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Effect of different herbal oil and formulations on mosquito (Order: Diptera)

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Abstract
The herbal formulations and oils were prepared from the *Azadirachta indica, Oscimum sanctum, Eucalyptus,* Lily and Turmeric. These oils and extracts were used as a green mosquito repellent and tests on mosquitoes were carried with varying. The herbal formulation of leaves of *Azadirachta indica, Oscimum sanctum, Eucalyptus,* Lily and Turmeric are more effective against mosquitoes than the synthetic entomotoxicity containing 0.1% D-allethrin in Mortein, 0.2% allethrin in Goodknight, Allout, Maxo and Mortein mats (1% Pralletrin), Goodknight mats (1.2% Pralletrin). Percent mortality of *Azadirachta indica, Oscimum sanctum, Eucalyptus, Lily and turmeric formulation extract were* 60.50%, 66.62%, 62.33%, 58.6%, 48.5% and 82.65% respectively.

Keywords: essential oil, vector borne disease, *Azadirachta indica, Oscimum sanctum*

Introduction
Mosquito is one of the insect belong to the order Diptera. There are 2500 different species of mosquitoes reported throughout the world (Kumar *et al*., 2007; Tennyson & Jayakumar, 2007) [14, 15, 16]. Mosquito has carried number of organisms which caused the number of disease such as protozoan disease i.e. malaria, filarial diseases such as dog heartworm, viral diseases such as Dengue, Encephalitis and yellow fever etc. More than million peoples have been died due to mosquito born diseases per year (Durden & Mullen, 2019; La Deau *et al*., 2015; Lee *et al*., 2018) [8, 7]. Not only mosquitoes carry disease that suffers in the human society, But they also transmit several organism and parasites to the dogs and horses (Bartlow *et al*., 2019) [4] Animals are very susceptible to mosquito. In addition mosquito bites can cause severe skin irritation trough an allergic reaction to the mosquito saliva – like red bump and itching (Fostini *et al*., 2019) [11]. WHO has reported that about three lakh death occurred annually due to Malaria. In Worldwide, mosquitoes transmit disease more than 700,000,000 people annually are responsible for the deaths of 1 of every 17 people currently alive (Kumar *et al*., 2007) [14, 15, 16].
The repellants may be chemicals or derived from plants. *Vitex negundo* has effective against the larvae of *Culex quinquefasciatus* in access pits and wells only at 41.41 ppm (Kannathasan *et al*., 2007) [14]. Aqueous, Methanol, ethanol and Petroleum ether extracts of Lucas aspera has tested for larvicidal efficacy of *Culex quinquefasciatus.* The smoke of two plant leaves *Lucas aspera* and *Vitex negundo* was found effective against *Culex quinquefasciatus* (Elumalai *et al*., 2017) [10]. Larvicidal properties of Azadirachtin rich fractions were tested against *Anopheles culcifacies* and *Culex quinquefasciatus* (Ayinde *et al*., 2020; Marimuthu *et al*., 2012). Neem products such as azadirechtin rich fractions from the Neem tree *Azadirachta indica* is passes anti-feedent, repellant, growth inhibiting and ovicidal activities against insect pests (Chaudhary, 2017) [6]. The vapor of synthetic Pyrethroids affected the central nervous system of mosquitoes (Bibbs & Kaufman, 2017) [5]. Thousands of plant have been tested as potential source of insect repellants (Şengül Demirak & Canpolat, 2022; Singh *et al*., 2012) [23, 24]. Plants whose essential oils have been reported to have repellant activity include citronella, cedar, verbena, pennyroyal, geranium, lavender, pine, cinnamon, cajuput, rosemary, basil, thyme, garlic and peppermint (Duke J. https://www.arsgrin.gov/ngrlsb/). Unlike synthetic repellants, plant-derived repellants have been relatively poorly studied. When tested, most of these essential oils tend to give short lasting protection; usually less than 2 hrs. "Neemark" a plant based insect anti-feedent and repellant was evaluated for its acute oral toxicity in mice and rats (Li *et al*., 2021) [19]. Allethrin and prallethrin are the common insecticides used in mosquito coils and mats available in market. Allethrin is slightly toxic by dermal absorption and ingestion. Short-term dermal exposure to allethrin may cause itching, burning, tingling, numbness, or a feeling of warmth, but not dermatitis (Narendra *et al*., 2008) [22]. Following oral administrations, allethrin is readily absorbed and metabolized in mammalian systems to less toxic compounds, which may be more easily eliminated by the body. Prallethrin is used in mosquito mats. Bite blocker a plant based repellant that was released in U.S. in 1997. Pyrethrum is a powerful insecticide derived from the crushed flowers of *Chrysanthemum cinerariifolium* (Casida *et.al*, 1995). Bite Blocker combines Soybean, geranium oil, and coconut oil. This formulation showed more 97% protection against Aedes mosquito under field conditions even 3-5 hrs. after application (Maia & Moore, 2011) [20].

Different mosquito methods have been used for adult mosquito control, repellants method is commonly used. The repellants are substances that make mosquito avoid biting people. In the present study, a different medicinal plant extract, its combine formulation and marketable insect repellant products were tested against on mosquitoes.

Material and Methods

Collection of plants

All plants were collected from in and around the KTHM College campus, Nashik Maharashtra. These plants were taxonomical identifies and authenticate from department of Botany of our college.

Preparation of Herbal extract

Five medicinal plats were selected for extraction of herbal oil extract. *Azadirachta indica*, *Oscimum sanctum*, *Lily leaves*, *Eucalyptus*, *Turmeric* leaves were collected, washed, dried, crushed and extract the oils for testing using distilled water for 4hr. The essential oil was dried over anhydrous sodium sulphate. These dried extract used against mosquitoes.

Collection of Adult mosquito

The adult mosquitoes were collected locally from in and around M.V.P Samaj KTHM College Campus, Nashik. A small insect net was used for collecting the adult mosquitoes. The collected mosquitoes were transferred into mosquito cage.

Experiment of mosquito repellants

The experiment was carried in a closed room of length 13ft, breadth 10 ft and height 9 ft. Generally 20 mosquitoes were taken for each test. The mosquitoes were collected on earlier days before the experiment actually starts. The cage containing mosquitoes and kept in a room. 20 ml herbal extract of experimental plants were kept in liquid bottle to produce a oil fumes of tolerable limit to human beings and were allowed to spread over the experimental closed room. The experiment was carried out from 6:00 pm to 6:00 am to find out mosquito mortality. The same procedure was also applied for other extract and marketable product of mosquito like mats and coils (Mortein, Goodnight, All out, and Maxo) easily available in the market. Three trials were carried out for each test. The toxic effect of herbal oils, mosquito mats, coils were recorded.

Results

In the present work herbal extract of leaves of five plants viz *Azadirachta indica*, *Oscimum sanctum*, *Lily*, *Eucalyptus* and *Turmeric* were tested. The study showed that commercial repellant and herbal crude extract was lethal to mosquitos. Goodknight, Mortein, All out, Maxo coils shows the 80.50%, 71.92%, 65.26% respectively. Similarly Goodknight and Mortein mats were showed the 62.62% and 59.94 % lethality respectively. Percent mortality of *Azadirachta indica*, *Oscimum sanctum*, *Eucalyptus*, *Lily and turmeric formulation extract were* 60.50%, 66.62%, 62.33%, 58.6%, 48.5% and 82.65% respectively. The preliminary trials revealed that all the concentrations of commercial mosquito repellant and herbal extract elicited absolute (50.9-82.62 %) mortality against mosquito. The trend of the effectiveness of herbal extract (*Azadirachta indica*, *Oscimum sanctum*, *Eucalyptus*, *Lily and turmeric*) and other commercial mosquitocides as adulticides at different percent are shown in Figure 1.

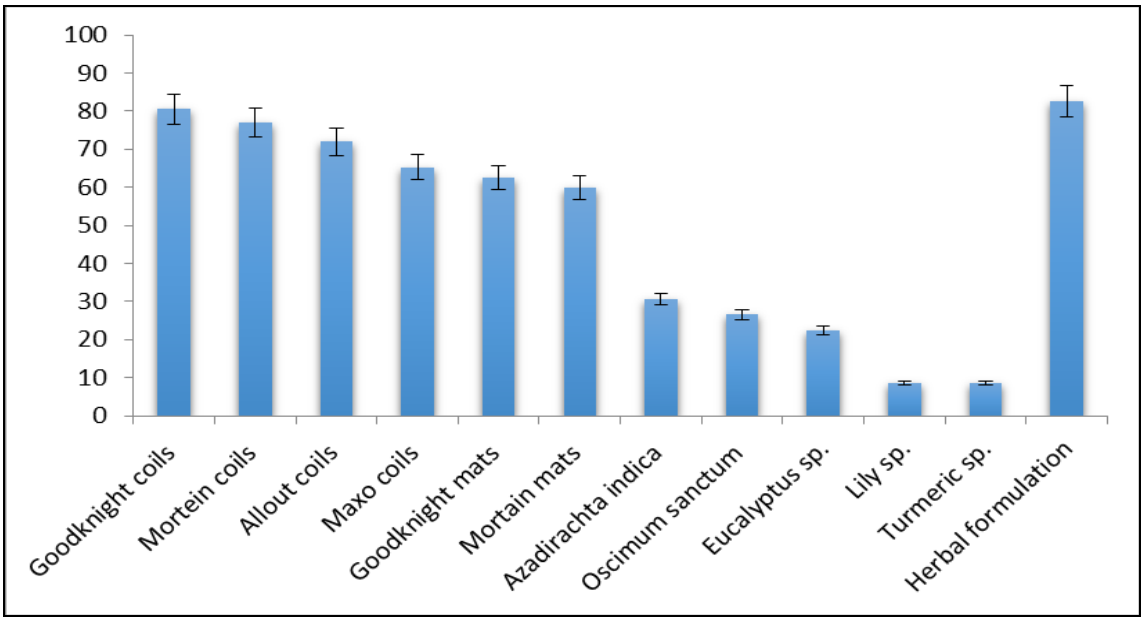

Fig 1: Effect of commercial and herbal mosquito repellants on mosquito mortality.

Discussion

The use of environmentally safe biodegradable pesticides in herbal formulations to combat mosquito-borne disease is becoming more popular. The repellent effectiveness of emulsified herbal extract and commercial mosquito repellant formulation against entomotoxicity was investigated in this study. Repellency is one of the most well-known methods for decreasing man-vector contact and thereby avoiding vector-borne illnesses. Mosquito repellents made from neem are efficient. (Asadollahi *et al*., 2019; Ayinde *et al*., 2020; Govindarajan *et al*., 2011) [2, 3, 12]; Asadollahi *et al*., 2019; Ayinde *et al*., 2020; Govindarajan *et al*., 2011) [2, 3, 12]. Mosquito repellent properties have been discovered in a variety of oils. They most likely work in a variety of ways by lowering short-range enticing cues such as kairomones, water vapour, and temperature (Davis & Bowen, 1994; Eiras & Jepson, 1994) [7, 9], because the presence of long-chained fatty molecules reduces the evaporation and absorption of repellant actives (Maia & Moore, 2011) [20] Mosquitoes are known to be repellant to fatty acids in high concentrations (Skinner *et al*., 1970) [25]. Coconut oil and palm nut oils are two more plant-based oils that have exhibited repelling properties.

Due to the abundance of insecticidal chemicals found in plants as insect defenses, the field of plant repellent development is particularly fertile (Harrewijn *et al*., 1994) [13]. Modern pyrethroids are synthetic equivalents based on the chemical structure of pyrethrins, which were discovered in the pyrethrum daisy, *Tanacetum cinerariifoliu*m from the Dalmation region, and *Tanacetum coccineum* from Persia (Steketee & Campbell, 2010) [26]. To protect the seed against insect assault, the insecticidal component, which consists of six esters (pyrethrins), is present in tiny oil-containing glands on the surface of the seed case in the flower head. Pyrethrins are extremely powerful insecticides that are relatively safe for mammals (Ahmed *et al*., 2021) [1]. However, many other plants generate substances that are highly toxic to mammals and/or irritating to the skin, thus natural does not always imply safe. In recent years, a plant-based repellent known as PMD has been shown to be sufficiently effective and safe to compete with DEET in the field of disease prevention, and repellents have been recognized by the World Health Organization as a useful disease prevention tool to supplement insecticide-based vector control. India's flora is rich in aromatic plant diversity, which could lead to the creation of natural pesticides for mosquito and other pest management. These findings may stimulate researchers to look for additional active natural chemicals that could be used as a substitute for synthetic repellents and insecticides derived from other medicinal plants.

Conclusion

We may conclude that the combined herbal extract formulation is more efficient against mosquitoes than the commercial product or individual herbal plant extract. Repeated applications over time might provide better protection, similar to what some commercial synthetic mosquito repellants do. The herbal combination poses no threat to civilization.

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