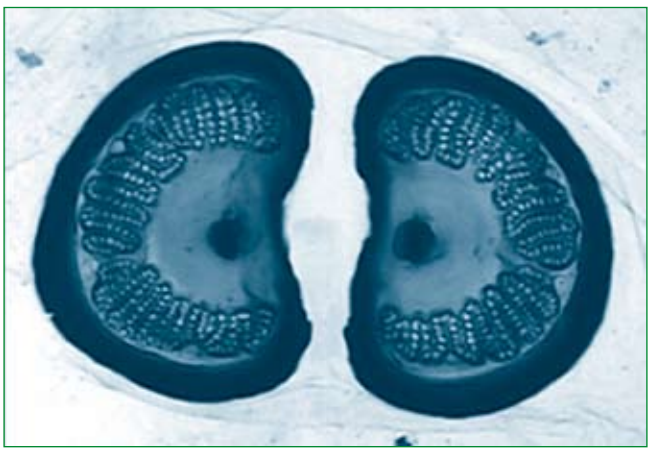

Fig 1c Posterior spiracle with D-shaped peritreme and worm-like spiracular slits (third instar larva).

(10.3%), *Neomyia lauta* (10.3%), *Musca ventrosa* (9.4%), *Myospila bina bina* (7.7%), *Musca sorbens* (5.1%), *Musca crassirostris* (3.4%), *Musca domestica* (1.7%), *Myospila lenticeps* (0.8%), *Neomyia indica* (0.8%) and *Haematobia* sp (0.8%) (Fig 3). Five species of muscids were identified as blood sucking flies: *M. inferior*, *S. calcitrans*, *M. ventrosa*, *M. crassirostris* and *Haematobia* sp.

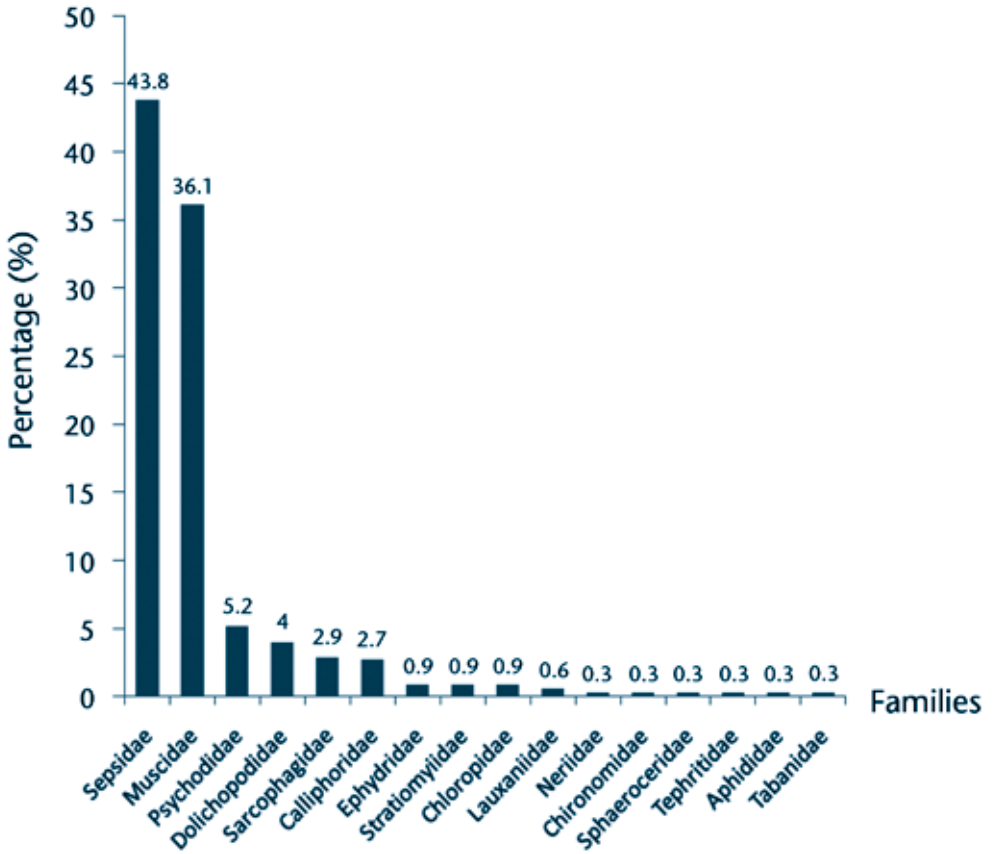

Fig 2 Percentage of dipteran families collected from cow dung.

Other than Diptera, various arthropods were found in the cow dung: ants (Formicidae), a praying mantis nymph (Acromantinae), leaf hoppers (Cicadellidae), scarab beetles, hidrophilid beetles (*Sphaeridium* sp), the larva of a carabid beetle, a centipede (Chilopoda), a Symphyla (Myriapoda), an earthworm (*Lumbricus terrestris*), an earwig (Dermaptera: Forticulidae), a firebrat (Thysanura) and a spider (Arachnida). A tiny frog (body length ~ 10 mm) was also discovered hiding in the dung.

Discussion

A. indica (Sepsidae) was the most numerous cow dung Diptera in our study. This finding is similar to Julio and Arico [17] and Psarev and Псарёв [20]. The sepsid larvae are dung tunnelers which contribute to dung aeration, which can help dung colonization by other arthropods. Therefore, they aid in the natural control of blood sucking flies such as *Haematobia irritans* [17]. In this study, we found sepsid larvae in the cow dung, similar to Byrd and Castner [21] and Charles and Norman [2]. The adults are of the first insects to arrive at fresh cattle droppings, often within minutes [22] and start looking for suitable places for oviposition [20]. Adult sepsids are common flies on dung and are found near material where larvae breed [2]. Sepsidae are not considered as nuisance pests to livestock but as coprophagous species which act as decomposers of animal excrement [3].

The blood sucking muscid flies constituted 22% of the total dipteran caught in this study. They are considered as veterinary and medically important vectors of disease to animals and humans who working on farms [18]. The bite of

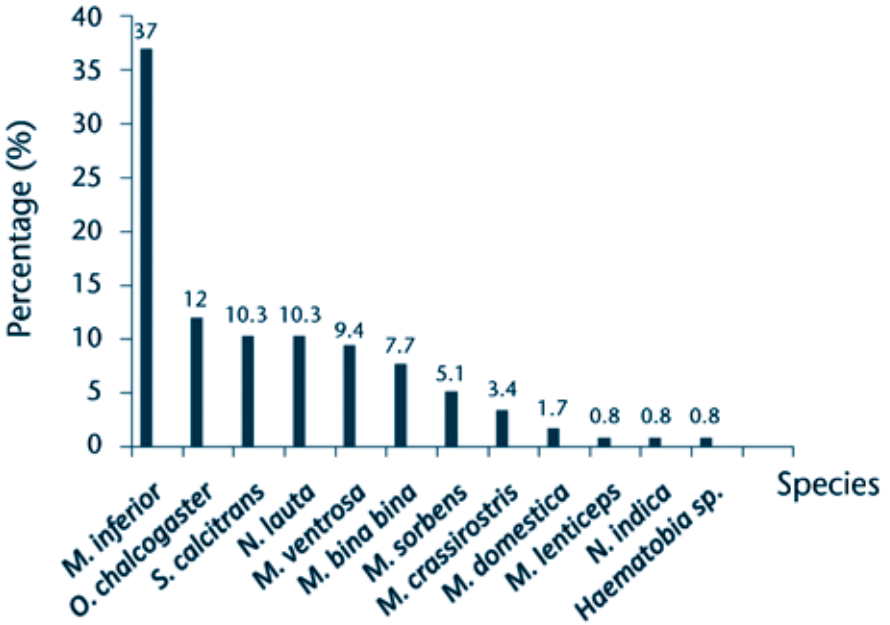

Fig 3 Percentage of species of Muscidae caught on cow dung.

S. calcitrans is painful and is a troublesome pest for people, cattle, horses and dogs [4]. It serves as a biological vector for *Habronema* and a mechanical vector for *Trypanosoma evansi* and *T. equinum* in the livestock industry [23]. In medicine, *S. calcitans* is a mechanical vector for African trypanosomiasis and *Dermatobia hominis* eggs which are responsible for cutaneous myiasis in Central and South America [4]. Both sexes of *Stomoxys* are noxious blood feeders; the females are more aggressive because they take several blood meals during the day. They distrub the animal and lead to the reduction of animal growth and decreased milk production which can impact veterinary economy [3]. In this study, *S. calcitrans* was found to be the second most common blood sucking fly after *M. inferior*.

In our study, *M. inferior* was the most common blood sucking species in a cattle farm. They have a stout proboscic with mentum and draw blood by scratching the animal's skin with its prestomal teeth. The species is oviparous and the larvae breed in cow dung [18]. However, we did not find any blood sucking fly larvae in cow dung throughout the study. In 1974, Norris and Ferrar [24] reported *M. inferior* as livestock flies new to Papua New Guinea. Patton [25] reported *M. inferior* is widely distributed in India but it has never been seen in large numbers. We found this fly can be observed quite frequently on cattle dung in Sentul Timur; this may be attributed to the variation in geographical distribution.

M. ventrosa was the third most common blood feeding species in our study site (9.4%). This small fly can be easily identified by the dark thorax with four stripes and orange-yellow abdomen [18,25]. They feed on wounds, sores and bites inflicted by other insects. They are also dung visitors and the larvae breed in cow dung [25]. Nazni *et al* [26] collected small number of *M. ventrosa* from lakes, wetlands, jungle fringes and housing areas in Putrajaya and reported this species is diurnally active in nature.

M. crassirostris were collected in small numbers (3.4% of the total Muscidae caught) and were not observed to have any significant impact to livestock in comparison to *M. inferior* and *S. calcitrans*. They are often seen sucking blood from the legs and abdomens of cattle, horses and donkeys and in some occassions biting man [18].

M. crassirostris is one of the most important cattle pest in India; there animals spend most of their time trying to drive them off. The cattle are often forced to lie down and curl their legs under thier bodies to protect themselves from the vicious bites of these flies [25]. In Oman, *Lyperosia minuta* and *M. crassirostris* have been found to attack local cattle intensely at certain times of the year making it difficult for them to graze during the daytime [27].

Only one specimen of adult *Haematobia* sp was collected during this study. The adults bite buffalos, cattle, horses and occasionally dogs and men. The female flies lay their eggs on fresh droppings and the dung serves as a food source for the larvae. Pupation takes place in the soil just below the dung [18]. Georgi [28] reported *Haematobia* can impair milk production and weight gain in animals. It also serves as a biological vector for *Stephanofilaria stilesi* in cattle. Shaw and Sutherland [29] found the prevalence of *Stephanofilaria* in *H. irritans exigua* ranged from 29% to 57% in four locations studied in Central Queensland, Australia, which indicates a high level of transmission of the filarial worm to cattle. However, no data is available in Malaysia regarding the role of *Haematobia* sp in the parasite transmission. Another blood sucking fly discovered in this study was a tabanid. Unfortunately, this specimen was not identified.

Several *Neomyia* were recovered in this study; including *N. lauta* and *N. indica*, in which *N. lauta* was more prevalent (10.3%). *N. lauta* can be differentiated from *N. indica* by having palpi and antenna which are brownish-orange in color and silver whitish parafacialis, while the latter have bright yellowish third antenna segments and golden parafacialis. *Neomyia* spp are common on cow and horse dung. The female lay eggs under the dung surface and the larvae are purely saprophagous and coprophagous. The larvae of *Neomyia* serve as food sources for other carnivorous larvae living in the cow dung [18].

We also collected some adult *M. domestica*, *M. sorbens* and *Ophyra chalcogaster*. They are dung visitors and non-blood feeders. However, they can act as mechanical vectors for certain parasites and bacteria. Their larvae are found in dung [4,18]. The larvae of *O. chalcogaster* are known to be predacious on other fly larvae [18].

Two species of *Myospila* were collected: *M. bina bina* and *M. lenticeps*. The former was more prevalent at 7.7% compared to only 0.8% of the total muscid flies. *Myospila* are mainly distributed in Palaeo-tropical regions and New Guinea and this genus contains many dung-frequenting flies. It was formerly placed under the genus *Xenosia*. *M. bina bina* larvae are categorized as obligatory carnivorous species and it hatches from the egg as a second instar [30]. However, we did not find any larvae of *Myospila* residing in the cow dung. This is probably due to the lower population of *Myospila* in the study area. *M. lenticeps* was first recorded in Malaysia by Omar *et al* [31] who used mix-fruit bait as fly attractant. Zuha *et al* [32] recorded the behavior of *M. pudica pudica* associated with monkey carrion in Malaysia. From previous and present studies, *Myospila* spp are most likely to be attracted to dung, decaying vegetables and carrion in nature. According to Iwasa [30], the larva of *M. bina bina* has ventral pharyngeal ridges which are incomplete and disappear in the posterior part of pharyngeal floor, which suggests the shape and structure of the pharyngeal sclerites are closely correlated with their feeding habits.

Besides Muscidae, we collected *Chrysomya megacephala* and *Hemipyrellia ligurriens* (family Calliphoridae) and four species of flesh flies (Sarcophagidae). The *C. megacephala* and sarcophagids flies may serve as facultative myiasis agents for animals, especially when there are exposed to untreated wounds [19,28]. In some situations, the larvae of sarcophagids are capable of preying on other fly larvae in dung [17].

In this study, moth flies (*Psychoda* sp) were in the cow dung. Satchell [33] raised *Psychoda* sp on cow dung, decaying vegetable matter and organic mud in Britain. The psychodids are small, hairy, moth-like flies and the adults live in moist, shady places, drains or sewers. The larvae can live in decaying vegetable matter, mud, moss or water. Most psychodids are harmless to humans and

animals except those in the genus *Phlebotomus* and *Lutzomyia*, who are blood sucking and vectors for leishmaniasis [2,4].

Conclusions

Muscidae were the most diverse family on cow dung; it consisted of five blood sucking species. The most important blood sucking muscids in this study were *M. inferior* and *S. calcitrans*. From the total dipterans caught, *A. indica* (Sepsidae) was the most abundant Diptera found. Studies of cow dung Diptera should be collected seasonally throughout the year to provide a more complete picture of veterinary important dipterans in cattle and horse dung in Malaysia for a better management of fly control programs in the future.

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