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Original article

Olfactory response of two different *Bactrocera* fruit flies (Diptera: Tephritidae) on banana, guava, and mango fruits

Waqar Jaleel [a,b,c,d,e,*], Rabia Saeed [f], Muhammad Zeeshan Shabbir [d], Rashid Azad [g], Shahbaz Ali [h], Muhammad Umair Sial [i], Dalal M. Aljedani [j], Hamed A. Ghramh [k,l,m], Khalid Ali Khan [k,l,m], Desen Wang [a,b,c], Yurong He [a,b,c,*]

[a] *Department of Entomology, South China Agricultural University, Guangzhou 510642, China*
[b] *Key Laboratory of Bio-Pesticide Innovation and Application, Guangdong Province, Guangzhou 510642, China*
[c] *Engineering Research Center of Biological Control, Ministry of Education, Guangzhou 510642, China*
[d] *Plant Protection Research Institute, Guangdong Academy of Agricultural Sciences, Guangzhou 510640, China*
[e] *Department of Bioinformatics, College of Life Science, Institute of Life Science and Green Development, Hebei University, Baoding 071002, China*
[f] *Central Cotton Research Institute, Multan Pakistan*
[g] *Department of Entomology, The University of Haripur, Pakistan*
[h] *Fareed Biodiversity and Conservation Centre, Department of Agricultural Engineering, Khawaja Fareed University of Engineering and Information Technology, Rahim Yar Khan, Punjab, Pakistan*
[i] *Institute of Plant Protection, Muhammad Nawaz Shareef University of Agriculture, Multan, Pakistan*
[j] *Department of Biological Sciences, College of Science, University of Jeddah, Jeddah, Saudi Arabia*
[k] *Research Center for Advanced Materials Science (RCAMS), King Khalid University, P.O. Box 9004, Abha 61413, Saudi Arabia*
[l] *Unit of Bee Research and Honey Production, Faculty of Science, King Khalid University, P.O. Box 9004, Abha 61413, Saudi Arabia*
[m] *Biology Department, Faculty of Science, King Khalid University, P.O. Box 9004 Abha 61413 Box 9004, Abha 61413, Saudi Arabia*

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ABSTRACT

Bactrocera dorsalis and *B. correcta* (Diptera: Tephritidae) are economically important pests of fruits and have caused serious damage to fruits for the last several years worldwide. In China, *B. correcta* is second economic pest of fruits after *B. dorsalis*. Considering the importance of Integrated Pest Management (IPM) programs, Information regarding host preference and fitness of both *Bactrocera* species are necessary for better management strategies. Therefore, the current study explains the response of both *Bactrocera* species on banana, guava, and mango fruits. The cultivar of banana, guava, and mango fruits used first time in this study. Therefore, the volatile/aromatic components of banana, guava, and mango fruits were determined using porapak Q via gas chromatography-mass spectrometry (GC–MS). Results concluded that the number of male flies of both species on each types of fruits were lower in comparison to female flies. The number of flies and oviposition punctures by female *B. dorsalis* flies were maximum on mango fruits than those of guava and banana fruits. While in the case of *B. correcta*, the guava fruits were preferable for visits and oviposition punctures than those of other two fruits. Mango fruits were more favorable for the development and survival of both *Bactrocera* species than those of other two fruits. The GC/MS results indicated that butanoic acid-3-methylbutyl ester, α-caryophyllene, and 3-carene were the major volatile components of banana, guava, and mango fruits, respectively. Based on the results, mango and guava fruits were more suitable for both *Bactrocera* species. Future studies are needed to confirm the results of this laboratory study in the fruit orchards.

1. Introduction

Insect pests, especially *Bactrocera* species (Diptera; Tephritidae) are important pests and have caused serious damage to fruits for the last several years (Allwood et al., 1999, Jamal et al., 2021). Among *Bactrocera* species, *Bactrocera dorsalis* Hendel and *Bactrocera correcta* Bezzi are economically important pests of fruits in Asia (Jaleel et al., 2019, Jaleel et al., 2018a, Jaleel et al., 2018b, Jaleel et al., 2018c, Jaleel et al., 2020, Jaleel et al., 2021, Allwood

* Corresponding authors at: Department of Entomology, South China Agricultural University, Guangzhou 510642, China.

E-mail addresses: waqar4me@yahoo.com (W. Jaleel), yrhe@scau.edu.cn (Y. He).

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et al., 1999). Nowadays, *B. correcta* is the second to *B. dorsalis* as serious pest to fruits in China. *B dorsalis* is one of the most polyphagous pests that can infest more than 250 host plant species, especially fruits (Jaleel et al., 2018b). Mango, guava, papaya, banana, and citrus fruits are the favorite hosts of *B. dorsalis* (Zhang et al., 2018). Similarly, *B. correcta* is a serious pest of guava fruits. Other fruits such as mango, cashew nut, orange, banana, cherry, jujube, carambola, and wax apple has also been reported as host (Liu et al., 2013, Jaleel et al., 2020). Both *B. dorsalis* and *B. correcta* prefer to oviposit on the most favorable hosts (Cunningham et al., 2016). Female adults of *B. dorsalis* recognize the suitable host at an optimal distance using visual and olfactory chemical cues (García Gonzalez et al., 2018). However, most of *Bactrocera* species dislike the unripe fruits, or with a hard skin for oviposition or their immature development (Rattanapun et al., 2009, Jaleel et al., 2018b).

The host preference of female *Bactrocera* flies usually depends on the host aroma emission rate, softness, (Metcalf et al., 1983, Jamal et al., 2021), and sugar level (Rattanapun et al., 2009, Naeem-Ullah et al., 2020). The physical characteristics of fruits are essential for study the olfactory and ovipositional behavior of *Bactrocera* species. Because skin toughness and sugar level (Brix) of fruits have a significant impact on the selection behavior of female *Bactrocera* flies for their immature development (Jaleel et al., 2018b, Rattanapun et al., 2009).

The development and survival rate of *Bactrocera* species usually varies on different fruits (Rattanapun et al., 2009, García Gonzalez et al., 2018). Soft and juicy skin fruits are more suitable for the survival and development of *Bactrocera* species (Rattanapun et al., 2009, Jaleel et al., 2018b). The nutrition level of fruits may have a significant effect on the development and survival of the *Bactrocera* offspring (McGraw et al., 2005, Khan and Ghramh, 2021). However, fruits have a different level of toxins, which may affect the development of the larvae of *Bactrocera* (Rattanapun et al., 2009). However, to the best of our knowledge, any works has been carried out on the *B. correcta* preference for mango fruits.

Identification of volatile constituents from fruits is necessary because most of the volatile components are good attractants for *Bactrocera* species (Biasazin et al., 2014, Jaleel et al., 2019). Mango (*Mangifera indica* L. Anacardiaceae), guava (*Psidium guajava* Linn. Myrtaceae), and banana (*Musa* spp. Musaceae) are economically valuable fruits and kept essential vitamins for human nutrition (Paniandy et al., 2000, Maldonado-Celis et al., 2019). Aromatic or volatile compound of fruits are very important to make fruit attractive as a source for pests such as species of *Bactrocera*. Cyclopentasiloxane and tetradecamethyl- were reported as aromatic compounds of banana fruits (Jaleel et al., 2021). 3-methyl butyl acetate, isoamyl butanoate, and isoamyl isovalerate were the major aromatic components of banana fruits (Schwab et al., 2008). Caryophyllene and humulene were the major volatile components of guava fruits (Jaleel et al., 2021). The 3-carene has been reported one of the aromatic compounds of mango (Tamura et al., 2000, Jaleel et al., 2021). Acetic, butyric, hexanoic acids and ethyl 3-hydroxybutyrate are aromatic components of mango fruits (Sakho et al., 1985). Acetaldehyde, acetone, methanol, ethanol, a-pinene, caryophyllene, 3-carene, b-pinene, myrcene, limonene, terpinolene, a-copaene, and r-cymene were reported from mango fruits (Baldwin et al., 1999, Pino & Mesa, 2006).

In the context of Integrated Pest Management programs, farmers need reliable control methods (Saeed et al., 2019) against both *Bactrocera* species. Understanding their behavior on fruits is necessary for scheming and applying safe control strategies in the fields. The behavior and fitness of *B. dorsalis* and *B. correcta* were yet described on banana, papaya, and guava fruits (Jaleel et al., 2018b). In this study, the mango fruits were selected to study the behavior or host preference of *B. correcta* in comparison to *B. dorsalis* on three different fruits 1. banana: *Musa acuminata* L. var. wn Thang Huanga, 2. guava: *Psidium guajava* Linn. var. Zhenzhu or Pearl, and 3. mango: *M. indica* L. Hanana Datai Nong Mang). The cultivar of banana, guava, and mango fruits used first time in this study. The objectives of this work were (1) to find out the aromatic profile and (2) to study the attraction behavior of *Bactrocera* species.

2. Material and methods

2.1. Organisms of study

Both *Bactrocera* species (*B. dorsalis* and *B. correcta*) were reared according to the methodology described by Jaleel et al. (2018b, c). Colonies of both species were reared up during two generations for acclimatization on each host in the laboratory (26 ± 2 °C, 12:12 h L: D). We used gravid female flies (aged: 15–18 days) in all experiments.

2.2. Characteristics of selected fruits

Banana, guava, and mango fruits were purchased from different orchards located in Guangzhou, Guangdong, China. Based on discussion with farmers, each fruit types were bagged at early ripening stage. A fruit of banana, guava, and mango were kept separately in a plastic jar (23.5 × 15.8 × 10 cm) containing a 3-cm layer of soil in the laboratory. Fifteen replicates were made for each fruit. Each fruit was observed daily for 15 days. There was no infestation by wild insect pests was observed in each type of fruits. Fruit characteristics e.g., Total soluble solids (TSS) of each fruit were measured using a handheld pocket refractometer pal-1 (ATAGO, PR-101*a*, Brix 0–45%, Tokyo Tech. Japan). The pericarp toughness or firmness of each fruit type was measured using a TMS-Pro texture analyzer (FTC-TV, USA) with probe (1 mm diameter) (Rattanapun et al., 2009, Balagawi et al., 2005, Díaz-Fleischer and Aluja, 2003, Jaleel et al., 2018b).

2.3. Gender

For recognition between male and female flies of *B. dorsalis*, red permanent marker was used to cover the thorax of male flies. While green color marker was used for female flies. So, ten pairs of *B. dorsalis* (15–18 days old) were prepared (colored) and released in the cage, and 3 different fruits (one banana, one guava, and one mango) were kept. Observation done for 10 h to record the number of male and female flies present on the fruit surface. Each fruit was observed for 2 min/h. This experiment was replicated six times. Same experiments was done on the *B. correcta.*

2.4. Time spent

Two types of experiments were conducted to assess the movement behavior *B. dorsalis* and *B. correcta.* Firstly, a no-choice test was carried out using a mated female of *B. dorslais* released into a plastic jar (23.5 × 15.8 × 10 cm) containing one fruit type. Twenty replications were conducted for each fruit. The time spent by female *B. dorsalis* on each fruit was recorded from 9.00 am to 2.00 pm in a day. Similarly, ths same experiment was done for *B. correcta.* Second, a multiple-choice test was conducted also using mated females of each species. The *B. dorsalis* female adult was released into a plastic jar (23.5 × 15.8 × 10 cm) containing banana, guava, and mango fruits. Twenty replications were conducted for this experiment. Similarly, the same experiment was done for *B. correcta.*

2.5. Number of flies and oviposition punctures

Choice experiments were designed with the following treatments for female *B. dorsalis* adults, as three different fruits (one banana, one guava, and one mango) were offered in a cage. Twenty gravid female flies of *B. dorsalis* were released into the cage. The numbers of female flies settling/fruit on each fruit type were recorded, as mentioned above. After 48 h, the number of oviposition punctures/fruit were counted. Each experiment was replicated six times (Jaleel et al., 2018b). Similarly, the same experiment was done for the *B. correcta.*

2.6. Immure development

To check out the influence of different fruits on the larval performance of both *Bactrocera* species, eggs of both female flies were collected from banana, guava, and mango by removing the skin with a sharp knife under a stereomicroscope; the soft camelhair brush was used to collect the eggs. Twenty eggs of *B. dorsalis* were transferred inside of each fruit by the making cut with the sterilized fine sharp scissor on each fruit type (3 × 3 cm). Then each fruit was introduced into a separate plastic jar. Development time (days) from egg to adult emergence and pupal survival were check out for both flies. A similar experiment was done for *B. correcta*. Each experiment was replicated six times.

2.7. Volatile components

To find out the reasons for the behavior differences conducted by both *Bactrocera* species on the three kinds of fruits (banana, guava, and mango), as well as the aromatic profile of three different fruits. Ripening influences the softening of the pulp and physiological changes of fruits (Fabi et al., 2019). Each fruit cultivar type was described the first time in this study.

The collection of volatiles from the skin of banana, guava, and mango fruits was done using porapak Q. Before the collection of samples, the porapak Q tube preconditioned at 280 °C for 30 min and washed with dichloromethane, then dried under charcoal purified nitrogen. This apparatus setup was connected with air pump, an airflow meter (AFM) (for controlling the flow of air through the system), water bottle, charcoal, plastic bag (Oven bag, Turkey size, 482 × 596 mm), porapak Q (80–100 mesh; Alltech, Deerfield, IL, USA), and air pump. The air pump connected to AFM then attached to water jar and proceeds to the flask, having activated charcoal (for absorbing any volatile foreign compounds in the air). For activation of charcoal, it preheated at 200 °C for 3 h. The charcoal flask followed by an oven bag containing a specified amount (2 kg) of the sample (fruits). Air after passing through the oven bag then passed through the porapak Q, the absorbent material inside the porapak Q. Volatiles eluted from the adsorbents of porapak Q with the help of 1 ml CH_2Cl_2 and then stored at − 80 °C. A micro syringe (1000 µl) used to collect the volatile compounds/components from the porapak Q (capacity 2 ml). Experiments were repeated eight times for each fruit type (banana, guava, and mango). The 0.1 µ*l* was taken from a sample of fruits and used for the analysis.

The quantitative and qualitative analysis of GC–MS ran in Agilent GC–MS (7890 N, gas chromatograph, Agilent 5975C, a mass selective detector equipped with an HP-5 MS, capillary column: 30 m × 0.25 mm ID, film thickness: 0.25 µm, and Agilent Technologies, USA). The temperature was programmed from 45 (held for 1 min) to 280 °C at 10 °C / min. The solvent delay kept for 5 min, while the injector temperature was set at 250 °C, and helium gas used as the carrier. Electron ionization mass spectra were recorded from m/z 29 °C to 280 °C at 70 eV with the temperature at 230 °C using an iron source. Quantitative and qualitative constituents' analysis of different fruits (banana, guava, and mango) was done based on their retention times (RT) and mass spectra in the computer library (NIST. 11). The quantity of each fruit component was compared using the area of the peak.

2.8. Statistical analysis

The treatments, including time spent, no. of flies, oviposition punctures, development time from egg to adult, and pupal survival (when having three fruits) were analyzed using one-way ANOVA for each species of *Bactrocera*. The effect of factors on the explanatory variables was assessed using the Fisher's LSD test ($P < 0.05$). All analyses were run using SPSS Statistics 15.0 (SPSS Inc., Chicago, IL, USA). Quantitative and qualitative analysis of constituents of fruits was done based on their retention times (*Rt*) and mass spectra in the computer library (NIST. 11).

3. Results

3.1. Characteristics of selected fruits

Physical parameters, e.g., width (cm), length (cm), thickness (cm), total soluble solids (TSS), and Brix firmness/hardness (N) of banana, guava, and mango fruits have shown in table 1. The pericarp toughness of mango fruits was lower than those of the other two tested fruits (banana and guava). While the Brix level of mango fruits was higher than those of the other two tested fruits (Table 1).

3.2. Gender

The number of male *B. dorsalis* flies was not remarkably different on banana (1.20 ± 0.30 numbers), guava (1.00 ± 0.50 numbers), and mango fruits (1.40 ± 0.30 numbers) ($F_{2,15}$ = 0.97, P = 0.397). While the number of female *B. dorsalis* flies was more on mango fruits (4.50 ± 0.50 numbers) than those on other two fruits e.g., guavas (3.50 ± 0.30 numbers) and bananas (1.50 ± 0.40 numbers) ($F_{2,15}$ = 6.93, P = 0.003; Fig. 1A). While, the female *B. correcta* flies was more on guava fruits (4.00 ± 0.50 numbers), in comparison to other fruits ($F_{2,15}$ = 21.40, P < 0.001; Fig. 1B). Female flies of both species were observed more than males on the fruits; based on this result, we used female flies of both species for the next experiments.

3.3. Time spent

The time spent by the female fly of *B. dorsalis* was significantly longer on mango fruits (148.33 ± 4.30 min) than those on the other two fruits in a no-choice test ($F_{2,57}$ = 626, P < 0.001; Fig. 2A). In comparison, the time spent by the female fly of *B. correcta* was longer on guava fruits (127.16 ± 2.35 min) than those on the other two fruits ($F_{2,57}$ = 1206, P < 0.001; Fig. 2A).

The time spent by the female *B. dorsalis* fly was significantly longer on mango fruits (74.16 ± 2.45 min) than those on the other two fruits ($F_{2,57}$ = 790, P < 0.00; Fig. 2B). The time spent by the

Table 1
Mean (±SE) of physicochemical properties of banana, guava, and mango fruits.

Fruit Properties	Banana fruits	Guava fruits	Mango fruits
Length (cm)	20.29 ± 1.23	8.99 ± 0.36	13.50 ± 1.09
Width (cm)	3.35 ± 0.32	5.71 ± 0.20	10.20 ± 2.05
Thickness (cm)	10.64 ± 0.64	23.78 ± 0.61	22.25 ± 0.05
Pericarp toughness	7.19 ± 0.46	9.25 ± 0.43	3.14 ± 0.09
TSS (°Brix)	8.90 ± 0.31	4.57 ± 0.38	13.2 ± 0.43

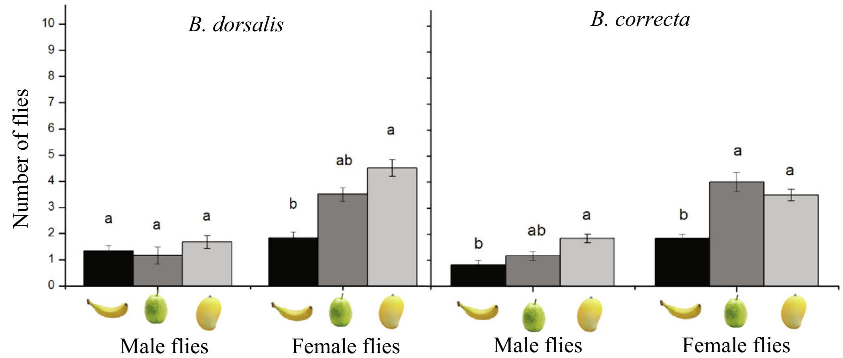

Fig. 1. Mean number (±SE) of male and female flies of *B. dorsalis* and *B. correcta* in a choice test among three different fruits.

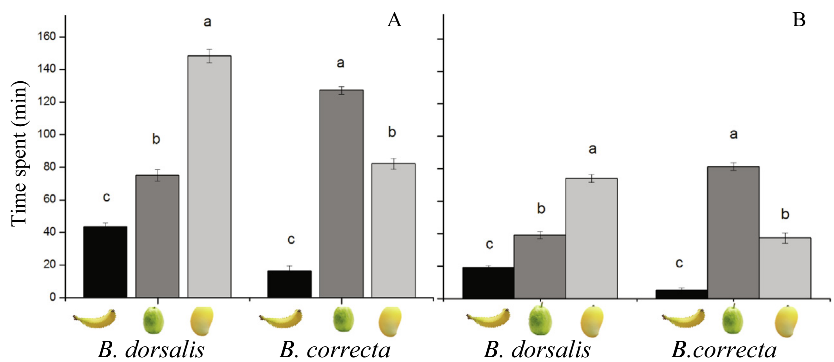

Fig. 2. Mean (±SE) time spent by a female of *B. dorsalis* and *B. correcta* in the (A) no-choice test and (B) choice test among banana, guava, and mango fruits.

female fly of *B. correcta* was significantly longer on guava fruits (81.33 ± 2.40 min) than those on the other two fruits in a choice test ($F_{2,57}$ = 1021, P < 0.001; Fig. 2B).

3.4. Number of flies and oviposition punctures

In choice test, the no. of female *B. dorsalis* flies was maximum on mango fruits (7.5 ± 0.51 numbers) than those on other two fruits, e.g., guava (5.5 ± 0.49 numbers) and banana fruits (3.16 ± 0.47 numbers) ($F_{2,15}$ = 46.4, P < 0.001; Fig. 3A). While, the female *B. correcta* flies was maximum on guava (4.00 ± 0.25) and mango fruits (3.83 ± 0.30 numbers) than banana fruits ($F_{2,15}$ = 19.50, P = 0.07; Fig. 3A).

In choice test, the oviposition punctures by female *B. dorsalis* flies were more on mango fruits (10.66 ± 0.89 numbers) than guava and banana fruits ($F_{2,15}$ = 65.50, P < 0.001; Fig. 3B). While, the oviposition punctures by the female *B. correcta* were more on guava fruits (7.16 ± 0.62 numbers) than mango and guava fruits ($F_{2,15}$ = 119, P < 0.001; Fig. 3B).

3.5. Immature development

The developmental time (egg to adult) of *B. dorsalis* was longer on banana fruits (14.16 ± 0.75 d) than those of other two fruits ($F_{2,15}$ = 77.1, P < 0.001; Fig. 4). While in a case of *B. correcta*, there were no statistical difference in developmental time between guava (11.00 ± 0.63 d) and mango fruits (10.50 ± 0.51 d) but was significantly longer on a banana fruits (15.00 ± 0.63 d) ($F_{2,15}$ = 24.80, P < 0.001; Fig. 4).

Pupae (%) of *B. dorsalis* ($F_{2,15}$ = 51.67, P < 0.001) and *B. correcta* ($F_{2,15}$ = 24.60, P < 0.001) were higher on mango fruits e.g., 92.00 ± 2.44% and 89.00 ± 1.51% respectively than other two fruits, e.g., banana and guava fruits (Fig. 5).

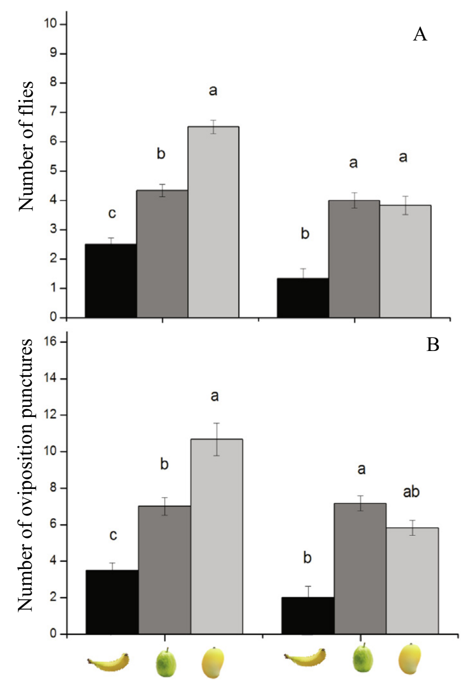

Fig. 3. Mean (±SE) (A) no. flies and (B) oviposition punctures done by female *B. dorsalis* and *B. correcta* adults in a choice test among banana, guava, and mango fruits.

3.6. Volatile components

The volatile components of bananas have presented in table 2. Overall, 99.99% of constitutes identified through the retention

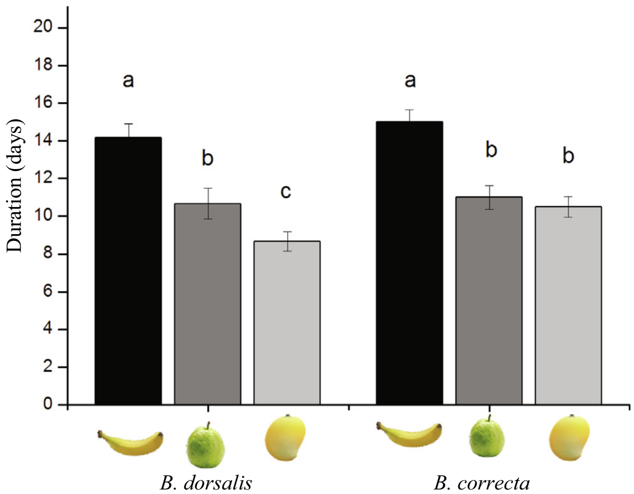

Fig. 4. Mean (±SE) developmental time (d) from egg to adult of *B. dorsalis* and *B. correcta* reared on banana, guava, and mango fruits.

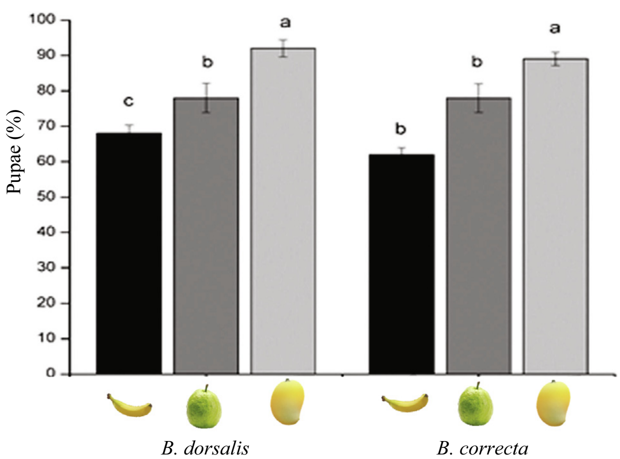

Fig. 5. Mean % (±SE) pupae of *B. dorsalis* and *B. correcta* when reared on banana, guava, and mango fruits.

index and NIST 11. The major dominating constitutes are butanoic acid, 3-methyl butyl ester (21.80%), benzaldehyde, 4-ethyl- (7.89%), 2-pentanol, acetate (7.79%), acetic acid, pentyl ester (5.53%) and 1-butanamine, 3-methyl- (5.49%), which accounts (48.50%) of total constitutes. While other minor constitutes, which make up the balance have given in the table 2. The GCMS analysis of the volatile components of guava fruits has shown in table 3. Overall, 99.99% of constitutes identified through the retention index and NIST 11. The major dominating constitutes were α-caryophyllene (39.88%), 9-octadecenamide, (Z)-(16.86%), α-copaene (10.71%), which overall accounts (67.50%) of total constitute identified. While other minor constitutes which makeup, the balance has presented in table 3. The GCMS analysis of the volatile composition of mangoes has shown in table 4. Overall, 99.99% of constitutes identified through the retention index and NIST 11. The major dominating constitutes were 3-carene (24.98%), hexanoic acid, ethyl ester (20.35%), butanoic acid, ethyl ester (10.47%), which overall accounts (55.95%) of total constitute identified. While other minor constitutes which makeup, the balance has presented in the table 4.

4. Discussion

The olfactory and ovipositional response of both flies (*B. dorsalis* and *B. correcta*) is very important for the bait development study. In China, no detailed studies have been carried out on the susceptibility of banana, guava and mango fruits to *B. dorsalis* in comparison to *B. correcta*, information which is required for both production and export systems. The preference of *Bactrocera* species for fruits may be affected due to the differences in pericarp toughness and TSS ratio. Most of *Bactrocera* species prefer to lay eggs into soft skin fruits (Jaleel et al., 2018b, Rattanapun et al., 2009). However, it is not right for all *Bactrocera* species and other insects (Verghese et al., 2011, Ghramh et al., 2019).

Biasazin et al. (2014) reported the behavior of *Bactrocera invadens* on mango and guava fruits. They found female flies were more attracted than male flies on both fruits. Similarly, in this study, female flies of both *Bactrocera* species were more attracted in comparison to male flies on all types of fruits. The host preference depends on volatiles emission, texture, and skin toughness of fruits (Rattanapun et al., 2009, Jaleel et al., 2018b). Rattanapun et al. (2009) have reported that *B. dorsalis* preferred soft skin mango. Jaleel et al. (2018b) have reported that *B. dorsalis* attracted to soft skin fruits. Rattanapun et al. (2009) explained that when female *Bactrocera* flies try to inject their eggs into hard skin fruits, the resin comes out immediately and pushes the eggs outside the fruit. The resin inside the mango has a high level of phenol (Keil et al., 1946); this may cause the mortality of immatures of *Bactrocera*

Table 2
Volatile components of banana fruits.

Peak #	RT[a]	Components name[b]	Relative %	KI(Exp)[c]	AI(Exp)[d]
1	4.955	1-Butanamine, 3-methyl-	5.439	898	898
2	5.003	2-Pentanol, acetate	7.700	902	902
3	5.351	1-Butanol, 3-methyl-, acetate	3.793	924	927
4	5.392	Acetic acid, pentyl ester	5.523	927	930
5	6.562	1,3-Butadiyne	3.277	1003	1004
6	6.585	Butanoic acid, 2-methylpropyl ester	3.850	1005	1006
7	7.201	Butanoic acid, butyl ester	1.709	1045	1047
8	7.658	Butanoic acid, 1-methylbutyl ester	2.594	1074	1076
9	7.923	2-Heptanol, acetate	0.975	1091	1092
10	8.174	Butanoic acid, 3-methylbutyl ester	21.804	1108	1108
11	8.666	Benzene, 1-ethenyl-4-ethyl-	1.223	1141	1143
12	8.909	Butanoic acid, 3-methyl-, 3-methylbutyl ester	1.667	1157	1159
13	9.882	Benzaldehyde, 4-ethyl-	7.897	1223	1224
14	10.105	Isophthalaldehyde	2.616	1239	1240
15	10.911	1,4-Benzenedicarboxaldehyde	0.781	1295	1296
16	11.320	m-Ethylacetophenone	1.712	1326	1327
17	11.593	Ethanone, 1-(4-ethylphenyl)-	0.828	1346	1347
18	12.319	1H-Indol-4-ol	1.700	1400	1400
19	12.632	1-Propanone	0.750	1425	1426
20	13.609	Ethanone	0.535	1502	1502

Table 3
Volatile components of guava fruits.

Peak #	RT[a]	Components name[b]	Relative %	KI(Exp)[c]	AI(Exp)[d]
1	12.663	α-Copaene	10.715	1427	1428
2	13.275	α-Caryophyllene	39.877	1475	1476
3	13.526	Aromandendrene	6.762	1495	1495
4	13.649	*cis*-Muurola-3,5-diene	3.515	1505	1505
5	13.711	α-Humulene	3.785	1510	1511
6	13.809	Caryophillene	1.785	1518	1519
7	14.204	(+)-epi-Bicyclosesquiphellandrene	2.366	1551	1552
8	14.234	Naphthalene	1.732	1554	1555
9	14.517	Isoledene	7.695	1577	1578
10	14.649	γ-Langene	2.778	1588	1589
11	15.331	Globulol	2.127	1648	1649
12	22.793	9-Octadecenamide, (Z)-	16.864	2432	2433

Table 4
Volatile components of mango fruits.

Peak #	RT[a]	Components name[b]	Relative %	KI(Exp)[c]	AI(Exp)[d]
1	3.564	Butanoic acid, butyl ester	1.660	798	799
2	3.644	Butanoic acid, ethyl ester	10.479	800	800
3	3.804	Propanoic acid, 2-methyl-, ethyl ester	3.741	812	814
4	4.134	2-Butenoic acid, ethyl ester, (E)-	0.422	837	841
5	4.194	Oxazole	3.843	841	845
6	6.505	Hexanoic acid, ethyl ester	20.353	1000	1000
7	6.738	Octanoic acid, ethyl ester	10.240	1015	1016
8	7.012	Limonene	0.888	1033	1035
9	7.169	2-Hexenoic acid, ethyl ester	0.570	1043	1045
10	7.942	(+)-4-Carene	11.739	1093	1093
11	8.414	Octanoic acid, methyl ester	0.630	1124	1125
12	9.381	4-Octenoic acid, ethyl ester, (Z)-	1.203	1188	1189
13	9.544	3- Carene	24.985	1199	1199
14	10.207	Ethyl (E)-2-octenoate	1.470	1246	1248
15	12.034	Ethyl *trans*-4-decenoate	4.328	1379	1380
16	12.736	β-Ylangene	1.007	1433	1434
17	12.872	β-Copaene	0.603	1444	1445
18	13.066	Cedrene	0.212	1459	1460
19	13.189	γ-Muurolene	0.271	1469	1470
20	13.536	Isoledene	0.786	1496	1496
21	13.617	α-Guaiene	0.334	1502	1503
22	15.067	Cedrol	0.235	1625	1625

species. While Seo et al. (1982) have been observed that female *B. papaya* flies were more attracted to papaya fruits having hard skin (Jang & Light, 1991). Oviposition may depend on the pericarp toughness and availability of fruits. In the current study, mango and guava fruits were more suitable for oviposition by *B. dorsalis* and *B. correcta,* respectively. Fitness of *B. dorsalis* was less than 20% in hard skin fruits that indicating the poor host (Rattanapun et al., 2009). Larval diets have a significant impact on adult fitness (Jaleel et al., 2018b). In our study, pupal survival (%) of both species was lower in banana than those of the other two fruits, e.g., guava and mango fruits.

Mixtures of volatile components have a significant role in calling or attracting *Bactrocera* adults (Jaleel et al., 2019). Cyclopentasiloxane and tetradecamethyl- were reported as the major aromatic compound of banana fruits (Jaleel et al., 2021). 3-methyl butyl acetate, isoamyl butanoate, and isoamyl isovalerate considered major volatile components of banana fruits (Schwab et al., 2008). Butyl acetate, isoamyl acetate, ethyl acetate, butyl butanoate, and isoamyl isobutanoate called major aromatic components of banana fruits (Cano et al., 1997, de Vasconcelos Facundo et al., 2012, Bugaud et al., 2009). In our study, butanoic acid was the major aromatic components of banana fruits. Caryophyllene was reported as the major aromatic components of guava fruits (Jaleel et al., 2021). Caryophyllene and humulene were the major volatile components of guava fruits. Both were found best attractant of *Bactrocera* species (Nishimura et al., 1989, Tamura et al., 2000, Jaleel et al., 2019). In our study, the α-caryophyllene, α-copaene, and aromadendrene were the main volatile components of guava fruits. In the Coche mango, the predominant components were 3-carene, b-selinene, terpinolene, and limonene (Malo et al., 2012). The 3-carene considered a major fruity order of mango fruits (Tamura et al., 2000, Jaleel et al., 2021). Acetic, butyric, hexanoic acids and ethyl 3-hydroxybutyrate considered main aromatic components in mango fruits (Sakho et al., 1985). Acetaldehyde, acetone, methanol, ethanol, a-pinene, caryophyllene, 3-carene, b-pinene, myrcene, limonene, terpinolene, a-copaene, and r-cymene were reported in the aromatic profile of mango fruits (Baldwin et al., 1999, Pino & Mesa, 2006). In our study, the octanoic acid, ethyl ester, (+)-4-carene, and 3-carene were the main volatile components of mango fruits. Jaleel et al. (2021) reported that 3-carene and the mixture of *β*-caryophyllene and *α*-humulene were good attractants for female *B. dorsalis* and *B. correcta* flies, respectively in laboratory tests. Based on study results, we recommend that mango and guava fruits are favorable and containing most important volatile attractants for Both flies. This study will be more useful for field study to confirm the efficacy of attractant against both flies.

5. Conclusion

In current study, we concluded that mango and guava fruits were favorite hosts of *B. dorsalis* and *B. correcta* respectively in the laboratory. It might be that both fruits (mango and guava) have soft skin as compared to banana fruits. Both fruits have important volatile components that are good attractant for *Bactrocera* fruit flies. Butanoic acid-3-methylbutyl ester, α-caryophyllene, and 3-carene were the major volatile components of banana, guava, and mango fruits, respectively, and can be used for future studies at field level.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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