Plants Used as Mosquito Repellents Among *Soligas* Tribe in Chamaraja-nagar District of Karnataka, India

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Abstract

alaria, Dengue fever, Filaria and Yellow fever are serious public health problems in tropical and sub-tropical regions of the world. These diseases are transmitted through mosquito bites. Though sincere efforts are being done to overcome the problem, still there is entire need to explore effective measures to prevent individuals from mosquito bite. There are a number of synthetic/chemical mosquito repellents available in the market. But their toxic effects are harmful for human health. The safe and effective natural sources to control mosquito bite are needed to be explored. Natural plant based material may provide effective preparation to overcome the problem. Present paper deals with the herbal mosquito repellents used by Soligas tribes in Chamrajanagar district, Karnataka. The outcome of ethnobotanical survey carried out among the Soligas tribes of Chamrajanagar district during 2009-2010 forms the basis of the paper. Information on 30 plants species used as mosquito repellents have been documented. These plants are used as mosquito repellents in different forms by the inhabitants of the study area.

Key words: Ethnobotany, *Soligas* tribe, Mosquito repellent, Medicinal plants, Karnataka.

Introduction

Mosquitoes constitute a major public health problem as they serve as vector of serious human diseases such as Malaria, Filariasis, Japanese encephalitis, dengue fever and yellow fever etc. Mosquito transmitted diseases remain a major source of illness and death worldwide, particularly in tropical and subtropical countries (Becker *et al.*, 2003). Mosquitoes alone transmit diseases to more than 700 million people annually (Taubes, 2000). Among this malaria is the most important, affecting 300-500 million people and killing over one million annually throughout the world (Snow *et al.*, 2005). Malaria is transmitted by female mosquitoes of the genus *Anopheles*.

Repellents play an important role in preventing the transmission of vector-borne diseases by minimizing the contact between human and vectors. Most common synthetic mosquito repellent formulation available in the market as DEET (N, N-diethyl-meta toluamide), Permethrin, P-mentane-3, 8-diol, metofluthrin, which has shown excellent repellent action against mosquitoes and other insects (Walkers *et al.*, 1996). But the use of chemical repellants in higher concentrations may have adverse affect on eyes, skin, central nervous system, lungs and liver.

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On the other hand plants have been used in the form of crude fumigants where they are burnt to drive away mosquitoes and also as oil formulations applied to the skin or clothes which was first recorded in writings by ancient Greek, Roman (Owen, 1805) and Indian scholar (Johnson, 1998). Essential oils and extracts of plants of *Citronella* genus are commonly used as ingredients of plant-based mosquito repellents. It was used by the Indian Army to repel mosquitoes at the beginning of the 20th century (Covell, 1943). The repellent action of plant parts or oil extracts from *Ocimum* species have been reported against Afro-tropical mosquitoes (Seyoum *et al.,* 2003; Waka *et al.,* 2006).

According to Kim *et al*. (2002) plants may be an alternative source of mosquito repellent agents because they constitute a rich source of bioactive chemicals. Plant products have been used traditionally to repel or kill mosquito in many parts of the world (Seyoum *et al*., 2003). The repellent properties of plants to mosquitoes and insects were well known before the advent of synthetic chemicals (Karunamoorthi *et al*., 2008). Plant derived repellents usually do not pose hazards of toxicity to humans and domestic animals are easily bio-graded compared to synthetic compounds, natural products are presumed to be safer for human use (Sharma *et al*., 1993; Sharma and Ansari, 1994). The existing modern synthetic chemical repellents are generally more expensive. Besides, their toxicity, adverse side effects are harmful for human health. Few of them require electricity for their usage. Traditional plant based repellents are extremely useful in the inaccessible rural areas, where there is lack of electricity. Further, the plant based repellents are inexpensive, easily available, locally known, and culturally acceptable.

In Karnataka ethnobotanical studies have been accomplished in and around the forest among the tribal people by the researchers (Maruthi *et al*., 2000,. Prakasha and Krishnappa., 2006. Kalyana Sundaram and Indira., 1998., Rajesh and Mohamed Isaq., 2004.) But the extensive reports on medicinal plants are limited and so for no systematic ethnobotanical survey has been made in Chamarajanagar.

The traditional repellents are commonly used in different cultures and communities of Chamarajanagar and adjacent localities. Different communities use plants in various forms to protect themselves against Mosquitoes and other insect bites. In an attempt to search plant based material for use as mosquito repellent, ethno-pharmacological survey was undertaken in the forest areas of Chamarajanagar district in the state of Karnataka. The area is inhabited by Soligas tribal community and other rural folks. Perusal of literature reveals that the area has not been explored to record folk knowledge of the Soligas

tribe of Chamarajanagar district. It was for this reason, the survey team from Regional Research Institute of Unani Medicine (RRIUM), Chennai conducted ethno-pharmacological survey in this under explored area. The survey team recorded ethno-pharmacological data from the inhabitants of the study area, particularly from Soligas people. During the study information on 30 plants species used as mosquito repellent were also recorded. The present paper deals with the data obtained on plants as mosquito repellent from the Soligas tribe in Chamarajanagar, district of Karnataka State.

The Study Area

Chamarajanagar district is situated between 13°42 ‘ and 14°06’N latitude and between 75°35’ and 75°52’ E longitude. The district is located in Southern part of Karnataka. It is surrounded by Mandiya and Mysore in north. About 49% of the total area in the district is covered by forest. Chamarajanagar wildlife forest division consists of five forest ranges including Chamarajanagar, Yelanthur, Kolegal, Bylore and K. Gudi. The elevation ranges from 300 to 900m.

About 52 tribal villages are located in this district forest, particularly Bilgrims Ranganathan Temples (BRT) hills in Yelanthur, Bylore, Punjur and K. Gudi ranges. BRT wildlife sanctuary is well known for its rich diversity of flora and fauna covering the area of about 572 sq km. Vegetation pattern includes scrub jungle, dry deciduous, moist deciduous, semi evergreen, evergreen and shoal forest all over the sanctuary. It receives an annual rainfall ranging from 750-1950 mm. Large number of endemic species of medicinal plants occur in the area. Hence, it has very high population of forest dwelling tribals, with large number of *Soligas* followed by Jenu Kurumba, Betta Kurumbas. Most of the tribals are inhabitants of the forest of BRT hills.

In Karnataka state, ethnomedicinal value of plants in possession of various tribal and rural folk communities for treating various diseases have been explored to some extent (Bhandary *et al*., 1995; 1996. Harsha *et al*., 2002; Parinitha *et al*., 2005). However, ethnobotanical studies in Chamarajanagar district have not been undertaken. Therefore, the district was selected to explore the medicinal plants wealth of forest areas of the district used by the tribal and other rural folks.

Materials and Methods

Information recorded on plants species from the Soligas tribal community of Chamarajanagar district of Karanatka State forms the basic material of this paper. The data was collected through general conversations with tribal about

mosquito repellents, field surveys were made in Chamarajanagar district. Each area was visited twice in different seasons in 2009-2010. Details on medicinal plants used to repel mosquitos, parts used and mode of administration were recorded through interacting with them. Information from seventy persons aged between 40-80, who had good knowledge on plants was collected. The specimens were processed and preserved on herbarium seeds and identified with the help of flora of presidency of Madras (Gamble, 1936) and the flora of Tamil Nadu Carnatic (Matthew, 1983). The identified plants specimens were further confirmed through matching in the herbaria of botanical survey of India, Coimbatore. The specimens are deposited in the herbarium of survey of medicinal plants unit, Regional Research Institute of Unani Medicine, Chennai.

Observations

Based on field studies information on 30 plants species used as mosquito repellents were recorded from the Soligas tribe of Chamarajanagar district of Karnataka state. Data recorded on plants has been presented in Table 1. Plants are arranged in alphabetical order by their botanical name, local name, part used and mode of usage.

Table 1 Medicinal plants used to repel mosquito among Soligas tribes in Chamarajanagar district, Karnataka.

S. No.	Botanical Name/Family Name/Voucher specimen Number	Local Name	Part Used	State	Mode of application
1	*Abrus precatorius* L./ Papilionaceae/RRIUM CH:9332	Kundumani	Leaves/ Fruit	Fresh	Smoke
2	*Adhatoda zeylanica* Medic./ Acantaceae/RRIUM CH:8982	Adathoda	Leaves	Fresh	Smoke
3	*Aloe vera* (L.) Burm.f./ Liliaceae/RRIUM CH-9942	Kumari	Leaves	Fresh	Smoke
4	*Alpinia galanga* Sw/ Zingiberaceae/RRIUM CH:9539	Sitharathai	Leaves	Fresh	Smoke
5	*Angelonia biflora* Benth./ Scrophulariaceae/RRIUM CH:9249	Angelionia	Whole plant	Fresh	Smoke
6	*Azadirachta indica* A.Juss./ Meliaceae/RRIUM CH-10098	Vambu	Leaves	Fresh	Smoke

S. No.	Botanical Name/Family Name/Voucher specimen Number	Local Name	Part Used	State	Mode of application
7	*Calotropis gigantea* (L.) R.Br. ex Ait/ Asclepiadaceae/RRIUM CH-8883	Eruku	Leaves	Fresh	Smoke
8	*Chrysanthemum cinerariaefolium* Vis.// Astraceae/RRIUM CH:9380	Samanthi	Leaves	Fresh	Smoke
9	*Citrus limon* (L) Burm/ Rutaceae/RRIUM CH : 9465	Elumichai	Fruit peel	Fresh	Paste externally applied
10	*Datura fastuosa* L./ Solanaceae/RRIUM CH-9942	Karu oomathai	Leaves	Fresh	Smoke
11	*Datura metel* L./ Solanaceae/RRIUM CH:9176	Vellai oomathai	Leaves	Fresh	Smoke
12	*Eucalyptus globulus* Labill/ Myrtaceae/RRIUM CH-10538	Thailamaram	Leaves	Fresh	Smoke
13	*Jatropha curcas* L/ Euphorbiaceae/RRIUM CH:9179	Amanaku	Fruit	Dried	Smoke
14	*Lantana camara* L./ Verbenaceae/RRIUM CH:9382	Jamuki mali	Leaves	Fresh	Smoke
15	*Lippia nodiflora* Mich./ Verbenaceae/RRIUM CH:9262	Poduthalai	Plant	Dried	Smoke
16	*Mangifera indica* L./ Anacardiaceae RRIUM CH:9249	Mamaram	Seed	Dried	Smoke
17	*Morinda tinctoria* Roxb./ Rubiaceae/RRIUM CH:9342	Nuna	Leaves	Fresh	Smoke
18	*Nicotiana tobacum* L./ Solanaceae/RRIUM CH:Museum Sp.No : 62	Pokaiyulai	Leaves	Dried	Smoke
19	*Ocimum canescens* L./ Lamiaceae/RRIUM CH:9374	Nay thulasi	Leaves	Fresh	Smoke

S. No.	Botanical Name/Family Name/Voucher specimen Number	Local Name	Part Used	State	Mode of application
20	*Ocimum tenuiflorum* Roth../ Lamiaceae/RRIUM CH-10039	Thulasi	Leaves	Fresh	Smoke
20	*Orthosiphon thymiflorus* L./ Lamiaceae/RRIUM CH:9442	Poonaimesai chedi	Whole plant	Dried	Smoke
21	*Ricinus communis* L./ Euphorbiaceae/RRIUM CH:9018	Kotaimuthu	Fruit	Dried	Smoke
22	*Rosmarinus officinalis* L./ Ebenaceae/ RRIUM CH: Museum Sp.No:63	Marikozhindu	Whole plant	Fresh	Juice externally applied
23	*Ruta graveolens* L./ Rutaceae/RRIUM CH: 9538	Aruvathamchedi	Leaves	Fresh	Smoke
24	Saccharum officinarum L./ poaceae/RRIUM CH:9317	Karumbu	Stem	Fresh	Juice externally applied
25	*Sphaeranthus indicus* L./Asteraceae/RRIUM CH:9491	Kottai kranthai	Whole plant	Fresh	Smoke
26	Cymbopogon citratus (DC. ex Nees) Stapf/Poaceae/ RRIUM CH:9556	Thailapullu	Leaves	Fresh	Smoke
27	*Syzygium cumini* (L) Skeels/Myrtaceae/RRIUM CH-9148	Karunaval	Leaves	Fresh	Smoke
28	Tagetes erecta L./ Asteraceae/RRIUM CH:9568	Sendu malligai	Leaves	Fresh	Smoke
29	*Viola pilosa* L./Violaceae/ RRIUM CH:9415	Sweet violet	Leaves	Fresh	Smoke
30	*Vitex negundo* L./ Verbenaceae/RRIUM CH:9236	Nochi	Leaves	Fresh	Smoke

Results and Discussion

Chamarajanagar district wild life forests have a variety of medicinal plants which are used by Soligas for their primary health care. The present study

identified 30 species as mosquito repellents. Majority of the applications reported in the present study to repel mosquitoes are leaves used in the form of smoke. These plants are commonly occurring in the forests of the district. This is in confirmation with other general observations which have been reported earlier in relation to mosquito repellant plants studied by Indian authors (Dua *et al.,* 1996) and other countries (Maguranyi *et al*., 2009). Similar to the result of this study, leaves were the most common plants parts used to repel mosquitoes in north western Ethiopia (Karunamoorthi *et al.,* 2009) and other plant parts are also used (Cunningham, 2001). Most of the ethnobotanical studies confirmed that leaves are the major portion of the plant used for the treatment of diseases. The reasons why leaves are used mostly is that they are easily accessible and are active in photosynthesis and production of secondary metabolites (Ghorbani, 2005). Most of the plants parts are used in the form of fresh some are in dry state. Burning of plant materials with charcoal to make smoke was the most common methods among the soligas. Similar reports reported in Ethiopia (Karunamoorthi *et al*., 2008) in West Africa (Palsson and Jaenson, 1999).

The traditional knowledge about utilization of local plant species is vital in alternate health care system as well as for the self sustenance of local population. High costs coupled with numerous side effects of synthetic Mosquito repellents are forcing people to depend on the locally available herbs to repel mosquitoes and prevent the vector transmitted diseases. Mosquitoes are an ancient group of insects, which have persisted for millions of years. Mosquitoes that belong to the genera , *Aedes, Anopheles* and *Culex* are important in terms of public health as they transmit a number of diseases, such as Dengue, Chikungunya, Malaria, Filariasis, Japanese encephalitis, etc., that affect millions of people worldwide (WHO, 2009). N, N-diethyl-meta toluamide (DEET) has been considered one of the most effective synthetic repellents against mosquitoes. However, its toxic reactions have been reported in some circumstances, especially among children and the elderly people (Moody *et al*., 1989; Clem *et al*., 1993). DEET also acts as a plasticizer and has an objectionable odour to some individuals.

Botanical insecticides and phyto-toxic compounds have received much attention. Most insecticides of these are plant extracts containing a group of active ingredients of diverse chemical nature and phyto-toxic compounds are generally secondary metabolites with protective action against mosquitoes. Many plant species have been screened for anti-mosquito activities and mosquitocidal properties of the crude extracts and active phyto-chemical compound have also been studied by Singh *et al.* (2000). It shows that crude

plant extracts are highly efficacious for the control of mosquitoes (Jang *et al*., 2002; Cavalcanti, 2004,) Undoubtedly, plant derived toxicants are a valuable source of potential insecticides and may play a more prominent role in mosquito control programs in future (Mordue and Blackwell,1993).

Conclusion

Undeniably, global warming concomitant effects, insecticide resistance, and drug resistance have created resurgence and insurgence of many vector-borne diseases, mainly malaria. Major victims for these malicious killers are the poorest resource-constrained areas like Chamarajanagar. Globally, numerous studies including the present investigation results evidently suggest that the traditionally used plant-based insect repellents are promising and could potentially contain vectors of disease. Above and beyond, due to its user- as well as environmental-friendly nature, it should be promoted among indigenous and marginalized population in order to reduce man-vector contact. In addition, this appropriate strategy affords the opportunity to minimize chemical repellents usage and the risks associated with adverse side effects. Traditionally used plant-based insect repellents could be viable safer alternative sources for chemical insect repellents.

The present study shows that Soligas of Chamrajanagar district use plant materials to repel mosquitoes. Plants materials were commonly used because they are cost-free and easily accessible. Thirty plant species were documented and 12 of them are reported for the first time as mosquito repellents. This report will provide the basis for further studies in developing new, effective, safe and affordable plant-derived mosquito repellents especially for India where malaria is highly prevalent. The present study may provide basic material for documenting and conserving traditional knowledge of mosquito repellent plants for further laboratory studies and uses.

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