



Research Article

PLANTS HAVING MOSQUITO REPELLENT ACTIVITY: AN ETHNOBOTANICAL SURVEY

B. Pattanayak¹ and N.K.Dhal²

1. Department of Biotechnology, F.M.University, Balasore, Odisha
2. Department of Environment and Sustainability, CSIR-IMMT, Bhubaneswar, Odisha, India)

*Corresponding Author: Email pattanayak32@gmail.com

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ABSTRACT

Plant-based repellents have been used for generations in traditional practice as a personal protection measure against host-seeking mosquitoes. Knowledge on traditional repellent plants obtained through ethnobotanical surveys, is a valuable resource for the development of new natural products. An attempt has been made to prepare herbal formulations from natural products such as flowers, leaves and whole plants of under-listed 29 plants. The present study is attempted to highlight the plants claimed to be used or associated with mosquito repellent activities by different tribals located in different forest pockets of Odisha, India. The summary of recent information on claiming and efficacy of plant-based repellents are suggested for further drug development programme. These plant oils and dry leaves as well as whole part may represent an alternative in formulating potent and affordable products in the control of mosquitoes.

Keywords: Repellents, Ethnobotanical, plants.

INTRODUCTION

The world is gradually turning to herbal formulations which are known to be effective against a large repertoire of diseases and ailments. Many of the herbs and shrubs are found to have promising medicinal properties, and mosquito repellent properties. From the dawn of Civilisation, man has been exploiting the secrets of nature. The Drugs used by the ancient Civilisation were mainly the extract of plants, animals and few inorganic salts. Though several approaches to unravel the intricacies of ethnobotanical practices are envisaged, field recording of plant uses directly from the ethnic people and Tribal healers has priority and most reliable. The following approaches gives in brief the whole gamut of ethnobotany. Owing to the fact that application of synthetic larvicide has envenomed the surroundings as well as non-target organisms, natural products of plant origin with insecticidal properties have been tried as an indigenous method for the control of a variety of insect pests and

vectors in the recent past. The use of plant parts for insect control has several appealing features, as these are generally more biodegradable, less hazardous, and rich storehouse of chemicals of diverse biological activity (Mudrigal, R.V. et al 1979). Plant based repellents are still extensively used in the traditional way throughout rural Tribal communities in the tropics because for many of the poorest communities the only means of protection from mosquito bites that are available and indeed for some of the communities "natural" smelling repellents are preferred because plants are perceived as safe and trusted means of mosquito bite prevention. (Koul Oet al, 2008). According to Census 2011. the total population of Odisha is 41,947,358 out of which male and female are 21,201,678 and 20,745,680 respectively. The population of Odisha forms 3.47 percent of India in 2011. Literacy rate in Odisha has seen upward trend and is 73.45 percent as per 2011 population census. The population density of Odisha is 269

per sq km which is lower than national average 382 per sq km. Sex Ratio of Odisha is 978 i.e. for each 1000 male, which is below national average of 940 as per census 2011. The Scheduled Tribe (ST) population of the State of Odisha is 8,145,081. This constitutes 22.1 percent of the total population of the State and 9.7 per cent of the total tribal population of the country. Malkangiri district has the highest proportion of STs (57.4 per cent) followed by Mayurbhanj (56.6 per cent), Rayagada (55.8 per cent) and Nabarangapur (55 per cent). Puri district has the lowest by proportion of STs (0.3 per cent). Out of sixty two (62) STs, living in odisha Khonds is the most populous tribe followed by Gond. The other major tribals living in odisha are Santal, Kolha, Munda, Saora, Shabar and Bhattada, Bhumij, Bhuiya, Oraon, Paroja and Kisan. Languages spoken by them are different from Odia though many of the tribals now understand Odia.

Definition of mosquito repellent

A mosquito repellent is a substance applied to skin, clothing, or other surfaces which discourages insects (and arthropods in general) from landing or climbing on that surface. There is also mosquito repellent products available based on sound production, particularly ultrasound (inaudibly high frequency sounds).

Methods of mosquito control

Mosquito-borne diseases affect millions of people worldwide each year. The bite of a mosquito can result in anything from a skin irritation to contracting malaria. Clearly, mosquitoes are not just a nuisance, but also potentially harmful. To handle these biased situation different types of literature reviewed mosquito control methods are discussed.

In Table 2. Listed plants are already reported as mosquito repellent. Many synthetic compounds are isolated from their leaves, Seeds and whole plant parts.

Table 1. Methods of mosquito control

| Chemical methods | Non-chemical methods | Biological methods |
|---|---|---|
| Synthetic repellents: DEET, Permethrin Natural repellents: Neem oil, Citronella Oil. | Physical method: Medicated net, Non medicated net, Mosquito traps. Mechanical methods: Electric mosquito zapper, Mosquito magnet | By growing some fish species that feeds on mosquito larvae in water bodies. |

Table 2: An Overview of repellent plant efficacy from literature review

| Sl no. | Name of plant | Family | Other name | Location | Repellent compounds | Parts used | References |
|--------|------------------------------|---------------|-----------------|----------------|-------------------------|--------------------------|-----------------|
| 1. | <i>Eucalyptus spp.</i> | Myrtaceae | Eucalyptus | Ethiopia | 1,8cineolecitronellal Z | Leaves | Ansari,2005 |
| 2. | <i>Eugenia aromaticu</i> | Myrtaceae | Cravinhoda | India | Eugenol-cinnamaldehyde | Seed oil | CampbellC,2010 |
| 3. | <i>Lantana javanica</i> | Verbenaceae | Lemonbush | Kenya | Camphor | Plant extract | Hao H,2008 |
| 4. | <i>Ocimum americanum</i> | Lamiaceae | Myenimadongo | Nigeria | Linoleic acid | Leaves and seeds | Hill N,2007 |
| 5. | <i>Mentha arvensis</i> | Lamiaceae | Hortela-documpo | Malaysia | Myrcene | Leaves | Syed Z,2008 |
| 6. | <i>Cymbopogon nardus</i> | Poaceae | | Brazil | Citronella | Seed oil | Fradin MS2007 |
| 7. | <i>Cymbopogon excavates</i> | Poaceae | | Ethiopia,India | Azadirachtin saponins | Leaves and plant extract | Ritchie SA,2006 |
| 8. | <i>Artemisia monosperma</i> | Asteraceae | Felon herb | Brazil | limonene | Leave extract and bark | How H,2008 |
| 9. | <i>Zanthoxylum limonella</i> | Rutaceae | Makaen | Thailand | | Seed oil | Caroll SP,2006 |
| 10. | <i>Curcuma longa</i> | Zingiberaceae | Turmeric | Nigeria | | Seed oil | Hill N,2007 |

These synthetic compounds are responsible for mosquito repellent activity. It was discovered that the waste distillate remaining after hydro-distillation of the essential oil was far more effective at repelling mosquitoes than the others. Many plant extracts and oils repel mosquitoes, with their effect lasting from several minutes to several hours due through the traditional method. Their active ingredients tend to be highly volatile.

Evaluation of Ethnobotanical Study

Area of Study

Various tribal rich forest pockets like, Gandhamadan, Mayurbhanj, Nabarangpur, Boudh, Malyagiri, Deogarh, Malkangiri, Nuapada and Rayagadda etc were identified and field trips were conducted at regular intervals in different seasons. Latitude and longitude of these following areas are given below | table no. 3. Folk lore claims were documented along with voucher specimens.

As different species come to be flowering and fruiting at different seasons. Field surveys were executed in such a way as to accommodate all relevant information in different stages of their life history.

Cris-cross checking

Tribal medicine men from different forest pockets were interviewed to gather fast hand information on ethnomedicinal uses. Efforts were also made to cross check the folklore claims. This study involved checking and rechecking of particular folklore claim by different forest pockets. This method was followed to clear many doubts regarding the use of identity of plant specimen.

Data recording

The detailed information about the plants, parts, dosages, duration, method of preparation, mode of administration, precaution to be taken etc. were recorded.

Table 3. Latitude and longitude of these following areas are given.

| Area | Latitude | Longitude |
|-------------|---------------------|-----------------------|
| Gandhamadan | 20°42'- 21°00' N | 82° 41' - 83° 05' E |
| Harishankar | 20°42'- 21°00' N | 82° 41' - 83° 05' E |
| Nabrangpur | 9°10'42"-20°06'12"N | 81°51'30"- 82°52'36"E |
| Malyagiri | 84°28'- 85°15'N | 21°11'- 21°43'E |
| Deogarh | 84°28'- 85°15'N | 21°11'- 21°43'E |
| Malkangiri | 17°45'-18°40' N | 81°10'-82°00'E |
| Mayurbhanj | 21°0'16'-22°0'34"N | 85°0'40'-87°0'11'E |
| Boudh | 20°22'-20°50'N | 83°34'- 84°49'E |
| Nuapada | 20°0'-21°05' N | 82°20'-82°53'E |
| Rayagadda | 19°10'N | 18°25'E |

Questionnaire Model for collecting information on Tribal knowledge

Name of the Informant.....
 Fathers name.....
 Sex(M/F)
 Age.....
 Tribe.....
 Language.....
 Village name.....
 Gram Panchayet.....
 District.....
 State.....
 Parts Used.....
 Common Name of the Plant.....
 Method of Preperation.....

Signature/Thumb impression of Knowledge Holder

Table 4: List of plants having Mosquito Repellent activities

| S. No. | Botanical name | Family | Locality | Common name | Parts used for repellent | Name of the tribes |
|--------|--|----------------|--|----------------------------------|-----------------------------------|--------------------|
| 1. | <i>Homalium nepalense</i> Benth. | Flacourtiaceae | Frequently in mixed forests, Gandhamardan | Kakhara | Dry Leaves+Jhuna dust | Kondh |
| 2. | <i>Strychnos nux vomica</i> L. | Strychnaceae | Common in scrub forests, Nabarangpur | Kochila | Seed oil | Gond |
| 3. | <i>Lantana camara</i> L. | Verbenaceae | Common in scrub forests, Mayagiri | Nagaboiri, Naguari | Dry leaves+ cowdung | Munda |
| 4. | <i>Vitex nigundo</i> L. | Verbenaceae | Frequently ground, Boudh in waste | Begunia, Nirgundi | Dry leaves+ cowdung+jhuna | Ho |
| 5. | <i>Clerodendrum viscosum</i> Vent. | Verbenaceae | Common in shady wastelands, edges of forests etc, Nrusinghanath | Buhasin, Sweta bhunarmala | Leaf and Flower | Kondh |
| 6. | <i>Clerodendrum indicum</i> (L.) Kuntze | Verbenaceae | Occasional in open places Nrusinghanath | Nagri, Bhaunarmal, Bharmal | Leaf and Flower | Khond |
| 7. | <i>Nyctanthes arbor-tristis</i> L. | Oleaceae | Frequently in open forests, Deogarh | Gangaseoli, Singhara, | Dry Leaves+Coir pith | Munda, Kolha |
| 8. | <i>Andrographis paniculata</i> (Burm.f.) Wall.ex.Nees. | Acanthaceae | Common in forests, Malkangiri | Bhuinimbo, chirata. | Whole plant | Bondo and Kui |
| 9. | <i>Justicia adhatoda</i> L. | Acanthaceae | Often found in near villages, sometimes planted in hedges, Boudh | Vasak, Basango, Basak | Dry Leaves+dry curcuma leaves | Jani |
| 10 | <i>Barleria prionitis</i> L. | Acanthaceae | Frequently in open places, often near villages, Malkangiri. | Daskeranta | Dry Leaves+ coir pith | Sao |
| 11 | <i>Jatropha gossypifolia</i> L. | Euphorbiaceae | Common in waste ground, village hedges, Mayurbhanj | Johaji, Baigoba | Seed oil | Santhal |
| 12. | <i>Ocimum sanctum</i> L. | Lamiaceae | Commonly planted in houses in Mayurbhanj | Tulsi | Leaves+Dry banana leaves | Santhal |
| 13 | <i>Hyptis suaveolens</i> L. | Lamiaceae | Fairly common, Harishankar | Ganga Tulsi | Seed oil | Kondh |
| 14 | <i>Ocimum canum</i> Sims. | Lamiaceae | Fairly common weed especially in cultivated land, Mayurbhanj | Ganga Tulsi | Dry leaves+Coir pith | Gudaba |
| 15 | <i>Ocimum gratissimum</i> L. | Lamiaceae | Common in shady waste ground, Rayagarh | BanTulsi | Dry Leaves+Coir pith | Bhumija |
| 16 | <i>Leucas aspera</i> (Willd.) Link. | Lamiaceae | Common in cultivated land, Nabarangpur | Gaiso | Dry leaves+dry leaves of Kamini | Kondh |
| 17 | <i>Ageratum conyzoides</i> L. | Asteraceae | Fairly common weed, Nuapada | Poksunga, Boksunga, Densingi | Dry Leaves+cowdung | Kondh |
| 18 | <i>Eclipta alba</i> (L.) Hassk. | Asteraceae | Frequent in moist places along cultivated lands etc, Nabarangpur | Bhringaraj, Kesardra, Bhringaraj | Seed oil | Kondh |
| 19 | <i>Cymbopogon citratus</i> (DC.) Stapf. | Poaceae | Cultivated in garden, Malyagiri | Lemon grass | Seed oil | Kondh |
| 20 | <i>Glycosmis pentaphylla</i> (Ret z.) DC. | Rutaceae | Fairly common in scrub forest, Mayurbhanj | Chauli, chowal dua | Dry Leaves+coir pith | Kondh, Kui, Sao |
| 21 | <i>Tinospora cordifolia</i> (Willd.) Hook.f. & Thoms. | Menispermaceae | Frequently in forests, Deogarh | Gulachi | Dry Leaves+dry lemon grass leaves | Khond |
| 22 | <i>Celastrus paniculata</i> Willd. | Celastraceae | Commonly in forests, Harishankar | Pengu | Seed oil | Saora |
| 23 | <i>Argemone mexicana</i> L. | Papaveraceae | Fairly common weed throughout the area, Nuapada | Agara | Seed oil | Bhumija |
| 24 | <i>Michelia champaca</i> L. | Magnoliaceae | Common in Nabarangpur | Champa | Dry Flowers+Jhuna | Munda |
| 25 | <i>Annona squamosa</i> L. | Annonaceae | Cultivated and naturalized, often found self-sown in hedges etc, Nuapada | Ata | Dry Leaves | Sao |
| 26 | <i>Melia azadirachta</i> L. | Meliaceae | Commonly occurring in forests, Boudh | Maha Limba | Seed oil | Sao, Kondh |
| 27 | <i>Eucalyptus citriodora</i> Hook. | Myrtaceae | Commonly planted, Deogarh | Eucalyptus | Dry leaves + cowdung | Kondh, Munda |
| 28 | <i>Woodfordia fruticosa</i> (L.) Kurz. | Lytharaceae | Fairly common especially in hills, Nabarangpur | Dhai, Dhatuki, Dhatuk, Jaliko | Dry Leaves+dry lemon leaves | Sao, Kondh |
| 29 | <i>Swertia angustifolia</i> Buch.-Ham.ex D. Don | Gentianaceae | Common in grass lands, Malkangiri | Chireita | Dry leaves + cowdung | Bonda |

The folklore claim as revealed by the practione in colloquial languages were recorded in the tape recorder. Whenever difficulties were encountered in understanding the language , the taps were replayed before the tribal chiefs and the correct meanings were ascertained. The plants were correctly identified with the help of Flora(Haines 1921-25,Saxena and Brahmam (1994-96).Authentication of voucher specimens was done consulting the herbarium of RRL-(B).Plants having claims are provided in table 4. with botanical name ,family , locality, common names, parts used and name of the tribes.

Ethnobotanical claim

The study listed 29 species of plants used by the various tribes of odisha, India with insect-repellent property. The tribal people utilized mainly a combination of the dried stem and leaf of the plant, seed oil which is burnt to elicit its repellent activity against hematophagous insects. The dry leaves and leaf extract of Herbal plants like Homalium nepalense, Lantana camara,, Ocimum sanctum, Vitex nigundo, Ageratum conyzoides, Tinospora cordifolia, Ocimum canum, Ocimum gratissimum, Barleria prionitis,, Clerodendrum viscosum, Clerodendrum induicum., Justicia adhatoda., Annona squamosa., Woodfordia fruticosa., Swertia angustifolia and whole part of these plants like Michelia champaca, Clerodendrum viscosum and Andrographis paniculata have found extensive use as mosquito repellent .The above listed formulations need to be scrutinised pharmacognostically as well as pharmacologically.The phytochemical analysis should be undertaken for the scientific validation of the documented c laims.

CONCLUSIONS

Plants as alternative source of repellent agent, reported in numerous ethnobotanical evaluations. The summary of recent informations on claiming and efficacy of plant-based repellents as well as promising new developments in the field. Plant-derived repellents usually do not pose hazards of toxicity to humans and domestic animals and are easily biodegraded. Compared to synthetic compounds, natural products are presumed to be safer for human This study has attempted to highlight the plants claimed to be used or associated with mosquito repellent therapy .These plants may probably contain yet undiscovered anti-malaria

properties, which can serve as a need for a multidisciplinary approach to develop potentially effective drugs . As Malaria is very common in most of the tribal dominated areas, development of low cost herbal mosquito repellents will save the precious life of many poor people.

DISCUSSION

All these 29 plants represent a class of herbal drug with very strong conceptual or traditional base as well as strong experimental base for its use. The mixture is acting as mosquito repellent.Here we use Jhuna mixture because the presence of resin is used for the treatment of various inflammatory condition.when cowdung is burnt with neem it acts as an excellent antiviral agent.Cowdung has a pleasant smell that keeps environment fresh and free from bacteria.its smoke is a potentially antioxidant.Coirpith is highly lignocellulosics waste .Due to its high lignin content slow degradation occur in natural environment.Sometimes we used dry banana leaves due to its antifungal and antibiotic activity. We use dry lemon grasses leaves due to its antifungal and insecticide efficacy as well as potential anticarcinogenic activity while it should suggested hypotensive and hypoglycaemic actions. Curcuma leaves are used as a mosquito-repellent because of its antioxidant properties. Oral interview of the subjects used for the study showed that there were no adverse impact in the form of rashes, irritation, pains or other skin problems during the three-month study. Documented research reports equally confirmed that the volatile oil of Murraya paniculata has low acute toxicity, no mutagenic risks and is not irritable on the skin.The toxicity test can be conducted only when the composition and constituents are known. Due to the rich folk claims of the above plants ,we strongly recommend for immediate conservation.

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