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Formulation of low smoke herbal mosquito repellent sticks by using different essential oils

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Abstract

Mosquitoes control and personal protection from mosquito's bites is one of the serious ways for preventing of contagious diseases proliferation. In recent years, interest in plant based products has been revived because of the development of resistance, cross-resistance and possible toxicity hazards associated with synthetic insecticides and their rising costs. Presently most of the mosquito repellents available in markets are based on chemical and they are toxic against the skin and nervous system like rashes, swelling, eye irritation, and other health problems. Most of the people still dislike the smoke of the synthetic pyrethroid containing mosquito coils. Hence herbal mosquito repellents were preferred than chemical based mosquito repellents. Essential oils belonging to various plant species and their mixtures have been seen to act as effective repellent against various mosquitoes and pests. The easy availability and less adverse environmental impact have led to the increased interest in plant origin repellants which are safe and biodegradable alternatives to synthetic chemical repellants for use against mosquitoes. Hence attempts have been made to find out the novel formulations containing fixatives with combination of different essential oils for mosquito repellent stick. The essential oils used mainly were "*Cymbopogon Citrullus*, *Azadirachta indica*, *Cymbopogon nardus*, *Eucalyptus globulus*, *Cymbopogon martini*, *Mentha piperita*, *Ocimum basilicum*, *Rosmarinus officinalis*, *Cinnamomum Zeylanicum*, *Syzygium aromaticum*". They were formulated individually and in different combinations with supportive ingredients such as filler, binder, burning agent, adhesives, smell enhancer etc. Results of analysis showed that formulations containing *Cymbopogon Citrullus*, *Azadirachta indica* and *Eucalyptus globulus* essential oils have the most promising activity exhibiting 80-95% repellency as compared to other repellent essential oils. The combinations containing *Azadirachta indica* showed prolonged burning and repellency both as compared to other formulations. In present investigation, the ingredients used in almost all of the formulations were herbal based and ecofriendly. Since, it has no side effect on inhalation. Same formulations were evaluated for texture, efficacy, and stability etc. The present study demonstrates the potential for using essential oils from medicinal plants in mosquito repellent formulations.

Keywords: low smoke herbal mosquito, different essential oils, mosquitoes control

Introduction

Mosquito borne diseases are major human health problem and controls of such serious diseases are becoming increasingly difficult because of the high rate of reproduction and development of resistance to insecticides in mosquitoes. Synthetic pesticides/repellants have been extensively used for mosquito control by either killing, preventing adult mosquitoes to bite human beings or by killing mosquito larvae at the breeding sites of the vectors. However its deleterious impact on non-target population and the development of resistance prompted for the search of alternative, simple and sustainable methods of mosquito control. The need for development of effective insecticides/repellents should be taken into consideration due to the toxicity problems, together with the increased incidence of insect resistance (Mirospicos *et al.* 2010). In most parts of the world, Synthetic chemical larvicides continue to be applied for controlling mosquitoes but many of these chemicals are toxic to human, animal and plant life and resistance can be problematic in regulating the control of the same. Therefore, researchers are currently exploiting natural substances to be used as insecticides for controlling larval mosquitoes or repellants for the same. According to a recent WHO pesticide evaluation, the main insecticides used against mosquitoes in the Americas are pyrethroids and organophosphates. Common chemical-based insect repellents used for mosquitoes are DEET (N, N diethyl- m-toluamide) which is a registered pesticide, but possible side effects and warnings include: skin and eye irritation, insomnia etc. Permethrin, resmethrin and sumithrin are also other synthetic pyrethroids commonly used in mosquito control programs to kill adult mosquitoes. Many plant extracts have been identified as having insect-repellent effects

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and there has been increasing research in the last decade proving plant based mosquito repellents are just as, if not more effective than DEET like Citronella Oil, Neem Oil etc.

Plant products are emerging as a potential source of mosquito control and among them essential oils have special interest due to their insecticidal or repellent properties. Essential oils are volatile, naturally occurring, complex compounds characterized by a strong odour and are formed by aromatic plants as secondary metabolites (Madhumathy *et al.* 2007) ^[1]. They are liquid, volatile, rarely coloured, lipid soluble and soluble in organic solvents with a density generally lower than that of water. There are 17,500 aromatic plant species among higher plants and approximately 3,000 essential oils are known out of which 300 are commercially important for pharmaceuticals, cosmetics and perfume industries apart from pesticide and repellent potential. In nature essential oils play an important role in the protection of the plants as antibacterial, antiviral, antifungal, insecticides and also against herbivores by reducing their appetite for such plants (Rahuman *et al.* 2007) ^[5]. They also may attract some insects to favour the dispersion of pollens and seeds or to repel the undesirable.

Owing to the attraction for natural products like essential oils, despite their wide use and being familiar to us as fragrances, it is important to develop a better understanding of their mode of biological action for new applications in human health, agriculture and the environment. Some of them constitute effective alternatives or complements to synthetic compounds of the chemical industry without showing the same secondary effects. Hence the present study aims to develop an ecofriendly mosquito repellent, a substitute for chemical repellent by using different essential oils and to produce the natural repellent which is more cost effective, cheap and keeps the environment pleasant and health friendly.

Material and Methods

The raw materials used for the production of the herbal mosquito repellent Stick were Saw dust, Bark powder, Camphor, Sea salt, Gum acacia, and essential oil like Tulsi, Lemon grass oil, Neem oil, Eucalyptus oil used in this preparation. Different ingredients were used in this formulation have different function. The saw dust will enhance the combustion process. Bark powder is a repellent of mosquitoes having good binding property. The fumigation of Camphor is a good has qualities of making soothing atmosphere of calm serenity. Lemon grass and Tulsi are the most generally used medicinal plants and it has excellent antiviral and insecticidal property. Neem has antiviral and mosquito repellent properties. The other oils that work as a repellent includes Eucalyptus oil, Cinnamon oil, Clove oil, Citronella oil, Palmarosa oil, Rosemary oil, Mentha arvensis, Mentha citrata, Cedarwood oil, Artemisia annua. Apart from these ingredients, Gum Acacia acts as an excellent binder.

Method of Preparation

Mosquito repellent stick have mainly two parts of the ingredients. Part one contains the base material like Saw dust, Sea salt, Acacia gum and Kapoor and part two contain active ingredients or mixture of essential oil. All the required ingredients were taken in a mortar except oil and water. Mixed them properly and added given amount of essential oil as per treatment detail and mixed it uniformly. Add water as per requirement for binding the stick. All mixed material was filled in the stick mould and kept for drying. After 30 min. took out the stick from the mould and kept it in oven at 50 °C

for 6 hrs. After drying, packed them properly to disallow the moisture entrapment and kept it for further studies

Result and discussion

The attempts have been made here to prepare stick product using saw dust, bark powder based fillers along with herbal oils and powders with supportive ingredients. In the present study, 13 herbal oils and one herbal powder were tested each at different concentrations on the mosquito sticks against mosquitoes in the chamber for bioefficacy. Among these, some oils exhibit significant knock down activity. Table 2 showed the primary observation of the formulations such as ash weight, burning time, loss on drying etc. The volume of smoke exhibited by the mosquito repellent sticks shown successful results and it explains that natural insecticidal preparations are always effective than synthetic repellents. The same formulations were also tested for mosquito repellency in mosquito affected area. During the burning of herbal mosquito stick, it was shown that up to 90% of the mosquito number was greatly reduced. The formulations contain lemongrass (*Cymbopogon spp.*) and neem oil emerged as best composition with good aroma oil like geranium and Palma Rosa. Treatment S₁, S₂ and S₄ was the potential formulation for further evaluation. Yap *et al.* (1990) ^[8], studied that neem oil is mosquito repellent for up to 12 hours. As per Makhaik *et al.* (2005) ^[2], Cymbopogon plants have been traditionally used to repel mosquitoes in jungle regions such as the Bolivian Amazon. Palanisami *et al.*, (2014) ^[4], observed that Lemongrass oil showed good mosquito repellent activity in performed tests as well as strong mosquitocidal agent. Tripathi *et al.* (2009) ^[7], studied that the plant has been widely recognized for its ethno botanical and medicinal usefulness. Plant essential oils in general have been recognized as an important natural source of pesticides – insecticides, larvicides, and repellents. Essential oils of many plants were observed to have mosquito repellent property and essential oils have received attention as potentially controlling vectors of mosquito borne disease (Trabouisi *et al.* 2002). Therefore, the use of plant essential oil for the effective control of mosquito is an alternative pest control method for minimizing the noxious effects of some pesticide compounds on the environment.

Conclusion

From the present study, it revealed that Lemongrass oil showed good mosquito repellent activity in performed tests. Hence, Lemongrass essential oil, alone or in combinations with those obtained from other mosquito repellent plant species, could be potentially used for the preparation of mosquito repellent products. These could be in form of spray, cream, liquidator, coil, candle and sticks, and could be prepared using suitable carries/solvents/diluents, to get better protection from mosquito bites. Such formulations could help in reducing the harmful effects of synthetic mosquito repellents on human health. Moreover, the formulation is safe, eco-friendly, cheap, easy to use and has maximum repellence against mosquitoes. In addition, these home-made herbal repellents are less harmful to our health than the coils available in the market. It can be prepared at home as it does not require any heavy infrastructure and investment as compared to coils and mats. It is evident from the present study that Lemongrass oil exhibit significant knock down activity with combination of other essential oil. Further simulated and actual field trials required for commercialization of these herbal mosquito repellent

Table 1: Formulation contain essential oil other than main ingredients.

Sample No.	Essential oil	Sample No.	Essential oil	Sample No.	Essential oil
S ₁	Lemon grass oil Eucalyptus oil Neem oil	S ₇	Eucalyptus oil <i>Mentha Citrata</i> oil	S ₁₃	Eucalyptus oil Tulsi powder Lemon grass oil
S ₂	Lemon grass oil Eucalyptus oil	S ₈	Cinnamon oil Rose merry oil	S ₁₄	Eucalyptus oil Artemisia oil Tulsi powder
S ₃	Lemon grass oil Cinnamon oil	S ₉	Eucalyptus oil Neem oil Clove oil	S ₁₅	Eucalyptus oil Neem oil Tulsi powder
S ₄	Lemon grass oil	S ₁₀	Geranium oil Eucalyptus oil Citronella oil	S ₁₆	Geranium oil Tulsi powder Neem oil
S ₅	Eucalyptus oil	S ₁₁	Citronella oil <i>Mentha arvensis</i> oil		
S ₆	Lemon grass oil Cedar wood oil Rose merry oil	S ₁₂	Geranium oil Tulsi powder Palmarosa oil		

Table 2: Primary observation of herbal mosquito repellent stick

Formulations	Burning Time (minutes)	Ash weight (gm)	Irritability	Odour	Smoke Visibility
S ₁	41	1.72	No	Good	Average
S ₂	37	1.76	No	Good	Low
S ₃	45	1.84	No	Good	Low
S ₄	40	1.56	No	Good	Low
S ₅	40	1.79	No	Good	Low
S ₆	61	1.49	No	Good	Average
S ₇	40	1.54	No	Satisfactory	Low
S ₈	55	1.82	No	Satisfactory	Low
S ₉	50	1.78	No	Smoky	High
S ₁₀	47	1.61	No	Good	Average
S ₁₁	40	1.60	No	Satisfactory	Low
S ₁₂	45	1.68	No	Satisfactory	High
S ₁₃	44	1.80	No	Good	Average
S ₁₄	40	1.60	No	Satisfactory	Average
S ₁₅	39	1.74	No	Smoky	High
S ₁₆	40	1.71	No	Smoky	Average

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