



Plant Archives

Journal homepage: <http://www.plantarchives.org>
doi link : <https://doi.org/10.51470/PLANTARCHIVES.2021.v21.S1.379>

CONTROL OF MOSQUITOES WITH THE HELP OF PLANT BASED CHEMICALS OF *TAGETES* AND *MENTHA ARVENSIS*: A REVIEW

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ABSTRACT

Larvicidal activity of *Tagetes* and *Mentha arvensis* essential oil against the different instar larvae of *Culex* mosquitoes. Mosquitoes larvae are the attractive goal for pesticides as mosquitoes used to breed in standing water and therefore it is easy to deal with them in this type of habitat. The use of chemical pesticides may introduce harm to the lives of people and environment. Natural pesticides that we obtained from plants are better and promising than this chemical pesticides. Different aromatic plants oils that we obtained are used in different respects. Mosquitoes are the life threatening vectors which cause several harmful diseases like malaria, Zika virus and dengue. This study deals with the essential oils and extracts which work against this life threatening vector. The pesticidal activity of essential oil of *Mentha* against the mosquitoes larvae is due to its menthol content which is the main aroma spreading component of *Mentha*. Mosquitoes feed on the blood and severe as the important vector for spreading diseases related to human. Synthetic chemical pesticides are toxic and contaminating our environment. Natural pesticides may serve as a suitable alternative technique in future. The natural pesticides are effective, eco- friendly and safe surroundings. *Mentha* and *Tagetes* were tested for their repellency against *Culex quinquefasciatus*.

Keywords : Pesticides, environment, vectors, aroma, breed.

Introduction

Mentha arvensis (Peppermint) is a hybrid mint, a cross between watermint and spearmint. It has a higher menthol content. There are fungicidal and bacterial retardant properties in its oil that contain oil thymol. Peppermint is a quick spreading perennial herbal plant which grows best in the shades. It is a herbaceous perennial plant generally growing to 10- 60 cm and rarely upto 100 cm. Leaves are simple, hairy and coarsely serrated margin and are in opposite pairs, 2-6.5 cm long and broad (1-2 cm). Flower is five lobed having hairy calyx and it is 3-4 mm long. At the base level, mint plants (in both their natural and essential oil form) have been found to act as an effective deterrent against common pests such as wasps. Mint is a natural mosquito repellent option to keep mosquitoes away from children. Mint plants have a pungent smell that is a natural option to repel insects.

Mint is a good natural repellent when it is used in its oil form. The components were found in *Mentha arvensis* essential oil such as menthol, menthyl acetate, menthone, caryophyllene and 3- piene.

Tagetes (Marigold)

Size of *Tagetes* species generally varies from 0.1 to 2.2 m tall. *Tagetes* species grow well in almost any sort of soils. Depending on the species, marigold foliage has a musky, pungent scent through the same variants that have been bred to scintillate. The main principal constituents of the essential of *T. minuta* included : ocimene, dihydrotageton, tagetones,

ocimenes, piperitenone, 3,9-epoxy- p-Mentha- 1,8 (10) diencaryophyllenebicyclogermacrene and AR-turmerone. Marigold emits a pungent smell that repels mosquitoes and we can grow it easily annually. Mosquitoes resistance against different varieties of chemical pesticide had been frequently reported. *Tagetes* plants having essential oil that can act as a natural insecticide. Many vector borne diseases are caused by the parasite and pathogens which become a big health problem in different countries. Malaria, dengue fever, yellow fever, filariasis are several examples of potentially fatal diseases transmitted by mosquito bites. *Culex* serves as the main vector of Bancroftian filariasis. This problem can be ended by the termination of breeding places of larvae and adult mosquitoes. Development in insecticide resistance of their problems. Natural products have been widely used as alternative insecticide due to their cheap production value, lower pollution level and lower toxicity in humans. *Tagetes* contain bioactive substances like geraniol, limonene, beta-pinene and tagetone all of which have antifeedent properties. *Tagetes* plant, flower and leaves contain a component known as terpenoid is having repellent activities. *Culex* the genus of mosquitoes cause several diseases related to human, birds and other animals. They used to feed on human blood for growing, reproduction etc. The female Mosquitoes lay eggs in water mainly in stagnant water.

Essential oils of plants show antifeedent repellent growth regulatory activities against pest insects (Ali *et al.*,2016). *Tagetes* root extracts have toxic effects at high concentration use on micro- organisms tested. Although last

conducted experiments shows the effect of compound that is root extract of tagete alpha –terthienyl (Vasudevan *et al.*, 1997). Plant derived products are increasingly being used to combat crop pests because they are natural and are often assumed to be safe for the environment (Vasudevan *et al.*, 1997). Comparison of extracts from the flowers, foliage and roots of the plants showed that most of the activity is located in flower. The volatiles are highly effective toward both larvae and adult mosquitoes (Rana *et al.*, 2012). The use of plant extracts as insect repellent is well –known: many insecticides and repellants in current use are based on secondary products derived from plant tissue.

Peppermint oil that is essential was evaluated for larvicidal activity against mosquitoes (Kumar *et al.*, 2011). Recent investigations indicate that some chemical constituents of these essential oils interfere With the octopaminergic nervous system in insects (Ali *et al.*, 2016). Natural products are an excellent alternative to synthetic pesticides as a means to reduce negative impact to human and environment. They are safe and eco- friendly (Ali *et al.*, 2016). Essential oils are obtained commercially many of which are from mint species/ family.

Composition of oils are mainly of mixture of monoterpenes, phenols and sesquiterpene (Ali *et al.*, 2016). Cadmium nanoparticles are synthesized from petal extract of marigold that is ecofriendly approach and used against larvae of mosquitoes (Manzoor *et al.*, 2013). India is a vast country with a diverse flora of medicinal importance. It has been proved that essential oil like peppermint oil etc. are good mosquito repellent. Along with the essential oils the marigold flowers are the good source of essential oil (Manzor *et al.*, 2013).

The marigold infused oil is reported to be anti-bacterial, astringent, anti-fungal used in insect bite etc (Modise *et al.*, 2013). To control mosquitoes using natural plant products is a sustainable method. Repellents of plant origin do not pose hazards of toxicity to human and domestic animals and are rarely biodegradable (Elango *et al.*, 2009). The oils showed strong repellent action against adult mosquitoes when applied on human skin (Ansari *et al.*, 2000). It is a considerable international interest to develop a natural product that is alternative to synthetic insecticide to control insects. The fresh flowers of *T. erecta* were sun dried and finally dried in oven. The dried plant material then is extracted cold with ethanol (Dharmagadda *et al.*, 2005). The larvicidal effect of crude ethanol extracts and their solvent fractions were determined by standard procedure of WHO (Nath *et al.*, 2006). Due to mosquito resistance the use of higher quantities of synthetic insecticides in mosquito control results in progressive contamination of the eco- systems as well as danger to human health (Afzal *et al.*). There is great interest in finding natural substances to replace synthetic chemical compounds and the essential oils have been used to develop ecologically friendly that are generally safe to humans and other mammals (Afzal *et al.*). Mosquitoes repellent can be prepared synthetically or naturally, natural mosquito coil.

The most common dreadful diseases associated with mosquitoes are malaria, yellow fever, filariasis, Japanese encephalitis and the worst dengue hemorrhagic fever (Govindarajan *et al.*, 2012). Other toxic compounds available in all the ingredients are alkaloid, papain, terpene and

cyanogenic glycosides that are objectionable to human health (Govindarajan *et al.*, 2012). *Mentha piperita* oil that is obtained from the steam distillation process of *Mentha* leaves has a long tradition of medicinal use. Menthone present in high concentration in peppermint oil is reported to act as a natural pesticide (Singh *et al.*, 1987). The essential oil of *Mentha* showed a larvicidal activity against *Culex* larvae.

Beside repellents are often used to protect against mosquitoes bite by applying on human skin (Perich *et al.*, 1994). The larvicidal effect of this solution were determined by WHO against different instars of *Culex quinquefasciatus*. The *Culex* genus of mosquitoes found everywhere and cause several health hazards to human (Nikkon *et al.*, 2011). It is found that the botanical phytochemicals are more potent alternative to synthetic insecticides. The flowers of *Tagetes* are helpful to protect ourselves from colds, coughs and ulcers. There are different effects of *Tagetes* like antibacterial, antifungal and cytotoxic effects (Jayaraman *et al.*, 2015). There is a positive test of glycosides in ethanol extract and chloroform shows the presence of terpenoids and flavonoids. The crude ethanol extract shows more effectiveness against every instars of larvae of *Culex quinquefasciatus* (Nath *et al.*, 2006). The moiety of compound changes into more toxic substance in the larval alimentary canal, integument and it is a time dependent effect (Afzal *et al.*). Alpha terthienyl is a constituent of plants belonging to *tagete* species. The exposure of plant extract to fourth instar larvae of *Culex* shows high level toxicity under sunlight. (Afzal *et al.*) The different oils were there which have protection time of 8 hours and hundred percent repellency against the mosquitoes larvae. Nematocidal work of roots refers to thienyls but essential oils that we obtained are terpenoids (Govindarajan *et al.*, 2012). There is a wonderful effect of UV in flourishing the effect of thienyl. Various species of *Tagetes* oil identified by gas chromatography were shown to contain limonene, oscimenene (Nath *et al.*, 2006). The effect of extract obtained from plants part (roots, flower and leaves) now become important.

The dry leaves of *Tagetes* are rich in thiophenes on basis of dry weight. At 72 h it shows the more mortality rate of larvae. *Tagetes* species *Tagetes minuta* have six major components like Dihydrotagetone, E- Tagetone, Z- Tagetone and Z-Beta ocimene (Jayaraman *et al.*, 2015). The effect of extract is increased with concentration of oil. Vector control disease is stopped by using larvicidal recommended by WHO (Jayaraman *et al.*, 2015).

Essential oils are obtained by steam distillation . The cleavanger type apparatus is used for the extraction of essential oils. The more supplement of chemical larvicides will development of more resistance in vector (Amer *et al.*, 2006). It is a great challenge to introduce chemical pesticides in environment. It is a main attention of researchers to find out the best natural pesticides. Essential oils contain low molecular terpenes and phenolics (Amer *et al.*, 2006).

The compounds shows their their effects on larvae by neurotoxic effects involving different mechanism. There is induction of sub –lethal effects by the use of synthetic larvicides (Jayaraman *et al.*, 2015). The methanolic extract effect is more on the fourth instar larvae of *Cx. Quinquefasciatus*.

The formation of natural pesticides is less expensive, shows more effect on larvae and moreover it is ecofriendly (Perich *et al.*, 1994). The obtained extract was used at different concentration and another simple method to extract out is first to dried the plant and to powdered it. The acetone extracts of *Tagetes* showed growth inhibitory and juto the treated larvae. *Culex quinquefasciatus* is the main mosquito vector, it is a vector for different diseases like filariasis and 120 million people affected by this worldwide. Thus the higher mortality is shown after 72 h period. In recent years the natural larvicidal extracts gain the popularity among the organic growers and environment conscious consumers. The essential oils obtained shows the larvicidal, insecticidal as well as antifungal properties (Afzal *et al.*) People show their interest in new natural products that are environmentally safe and affordable. Recently two reports showed that *Tagetes* have strong biocidal effects on both larvae and adults. 4 Thiophenes are the powerful mosquito larvicidal agent. (Singh *et al.*, 1987).

Marigold extracts have many properties like phenylpropanoids, carotenoids, flavonoids, etc. Some *Tagetes* species shows the antioxidant properties. The level of thiophene rise up slowly and attain the peak value of 0.008 percent The extract usually stored at 4 degree Celsius. This study shows the biocidal activities of *Tagetes* and *Mentha arvensis* (Amer *et al.*, 2006). Essential oils from the tremendous plants have been used for the insects, etc present in home and gardens. *Tagetes* plant is worldwide recognized for its medicinal values. The tested insecticides have sublethal effect on oupicidal activity, pupal duration and adult mortality (Amer *et al.*, 2006)

By GC flame ionization detector thiophenes were also analyzed. The extract components will damage the functioning of the larvae and stopped their growth. To detect the concentration of desired compounds and constituents of thiophenes was carried out by GC method (Perich *et al.*, 1994) The extract of thiophene were applied on larvae of *Culex quinquefasciatus*. The essential oil obtained from *T. minuta* is rich in terpenes, it is examined by the GC analysis. Log probit method of finney is used to check out the mortality rate of larvae. More the concentration more will be the mortality, less the concentration less will be the mortality. It is also recorded that mortality level also increases with time. The flora and floral parts of *Mentha* and *Tagetes* are found from different regions. *Mentha* is the species which have the medicinal properties (Jayaraman *et al.*, 2015). Chemical components found are limonene, cis carveol, carvone. Third stage larvae shows the Response toward the essential oils obtained from *Mentha* (Jayaraman *et al.*, 2015).

Tagetes and *Mentha arvensis* have the larvicidal properties. The plant have the alkaloid that shows the toxic effect on larvae of mosquitoes. Petroleum ether extract of *Tagetes* shows the toxic effect on larvae of *tagete* (Amer *et al.*, 2006). For determination LC₅₀ value, the exposure time is very important. These extract are mainly applied in stagnant water and this would applied the fertility of adults formed from larvae exposed to oil (Amer *et al.*, 2006).

Essential oils are the volatile components which shows found in different plants. Eos extracted as chemical substances but consist of mixture of different compounds. Eos containing the compounds like sesquiterpenes which are the carrier of smell (Jayaraman *et al.*, 2015) The LC value of

limonene, carvone shows more effective against *Culex quinquefasciatus*. Skin protection by using these extracts. *Mentha arvensis* shows the awesome repellent activity. A new technology comes to protect the environment from chemical larvicides - Nanotechnology (Jayaraman *et al.*, 2015). The increase number of mosquitoes will increase the infections. Repellents are applied on human skin to protect ourselves from disease (Perich *et al.*, 1994). Strong repellent effect is shown by oil when applied on human skin (Amer *et al.*, 2006). Menthol constituent shows the repellent action. *M. piperita* shows the knockdown effect. The oil show repellent activity against adult mosquitoes when applied on human skin. Menthol is a waxy substance, it relieve irritation, fever.

Conclusion

It was reported that *Mentha arvensis* and *Tagetes* Eos shows toxicity towards the larvae of *Culex* mosquitoes. It exhibit potential larvicidal property for controlling mosquitoes. So it is necessary to find out new control method for controlling mosquitoes population.

Plants extract offer an advantage over synthetic pesticides and they are less toxic, eco-friendly, easily available and easily biodegradable. So suggests that extracts of leaves of plants have the potential to act as ecofriendly approach in controlling disease spread by mosquitoes. The result shows larvicidal activity against larvae of mosquitoes and further more experiments are required to improve this activity against all stages of species of mosquitoes. The extracts from the plant are helpful in creating of new biorational larvicides. *Culex quinquefasciatus* mosquitoes spread all over the world and *Tagetes* and *Mentha* plants have potential to control the vector from local areas during their spreading season and infestation seasons. And this step will help in promoting natural larvicides.

Anti- mosquito agents would develop by this study that is based on natural compounds obtained from plants. We find different bioactive components in *Tagetes* like terpenoids and polythienyl. Also, composition of constituents gets affected by different extraction methods. This review helps to understand about different components of extracts and their beneficial functions.

It can be concluded from this review that *Mentha arvensis* and *Tagetes* are very effected natural larvicide. The repellent plant produce smoke that is use to repel mosquitoes. The extract can be applied on human skin and it completely deactivate the biting possibility. *T. erecta* shows the knock down effect and this type of repellents can be used in local areas where these plants are easily available.

References

- Ali, A.; Tabanca, N.; Amin, E.; Demirci, B.; Khan, I.A. (2016) Chemical composition and biting activity of essential oil of *Tagetes patula* against mosquito. Natural product communications 11(10).
- Vasudevan, .P.; Kashyap, S.; Sharma, S. (1997) *Tagetes* : a multipurpose plant. Bioresource technology 62(1-2): 29-35.
- Rana, I.R. and Rana, A.S. (2012). Efficacy of essential oils of aromatic plants as larvicide for the management of filarial vector *Culex quinquefasciatus*. Asian pacific journal of tropical disease 2(30): 184-189.

- Kumar, P.; Mishra, S.; Malik, A. and Satya, S. (2011). Insecticidal properties of *Mentha* species. *Industrial crops and products* 34(1): 802-817.
- Manzoor, F.; Samreen, K.B. and Parveen, Z. (2013). Larvicidal activity of essential oils against *Aedes aegypti* and *Culex quinquefasciatus* larvae. *J. Anim. Plant Sci* 23 (2): 420-424.
- Modise, S.A. and Ashafa, A.O.T. (2016). Larvicidal, pupicidal and insecticidal activities of *Cosmos bipinnatus*, *Foeniculum vulgare* and *Tagetes minuta* against *Culex quinquefasciatus* mosquitoes. *Tropical journal of pharmaceutical research* 15(5): 965-972.
- Elango, G.; Rahuman, A.A.; Bagavan, A.; Kamaraj, C.; Zahir, A.A.; Venkatesan (2009). Laboratory study on larvicidal activity of indigenous plant extracts against *Anopheles subpictus* and *Culex tritaeniorhynchus*. *Parasitol Res.* 104: 1381-1388.
- Ansari, M.A.; Vasudevan, P.; Tandon, M. and Razdan, R.K. (2000). Larvicidal and mosquito repellent action of peppermint oil. *Bioresource technology*, 71(3): 267-271.
- Dharmagadda, V.S.S. (2005). Larvicidal activity of *Tagetes patula* essential oil against three mosquito species. *Bioresour Technol.*
- Nath, D.R.; Bhuyan, M. and Goswami, S. (2006). Botanicals as mosquito larvicides. *Defence science journal* 56(4): 507.
- Nikkon, F.; Habib, M.R.; Saud, Z.A. and Karim, M.R. (2011). *Tagetes erecta* Linn. and its mosquitocidal potency against *Culex quinquefasciatus*. *Asian pacific Journal of Tropical Biomedicine*, 1(3): 186-188.
- Afzal, S.; Shah, S.S.; Ghaffar, S.; Azam, S.; Arif, F. Review on activity of medicinal plant extracts against mosquito genera *Anopheles* and *Culex*. *International journal.*
- Govindarajan, M.; Sivakumar, R.; Rajeswari, M. and Yogalakshmi (2012). Chemical composition and larvicidal activity of essential oil from *Mentha spicata* against three mosquito species. *Parasitology research* 110(5): 2023-2032.
- Singh, S.P.; Sharma, P. and Vats, L.K. (1987). Light dependent toxicity of the extract of plant *Tagetes erecta* and alpha-terthienyl toward larvae of mosquito *Culex tritaeniorhynchus*. *Toxicological & Environmental chemistry* 16(1): 81-88.
- Perich, J.; Michael.; Wells, C.; Bertsch, W. and Tredway, K.E. (1994). Toxicity of extracts from three *Tagetes* against adults and larvae of yellow fever mosquito and *Anopheles stephensi*. *Journal of medical entomology*, 31(6): 833-837.
- Jayaraman, M. (2015). Evaluation of some aromatic plant extracts for mosquito larvicidal potential against *Culex quinquefasciatus*, *Aedes aegypti* and *Anopheles stephensi*. *Parasitol res.* 2015.
- Amer, A. and Mehlhorn, H. (2006). Larvicidal effects of various essential oils against *Aedes*, *Anopheles*, and *Culex* larvae. *Parasitology Research*, 99(4): 466-472.
- Nikkon, F. (2011). *Tagetes erecta* Linn. and its mosquitocidal potency against *Culex quinquefasciatus*. *Asian pacific journal of tropical biomedicine.*