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## DIVERSITY AND SUCCESSION PATTERN OF FORENSICALLY IMPORTANT DIPTERAN SPECIES ASSOCIATED WITH ORGANOPHOSPHATE PESTICIDES-INTOXICATED RAT CARCASSES IN SARAWAK, MALAYSIA

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### ABSTRACT

This research aimed to study the decomposition process of organophosphate-intoxicated rat carcasses and the succession pattern of associated insects at a secondary forest in Kuching, Sarawak, Malaysia. The animal model, *Rattus norvegicus*, weighing around 180-200g were assigned in T1 and T2 groups and were given LD<sub>50</sub> dosage of organophosphate, glyphosate, and chlorpyrifos via oral administration, respectively. Sixty minutes after oral administration, the rats were euthanized and brought to the study site. The rat carcasses were monitored daily and the carrion insects were collected throughout the decomposition process. From five trials of experiments, a total of 1454 individual flies were collected, belonging to three families and 10 species. The highest number of fly species collected was *Chrysomya rufifacies* (75.03%) being the predominant species infesting the carcasses. The dipteran diversity and succession pattern were similar for all groups of carcasses, even though insect abundance were the least in T2 carcasses. Five stages of decomposition were observed in all rat carcasses, with longer decomposition duration in intoxicated carcasses (T1: 7.85±0.51 and T2: 15.8±2.82 days) compared to the control group (7.25±0.59 days). In conclusion, the organophosphate has altered the decomposition duration and the number of flies infesting the carcasses especially on chlorpyrifos-intoxicated carcasses. This work provides relevant information regarding the insect's succession pattern and the changes in the decomposition period which may assist in the determination of post-mortem interval time in future investigation processes when organophosphate poisoning is suspected.

**Keywords:** Forensic entomology, organophosphate, decomposition, insect succession pattern

### ABSTRAK

Penyelidikan ini bertujuan untuk mengkaji proses penguraian bangkai tikus yang diracun dengan organofosfat dan corak sesaran serangga yang berkaitan di hutan sekunder di Kuching, Sarawak, Malaysia. Model haiwan, *Rattus norvegicus* dengan berat sekitar 180-200g

dibahagikan ke dalam kumpulan T1 dan T2 dan diberi dos LD<sub>50</sub> organofosfat, glifosat, dan klorpirifos masing-masing melalui pemberian oral. Setelah 60 minit pemberian secara oral, tikus tersebut dimatikan secara eutanasia dan dibawa ke lokasi kajian. Bangkai tikus dipantau setiap hari dan serangga pemakan bangkai dikumpulkan sepanjang proses penguraian. Dari lima percubaan eksperimen, sejumlah 1454 individu lalat dikumpulkan, yang terdiri daripada tiga famili dan 10 spesies. Jumlah spesies lalat tertinggi yang dikumpulkan adalah *Chrysomya rufifacies* (75.03%), iaitu spesies utama yang memakan bangkai. Kepelbagaian Diptera dan corak keberjayaan serangga adalah serupa untuk semua kumpulan bangkai, walaupun jumlah serangga paling sedikit di bangkai T2. Lima peringkat penguraian diperhatikan pada semua bangkai tikus, dengan jangka masa penguraian yang lebih lama dalam bangkai yang diracun (T1: 7.85±0.51 dan T2: 15.8±2.82 hari) berbanding dengan kumpulan kawalan (7.25±0.59 hari). Kesimpulannya, organofosfat telah mengubah jangka masa penguraian dan jumlah lalat pemakan bangkai terutama pada bangkai yang diracun oleh klorpirifos. Hasil dapatan kajian ini memberikan maklumat yang relevan mengenai corak sesaran serangga dan perubahan dalam tempoh penguraian yang dapat membantu dalam penentuan selang masa kematian dalam proses penyiasatan pada masa hadapan ketika keracunan organofosfat disyaki.

**Kata kunci:** Entomologi forensik, organofosfat, penguraian, corak keberjayaan serangga

## INTRODUCTION

In forensic entomology, several factors were taken into account in estimating the  $\text{minPMI}$  which include the decomposition stages, insect succession pattern, and insect developmental stages (Catts & Goff 1992; Oliveira -Costa & Mello-Patiu 2004). These factors are closely related because the decomposition process is heavily influenced by the organisms that feed on the body. During each stage of decomposition, the varying in biological, chemical, and physical changes that occur throughout the decay process will attract different species of insects, for example scuttle flies (Zuha & Disney 2023), blowflies, flesh flies and carrion beetles (Anderson & VanLaerhoven 1996).

However, the presence of drugs or poisons in the body can affect the estimation of  $\text{minPMI}$  (Goff & Lord 1994). Several studies investigated the effects of poisonous substances such as organophosphate (Abd El-bar & Sawaby 2011; Jales et al. 2020), ethanol (Tabor et al. 2005), gasoline (Rumiza et al. 2010), and morphine (Bourel et al. 1999). From their studies, the chemical or toxic substances not only affected the insects' arrival time and colonisation time, but it was also found that the chemicals interfered with the development of the insects that were infesting on the body (Carvalho et al. 2001; Mahat et al. 2009; Wolff et al. 2004). Pesticide poisoning is not new in Malaysia. A study conducted by the National Poison Centre of Malaysia from 2006 to 2015 showed an increasing trend in pesticide poisoning incidents over the 10-year duration with the highest number of poisonings being due to herbicides (44%) followed by agriculture insecticides (34%). Among herbicides poisoning, 53% are caused by glyphosate and chlorpyrifos was the top agent involved in poisoning among organophosphate insecticides (Kamaruzaman et al. 2020). This may be caused by the availability of the pesticides as it used for agricultural purposes which makes them one of the main causes of poisoning by accidental exposure, suicides and sometimes homicide (Sungur & Guven 2001).

This present study aims to observe the effect of organophosphate pesticides on the decomposition process of carcasses and to establish the baseline data for fauna succession populating decomposing rat carcasses in a secondary forest in Kuching, Sarawak, Malaysian Borneo.