



REPELLENT EFFECT OF PLANT ESSENTIAL OILS AGAINST THE MOSQUITO

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Received : Jan 2022 Accepted : March 2022

Abstract. Mosquitoes are among the most disturbing blood-sucking insects afflicting human beings several mosquito species belonging to genera *Anopheles*, *Culex* *Aedes* are vectors for the pathogens of various diseases like Dengue fever, Malaria, yellow fever, Japanese Encephalitis several other infections. Essential oils are volatile mixtures of hydrocarbons with a diversity of functional groups, and their repellent activity has been linked to the presence of mono-terpenes and sesquiterpenes. In some cases, these chemicals can work synergistically, improving their effectiveness. The repellent activity was studied under natural conditions in the field making use of the traditional knowledge as background. Field observations were taken in houses extract of plant leaves they act as a repellent mosquitocide and provided repellence with a protection time of six hours. *Piper Bettle*, *Eucalyptus Tereticornis*, *Cissus Quadrangularis*, *Azardirachta indica*, *Annona squamosa*, *Solanum surattense*, *Coleus amboinicus*, *Mimosa pudica*, *Solanum trilobatum*, *Phyllanthus Anarns*, *Ocimum tenuiflorum*, *Citrus medica*, *Hibiscus Rosa- sinensis*, *Solanum nigrum* and *Carica papaya* for their repellent activity against mosquitoes. Natural products from plants of insecticidal and medicinal values have higher efficiency in reducing mosquito. The essential oil total protection is against the mosquito bites. The intervals between the time of repellent application and the landing of the first mosquito for biting are considered as the protection time. The results were obtained from investigation of *Azardirachta indica*, *Citrus medica*, *Carica papaya*, *Coleus ambonicus*, *Annona squamosa* , *Hibiscus rosa- sinensis* was found to be more effective than other essential oils. However, the *Azardirachta indica* and *Citrus medica* exhibited high protection time than other essential oils.

1. INTRODUCTION

All over the developing countries in the tropical region mosquito menace has been very acute leading to many diseases. Many chemicals have been used for Mosquito repellency or killing,

however, they are extremely harmful to human beings as well. Recently, commercial repellent products containing plant-based ingredients have gained increasing popularity among consumers, as these are commonly perceived as "safe" in comparison to long-established synthetic repellents. Our paper describes Plant-based repellents for mosquitoes for personal protection measures. Based on the knowledge of traditional repellent plants obtained through ethno botanical studies, the development of new natural products is the need of the hour. The product developed offers high repellency as well as good consumer safety. Thus this plant-based repellent made from 5 plant leaves has promising results in the field study. Plant extracts are believed to be a good alternative to chemical insecticides. Many plant natural products have been tested as insecticides against mosquitoes as they are nontoxic to mammals and are promising candidates to replace conventional insecticides. The present work has been designed to evaluate the mosquito repellent leaves extracted from different medicinal plants against the mosquito, like Vetrilai, Eucalyptus, Pirandai, Vembu, Sita, Kandankathri, Omavalli, Thottarsurungi, Thoothuvalai, Keezhanelli, Thulasi, Elumitchai, Semparuthi, Manathakkali, Pappali.

MATERIALS AND METHODS

STUDY AREA AND REPELLENT FOR ASSESSMENT

The Selected site is my house located in SENTHIL NAGAR; PALAYAMKOTTI has been selected for the study. The materials like Vetrilai, Eucalyptus, Pirandai, Vembu, Sita, Kandankathri, Omavalli, Thottarsurungi, Thoothuvalai, Keezhanelli, Thulasi, Elumitchai, Semparuthi, Manathakkali, Pappali were tested for the repellent activity of selected essential oils against the mosquito.

PROTECTION TIME: The method adopted by Pandian and Chanrashkaran (1980)[1] was used to record the biting activity cycle of the mosquito. The time interval between the time of repellent and the landing of the first mosquito for biting is considered as the protection time. The experiments were conducted during dark hours indoors to compare the variation in efficacy of oils. % of protection =
$$\frac{(\text{No. of bites received by control}) - (\text{No. of bites received by treatment area})}{(\text{No. of bites received by control})} \times 100$$

REPELLENT USED FOR SCREENING

The selection of the plant was based on their availability as raw materials, scientific evidence and, folkloric use as mosquito repellents. The raw materials used for the protection of the herbal mosquito repellent liquid were Vetrilai, Eucalyptus, Pirandai, Vembu, Sita, Kandankathri, Omavalli, Thottarsurungi, Thoothuvalai, Keezhanelli, Thulasi, Elumitchai, Semparuthi, Manathakkali, and Pappali.

(1) *Ocimum tenuiflorum-Nalla thulasi*

Major components of the essential oil are eugenol, carvacrol, nerol and, eugenol-methylether. Leaves have been reported to contain ursolic acid, apigenin-7- O glucuronide, luteolin-7-O-glucuronide, orientin and, molludistin. Ursolic acid, isolated from leaves, exhibited significant protection of the mast cell membrane by preventing

granulation and decreased histamine release. The ethanolic extract(50%) and volatile oil of fresh leaves, and fixed oil from seeds showed antiasthmatic activity and significantly protected guineapigs against and, histamine and dyspnea . Infusion of leaves is consumed for cold and cough.

(2) *Solanum surattense* Burm-(Kandankathri)

The whole plant powder is mixed with water and taken internally to cure cold and wheezing trouble. Fruits solasonine, solamargine, beta - solamargine and, solasodine; petals yielded apigenin; stamens gave quercetin diglycoside and sitosterol. Both glyco alkaloid and fatty acid fractions of the plants extracts cause liberation of histamine from chopped lung tissue. The beneficial effect of the drug on bronchia asthma may be attributed to the depletion of histamine from bronchial and lung tissue.

(3) *Coleus amboinicus* Lour -(Omavalli)

Strongly aromatic, subsucculent herb. The leaf extract is used to cure a cold . Carvacrol is an essential oil. Cirsimartin and β -sitosterol, oleanolic, pomolic, euscaphic, torment and ursolic acids; salvigenin, quercetin, luteolin, apigenin, eriodictyol and taxifolin are present in leaves. Leaves contain a large amount of oxalacetic acid flavonoid, cirsimartin and, beta-sitosterol.

(4) *Eucalyptus tereticornis* Smith-(Thailamaram)

Boiled vapors of leaves are inhaled for cough and cold. Eucalyptus oil mixed with coconut oil is applied to chest to relieve dry cough and chest pain. Several potent globals, having closely related acyl- phloroglucinolmonoterpene structures, are isolated from the leaves and flower buds these compounds showed strong granulation-inhibiting activity and inhibition of TPA induced EBV (Epstein-Barr Virus) activation. Phloroglucin derivatives, isolated from leaves, showed better anti - inflammatory activity than indomethacin. Natural antioxidants have also been isolated from the plant.

(5) *Solanum trilobatum*- (Thoothuvalai)

The leaf juice is taken in the form of soup for cough and cold. The steroidal alkaloid, solasodine, is present in the fruit and leaf of the plant. A crude glycoalkaloid mixture, isolated from the plant material. 20% beta solamarine. The plant exhibited antimitotic, antitumour, anti -bacterial, and antifungal activity.

(6) *Annona squamosa*(Sita)

Roots contain alkaloids annonin, micheline, oxoushinesuine (lieiodenine), L-reticuline, analobine, also diazepine, sqamolone, root and, bark alkaloids cozydine, isocorydine, anonaine, glaucine, sitosterol, camphor, borneol and, a new monoterpene: tender

leavers and glaucine. The young fruits are dried and made into powder. A tablespoon of powder is mixed with water and taken internally to cure dysentery.

(7) *Citrus medica*(Elumichai)

A low shrub, on the hill forests in the dry evergreen belt, particularly abundant on the hill slopes; flowers white, fruit globose, very common Fruit juice mixed with milk is taken two times a day for dysentery. Bitter principle,retain and xanthyletin from roots: essential oil contains a -pinene. β - pinene, myrcene, camphene, limonene, a - phellandrene, 3 - carene, p - cymene, γ - terpinene, terpinolene nonyl aldehyde, and, citronellal oil.

(8) *Phyllanthus Anarns schum* (Kizhanelli)

The whole plant paste is mixed with goat milk and taken internally for three days to cure jaundice. Leaves contain the bitter substance Phyllanthus hypophyllanthin. Three new lignans niranthin, nirtetralin ,and phyltetralin from leaves. Kaempferol - 4 - rhamnopyranoside are eriodictyol rhamnopyranoside are obtained from roots. Stem contains saponin.

(9) *Piper betel* (vetrilai)

Extract of the leaves of piper betel is mixed with rhizome extract of zingiber resume and taken internally to relieve from liver infection.

(10) *Solanum nigrum*(Mana thakkali)

Solasomine and solamargine are found in leaves. Gluco - alkaloids are from immature fruits. The plant prepared in the form of soup is taken for stomach ulcers the paste of the leaf is used internally to cure Rabies.

(11) *Mimosa pudica*(Thottaasurungi)

The Plant contains β - amyirin, β - sitosterol and ,friedelin, mucilage of the seed contains galactose and mannose, and an adrenaline-like substance identified in extracts of leaves. The paste of the fresh leaf is applied externally until the cuts and wounds are cured.

(12) *Hibiscus rosa- sinensis* (Semparuthi)

Leaves and stems yield traverse Oac and - sitosterol flavones from flowers. Quercetin -3 - glucoside, 3,7 - glucoside, cyaniding -3, 5 - glucosidase, and cyaniding -3 - sophoro- side - 3 - 5 - glucoside from deep yellow flowers; all above compounds and kaempferol - 3 - xylosyl glucoside material exhibited hypotensive action and antispasmodic action in experimental animal tissues. Flowers are dried in shade and powdered. It is used for

cleaning hair and preventing the falling of hairs.

(13) *Azadirachta indica* (Vembu)

Azadirachta indica is evergreen and fast-growing tree that can reach a height of 15 - 16 m. All parts of the tree such as seeds, leaves, flowers, and bark, are used in the preparation of various medicinal preparations. Neem products have medicinal properties that prove to be anti-fungal, anti-diabetic, antibacterial, antiviral, and anti-fertility.

Limonoid compounds contained in neem seed extract seem to have insecticide and pesticide properties. The main limonoid in neem seed extract is azadirachtin. Additionally, azadiradione, fraxinellone, nimbin, salannin, silanol, veining, and vilasinin are also present in neem seed extract. The bitter properties of the neem oil are due to tannins, flavonoids, and sesquiterpene derivatives.

(14) *Cissus quadrangularis*(Pirandai)

Proteins, carbohydrates, mucilages, pectins, tartaric acid, potassium, and calcium oxalate are present in the plant. Paste of the plant is taken for improving digestion and to induce appetite. The young tops are used as a vegetable (cooked along with tamarind pulp juice).

(15) *Carica papaya*(Pappaali)

A tree cultivated in gardens is planted for its valuable edible fruits. Milky latex of the plant is applied on teeth to relieve teeth infection. Carpain, carposide and papain. Latex is antipruritic and is used for ulcers and abortion.

PLANT EXTRACT PREPARATION

Decoction method:

Collect fresh and healthy leaves of Vettilai, Eucalyptus, Pirandai, Vembu, Sita, Kandankathri, Omavalli, Thottarsurungi, Thoothuvalai, Keezhanelli, Thulasi, Elumitchai, Semparuthi, Manathakkali, and Pappali from near the home. Clean it with water, weigh the required quantity (10gms) of leaves. Leaves are boiled in a beaker containing 250 ml of water. Stop boiling when the extraction turned greenish-brown, similarly, the leaves can be ground and filtered with filter paper. The leaf extracts are kept in the water bath. So, the extraction gets concentrated up to 50 ml. Take 3gm of camphor, crush it and add 1ml of kerosene to dissolve it. Then this extract is filled into an empty liquidator. The repellency of freshly prepared extracts was evaluated in small room conditions for 6 hours. The mean protection time was used as a repellency time of freshly prepared extracts against the mosquito species (Sukhdev Swami Handa 2008)[11].



FIGURE 1



FIGURE 2



FIGURE 3

Result

Plants as an alternative source of the repellent agent are reported in numerous ethnobotanical evaluations. The summary of recent information on claiming and efficacy of plant-based repellents as well as promising new developments in the field. Plant-derived repellents usually

do not cause hazards of toxicity to humans and domestic animals and are easily biodegraded. Compared to synthetic compounds, natural products are presumed to be safer for humans. This study has attempted to highlight the plants claimed to be used or associated with mosquito repellent. The protection time recorded for essential oils (Table -1 and Fig-1) shows that there is a variation among them against the mosquito from January 2020 to February 2020.

Among these leaves extract of Vetrilai, Eucalyptus, Pirandai, Vembu, Sita, Kandankathri, Omavalli, Thottarsurungi, Thoothuvalai, Keezhanelli, Thulasi, Elumitchai, Semparuthi, Manathakkali, and Pappali. Showed very effective compared to other extracts. Vembu and Elumitchai showed more effectiveness in the indoor area.

The investigation found that Vembu, Elumitchai, Pappali, Omavalli, Sita, and Semparuthi exhibited more effectiveness than the control (Table 10 - 24). The protection were recorded Vembu (83.33%), Elumitchai (83.3%), 3 Pappali (80.95%), Omavalli (80.95%), Sita (64.28%), Semparuthi (66.66%). Table-2 and Fig-2. The number of mosquitoes alight in experimental baits after the application of plant-based oils like Vembu, Elumitchai, Pappali, Omavalli, Sita, and Semparuthi was high indoors and also high from January 2020 to February 2020.

TABLE - 1
MEAN PROTECTION TIME EXHIBITED BY VARIOUS ESSENTIAL OILS TESTED AGAINST MOSQUITOES

Repellent	Protection times(mins)			Mean	Standard deviation	Standard error
	Exp.1	Exp.2	Total			
Piper beetle	53.3	46	99.3	49.65	5.16	1.33
Eucalyptus tereticornis	51.3	46.6	97.9	48.95	3.22	0.85
Cissus quadrangularis	41.5	40	81.5	40.75	1.06	0.27
Azadirachta indica	57.1	51	108.1	54.05	4.31	1.11
Annona squamosa	51.1	50.3	101.4	50.7	0.56	0.14
Solanum surrattense	48.8	49.5	98.3	49.15	0.49	0.12
Coleus ambonicus	51.6	50	101.6	50.8	1.13	0.29
Mimosa pudica	19.3	48.1	67.4	33.7	20.36	5.26
Solanum trilobatum	44.5	48.6	93.1	46.55	2.89	0.74
Phyllanthus Anarns	40.8	46.1	86.9	43.45	3.74	0.96
Ocimum tenuiflorum	50	50.5	100.5	50.25	0.35	0.09
Citrus medica	53.5	51.6	105.1	52.55	1.34	0.34
Hibiscus Rosa- Sinensis	50.6	49	99.6	49.8	1.13	0.29
Solanum nigrum	48	48.8	96.8	48.4	0.56	0.14
Carica papaya	51.6	53.5	105.1	53.55	1.34	0.34

TABLE 1

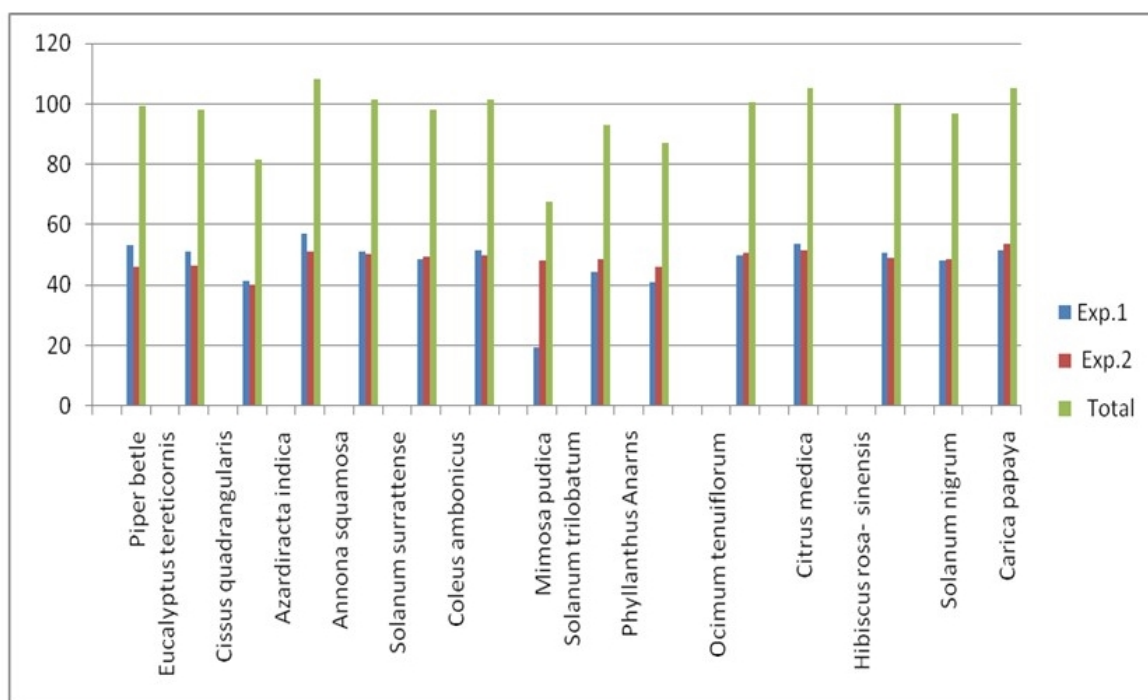


FIGURE 4

TABLE-2 PROTECTION TIME IN PERCENTAGE FOR ESSENTIAL OILS

Discussion

The control of insects includes everything that makes life hard for insects and tends to kill them. Chemical control is a very quick, effective, and popular method of pest control, but it creates acute and chronic poisoning in man and other non-target animals. Repellents are substances that as stimulants elicit avoiding reactions and are non-poisonous. Repellent substances cause insects to orient their movement away from the food source. Repellents are usually volatile chemicals and express their activity in the volatile phase. A strong repellent will be sensed by insects from a few centimeter distances causing them to fly or crawl away. Plant extracts are considered to be non-pollutant, less toxic, and easily degradable. Essential oils from plants belonging to several species have been extensively tested to assess their repellent properties as a valuable natural resource, particularly the Citronella group. Among the plant families with promising essential oils used as repellents, *Cymbopogon spp.*, *Ocimum spp.* and *Eucalyptus spp.* are the most cited. Individual compounds present in these mixtures with high repellent activity include alpha-pinene, limonene, citronellol, citronellal, camphor and thymol.

Sai Shankar. R et al., (2013)[4], said that an *Azadirachta indica*, *Citrus medica*, and *Murraya koenigii* provided repellence with a protection time of six hours followed by *Ricinus communis*

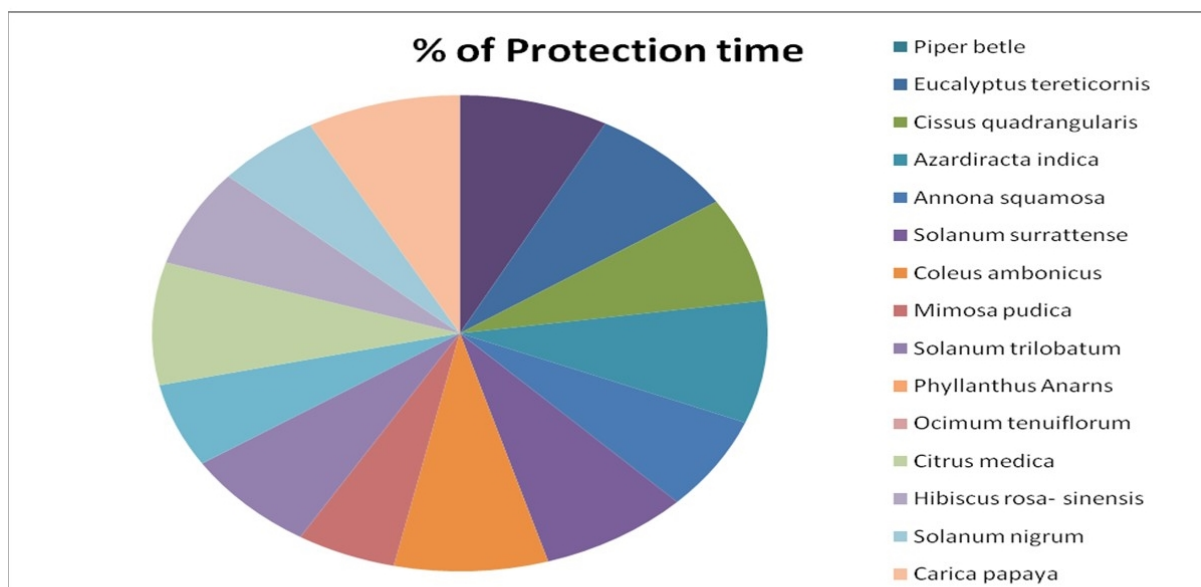


Figure-2 PROTECTION TIME IN PERCENTAGE FOR ESSENTIAL OILS

FIGURE 5

Repellent	No. of mosquitoes		% of protection
	Experiment	Control	
Piper beetle	9	42	78.57%
Eucalyptus tereticornis	9	42	78.57%
Cissus quadrangularis	12	42	71.42%
Azadirachta indica	7	42	83.33 %
Annona squamosa	15	42	64.28
Solanum surrattense	9	42	78.57%
Coleus ambonicus	8	42	80.95%
Mimosa pudica	20	42	52.38%
Solanum trilobatum	12	42	71.42%
Phyllanthus Anarns	18	42	57.14%
Ocimum tenuiflorum	10	42	76.19%
Citrus medica	7	42	83.33%
Hibiscus Rosa- Sinensis	14	42	66.66%
Solanum nigrum	8	42	80.95%

TABLE 2

and *Ocimum tenuiflorum* with five hours. They conclude that natural products from plants of insecticides and medicinal values have higher efficiency in reducing mosquito menace due to their repellent toxicity. In the present work, Vembu offered high protection time (83.33%) in an indoor area.

Effiom et al., (2012)[3], reported that the mosquito repellent activity of phytochemical extracts from Peels of five citrus fruit species, *Citrus sinensis*, *Citrus Limonum*, *Citrus aurantiifolia*, *Citrus reticulata*, and *Citrus Vitis*. The volatile phytochemical extracts were obtained from processed air-dried and powdered citrus fruit peels soxhlet extraction using Diethyl ether as solvent. Topical application of the extract concentration on human volunteers revealed that 20% and 25% repelled mosquitoes 2 hours and 5 hours, respectively. In the present work, Elumitchai offered in high protection time (83.33%) compared to other plant extracts.

T. Kazembe and C. Makusha (2012)[5] reported that the scientific basis for using mixtures of plant-based products in developing mosquito repellents is as they would have higher repellence and longer periods of protection against biting by mosquitoes. Mixtures of highly repellent extracts are likely to give repelling products although the repellency of the mixture is not likely to be a simple additive product of the repellencies of the constituent extracts of *Carica papaya* (80.95%). Any repellent that gives at least 70% protection is described as effective. A repellent that gives less than 70% protection is taken as being ineffective. The study confirms that *Carica papaya* has mosquito repellent potential. In the present work, Papaya extract showed medium protection time compared to other essential oils.

In the past few years, a plant-derived repellent has been proven to be suitably efficacious and safe to compete with DEET in the field of disease prevention, and repellents have been recognized by WHO as a useful disease prevention tool to complement insecticide-based means of vector control. The field of plant-based repellent evaluation and development had become far more rigorous in recent years and developments in methods of dispensing plant-based volatiles mean that extension in the duration of repellency and consequent efficacy of plant-based repellents will be possible in the future.

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