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Toxicity, behavioural and biochemical effect of *Piper betle* L. essential oil and its constituents against housefly, *Musca domestica* L.

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ABSTRACT

Housefly, *Musca domestica* L. is a pest of public health importance and is responsible for spreading diseases like typhoid, diarrhoea, plague etc. Indiscriminate reliance on synthetic insecticides has led to development of insecticide resistance and ill effect to humans and nontarget animals. This demands an alternative and safer pest control option. This study evaluates the biological effect of *Piper betle* L essential oil and its constituent eugenol, eugenol acetate, and β - caryophyllene on the housefly. The major components present in *P. betel* EO were safrole (44.25%), eugenol (5.16%), β -caryophyllene (5.98%), β -selinene (5.93%), α-selinene (5.27%) and eugenol acetate (9.77%). Eugenol caused 4.5fold higher ovicidal activity (EC_{50} 86.99 μg/ml) than *P. betle* EO (EC_{50} 390.37 μg/ml). Eugenol caused fumigant toxicity to adults (LC_{50} 88.38 mg/dm^3). On contact toxicity by topical application, eugenol acetate, eugenol and β-caryophyllene caused higher mortality to larval and adult stages than EO. FESEM (Field Emission Scanning Electron Microscope) images reveal that exposure to *P. betle* EO causes the shrinkage of the larval cuticle. Both EO and eugenol induced the detoxifying enzymes Carboxyl esterase (Car E) and Glutathione S – transferases (GST) in larvae and adults. EO and eugenol at 0.2% caused effective repellence and oviposition deterrence to *M. domestica* adults and this merits their use as alternative strategy to manage *M. domestica*.

1. Introduction

The housefly, *Musca domestica* L. is a pest of public health importance, as it transmits bacteria, viruses, fungi, protozoan and metazoan parasites to humans (Macovei et al., 2008; Tsagaan et al., 2015; Nassiri et al., 2015; Awache and Farouk, 2016) in rural and urban settlements across the world (Shah et al., 2016). In addition to transmitting diseases, the presence of flies in livestock and poultry sheds cause physical annoyance to animals and birds that lead to a decline in their production (Shah et al., 2016). Population build-up of *M. domestica* is widely managed using insecticides belonging to organophosphates, carbamates, pyrethroids, and neonicotinoids (Fenner et al., 2013; Abbas et al., 2015; Saeed et al., 2018; Shi et al., 2020). Indiscriminate use of synthetic insecticides ends in development of insecticide resistance to pyrethroids, organophosphates, spinosad, indoxacarb, spiromesifen, neonicotinoids, and resurgence in flies which may lead to a negative effect on humans and animals (Acevedo et al., 2009; Abbas et al., 2015; Khan et al., 2016; Meisel and Scott, 2018; Hubbard and Gerry, 2021). This situation demands a search for safe alternatives derived from plants to manage *M. domestica*.

The essential oils (EO) derived from plants pave the way to reinvigorate pest management as proved by their biological effect on an

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