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Review Article

A Review On Herbal Mosquito Repellent

Jayesh R. Patil^{1*}, Shreya M. Nalawade², Harshada S. Patil³, Raj Y. Pandya⁴

¹Student, Shri vile Parle Kelavani Mandal's Institute of Pharmacy, Dhule, Maharashtra, India

²Student, Mitcon Institute of Management, Pune, Maharashtra, India

³Student, IIM & Human Resource Development, Pune Maharashtra, India

⁴Student, School of Commerce & Management Studies Sandip University, Nashik Maharashtra, India

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ABSTRACT

Nowadays Majority of the disease or infection like malaria, dengue etc. caused by the different types of mosquitoes mainly female Anopheles mosquito to prevent these infection or diseases there are multiple synthetic pesticides are used in market. The various pesticides used as a mosquito repellent containing hazardous chemicals that causes the various health problems in humans and other living creatures, that pesticides also cause the environmental pollution by considering these facts we are here with mosquito repellent without hazardous chemicals known as **HERBAL MOSQUITO REPELLENT**. As the herb are easily accessible in our society, it is very beneficial to use these Holly herbs in mosquito repellent formulations The herbs are the core substance in our formulations, there are different active constituents such as alkaloids, fixed oils, essential oil, resins flavonoids, phenols etc. Which is present in specific parts of herbs as it is extracted by various methods like steam distillation, pressing techniques, solvent evaporation etc. The current paper summarizes research with aimed of developing the safe and effective herbal mosquito repellents. Our study aims at the investigating the herbs which has mosquito repellent activity but they do not cause the health hazard, environmental hazard and pollution, those herbs which have Mosquito repellent activity which are used in specific proportion depending on their mosquito repellent activity in herbal mosquito repellent formulation and formulations have been developed.

INTRODUCTION

Mosquito are the two-winged blood sucking ectoparasite that are found in all over world. they cause serious health hazard problem in man or animals. Certain Species of mosquito would cause

the many diseases such as malaria, dengue fever, Chikungunya, yellow fever etc. it is most serious problem for all over world. that disease causes death of millions of people. There are different 60-70 species of Anopheles mosquito that are

*Corresponding Author: Jayesh R. Patil

Address: Student, Shri vile Parle Kelavani Mandal's Institute of Pharmacy, Dhule, Maharashtra, India.

Email ✉: jayeshrp2001@gmail.com

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responsible for causing such a disease. Out of that 30 vectors are more important. According to WHO in 2020 there are estimated 241 million cases of malaria worldwide, estimated number of malarial patient deaths up to 627,000 in 2020. Malaria is a major cause of death in the world. According to WHO, children die from malaria every 30 seconds and 300 to 500 million cases occur every year. India has reported about 20,31,790 cases with 932 deaths in 2000 and India has reported about 3,38,494 cases with 72 deaths in 2019. Dengue is the most prevalent viral infection caused by Aedes mosquito, more than 3.9 billion people in over 129 countries with an estimated 96 million symptomatic and 40,000 deaths every year. Therefore, Mosquito Control is a very important strategy. Nowadays there are different conventional strategies for controlling mosquitoes, including various insecticidal nets, indoor residual spraying. But nowadays these nets are not possible for all people. So people use synthetic pesticides (insecticides). For example, DEET, PR allethrin, Diethyl phthalate, Allethrin etc. for mosquito control.

The synthesis of pesticides causes health hazards in two ways:

1. Acute

Problems are of short duration and temporary. E.g. Skin and eye irritation, headache, dizziness, nausea, weakness, difficulty in breathing, mental confusion, seizures, and coma and death.

2. Chronic

Problems are of long duration. E.g. Immune, reproductive disorders and cancer. For more than 50 years, synthetic DEET can be used as a mosquito repellent. That synthetic DEET causes dermatitis, allergic reaction, neurological (seizures, coma), cardiovascular disease, and such synthetic insecticides also cause environmental pollution.

In order to overcome such problems, we have to go for herbal plants. Formulation (phytoconstituents) used as mosquito repellents are eco-friendly. Herbal phytoconstituents are easily available, low cost, eco-friendly, cause less pollution than synthetic insecticides. From the onset of civilization, we know that certain herbs contain phytoconstituents (such as alkaloids, tannins, flavonoids etc.) which possess insecticidal properties. About 2000 species of herbs might have insecticide properties. For many years man has used plants as a source to cure illness or infection of insects. Use of plant extracts is an alternative mosquito control strategy from ancient times. The phytoconstituents of plant extracts used for mosquito repellents are biodegradable, less hazardous, and easily available. There are different active constituents such as alkaloids, phenols, fixed oils, glycosides, volatile oils, tannins, resins, and flavonoids found in plants which are deposited in specific parts of plants like roots, leaves, seeds, barks, flowers, fruits etc. which act as mosquito repellents. These phytoconstituents are obtained from plants by various methods of extraction such as steam distillation, solvent extraction, and pressed technique etc.

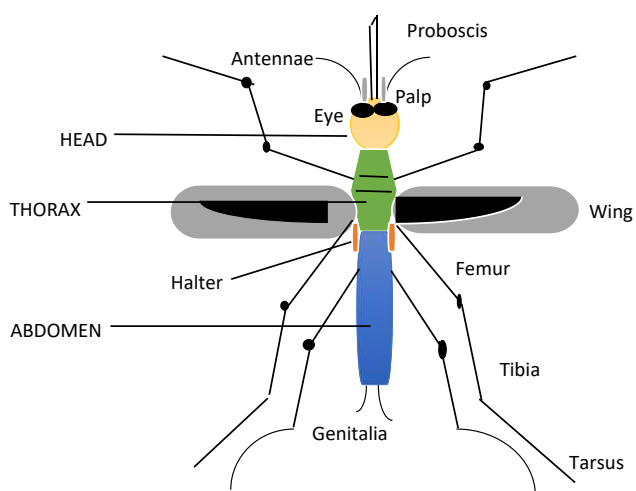
MORPHOLOGY AND ANATOMY OF MOSQUITO

Mosquitoes are ectoparasitic insects. They have six definite legs, two antennae, a hard shell, four wings, and two eyes. The upper hard shell of a mosquito is called an exoskeleton; it is made up of chitin, which is a solid hard protein. It prevents dehydration.

Mosquito body parts consist of: -

1. Head
2. Thorax
3. Abdomen





1. Head: -

- Head of mosquito consist of different organs that are Antennae, Palps, Proboscis and Eyes.
- Antennae are elongated cylindrical that detect the CO₂ from the person's breathing
- Palps are the organs in the middle of the antennae and sense odor.
- Proboscis is also called mosquito's mouth which helps to find out blood vessel it makes easy for blood sucking.
- Eyes of mosquitoes consist of two compound eyes has thousands of six sides lenses in different sides.

1. Thorax: -

- Thorax of mosquito consist of Halter, Wings and Legs.
- Halter are small organs it helps for steering when mosquito is flying.
- Wings of mosquitoes are long, narrow and Mosquitoes has two wings.
- Mosquito has six legs which consist of femur, tibia and tarsus are the end of legs help to stand and walk on water.

2. Abdomen: -

- Abdomen have long, narrow and 10 body segments connects thorax serves as stomach, reproductive system and respiratory system.

LIFE CYCLE OF MOSQUITO

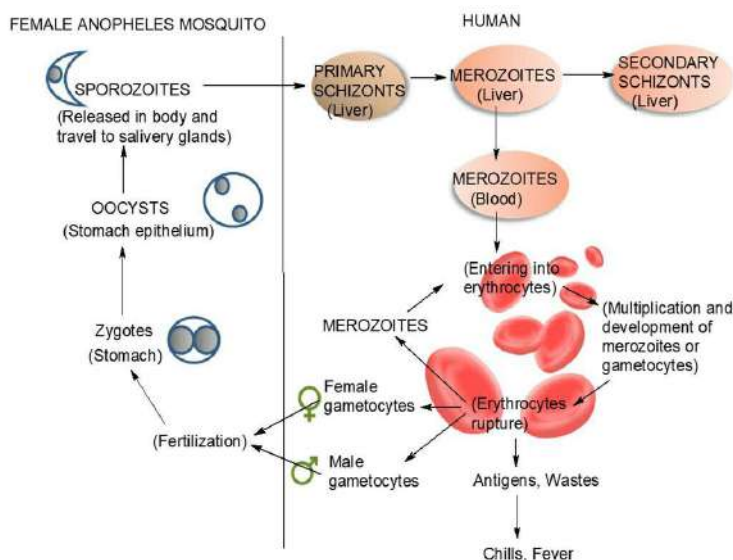


Figure: Life cycle of Malaria

The malaria is caused by Protozoa from the genus plasmodium and transmitted to human through a bite of female Anopheles mosquitos.

There are Three Stages –

A. Pre – Erythrocytic Stage / Exo – Erythrocytic Stage: -

1. Pre – Erythrocytic Cycle: -

- Malaria infection is initiated through the bite of infected female anopheles' mosquitos which release motile sporozoites into the human blood stream from its salivary glands.
 - Then Sporozoites gets enter into the parenchyma cells of the host liver.
 - This stage is symptoms free.
- 2. Exo – Erythrocytic Cycle: -**
- Through repeated nuclear divisions, Sporozoites multiply and develop into Schizonts.
 - After the period of 8 – 21 days, liver cell ruptures due to multiple repeated division of Schizonts.
 - This results in release of approximately 20,000 Merozoites into circulation.
 - In few cases, Merozoites enter into the tissues and act as a reservoir of parasites.

B. Erythrocytic Stage: -

- The Merozoites now enter into the blood circulation and invade the Erythrocyte / RBC.
- Some merozoites invade fresh liver cell and repeat Erythrocytic Cycle.
- Inside this erythrocyte, the merozoites continue to grow.
- As Heme is toxic to malarial parasites, the Heme converts into the Hemozoin by decreasing the pH of RBC.
- In Erythrocytes, the merozoites undergoes Asexual multiplication which results into formation of erythrocytic schizonts.
- Due to repeated multiplication of merozoites, Erythrocytes ruptures and release more Merozoites into the blood circulation.
- Each Merozoites again invade fresh Erythrocyte and the cycle of asexual multiplication is repeated again.
- This cycle continues for about 48 – 72 hrs.
- It shows the symptoms like Shivering, Cold, Fever, etc.

- This stage is also known as Schizogony phase of infection.

C. Sporogonic Stage: -

- After the Erythrocytic phase, Some of the Erythrocytic Merozoites develop into Male and Female Gametocytes by some undefined mechanism.
- Such infected blood when ingested by female anopheles' mosquitos, the sexual form of division. i.e.: - Gametocytes undergoes reproduction within the gut of insect.
- The resulting Zygote (Oocyte), through various stage of development give rise to the Infective Sporozoites.
- This Sporozoite get localized in the salivary gland of the insect and enter the host blood circulation.

Then, Cycle goes on Repeating.

WHAT ATTRACTS MOSQUITO TO CERTAIN PEOPLE

1. Carbon-dioxide(co2)

When people release (excrete) co2 while exhaling. This leads a indication to mosquito that the host is nearby.

2. Body Odor

The sweat associated with exercise and increase body temperature also called eccrine sweat is odourless to humans but not to mosquitos. Mosquitos not only smell sweat but they are also attracted to certain compounds present in sweat i.e. Lactic acid and ammonia (NH₃).

3. Body Temperature

Increase in body temperature attracts mosquitos.

4. Colour

Mosquitos are attracted to dark clothing (black, navy blue, red or orange).

5. What you eat or drink

- Eating has an effect on your metabolic rate, which can increase body temperature and sometimes leads sweating.
- Alcohol consumption leads to more co2 release, more sweating and raises body temperature or sometime these 3 factors in combination results attraction of mosquitos.

6. Pregnancy

Mosquito are attracted to pregnant women as they exhale more co2 and body temperature during pregnancy increases.



CHEMICALS USED AS MOSQUITO REPELLENT

1. N, N Diethyl-Meta Toulamide (DEET)
2. Picaridin
3. Permethrin
4. Scourge
5. Anvil
6. Malathion
7. IR3535 – Ethyl butylacetylaminopropionate
8. Para-methane-diol (PMD)
9. Metofluthrin
10. N, N-Diethyl-2-phenyl-acetamide (DEPA)

PROBLEMS ASSOCIATED WITH CHEMICALS USED AS MOSQUITO REPELLENT

- DEET can cause neurological problems in children, skin rashes, scarring in adults.
- Picaridin causes little acute dermal, oral, eye irritation and inhalation toxicity.
- Permethrin exposure can cause irritation to nose, lungs and throat. It also causes headache, dizziness, excessive salivation, fatigue and it directly affects the liver and immune systems.
- Scourge is a synthetic insecticide which has an effect on the nervous system also linked with liver and thyroid problems which is classified by EPA as a possible human carcinogen.
- Anvil is a synthetic insecticide which has an effect on the central nervous system and it boosts tumor growth in cancer of reproductive including breast and prostate cancer.
- Malathion is an organophosphate that acts as a carcinogen that can also cause acute and chronic neurological health problems.
- IR3535 causes little toxicity on oral, inhalational and dermal exposure.
- Para-methane-diol can cause eye or face irritation and it does not cause any environmental hazards.
- Metofluthrin causes neurotoxicity and the potential carcinogens, it has little toxicity on inhalational exposure.
- Synthetic pesticides or chemicals that can cause many acute and chronic health problems, acute eye and skin irritation, headache and

nausea, weakness, dizziness, breathing difficulty, mental confusion and seizures, coma.

- Chronic health problems include nervous, immune, cancer and reproductive disorders.
- Children are more susceptible than the adult on exposure of the chemicals due to their small body size, rapid growth cycle and immature immune systems.
- All pesticides are harmful for both human health as well as environments.
- Due to the use of synthetic chemicals they can cause environmental pollution.
- Chemicals that can be used as mosquito repellents they can also target other species including flies, humans, plants and other organisms.
- Chemicals can contaminate the water, soil, turf and other vegetation they can also act as developmental changes of many species and birth defects.

In order to avoid this environmental pollution and hazard to living creatures including man we have to go for HERBAL MOSQUITO REPELLANT products.

HERBS USED AS MOSQUITO REPELLENT

1. OIL OF LEMON EUCALYPTUS (OLE)

Biological Name

Eucalyptus citriodora Hook., Corymbia citriodora

Common Name

Lemon-scented gum (lemon-scented eucalyptus)

Biological Source

The oil of Lemon Eucalyptus is an essential oil which is obtained from steam distillation of fresh leaves and twigs (small branch or shoot) of species Eucalyptus citriodora Hook.

Family

Myrtaceae

Chemical Constituents

citronellal (76.3%), PMD (p-menthane-3,8-diol), citronellol (5.7%) and neo-isopulegol (5.5%).

MOA

- The specific component p-menthane-3,8-diol (PMD) in the oil of lemon eucalyptus
- which is obtained from the residue (waste) distillate after the extraction of oil by
- hydro distillation of leaves.



- The host consist of different factors like carbon dioxide, odor, temperature, humidity, color, alcohol, ammonia. PMD acts by masking(covering) up such environmental factors or signals due
- to which mosquitoes are unable or get confused to locate their prey(target).

Method: - Steam distillation

- a. Take 1 part of lemon eucalyptus oil and 8 parts of coconut oil or witch hazel in the glass spray
- b. bottle.
- c. Mix by shaking gently.
- d. spray to apply over skin.

Marketed preparation

Murphy's Repel Lemon Eucalyptus Natural Insect Repellent Pump

Spray.

Cost 1400 to 2500Rs

Duration

The length of time duration of protection against mosquitoes is up to 2 to 6 hrs.

2. CATNIP

Biological Name

Nepeta cataria L.

Common Name

Catmint, Catswort, Catnep

Biological Source

The oil extracted from catnip is an essential oil which is obtained from the steam distillation of dry leafs and stem(stalk) of species Nepeta cataria L.

Family

Lamiaceae

Chemical Constituents

Nepetalactone[4,7-Dimethyl-5,6,7,7a-tetrahydrocyclopenta[c]pyran-1(4aH)-one],1,8-cineole, E-geraniol, Alpha-pinene, citronellol, Beta-caryophyllene.

MOA

Catnip oil consist of an active ingredient i.e. Nepetalactone (iridoids) which is formed by adding oxygen atoms to geraniol that triggers mosquitoes TRPA1 pain or itch receptors that show same effect on mosquitoes as pepper spray has on human being.

Method

Steam distillation of leaves of catnip gives pale yellow to orange color essential oil

- i. The catnip leaves when rubbed between hands and then rubbed on exposed skin which gives protection for approx. 30 minutes.
- ii. The catnip essential oil is diluted with some carrier oil in approx. 1:1 ratio and apply directly on skin.

Marketed Preparation

1. Avi naturals catnip oil
2. Plant therapy essential catnip oil
3. Catnip essential oil Brand-edens garden
4. Catnip essential oil Brand-mystic moments
5. Kazima catnip essential oil
6. Go Woo catnip essential oil

Estimated Protection Time

> 4Hrs

3. BASIL

Biological Name

Ocimum sanctum, Ocimum basilicum L.

Common Name

French basil, Sweet basil, Tulsi, Great basil, Holy basil, Thai basil, Sacred basil.

Biological Source

The basilicum oil is an essential oil which is obtained from the steam distillation of leaves and flower top of species ocimum sanctum and ocimum basilicum L.

Family

Labiatae

Chemical Constituents

limonene, linalool, eugenol-methyl cinnamate, estragole, Fenchone, 1-8-cineole, nerolidol, citronella.

MOA

- Basil oil consist of four types of volatile compounds like citronella, limonene, estragole
- and nerolidol which reduce the ability of mosquitoes to locate the host by interrupting it's
- carbon dioxide and temperature sensors.
- Due to which mosquitoes gets confused to recognize the environmental cues and force
- them to leave recuperate their senses.

Method

Hydro distillation, steam distillation, solvent extraction, super critical fluid extraction.

- a. A mixture of 60% basil oil with 40% of lavender or bergamot oil will give protection for approx. 70 minutes.

- b. Boil the basil leaves the cool it and strain it in a glass spray bottle for use over required area.

Marketed preparation: -

- a. Eemensis basil oil
- b. Naturalis essence of nature holy basil essential oil
- c. Herbins basil essential oil

Estimated protection time

Between 20 and 100 minutes.

4.CITRONELLA

Biological Name

cymbopogon nardus and cymbopogon Winterianus

Common Name

lemon grass, silky heads, Cha de Dartiga longue, fever grass, tanglad, hierba Luisa, barbed wire grass or gavati chaha.

Biological Source

The oil of citronella is an essential oil which is extracted from the leaves(grasses) by steam distillation.

Two types of citronella oil: -

1. Ceylon- extracted from the species C. nardus
2. Java- obtained from the species C. winterianus.

Family

Poaceae

Chemical Constituents

citronellal, geraniol, citronellol, geranyl acetate.

MOA

The citronella oil consists of geraniol and citronellol which gives a citrusy like aroma that masks up the environmental cues(factors) like carbon dioxide and lactic acid due to which mosquitoes get confused to sensitize the cues by its olfactory sensory organ so they are unable to deter from getting close when such oil is applied over required surface area

Method

Steam distillation, water distillation

- a. combine one part of nard (citronella leaves /grasses and 10 parts of olive oil
- b. steam heat(cook) the above mixture
- c. strain out in a glass spray bottle with the help of cloth
- d. seal the bottle and use on required area

Estimated Protection Time

< 2 Hrs.

5.GARLIC

Biological Name

Allium sativum L.

Common Name

Lasun(Marathi), Lasan (Gujrati), Lahsun(Hindi), Naharu (Assamese).

Biological Source

The essential oil of garlic which is extracted by the steam distillation bulb of species Allium sativum.

Family

Amaryllidaceae

Chemical Constituents

diallyl disulfide, diallyl trisulfide, methyl allyl trisulfide, allicin.

MOA

The extract of garlic consists of allicin which is an oily yellow liquid component also known as allyl thiosulfinate which gives the lingering (long lasting)/abiding odor that triggers the mosquitoes' sensitive odor sensing antennae. Garlic oil smells cannot be detected by humans after few minutes but it can be detected by mosquitoes for approx. 30 days as they have more sensitive smell sensing organ(antennae). So as long as mosquito can sense the smell it will move away from the targeted area.

Method

steam distillation

- a. Natural garlic spray- Add 3 to 4 garlic cloves to carrier oil like sunflower oil and keep the mixture for about overnight. Add few drops of lemon juice to the above mixture and add approx. 300 ml of water to it. Fill the content in a glass spray bottle and use over required area.

Marketed Preparation: -

1. Olvedic garlic essential oil
2. Globatic herbs garlic essential oil
3. Korus garlic essential oil
4. Deve Herbes pure garlic essential oil

Estimated Protection Time

Approx. 30 days

6.PALMAROSA

Biological Name

cymbopogon martini

Common Name

Palm rose

Biological Source

The oil extracted from the Palma Rosa plant is an essential oil which is obtained by steam distillation of dry leaves of species *Cymbopogon martini*

Family

Poaceae

Chemical constituents

Geranial, geraniol, geranyl acetate, (E)- β -Ocimene, linalool, neral, caryophyllene, farnesol.

MOA

The fractional distillation of Palma Rosa plant leads to essential oil which contains an active ingredient geraniol which is an effective plant-based mosquito repellent.

Geraniol give such action by simply Binding with General Odorant Binding Protein [GOPBs] receptor present on the antennae/olfactory sensitizing organs, due to which mosquito is unable to detect the environmental cues like CO₂, temperature, body odor, alcohol of the targeted host. Hence, they do not come close to the host as long as they do not recover their sensory organs.

7.DILL

Biological Name

Anethum graveolens L.

Common Name

Shepu(Marathi), Sholpa(bengali), soa(punjabi), sowa

Biological Source

The Essential oil of Dill herb is extracted by steam distillation of seed, leaves, stem(stalk) of *Anethum graveolens* L.

Family

Apiaceae

Chemical Constituents

limonene, alphaphellandrene, carvone, alpha-pinene, cis-dihydrocarvone, Dill-apiol.

MOA

- The Dill herb consist of active ingredient d-limonene which is an effective natural mosquito repellent.
- The D-limonene affect mosquitoes' respiratory system on contact by disrupting (destroying) the wax layer of mosquitoes' respiratory system which tends the pesky mosquitoes to suffocate.

8.HIBA

Biological Name:

Thujopsis dolabrata

Common Name

Arborvitae or tree of life

Biological Source

The oil of Hiba plant is distilled from the wood by steam distillation of species *Thujopsis dolabrata*

Family

Cupressaceae.

Chemical Constituents

Sabinene, Thujopsene, carvacrol,4-terpineol, hinokitiol, alpha-thujaplicine.

MOA

- The steam distillation of aomori hiba trees (HIBA WOOD) leads to an essential which contains an active ingredient carvacrol which is highly effective in repelling mosquitos.
- It has spicy types, smoky, pungent odor which has a deodorizing property that mask odors of the environmental cues like carbon-dioxide, Body odor, alcohol due to which mosquitos are unable to locate the host. Mosquitos can't stand the spicy, smoky odor of essential oil.

9. HO LEAF

Biological Name

Cinnamomum camphora

Common Name

Camphor leaf, Ho-sho,Laurel camphor, Japanese camphor.

Biological Source

The oil obtained from Ho leaf herb is an essential oil which is extracted by steam distillation of leaf of species *Cinnamomum camphora*

Family

Lauraceae

Chemical Constituents

Linalool, camphor,1,8-cineole, alpha-terpineol, nerolidol.

MOA

The essential oil which is obtained from steam distillation of Ho leaves consists of volatile compounds like linalool, Nero diol, camphor having sweet, citrusy, floral like odor which reduce the ability of pesky mosquitos to detect the host by disturbing its olfactory sensors.Due to which mosquitos get confused to recognize the environmental factors and force them to leave recuperate their senses.



10. TAGETES

Biological Name

Tagetes minuta L.

Common Name

chinchilla, suica, anisillo, wild marigold, Aztec marigold, southern marigold.

Biological Source

The Tagetes plant oil is an essential oil which is obtained by steam distillation, solvent extraction of leaf, stem, stalk, peduncle and flower of species Tagetes minuta L.

Family

Asteraceae

Chemical constituents

limonene, alpha-terpineol, E and Z- beta-ocimenes, Z- tagetone, dihydrotagetone, Z- tagetenones.

MOA

- Tagetes oil consist of an active ingredient Limonene which is an effective mosquito repellent. The limonene has a citrusy odor which mosquito find offensive.
- The D-limonene on contact disrupts the wax layer of respiratory system of mosquitos which tends the mosquito to suffocate.

11. NEEM

Biological Name

Azadirachta Indica

Common Name

Nim, Margosa

Biological source

The oil of neem is an Glyceridic oil which is obtained from the continuous pressing method of the seed of species Azadirachta Indica.

Family

Meliaceae

Chemical constituents

Azadirachtin and others are nimbolinin, nimbin, nimbidin, nimbidol, sodium nimbinat, gedunin, salanin and quercetin, oleic, linoleic acid.

MOA

Azadirachtin is a chemical constituent of the neem which is act as anti-ecdysteroid and it kill the larvae by the cell wall disruption Azadirachtin is tetranortriterpenoid limonoid present in seed. It is key constituents for the mosquito repellent as well as the antifeedant.

Method

- a. Three percent of neem oil mixed with the coconut oil gives approximately 90-95% of the protection from the Anopheles mosquito, 80% From the Aedes and 60-90% from Culex spec.
- b. Take 10-12 drops of neem oil and 20ml of coconut oil to glass spray bottle, mix gently and approximately 2-4 hours. apply over required areas. Duration of the protection is

12. THYME

Biological Name

Thymus vulgaris L

Common Name

Himalayan Thyme, Wild Thyme, Creeping Thyme, Mother of Thyme, Hasha, Jangli ajwain.

Biological source

The oil of thyme is an essential oil which is obtained from the hydro distillation or steam distillation of the flower and leaf of the Thymus vulgaris.

Family

Lamiaceae.

Chemical constituents

Geraniol, P-cymene, Cisthujone, carvacrol, thymol (44.7%), terpinene (16.5%).

MOA

- Geraniol which is constituents present in thyme plants which is responsible for the disruption of cell walls and cell membrane of the mosquito. Mosquito also repelled by the
- geraniol binding with the General Odorant Binding protein (GOPB s) of the Olfactory sensory organs of mosquito, it also as insect repellent property by act on the antenna of insects.

13. TURMERIC

Biological Name

Curcuma Longa L.

Common Name

Haldi, Manjal.

Biological source

- The oil of turmeric is an essential oil which is obtained from the steam
- distillation and solvent extraction of the rhizomes of the curcuma Longa.

Family

Zingiberaceae

Chemical constituents



Alpha -beta – turmerons, curcumin, Alpha-phellandrene, 1,8-cineole, terpinolene, zingiberene, Beta -sesquiphellandrene.

MOA

Turmeric consists of some active ingredient likes turmerones and Ar -turmerones extraction of the oils from the curcuma longa which has the repellent activity, the Alpha and Beta turmerones and Aromatic turmerons can causes the strong aroma which repels to the mosquito growth.

14. CLOVE

Biological Name

syzygium aromaticum

Common Name

clove, cengkin, chengken, chingken

Biological source

The oil of clove is an essential oil which is obtained from steam distillation method of the flower bud of the species syzygium aromaticum.

Family

Myrtaceae

Chemical constituents

Eugenol, Caryophyllene, eugenyl acetate

MOA

Clove oil consist of an effective mosquito repellent constituent known as Eugenol. The eugenol has a sharp peppery, woody odor which is offensive to mosquitos. Mosquito can't bear the burning sensation of clove oil. The odor affects the olfactory sensory organ present on the antennae of mosquito. Due to which mosquitos are unable to detect the host cues like carbon-dioxide, temperature, alcohol, body odor and simultaneously stays away from the host. Eugenol when mixed with synergist chemical boost the effectiveness of repellency and killing the larvae of mosquitos.

Method

- Clove oil (50 %) mixed with lavender, thyme or geranium oil (50%) prevent biting from An. abimanus for about 1 to 2 1/2 hrs.
- Clove contain eugenol having peppery odor when mix with sour flavor of lemon gives effective mosquito repellent property.

15. GRAPEFRUIT

Biological Name

Citrus reticulata Blanco

Common Name

Pomelo, chinese grapefruit, Papanas (Gujarati), Batawi -nimbu (Hindi),Bampara(Marathi)

Synonyms

Citrus costata, Citrus pompelmons, Citrus maxima.

Biological source

Grapefruit is an essential oil which is obtained from the continuous pressing method of the peel of the Citrus reticulata Blanco.

Family

Rutaceae

Chemical constituents

limonene, geranial, neral, Nootkatone

MOA

- The Orange Peel i.e. cestrum which contains the oils known as Limonene Oil it has lethal effect on the mosquitoes. It directly acts on to Olfactory sensory organs of the mosquito and
- interfere with it to block the smelling ability by acting on the smell receptors of the mosquito. It also shows insects repelled activity by destroying its wax layer of the respiratory system so that insects causes the suffocation.

16. LEMON TEA TREE

Biological Name

Leptospermum Petersonii F.M. Bailey

Common Name

Lemon tea tree

Biological Source

The oil of the lemon tea is an essential oil which is obtained from the steam distillation of the leaf of the leptospermum petersonii. F. M. Bailey

Family

Myrtaceae

Chemical constituents

Neral, Geraniol, Geranial, Alpha -pinene, Citronellal, Terpinolene, Geranyl acetate

MOA

Lemon tea tree contain the Geraniol, Geranial and Citronellal which are responsible for the disruption of cell wall, membrane of mosquito by binding with General odorant. Binding protein (GOPBs) which is present in Olfactory sensory organs of mosquito, and inhibition of mosquito Growth.

17. VETIVER

Biological Name

Vetiveria Zizanioides [L.] Nash



Common Name

khush, chrysopogon Zizanioides

Biological source

The oils of the vetiver is an essential oil which is obtained from the steam distillation of the root of the *Vetiveria Zizanioides* [L.] Nash

Family

Poaceae

Chemical constituents

valencene, vetiverol, khushimol, isonootkaton, beta-vetivenene, Alpha and Beta Vetinones.

MOA

The vetiver oil consist of two important constituents valencene and vetiverol that is essential for mosquito repellency activity. Vetiver oil on contact with mosquito gives a strong irritancy action.

18. GERANIUM

Biological Name

Pelargonium Graveolens L'He'r

Common Name

Pelargoniums, stork's bills.

Biological Source

The oil of the Geranium is an essential oil which is obtained from the steam distillation of leaf and stem of the *Pelargonium graveolens* L'HE'R

Family

Geraniaceae

Chemical constituents

Geraniol, Geranial, Citronellol, Geranyl acetate, 2-phenylethanol.

MOA

Mosquito can be repelled or Inhibited by the geraniol and Citronellol It can be show the mosquito repellent activity by binding with the General Odorant Binding protein [GOPBs] in the mosquito. Which directly act on sensory organs of mosquito.

19. JASMINE

Biological Name

Jasminum Officinale L.

Common Name

Chameli, Mogra, Champa bela

Biological Name

The oil of Jasmin is an essential oil which is obtained from the solvent extraction of the flower of the *Jasminum Officinale* L.

Family

oleaceae

Chemical constituents

Linalool, Eugenol, Benzyl Acetate, z-jasmone, methyl and Benzyl Benzoate.

MOA

Jasmin contain some essential oils which have the mosquito repellent activity by their fragrances, which is act on the mosquitoes' sensory organs Jasmin produce smell that keeps away the mosquito.

20. ROSE

Biological Name

Rosa Chinensis

Common Name

China rose, bengal rose, chinese rose

Biological Name

Rose oils are an essential oil which is obtained from steam distillation and solvent extraction of petals of the Rose.

Family

Rosaceae

Chemical constituents

Citronellol, Geraniol, Linalool, 2-Phenethyl alcohol, Nonadecane.

MOA

- The essential oil obtained from steam distillation/solvent extraction of rose petal contains active like citronella, geraniol and linalool. The citronella and linalool is composed of citrusy like aroma that masks up the environmental cues like carbon-dioxide, body odor (NH₃, lactic acid, sweat) due to which mosquito are unable to sensitize the cues by its olfactory sensory organ and are unable to detect and unable to get close to host.
- The geraniol binds with General Odorant Binding Protein [GOPBs] in mosquito's antennae/olfactory sensory organ and block their ability to sensitize the host.

21. BERGAMOT

Biological name

Citrus bergamia

Common name

bee balm, horsemint, Oswego tea, Monarda,

Biological source



The oil of bergamot is an essential oil which is obtained by soaking the fresh or dried peel (rind) in water and then pressing the grind of species citrus bergamia.

Family

Rutaceae

Chemical constituent

Beta- pinene, Gamma-terpinene, linalool, linalyl acetate, limonene.

MOA

Bergamot oil include compound like limonene, linalool. Which reduce the capability of mosquitoes to discover the host by interrupting its temperature sensors. [Limonene: Limonene affects insects on contact, correctly suffocating them by unfavorable their respiratory systems] [Linalool: Linalool has been verified to lessen the presence of woman mosquitoes. It repels Mosquitoes]

Method

- Cold pressing
- Steam distillation
- Hydro distillation

22. FENNEL

Biological name

Foeniculum vulgare mill.

Common name

saunf, sweet cumin, large cumin

Biological Source

The oil of fennel is an essential oil, distilled from fennel plant which is obtained from steam distillation of fresh fruit of species foeniculum vulgare mill.

Family

Apiaceae

Chemical Constituent

Alpha -phellandrene, (+-) -limonene, (+) -fenchone, estragole, E-anethole

MOA

The fennel oil encompasses a lively component like (+) -limonene, (+) -Fenchone which have a robust odors (sweet) Which lessen the ability of mosquito to place the host via stressful it's carbon dioxide and sensors, because of which mosquitoes gets stressed to understand the environmental cues and force.

Method

steam distilled

- a. Take 5% of citronella mixed with 5% fennel oil and 26% of DEET which give protection from

mosquito for 6 hour (b)Use an indoor insect fogger or indoor insect spray to kill mosquitoes and treat areas wherein they lead relaxation.

Market preparation

- i. Fennel seeds essential oil
- ii. Fennel drop of Natural goodness

23. CAMPHOR

Biological name

cinnamomum camphora (L) J. Presl

Common name

camphora Officinarum, camphor wood, camphor laurel, Kapura (In Gujarat), karpura (In bengal), zhangnao (In China),

Biological source

The oil of camphor is an essential oil is synthesized from steam distillation of Timber (wood), leafage(leaf), bark of species cinnamomum camphor (L) J.

Family

lauraceae

Chemical constituent

sabinene, 1-8 cineole, Alpha terpineol, Alpha pinene, camphor, linalool

MOA

camphor oil encompass an lively substances that is 1,8-cineole, alpha-terpineol, alpha-pinene, linalool, Which lessen the capacity of mosquitoes to locate the host through interrupting it's Carbon dioxide and temperature sensors. Because of which mosquitoes gets harassed to recognize the environmental cues and pressure Them to go away recuperate their senses.

Method

steam distillation

24. SOYABEAN

Biological Name

Glycine max [L] merr.

Common Name

soja bean (soya bean)

Biological Source

The soybean oil is an essential oil which is obtained from continuous screw pressing and solvent extraction of seed(bears) and nuts of species Glycine max [L] merr.

Family

Fabaceae

Chemical Constituents

Alpha linoleic, oleic, linoleic, stearic acid and palmitic.

MOA

soya bean

- The soya bean oil contains of Fishy-Off odor with addition of phospholipids that usually drives away the mosquitos. Soya bean oil consist of long fatty acids like linoleic acid, oleic acid, linolenic acid that prevents the evaporation of essential oil and prolongs the deterrent activity.
- The Oleic acid has effective mosquito larvicidal activity gives action by swelling of mitochondria, endoplasmic reticulum, enlargement of vacuoles and also cause the lysis of epithelial cells and perforation of midgut.

Method

2% of soya bean oil with carrier oil gives approx. 5-6 hrs. protection when applied on skin. Commercially known as "BITE BLOCKER".

25. LAVENDAR

Biological Name

Lavandula latifolia, lavandula angustifolia, L. Vera and L. Officinalis.

Common Name

lavandula

Biological source

The lavender oil is an essential oil which is obtained from steam distillation of crushed lavender flowers of species Lavandula latifolia

Family

lamiaceae

Chemical Constituent

terpinen-4-ol, 1-8-cineol, linalool, linalyl acetate, linalyl acetate, 2-terpineol.

MOA

The lavender oil consists of an active ingredient like linalool which have a strong odor (sweet). Which reduce the ability of mosquito to located the host by disturbing it carbon dioxide and temperature sensors, due to which mosquito get confused to recognize clues factor the environmental clues and force them to leave recuperate their senses

Method

steam distillation

- a. Add 1-2 drops of lavender essential oil into carrier oil (rose oil, marigold oil).

- b. tablespoon of vegetable oil with lavender essential oil (10-25 drops) and 1 tablespoon of aloe Vera. Apply to skin as moisturizer.

Marketed preparation

1. Lavender essential oil by deyga
2. 2.French Lavender essential oil

26. CINNAMON

Biological Name

Cinnamomum zeylanicum Blume

Common Name

Cinnamomum verum, Ceylon Cinnamon

Biological Source

The Cinnamon oil is an essential oil which is obtained from steam distillation of bark and leaves of species cinnamomum zeylanium Blume.

Family

Lauraceae

Chemical Constituents

Eugenol, Cinnamic acid, Cinnamate and Essential oil such as trans-cinnamaldehyde, L-borneol, terpineol.

MOA

Cinnamon bark essential oil contains eugenol which is able to resist the bite of aedes aegypti and anopheles mosquitos. The mechanism of this process is not known as certain, but eugenol has a pungent odor and a very spicy & hot taste, thus the mosquitos do not like it. Cinnamon extracts, essential oil and their compounds have been likely to reported that it inhibits mosquitos and other bacterial insects by damaging cell membrane, cell division, inhibiting ATPase, membrane porins, altering the lipid profile, motility, biofilm formation and via anti-quorum sensing effects.

27. MINT

Biological Name

Mentha L. Spp.

Common Name

Spearmint, Bush Mint. Also known as Garden mint or Common mint.

Biological Source

The mint, mentha is an essential oil which is obtained from steam distillation of leaf and flower of species of Mentha L. Spp.

Family

Lamiaceae

Chemical Constituents

Menthone, Menthol, 1,8-cineol, 4-



terpineol and d-8-acetoxycarvotanacetone.

MOA

Mint

The essential oil of mint (menthol) which is a fragrance herb consist of insect repellency ingredient i.e. menthone has a nontoxic minty, pungent aroma that's makes mosquito 'NOSE BLIND' so mosquito can't detect the environmental cues i.e. (target factors) and repels and control pesky mosquito from biting host.

Method

Crushing the mint leaves between hand the released oil is applied topically that can give approx. 2 hrs. protection.

28. GINGER

Biological Name

Zingiber officinale Roscoe.

Common Name

Hindi -> Adi, Adrack(fresh), Sonth(dried).

Sanskrit -> Adaraka(fresh), Shunthi(dried).

Biological Source

The ginger is an essential oil which is obtained from steam distillation of rhizome part of species of zingiber officinale Roscoe.

Family

Lamiaceae

Chemical Constituents

Geranial, alpha-zingiberene, E-alpha farnesene, neral, ar-curcumene, geraniol, shagaol.

MOA

The Ginger oil consist of biocide active ingredient geraniol that have a pungent smell that mosquitoes hates the most. Geraniol gives mosquito repellent activity by binding with General Odorant Binding Protein [GOPBs] in antennae and upsetting it carbon-dioxide and temperature sensors, makes the mosquito nose blind due to which it can't detect the environmental cues. Ginger oil in its pure and undiluted form reduce number of mosquitos.

29. MUSTARD

Biological Name

Brassica L. Spp.

Common Name

Rai or Raya, Sarson, Saasime.

Biological Source

The mustard is an glyceridic oil which is obtained from pressed method of seed part of species of Brassica L. Spp.

Family

Brassicaceae

Chemical Constituents

Erucic, Oleic, Linoleic, Linolenic, Palmitic and Stearic acids.

MOA

The Compound Allyl isothiocyanate present in mustard oil gives a strong, pungent, sharp odor which is usually derogatory to mosquitos. The mustard oil derives free fatty acid mixture -Oleic acid, Linoleic, Palmitic and Stearic acid that provides strong repellency action against blood-sucking mosquito. The oleic acid is only fatty acid that shows larvicidal property.

30. CEDAR

Biological Name

Cedrus Trew (Cupressus L., Juniperus L.) spp.

Common Name

Devdaar Tree or Devdaar Wood

Biological Source

The cedar is a type of essential oil which is obtained from steam distillation of wood part of species cedrus Trew (Cupressus L., Junipeus L.) spp.

Family

Pinaceae (Cupressaceae)

Chemical Constituent

Thujopsene, Eudesmol, Limonene, alpha & beta – pinene, alpha & beta – cedrenes, beta – phellandrene, 3 –carene, Acetophenones, Carvacrol, Hinokitiol.

MOA

All organisms require a very specific chemical balance to stay alive. Unfortunately for mosquitos & bugs, cedar wood oil is substantially altering their unique chemistry, unbalancing their bodies pH level and ultimately causing death. Mosquitos and other insect bugs also depends on chemical called Pheromones to breed, navigate and find resources. Cedar wood oil hinders mosquitos and bugs ability to use and detect Pheromones, disorienting them and disrupting their body functions, which often both repels and kill them.

31. CASTOR

Biological Name

Ricinus communis L.

Common Name



Hindi -> Rende, Gujarati -> Divel, Aerende, Marathi -> Chandava

Biological Source

The castor oil is an glyceridic oils which is obtained from Pressed Mechanism method of seed of species *Ricinus communis* L.

Family

Euphorbiaceae

Chemical Constituent

Ricinolic, Linoleic, Oleic acid.

MOA

The chitin is the target substrate for the Mosquitocidal Toxin and leads to the degradation of Peritrophic membrane and thereby support the proposal mode of action for mosquitocidal metabolites)In the present study, The mosquitocidal toxin oleic acid, eicosyl ester sufficiently low level of chitinase (beta-N-acetyl glucosaminidase) in mosquitos species as well as the peritrophic membrane which is a protective sleeve for the midgut epithelium of mosquitos species & binds to the gut region of larvae of *Aedes aegypti*. Subsequently, oleic acid, eicosyl ester ingested larvae of both the mosquitos were died due to swelling of mitochondria, endoplasmic reticulum and Enlargement of vacuoles, followed by the lysis of epithelial cells & midgut perforation.

32. TOMATO

Biological Name

Solanum lycopersicum L.

Common Name

Tamaatar, Love apple, Cherry tomato, Solanaceous vegetable.

Biological Source

Tomato plant (*Lycopersicum esculentum/solanum lycopersicum*) is a elongated fruit/pear shaped red, scarlet or yellow edible herbaceous plant

Family

Solanaceae (Nightshade family)

Chemical Constituents

Minerals, vitamin B1(Thiamine), amino acids (leucine, threonine, valine, histidine, lysine), fatty acids (linoleic and linolenic acids), carotenoids (lycopene and Beta-Carotenoids), Beta-sitosterol, 2-undecanone (IBI 246).

MOA

Tomato is rich in an active ingredient known as Thiamine (vitamin B1) which act as an effective

mosquito repellent because as it is secreted from the skin of host, it masks up the human odors (sweat) due to which mosquito is unable to locate the target. 2-undecanone (methyl nonyl ketone) also known as IBI 246 present in stems of tomato which is a lipid compound drives away the mosquito by upsetting (blocking) their detection of carbon-dioxide emitted from host.

33. SOUR ORANGE

Biological Name

Citrus aurantium L.

Common Name

Bitter orange, Seville orange

Biological Source

The oil of sour orange is an essential oil which is obtained by pressing the peel of species *Citrus aurantium* L.

Family

Rutaceae

Chemical Constituent

Limonene

MOA

The oil of sour orange consists of active ingredient limonene having a citrusy aroma. The limonene has an action on mosquito respiratory system On contact it disrupts the wax layer of respiratory systems which tends the pesky mosquito to suffocate and acts as deterrent.

34. ROSEMARY

Biological Name

Rosmarinus officinalis L.

Common Name

Salvia rosmarinus, Gulmehendi

Biological Source

The essential oil of rosemary is obtained from steam distillation of flower of species *Rosmarinus officinalis*.

Family

Lamiaceae

Chemical Constituents

Verbenone, borneol, camphor, bornyl acetate, Alpha-terpineol, teroinen-4-ol, carnosic acid, carnosol, rosamarinic acid, limonene, eucalyptus, linalool.

MOA

Rosemary oil has an camphorous like powerful pungent odor which drives away the mosquitos. It

consists of various volatile essential oils like limonene, camphor, eucalyptol, borneol, linalool which acts as effective mosquito repellent.

Method

Add 10-15 drops of rosemary essential oil to 1 teaspoon with carrier oil (marigold, lavender oil). Pour the mixture in spray glass container and apply.

35. SAGE(SALVIA)

Biological Name

Salvia officinalis

Common Name

Culinary sage, Garden sage

Biological Source

The oil of sage is an essential oil which is obtained from steam distillation of leaf, flower and aerial parts of species salvia officinalis

Family

Lamiaceae

Chemical Constituents

Limonene, linalool, myrcene, Alpha-pinene, camphor, 1-8-cineole, camphene, Alpha-thujone, geraniol, 3-carene, Alpha-bisabolol, Beta-caryophyllene.

MOA

- The volatile component limonene, linalool, camphor, geraniol in the oil of sage makes it a mosquito repellent herb. The oil consists of sturdy (robust) and piquant (spicy) odor which is offensive to mosquitos. This smell masks up the environmental signal (indication) like Carbon Dioxide, body temperature, sweat, alcohol, etc. due to which mosquitos get confused to locate the target and stays away. The oil having limonene has an effect on respiratory system of mosquitos and tends them to suffocate.
- Geraniol effectively makes the mosquito "NOSE BLIND" (loss of ability to detect odor).

36. CORIANDER

Biological Name

Coriandrum sativum L.

Common Name

Cilantro or chinese parsley dhania (INDIA)

Biological Source

The essential oil of coriander is extracted by steam distillation of fruit and seed of species coriandrum sativum L.

Family

Apiaceae

Chemical Constituents

Geraniol, Geranyl acetate, Linalool, 3-dodecenal, 2-decenal.

MOA

The coriander oil consists of an active ingredient linalool that has a fresh, sweet and slight citrusy like odor which is offensive to mosquito so they stay away. The oil also consists of Geraniol which is an active mosquito repellent that binds on the General Odorant Binding Protein [GOPBs] receptor present on mosquito olfactory sensor and makes them NOSE BLIND and so are unable to detect the environmental cues.

37. LIME

Biological Name

Citrus aurantifolia L.

Common Name

Key lime, Neemboo

Biological Source

The lime oil is an essential oil obtained by steam distillation or by pressed method of peel of species citrus aurantifolia L.

Family

Rutaceae

Chemical Constituents

D-limonene, Alpha-terpineol, D-dihydrocarvone.

MOA

The lime essential oil consists of active ingredient D-limonene which is a powerful natural mosquito deterrent. The wax layer of respiratory system of mosquito on contact with D-limonene gets destroyed due to which the mosquito tends to strangle (suffocate).

38. HYSSOP

Biological Name

Hyssopus officinalis L.

Common Name

Hiope, Hisopo, Herbe de Joseph, Jufa

Biological Source

The oil of herbaceous Hyssop plant is extracted by steam distillation of leaves and flower of species Hyssopus officinalis.

Family

Lamiaceae

Chemical Constituents



1,8-cineole, Beta-pinene, camphor, linalool, sabinene, pinocamphene, pinocarvone, cis and trans-pinocamphones, isopinocamphone.

MOA

- The essential oil of Hyssop consists of an active ingredient camphor, Beta-pinene and linalool which act as an effective mosquito repellent.
- The leaves of Hyssop emit a pungent, camphorous scent that keeps mosquito away.
- The lively substance that is 1,8-cineole, linalool lessens the capacity of mosquito to locate the host through interrupting its carbon-dioxide and temperature sensors. Due to which mosquito gets harassed to recognize the environmental cues and pressure them to go away.

39. PEPPERMINT

Biological Name

Mentha piperita L.

Common Name

Pudina

Biological Source

The essential oil of peppermint is obtained by steam distillation of the aerial parts of species Mentha piperita

Family

Lamiaceae

Chemical Constituents

P-menthone, isomenthol, isomenthyl, menthyl acetates

MOA

peppermint oil is composed of menthol and P-menthone which gives the oil a mark of fresh and sharp, Minty smell but for mosquito it's a horrible odor.

The smell interrupts with the mosquitoes' olfactory sensory lobe due to which they get confused to recognize the host cues and force them to leave recuperate their senses.

40. VERBENA

Biological Name

Lippia triphylla

Common Name

Lemon verbena, aloysia citrodora, lemon bee brush.

Biological Source

The oil of verbena is an essential oil obtained by steam distillation of leaves of species Lippia triphylla

Family

Verbenaceae

Chemical Constituents

Geraniol, Limonene, Geranial, Neral

MOA

- The steam distillation of verbena plant leads to an essential oil which contains active ingredient geraniol and limonene which are effective plant based mosquito repellent.
- Geraniol gives action by simply binding to General Odorant Protein Binding [GOPBs] receptor of mosquito present on olfactory organ due to which they become nose blind and are unable to detect the signals like Carbon-Dioxide, Body Temperature, odor(sweat) of host and stays away from host as long as they recover their sensory organs.
- Limonene has an action on mosquito respiratory system and tends them to suffocate

Herb Essential Oil	Biological Name	Family	Part Of Herb	Extraction Method	Major Chemical Components	Ref No.
Star anise	Illicium verum Hook.f.	schisandraceae	seed	Steam	Star anise	
Marigold	Tagetes	Asteraceae	Flower	Steam distillation	Limonene, tagetone, dihydrotagetone	
Pine	Pinus sylvestris L.	pinaceae	Twig,	Steam distillation	3-carene,Alpha and Beta-pinene, Alpha-cadinol, camphene	

Juniper	Juniperus communis L.	cupressaceae	Fruit	Steam distillation	Alpha-pinene, myrcene, sabinene, germacrene D
Pepper	Piper nigrum L.	piperaceae	piperaceae	Steam distillation	Limonene, Beta-pinene
Olive	Olea europaea L.	oleaceae	Fruit	Pressed	Oleic, palmitic, linoleic, stearic acids
Parsley (curl leaf)	Petroselinum crispum (Mill).Fuss	Apiaceae	Leaf, Stem, Seed	Steam distillation	Alpha and Beta-pinene, myrcene
Tarragon	Artemisia dracunculus L.	Asteraceae	Leaf, Flower	Steam distillation	Sabinene, elemicine, methyl eugenol
Patchouli	Pogostemon cablin (Blanco) Benth.	Lamiaceae	Dry FermentLeaf	Steam distillation	(-)-patchoulol, Alpha-guaiene, Beta-caryophyllene, pogostrol, selinene, Beta-bulnesene
Ylang-Ylang	Cananga odorata	Annonaceae	Flower	Steam distillation	Linalool, benzyl acetate, benzyl benzoate
Coconut	Cocos nucifera	Arecaceae	Kernal, Coconutpalm	Pressed	Fatty acids –Capric acid, stearic acid, linoleic acid, palmitic acid, oleic acid
Angelica	Angelica archangelica L.	Apiaceae	Root	Steam distillation	Alpha and Beta-pinene, carvacrol, 3-carene, limonene
Marjoram	Origanum majorana L.	Lamiaceae	Leaf, Flower	Steam distillation	Linalool, terpinen-4-ol, p-cymene, terpinene
Tea Tree (melaleuca)	Melaleuca alternifolia Cheel	Myrtaceae	Leaf	Steam distillation	Terpinen-4-ol, Gamma-terpinene, Alpha-terpinene, 1,8-cineole
May chang	Litsea cubeba	Lauraceae	Fruit	Steam distillation	R-limonene, geranial, citronellal
Sandalwood	Santalum L.spp	Santalaceae	Heartwood	Steam distillation	Alpha-santol, trans-alpha-bergamotene, trans-alpha-bergamotol
Spearmint	Mentha spicata L.	Lamiaceae	Flower	Steam distillation	Carvone, limonene
Eucalyptus	Eucalyptus L.spp	Myrtaceae	Leaf	Steam distillation	,8-cineole, p-menthane-3,8-diol, Alpha-pinene,

					citronellol, Alpha-terpineol	
Cypress	Cupressus sempervirens L.	Cupressaceae	Needle, Twig	Steam distillation	Sabinene, Alpha-pinene, terpinen-4-ol, limonene	
Castor	Ricinus communis L.	Euphorbiaceae	Seed	Pressed	Ricinolic, linoleic, oleic acids	

EXTRACTION METHOD OF ESSENTIAL OIL FROM HERBS HAVING MOSQUITO REPELLENT ACTIVITY.

and isolation of temperature reactive (sensitive) materials like naturally occurring aromatic compounds.

1. Fire
 2. Water
 3. Fire Source
 4. Steam
 5. Aromatic Plants
 6. Steam fixed with essential oil
 7. Condenser
 8. Hot Water
 9. Cold Water
 10. Water mixed with essential oil
 11. Hydrolate (aromatic water)
 12. Separator
 13. Essential oil
- The steam required for distillation of essential oil is generated (produced) from boiling water.
 - The steam is then passed through the aromatic plant biomass, the steam disrupts (breaks up) the plant biomass micro particles.
 - Ultimately cause separation of the volatile and non-volatile organic plant compounds, and both rise up with the steam.
 - The assembly consist of a condenser which cools down the steam (vapours) which is converted (transform) back to water.

A. STEAM DISTILLATION METHOD

Essential oils are obtained by 'Steam distillation' which is an separation process which cause purification

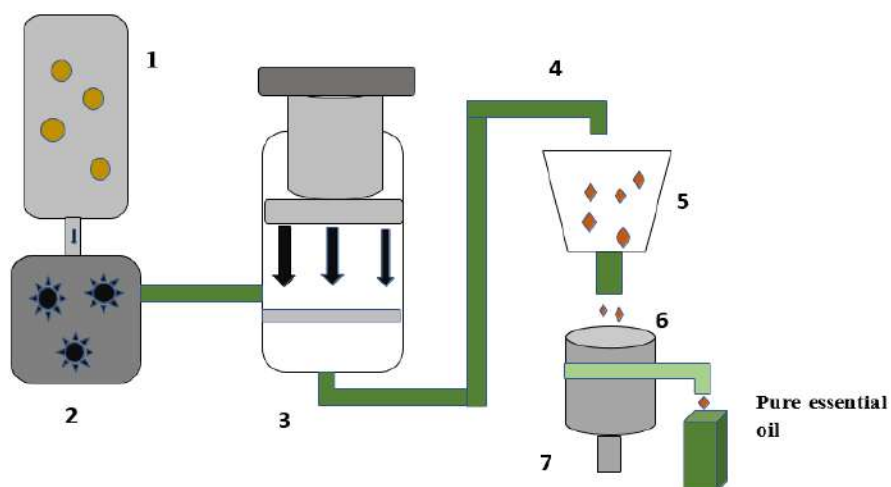
- The volatile based compounds (essential oils) rise up to the top of separator and are extracted (isolated) that are useful as mosquito repellent.
- The remaining part contains non-volatile plant compound also known as Herbal distillates (Floral water, Essential water) also called 'Hydrosols'.
- The extracted essential oils are analyzed and tested for purity and sold on the market.

Note:

Not all essential oils are steam distilled. Some essential oils when obtained by steam distilled have compounds that may be denatured or degraded and lose some of their aroma and other beneficial properties i.e. impact negative effect on the essential oil composition. These types of oil are extracted by distillation method which do not involve heat known as "cold-pressed" method also known as Scarification Method. Mainly used for extraction of essential oils from citrus, lemon, oilseeds like sunflower, coconut or sesame.

B. COLD -PRESSED METHOD

1. Dried plant material / oil Seeds
2. Cutter
3. Presser (Inner Gas Chamber)
4. Raw oil
5. Filter Sheets
6. Pure Essential Oil
7. Leftover Residue



- Cold Pressing method involves grinding of various seeds, flowers and other parts of plants or herbs.
- The material to be extracted is placed in a container and descends down the conveyor.
- The essential oil sacs of seed or plant are ruptured (pierced) by expeller(cutter).
- Further the material is pressed with a hydraulic platform by using high pressure.
- The raw oil formed is passed through filter sheets to filter solids from the liquids.
- The filtrate (emulsion) is treated in a centrifuge where essential oil is lighter so remains separated from other residue.
- Simultaneously, Pure essential oil of respective material is obtained.

CONCLUSION

The locating of this study display that extract and essential oils of certain plants have strong repellent activity against the mosquitoes. In last two decades, researchers looking for the innovative mosquito repellent and while certain herbs show mosquito repellent activity, Natural herbal formulations have been developed. Entomologist and individual running in the field of mosquito-borne disease Should refer this review to learn more about the convenient and possible role of herbal mosquito repellent in disorder control.

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