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# Synergistic Toxicity of Plant Essential Oils Combined with Pyrethroid Insecticides against Blow Flies and the House Fly

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**Abstract:** Blow flies (Diptera: Calliphoridae) and the house fly (Diptera: Muscidae) are filth flies of medical importance, and control of their population is needed. As insecticide applications have resulted in fly resistance, and the exploration of plant essential oils (EOs) has increased against filth flies, this study assessed the combination of EOs with pyrethroids to enhance toxic efficacy. The EOs of five effective plants were screened initially against the house fly (*Musca domestica* L.). Their chemical constituent was performed using gas chromatography-mass spectrometry (GC-MS) analysis. The main components of *Boesenbergia rotunda* (Zingiberaceae) rhizome, *Curcuma longa* (Zingiberaceae) rhizome, *Citrus hystrix* (Rutaceae) fruit peel, *Ocimum gratissimum* (Lamiaceae) seed, and *Zanthoxylum limonella* (Rutaceae) fruit were  $\delta$ -3-carene (35.25%),  $\beta$ -turmerone (51.68%),  $\beta$ -pinene (26.56%), p-cumic aldehyde (58.21%), and dipentene (60.22%), respectively. The screening test revealed that the three most effective plant EOs were from *B. rotunda*, *C. longa* and *O. gratissimum*, which were selected for the combination with two pyrethroid insecticides (permethrin and deltamethrin), in order to enhance their synergistic efficacy against the blow flies, *Chrysomya megacephala* Fabricius, *Chrysomya rufifacies* Macquart, and *Lucilia cuprina* Wiedemann, and the house fly. Synergistic action was presented in almost all of the flies tested with permethrin/deltamethrin/EOs mixtures. It was interesting that the combination of deltamethrin with three EOs showed a synergistic effect on all of the tested flies. However, an antagonistic effect was observed in *C. megacephala* and *M. domestica* treated with permethrin-*B. rotunda* and *C. megacephala* treated with permethrin-*O. gratissimum*. The LD<sub>50</sub> of insecticides decreased when combined with plant EOs. This alternative strategy will be helpful in developing a formula for effective fly control management.

**Keywords:** plant; essential oil; pyrethroid; synergism; fly control