Plant materials have been used for generations in traditional practice as a personal protection measure against host-seeking mosquitoes. Our ancestors depended entirely on the use of plants to kill and repel insects and agricultural and medical arthropods. In the modern words, many societies still use plants for a wide range of medicinal and entomological uses, yet very little research has been put into finding out which of these plants are effective. Plants have also been used for centuries in the form of crude fumigants where plants were burnt to drive away nuisance mosquitoes and later as oil formulations applied to the skin or clothes which was first recorded in writings by ancient Greek in 484BC- 425BC (Herodotus, 1996; Charlwood, 2003). The use of plants against biting insects was first recorded among the ancient Greeks and plants are still use for this purpose by enormous number of people today, also Roman and Indian scholars (Johnson, 1998). Bacot and Talbot (1919) used first time case bioassay experiment for evaluation of mosquito repellent using *Ae. aegypti* mosquitoes. They used human volunteers treating the forearm from wrist to elbow with 1 gm of the experimental material. This method is even today the most commonly practiced test procedure worldwide and *Ae. aegypti* a day biter mosquito is still the most commonly used species.

There are various methods for management of vector control such as repellents, attractants, insecticides, insect growth regulators, biological environmental, genetics control etc. since every methods has own merits and demerits. Therefore it is necessary to develop ecofriendly methods for the control of mosquito borne diseases. Plant-based repellents are still extensively used in this traditional way throughout rural communities in the tropics because for many of the poorest communities the only means of protection
from mosquito bites that are available (Moore, 2006) and indeed for some of these communities (Moore et al., 2007; Debboun et al., 2007) as in the Europe and North America (Trumble, 2002) “natural” smelling repellents are preferred because plants are perceived as a safe and trusted means of mosquito bite prevention. 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 and trusted means of mosquito bite prevention (Isman, 1995).

The discovery of plant-based repellents is heavily reliant on ethno-botany. A plant extract called photochemical extracted from either whole plants or specific part of the plant to be used in the integrated pest management programs against both agricultural pests and medically important insects. Investigators have found that the effectiveness of chemicals derived from specific plant parts often varies with the mosquito species. Wilcoxon et al. (1940) examined the extracts derived from the male fern, Aspidium filixmas contains a toxic constituent, filicin, a phloroglucinol propyl ketone, which proved toxic to Cx. quinquefasciatus mosquitoes. Hartzell and Wilcoxon (1941) observed 150 species of plant extracts are toxic to mosquitoes and found several to be very effective.

Citronella was originally extracted for use in perfumery and it was used by the Indian Army to repel mosquitoes at the beginning of the 20th century (Covell, 1943) and was then registered for commercial use in the USA in 1948. Citronella name derives from
the French Citronelle around 1858. Today, citronella is one of the most widely used natural repellents on the market, used at concentrations of 5-10%.

Jacobson (1958) studied on several phytochemicals against mosquitoes. However, Thyme oil at 100% is repellent against *Ae. aegypti, Ae. quadrimaculatus, An. albimanus* at least 30 minutes, when applied to cloth (USDA, 1967).

In the previous study Thorsell *et al.* (1970) reported that extracts *Ledum palustre*, *Lycopersicon lycopersicon*, and *Myrica gale* exhibited effective repellent against *Ae. aegypti* mosquitoes. Li *et al.* (1974) use *p*-menthane-3, 8-diol (PMD) extract of the lemon eucalyptus *Eucalyptus cetridera* (Chinese name Quwenling) and *p*-menthane-3, 8-diol and observed only one hour protection against *Ae. aegypti* mosquitoes.

Chogo and Crank (1981) observed many essential oils like leaf oil of *Ocimum suave* showed repellent effects against mosquitoes and other blood feeders. Jacobson (1982) has classified the effect of plant materials on insects in 6 groups such as, Attractive to insects, Repellent to insects, Kill to insects, Inhibiting or abnormally accelerating insect growth or development, Sterilize insects, Antifeedants. Using plant derived chemicals that offer not only effective mosquito control agents, but also are alternatives to organic synthetic pesticides or chemicals due to high degree of degradation. Today essential oils represent a market estimated at 700 million dollars and a total world production of 45000 tons. About 90% of this amount is concentrates on fifteen products, particularly mints (*Mentha piperita, M. arvensis*, and *M. spicata*), citrus
(orange, lemon and lime) and some other important species such as *E. globulus, Litsea cubeba (Lauraceae)*, clove and cedar.

Hwang *et al.* (1985) showed camphor, linalool, terpenen-4-ol, $\alpha$ and $\beta$-thujone, $\beta$-pinene, myrcene, limonene and cineol components in *Artemisia vulgaris* are effective repellent against *Ae. aegypti*. Curtis (1987) observed citronella, which contains citronellal, citronellol, geraniol, citral and limonene is an effective dose as N, N-diethyl-m-toluamide (DEET).

Sukumar *et al.* (1991) discussed some phytochemicals act as general toxicants to all life stages of the mosquitoes, whereas others interfere with growth and reproduction, or act on the olfactory or repellency. Hebbalkar *et al.* (1992) studied on dried leaves extracts of *Vitex negundo* that contains terpinines, terpeneol, and sesquiterpene alcohols protect up to 3 hours against *Ae. aegypti* in cage bioassay and also showed that extracted flower of *L. camara* provided more than 50% repellency up to 4 hours against *Aedes* mosquitoes. Watanabe *et al.* (1993) isolated a new compound eucamol, and 4 isopropylbenzyl alcohols from *E. camaldulensis* showed active repellency up to 3 hours against *Ae. aegypti*.

Dua *et al.* (1995) used 2gm/cm² neem cream against mosquitoes and observed 78%, 89% and 94.4% protection against *Aedes, Culex* and *Anopheles* mosquitoes respectively. Dua *et al.* (1996) work carried out on repellency of *Lantana camara* (Verbenaceae) flowers against Aedes mosquitoes. The repellent effect of *L. camara*
flowers was evaluated against Aedes mosquitoes. Lantana flower extract in coconut oil provided 94.5% protection from *Ae. albopictus* and *Ae. aegypti*. The mean protection time was 1.9 hr. One application of *L. camara* flower can provide more than 50% protection up to 4 hr against the possible bites of Aedes mosquitoes. Lindsay *et al.* (1996) determined the chemical constituents present in citronellal such as citronellol, geraniol, citral and limonene showed effective repellency as compared to N, N-diethyl-m-toluamide (DEET). Lukwa *et al.* (1996) said that, *Lippia javanica* and *O. canum* ethanolic extracts repelled mosquitoes for 5 hours.

In cage experiment, Tyagi *et al.* (1997) observed *Tagetes minuta* showed 86.4% repellency against *An. stephensi*, 84.2% against *Cx. Quinquefasciatus*, and 75% against *Ae. aegypti* up to 6 hours. Oungpipat *et al.* (1997) reported that the methanol extract of ginger, pai and clove at 50% concentration provided 150 to 210 minutes protection against *Ae. aegypti*.

Jantan and Zaki, (1998) evaluated four essential oils such as *Litsea elliptica*, *Cinnamomum mollissimum*, *Cymbopogon nardus*, and *Pogostemom cablin* for their repellency effect against *Ae. aegypti*.

Barnard (1999) reported that clove and thyme at different concentration i.e. 5-100% against two mosquito species *Ae. aegypti* and *An. albimanus* showed 1.5 to 3.5 hours of protection. Barnard also tested several concentrations of *M. piprita* essential oils against *Ae. aegypti* and observed that 100% concentration provide 45 minutes and 25%
provide only 30 minutes protection. Jantan et al. (1999) studied on different medicinal plant coil against *Ae. aegypti*. Among the 19 tested Malaysian plants, only *C. nardus*, *A. indica*, *Fernandao adenophylla*, *Aloe vera* and *Eurycoma longifolia* showed interesting knockdown values.

Ansari et al. (2000) observed that, the peppermint oil (*M. piperita*, L.) showed strong repellent action against *An. annularis*, *An. culicifacies* and *Cx. quinquefasciatus* adult mosquitoes when applied on human skin. Tawatsin et al. (2001) investigated that the repellency of some volatile oils such as *Curcuma longa*, *Citrus hystrix*, *Cymbopogon winterianus* and *O. americanum* with 5% vanillin up to eight hours against *Ae. aegypti*, *An. dirus* and *Cx. Quinquefasciatus*. Venkatachalam et al. (2001) studied on repellent activity of *Ferronia elephantum* Corr. (Rutaceae) leaf extract against *Ae. aegypti*. The repellent activity of *F. elephantum* at 1.0 and 2.5mg/cm² concentrations gave 100% protection up to 2hr and 4hr, respectively.

An experiment was performed comparing a clove, soy oil, Andiroba oil. Clove gives 104 minutes, Andiroba oil gives 213 minutes, and soybean oil gives 77 minutes repellency against *Ae. aegypti* (Oyedele et al., 2002).

According to Mittal and Subbarao (2003) the extract of leaves from *Ferronia elephantum* (Rutaceae) on *Ae. aegypti*, and the flower of *Lantana camara* (Verbenaceae) with coconut oil showed repellent effect against *Ae. aegypti* and *Ae. albopictus*. 

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In cage bioassay Choochote et al. (2004) observed that hexane extracted *Apium graveolens* L., provided 3 hours protection against *Ae. aegypti*. According to Miot et al. (2004) Andiroba oil (*Carapa guianensis*) showed 50% repellency against *Ae. aegypti*. Thomas et al. (2004) studied on evaluation of repellent properties of volatile extracts from the Australian native plant *Kunzea ambigua* against *Ae. aegypti*.

Cantrell et al. (2005) made an attempt to identify the isolated compound from *Callicarpa japonica* is spathulenol and from *C. Americana* the isolated compounds alpha-humulene, humulene epoxide II, and intermedeol showed significant repellent activity against *Ae. aegypti* and *An. stephensi*. Prajapati et al. (2005) noticed that, the essential oil of *Cinnamomum zeylanicum* highest repellent (RD₉₅) values of 49.6, 53.9 and 44.2 mg/mat against *An. stephensi*, *Ae. aegypti* and *Cx. quinquefasciatus*. The mosquito repellent activity of 38 essential oils from plants at three concentrations was screened against the mosquito *Ae. aegypti* under laboratory conditions using human subjects (Trongtokit et al., 2005). They observed *C. nardus*, *Pogostemon cablin*, *Syzygium aromaticum* and *Zanthoxylum limonella* essential oils at 10% to 50% concentration provide complete protection up to 2 hours. Choochote et al. (2005) studied on hexane extracted *Curcuma aromatica* at 25% concentration gives complete protection for one hour against *Ae. aegypti*. Another study attempted on repellent properties of celery, *Apium graveolens* L., formulations (10-25% with and without vanillin) provided 2-5 hour’s protection against female *Ae. aegypti* (Tuetun et al., 2005).
Adewoyin et al. (2006) reported that the repellent activity of *Piper guineense* (35%) and *Xylopia aethiopica* (30%) fruits oils in liquid paraffin showed complete protection for 2 hours against *Ae. aegypti*. According to Tawatsin et al. (2006) *O. canum* essential oils at 25% concentration showed repellency up to 4 to 8 hours against *Ae. aegypti, Ae. albopictus, An. dirus* and *Cx. quinquefasciatus*. Amer and Mehlhorn (2006) investigated the repellent effect of forty one essential oils against *Aedes, Anopheles*, and *Culex* mosquitoes. In the laboratory condition, 20% *E. citriodora* oil gave protection up to 150 minutes, 480 minutes and 480 minutes against *Ae. aegypti, An. stephensi* and *Cx. quinquefasciatus*, respectively. The cream based *Cinnamomum cassia* at 5% concentration showed more than 80% repellent up to 50 minutes against *Ae. aegypti* female mosquitoes (Chang et al., 2006). In the laboratory tests, ethyl acetate extracts of *Hyptis suaveolens* Poit, *Hyptis harmaja* L, *Rhododendron tomentosum* (Stokes) and *Myrica gale* L, and in the field experiment they found leaves extracts from *Rhododendron tomentosum, Myrica gale* and *Achillea millefolium* significant repellent activity against *Ae. aegypti* mosquitoes (Jaenson et al., 2006). Tunon et al. (2006) investigated a toluene extract of southernwood (*A. abrotanum*) and the essential oil from the flowers of carnation (*Dianthus caryophyllum*) exerted pronounced a repellent effect both against ticks (nymphs of *Ixodes ricinus*) and yellow fever mosquitoes *Ae. aegypti*.

Choochote et al. (2007) observed that *Zanthoxylum piperitum, Anethum graveolens* and *Kaempferia galanga*, exerted protection against *Ae. aegypti*, with median complete protection times of 1, 0.5 and 0.25 h, respectively and the highest potential was
established from *Z. piperitum* oil + 10% vanillin provided complete protection up to 2.5 hours against *Ae. aegypti*. The plant essential oil combined with vanillin showed strong repellency against mosquitoes. Essential oil *Z. piperitum* with 5% vanillin provided complete protection up to 2.5 hours female *Ae. aegypti* mosquitoes (Kamsuk *et al.*, 2007).

Eucalyptus, citronella and clove oils essential oils showed effective repellent activity against *Culex* and *Aedes* (Tjahjani, 2008). Norashiqin *et al.*, (2008) investigated that the repellent of *P. aduncum* Linn (Family: Piperaceae) essential oil at 0.4gm/cm² provided 70% repellency up to 8 hours against *Ae. aegypti* under laboratory condition. Noosidum *et al.*, (2008) studied on the repellent properties of essential oils from *Melaleuca leucadendron*, *Litsea cubeba* and *L. salicifolia* studied against *Ae. aegypti* mosquitoes. Polsomboon *et al.* (2008) observed a high escape response was seen at 2.5% catnip oil from the contact chamber against *Ae. aegypti*. Unfortunately essential oils have short period of efficacy compared to synthetic repellent, because essential oils are volatile or quickly absorbed and lost from the skin surface. However, efficacy of catnip essential oils against *Aedes* species gives up to 4 hour as compared with 6 hour for DEET (Baker *et al.*, 2008). Gillij *et al.* (2008) studied on repellent effect of some essential oils from Argentina i.e. *Acantholippia seriphioides*, *Achyrocline satureioides*, *Aloysia citriodora*, *Anemia tomentosa*, *Baccharis spartioides*, *Chenopodium ambrosioides*, *Eucalyptus saligna*, *Hyptis mutabilis*, *Minthostachys mollis*, *Rosmarinus officinalis*, *Tagetes minuta* and *T. pusilla* against *Ae. aegypti* mosquitoes. They observed that at concentrations of 12.5% *B. spartioides*, *R. officinalis* and *A. citriodora* showed the longest repellency times.
Gu et al. (2009) work carried out on Cryptomeria japonica (Pinaceae) essential oils against Ae. aegypti and Ae. albopictus. They observed C. japonica gave 55% and 63% repellency against Ae. aegypti and Ae. albopictus respectively. Samidurai et al. (2009) investigated that the crude leaf extracts of Pemphis acidula for skin repellent test at 1.0, 2.5 and 5.0 mg/cm² concentration gave complete protection up to 2.45, 4.30 and 7.0 hours respectively against Ae. aegypti mosquitoes. Paluch et al. (2009) observed that botanical sesquiterpenes isolated from two plants, amyris (Amyris balsamifera) and Siam-wood (Fokienia hodginsii) gave effective repellent against Ae. aegypti.

Rajkumar and Jebanesan (2010) reported on Clausena dentate essential oil at 2.5% showed 180 minutes and at 10% showed 255 minutes complete protection against Ae. aegypti. A new tool, technologies, knowledge of mosquito behaviour provided information about activity of insect repellent (Paluch et al., 2010). Specos et al. (2010) work carried out on microencapsulated citronella oil for mosquito repellent finishing of cotton textiles. The hand and arm covered with Citronella treated textiles was exposed against Ae. aegypti gives more than 90% repellency for three weeks.

Kumar et al. (2011) observed that pure M. piperita essential oil showed 100% protection till 150 minutes against Ae. aegypti. Phasomkusolsil et al. (2011a) investigated that at 0.21 mg/cm² C. citrates provided complete protection up to 72 minutes for Ae. aegypti, 132 min for An. dirus and 84 min for Cx. quinquefasciatus. The combination of citronella oil and vanillin provided complete repellency at least 3 hours against Aedes sp also observed by Kongkaew et al. (2011). Sritabutra et al. (2011) reported on the
repellent activity of herbal essential oils from *Allium sativum, Syzygium aromaticum, C. citratus, C. nardus, M. piperita, E. globulus, C. sinensis* and *O. basilicum* and their combinations against *Ae. aegypti* and *An. dirus* under laboratory conditions. The use of volatile plant oils for protection for biting and prevention of spreading deadly diseases controlled by interfering with their chemical communication system (Miot *et al.*, 2011). Swathi *et al.* (2011) studied on repellent activities of ethanolic extract of *Pongamia Pinnata* leaves against mosquitoes. The ethanol extract of *P. pinnata* at 1% concentration provided complete protection up to 99, 141, 144 minutes against *Ae. aegypti, An. stephensi* and *Cx. quinquefasciatus* respectively. Essential oil of *Zingiber officinalis* and *Achyranthes aspera* 0.5mg/cm² gave 5 hours protection against *Ae. aegypti* and *Cx. quinquefasciatus* (Khandagle *et al.*, 2011). Repellency of essential oils extracted from *Acantholippia salsoloides, Aloysia catamarcensis, A. polystachya, Lippia integrifolia, L. junelliana* (Verbenacea), *Baccharis salicifolia, Euphoratorium buniifolium* and *Tagetes filifolia* (Asteraceae) against *Ae. aegypti* were studied by Gleiser *et al.* (2011). They investigate *L. junelliana* was the most effective repellent against *Ae. aegypti*. Dube *et al.* (2011) observed that the smoke of dried leaves gave more repellent than fresh leaves such as *Corymbia citriodora* (52% to 76%), *Ocimum suave* (58% to 68%), *Olea europaea* (23% to 40%) and *Ostostegia integrifolia* (29% to 56%) against *Ae. aegypti*.

The blend of lemongrass oil, xanthoxylum oil and vanillin plant essential oil provided complete protection up to 270 minutes against *Ae. aegypti* (Diptera: Culicidae) reported by Kim *et al.* (2012). They also observed that the combination of citronella
oil and vanillin provided complete repellency at least 3 hours against *Aedes* sp. The study was carried out to evaluate the efficacies of the crude extracts and of the essential oils from three plants which are used as mosquito repellents (Kazembe and Chaibva, 2012). The crude extracts were obtained from the leaves of *Jatropha curcas*, *O. americanum* and *C. limon* gives 100% repellency for 1 to 1.5 hrs against *Ae. aegypti*. Kazembe and Nkomo (2012) investigated that the oils of *Blumea alata, Bidens pilosa and Chenopodium ambrosioides* extracts were effective mosquito repellents against *Ae. aegypti*. The crude extracts of *Ageratum houstonianum* leaves in combination with coconut oil showed repellent activity against adult *An. stephensi, Ae. aegypti* and *Cx. quinquefasciatus* (Tennyson, 2012). Vongsombath *et al.* (2012) observed that essential oils of *Hyptis suaveolens* (Lamiaceae), *Croton roxburghii* (Euphorbiaceae) and *Litsea cubeba* (Lauraceae) at concentrations of 1.7 g/cm², 3.3 g/cm², and 6.3 g/cm² provided significant repellency over control against *Armigeres, Culex*, and *Aedes*.

Phasomkusolsil *et al.* (2013) studied on repellent activity of lemon grass (*C. citrates*) and citronella grass (*C. nardus*) oils against *Ae. aegypti* and *An. dirus*. Dhanasekaran *et al.* (2013) discussed on repellent activity of medicinal plants such as *Celosia argentea, Anthocephalus cadamba, Gnetum ula, Solena amplexicaulis* and *Spermacoce hispida* against the medically important mosquito vectors *An. stephensi, Ae. aegypti* and *Cx. tritaeniorhynchus*. Tabanca *et al.* (2013) observed that *Monarda bradburiana* and *Monarda fistulosa* essential oils showed good repellent activity with minimum effective dosages (MED) of 0.055 ± 0.036 and 0.078 ± 0.027 mg/cm², respectively as compared to DEET (0.039 ± 0.014 mg/cm²). Demirci *et al.* (2013) determined the
minimum effective dosage (MED) for repellency for the *Phoenix dactylifera* (date palm oil) was 0.051mg/cm\(^2\), which had moderately lower potency compared to DEET (0.018mg/cm\(^2\)) in the "cloth patch assay" against *Ae. aegypti* mosquitoes. Hsu *et al.* (2013) reported the mixture of citral, myrcene, and citronellal (6:4:1 v/v) showed effective repellent effect as compared to DEET against *Ae. aegypti*.

Phukerd and Soonwera (2014) investigated that at 10% concentration, *Zingiber zerumbet*, *Litsea petiolata Curcuma zedoaria* and *Zingiber cassumunar* essential oils showed more the 100% repellency up to 2 hours against *Ae. aegypti* and *Cx. quinquefasciatus*.

Behavioural and electrophysiological response of plant volatile compounds against blood sucking insects is useful for identification and development of effective repellent (Davis and Bowen, 1994). An olfactometer was used to evaluate the efficacy of selected commercial insect repellent products against *Ae. aegypti*. This is a simple, reproducible method to evaluate the efficacy of insect repellents and is recommended for preliminary screening of new insect repellents or formulations (Chou *et al.*, 1997). Another study using a Y-tube olfactometer showed that the thyme oil and clove oil repelled *Ae. aegypti* and *A. albimanus* (Barnard, 1999).

Kline *et al.* (2003) used triple cage a dual port olfactometer for spatial repellency responses linalool and dehydrolinalool against *Ae. aegypti*. They observed 33.6% repellency of Linalool and dehydrolinalool. Repellent activity of essential oils against
*Cx. pipens* studied by Erler *et al.* (2006) with the help of a glass Y-tube olfactometer. The result clearly indicates that the essential oils of Eucalyptus, Basil and Anis had the most repellent activity against *C. pipiens*. Kang *et al.* (2009) studied on repellent activity of 33 essential oils against *C. pipiens* with the help of T-tube olfactometer.

Insect use a wide range of chemical signals such as pheromones, plant volatile, animal odors etc. for detection of suitable host and Olfaction play important role in attraction and recognition of the host. In the sensilla of insects, specialized odorant binding proteins (OBPs) respond to volatile monotropenes for example, trichoid sensilla of the female silkworm, *Bombyx mori*, responded to linalool (Picimbon *et al*., 2005). The minute particles of volatile chemicals enter the antenna and other sensory organ via sensillum lymph surrounding the olfactory neuron dendrites. The odorant binding protein and chemosensory proteins including the general odorant binding protein (GOBPs) capture and transport the volatile molecules to the insect olfactory receptor (Xu *et al*., 2005; Syed *et al*., 2006). In *Ae. aegypti* 66 odorant binding proteins (OBPs) sequences analysis by Zhou *et al.* (2008). These advantages strongly warrant further investigations into the use of plant oils as repellents (Curtis *et al*., 1987).

Gas chromatography-electroantennogram detection (GC-EAD) is a valuable tool to rapidly screen components detectable by insect antennae with complex volatile blends (Arn *et al*., 1975). However, Electrophysiology has applied to identify essential oils chemicals that may carry the repellent activity (Du and Miller, 1999; Costantini *et al*., 2001; Qiu *et al*., 2004; Jhummur *et al*., 2007). In GC-EAD analyses of garlic oil,
antennae of female *Ae. aegypti* responded to 14 compounds were isolated or synthesized and tested for their ability to repel host-seeking female *Ae. aegypti* (Campbell *et al.*, 2010). Campbell also studied on forty-two compounds in eleven essential oils are effective for mosquito repelling against *Ae. aegypti*. They analyse several essential oils by GC-EAD on the antennae of the yellow fever mosquito, *Ae. aegypti* L. (Diptera: Culicidae). The essential oils of catnip, cinnamon, citronella, cumin, eucalyptus, geranium, ginger, melissa, peppermint, rosemary, and thyme, 42 components induced antennal responses, most commonly β-caryophyllene, linalool, 1,8-cineole, geraniol, and geranial. GC-EAD screening of essential oils is a viable analytical technique to detect quantitatively minor constituents of essential oils. In another attempt, in *Ocimum forskolei* only two components i.e. linalool and methyl cinnamate elicited antennal responses in the antenna of *Ae. aegypti* female mosquito (Dekker *et al.*, 2011).

The high volatile property of essential oil showed low repellent activity as compared to synthetic repellents. According to Zhu *et al.* (2001) essential oils with low volatility may allow a longer repelling period. Therefore the use of gas chromatography and mass spectrometry (GC/MS) retention times of major chemicals may be a useful parameter for developing effective and long-term repellents against insects. The oils that were used in this study were analyzed using GC/MS to get the retention times and molecular weight of miner constituents of each oil.

In tropical developing countries a disease transmitted by *Ae. aegypti* is dengue and dengue haemorrhagic syndrome. The best method for vector control is uses of plant
substances because it is safe, pleasant to use and environmentally sustainable. The essential has low repellency with respect to chemical repellent. The most important consideration is improving the protection period of plants oil as repellents. Several studies looked at improving formulations of plant oils to increase their longitivity through development of nanoemulsions (Sakulku et al., 2009; Nuchuchua et al., 2009). Many researchers used fixatives for fixation of essential oil in skin and for reducing volatile property of oils for effective results. The use of insect repellents provides a practical and economical means of preventing mosquito borne disease. The plant essential oils supply a wide promising field in many different ways industry, pharmacy, alternative medicine, integrated pest management, etc.

Plant based product are safe and alternative source for mosquito repellent as compared to synthetic repellent (Novak and Gerberg, 2005). The different strategies for investigation of repellent activity of essential oils against mosquitoes with the help of new techniques and technology are beneficial for the development and formulation for new insect repellent.