



# Microbiota and potential opportunistic pathogens associated with male and female fruit flies of Malaysian *Bactrocera carambolae* (Insecta: Tephritidae)



Hoi-Sen Yong<sup>a</sup>, Sze-Looi Song<sup>b,\*</sup>, Kah-Ooi Chua<sup>a</sup>, Phaik-Eem Lim<sup>b</sup>, Praphathip Eamsobhana<sup>c</sup>

<sup>a</sup> Institute of Biological Sciences, Faculty of Science, University of Malaya, Kuala Lumpur, Malaysia

<sup>b</sup> Institute of Ocean and Earth Sciences, University of Malaya, Kuala Lumpur 50603, Malaysia

<sup>c</sup> Department of Parasitology, Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok, Thailand

## ARTICLE INFO

### Keywords:

Microbiota  
*Bactrocera carambolae*  
 Potential opportunistic pathogens  
 Wild fruit fly  
 Bacterial communities

## ABSTRACT

*Bactrocera carambolae* Drew & Hancock is an agricultural pest that causes considerable damage to various fruit crops in Southeast Asia and South America. We report here the bacterial communities associated with field-caught male and female adult flies from University Malaya campus. The microbiota was determined by targeted 16S rRNA gene (V3–V4 region) sequencing using the Illumina MiSeq. At 97% similarity, four bacterial phyla (with relative abundance of  $\geq 1\%$  in at least one specimen) – Bacteroidetes, Firmicutes, Proteobacteria, and Tenericutes – were recovered from the adult flies. Proteobacteria was the predominant phylum in all the samples, with the female flies ( $86.81 \pm 6.57\%$ ) having higher mean relative abundance than the male flies ( $71.57 \pm 18.37\%$ ). The Firmicutes was more abundant in the male flies ( $14.47 \pm 17.30\%$ ) than female flies ( $0.69 \pm 1.25\%$ ). There were in total seven classes, nine orders, 13 families, 23 genera, and 31 putative species. Thirteen genera had higher mean relative abundance in male flies, and nine in female flies. *Klebsiella* was the predominant genus in female flies, while *Desulfovibrio* was more abundant in some male flies. The mean relative abundances of the putative species *Orbus sasakiae* and *Enterococcus moraviensis* were significantly higher in male than female flies, while female flies had significantly higher mean relative abundance for *Escherichia fergusonii* and *Klebsiella variicola*. Alpha diversity indices indicated that the bacterial diversity varied within and between male and female flies, and the mean bacterial diversity was significantly higher in male flies. The differences in bacterial diversity and relative abundance may be reasonably attributed to stochastic processes, in part to environmental factors such as food resources and habitats. It is significant that several putative bacterial species recovered in the present study have not been reported in *Bactrocera* fruit flies. Sixteen of the 31 detected putative bacterial species are potential opportunistic pathogens of medical/public health importance.

## 1. Introduction

The carambola fruit fly *Bactrocera carambolae* Drew & Hancock is a member of the *B. dorsalis* species complex (Drew & Hancock, 1994). It is one of the most severe pests of economic importance in the Pacific Region (Vargas et al., 2015) and Suriname (van Sauer-Muller, 2005). It is highly polyphagous, infesting many plant families (Yong, 1994; Allwood et al., 1999; Malavasi et al., 2013; Lemos et al., 2014; Marchioro, 2016).

*B. carambolae* is native to Southeast Asia (Vietnam to Indonesia) and India (Andaman Island) but has been introduced into South America (Drew & Hancock, 1994; van Sauer-Muller, 2005; Malavasi et al., 2013; Lemos et al., 2014; Vargas et al., 2015; Marchioro, 2016). It is listed as a quarantine insect pest (version 2017–09) by the European and Mediterranean Plant Protection Organization (EPPO, 2017).

To date, the microbiota associated with *B. carambolae* has been reported for the developmental stages recovered from the host fruit *Averrhoa carambola* L. (family Oxalidaceae) (Yong et al., 2017a) and field-caught adult male flies (Yong et al., 2017b). The microbiota reports on the different life stages of *B. carambolae* indicate transmission of bacteria from the immatures to the newly emerged adults, and from the exuviae to the environment (Yong et al., 2017a). There is however no study on the microbiota of field-caught adult female flies, and therefore differential diversity and abundance of the associated microbiota in male and female flies. Studies on the field caught adult flies will also contribute to our knowledge on the transmission modes of the associated microbiota. Male *B. carambolae* flies are attracted to methyl eugenol while the female flies are not. Many plants possess methyl eugenol or eugenol that attract the male flies and would therefore cause them to pick up environmental microbes on these plants (Shelly, 2010).

\* Corresponding author at: Institute of Ocean and Earth Sciences, University of Malaya, 50603 Kuala Lumpur, Malaysia.

E-mail address: [szelooi@um.edu.my](mailto:szelooi@um.edu.my) (S.-L. Song).

<https://doi.org/10.1016/j.mgene.2018.12.002>

Received 3 October 2018; Received in revised form 30 November 2018; Accepted 6 December 2018

Available online 11 December 2018

2214-5400/ © 2018 Elsevier B.V. All rights reserved.