



---

## Research Article

---

### PLANTS HAVING MOSQUITO REPELLENT ACTIVITY: AN ETHNOBOTANICAL SURVEY

B. Pattanayak\*<sup>1</sup> and N.K.Dhal <sup>2</sup>

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](mailto:pattanayak32@gmail.com)

(Received: June 26, 2015; Accepted: July 28, 2015)

#### 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
<b>Synthetic repellents:</b> DEET, Permethrin  <b>Natural repellents:</b> Neem oil, Citronella Oil.	<b>Physical method:</b> Medicated net, Non medicated net, Mosquito traps. <b>Mechanical methods:</b> 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-cinnamoldehyde	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 I 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	210°16 -220°34 N	850°40 -870°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,Na guari	Dry leaves+ cowdung	Munda
4.	<i>Vitex nigundo</i> L	Verbenaceae	Frequently ground ,Boudh in waste	Begunia,Nirgundi	Dryleaves+cow dung+jhuna	Ho
5.	<i>Clerodendrum viscosum</i> Vent.	Verbenaceae	Common in shaddy wasteplaces,edges of forests etc, Nrusinghanath	Buhasin,Sweta bhunarmala	Leaf and Flower	Kondh
6.	<i>Clerodendrum indicum</i> (L.)Kuntze	Verbenaceae	Occasional in open placesNrusinghanath	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,villagehedges,Mayurbhanj	Johaji,Baigobara	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	GangaTulsi	Dryleaves+Coir pith	Gudaba
15	<i>Ocimum gratissimum</i> L.	Lamiaceae	Common in shaddy waste ground,Rayagarh	BanTulsi	Dry Leaves+Coir pith	Bhumija
16	<i>Leucas aspera</i> (Willd.) Link.	Lamiaceae	Common in cultivated land.,Nabarangpur	Gaiso	Dryleaves+dry leaves of Kamini	Kondh
17	<i>Ageratum conyzoides</i> L.	Asteraceae	Fairly common weed,Nuapada	Poksunga,BoksungaDensingi	Dry Leaves+cowdung	Kondh
18	<i>Eclipta alba</i> (L.)Hassk.	Asteraceae	Frequent in moist places along cultivated lands etc, Nabarangpur	Bhringaraj,kesarada,Bhrungaraj	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 scrubforest,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 hedgesetc,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	Eucaluptus	Dryleaves + 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.

#### **Acknowledgement**

The authors are grateful to the H.O.D of Biotechnology Department of Fakir Mohan University, Balasore, Odisha, India, for providing the facilities to pursue the research work.

#### **REFERENCES**

1. Ansari MA, Mittal PK, Razdan RK, Sreehari U (2005) J. Vector Borne Dis. 42:95-99.
2. Bernier UR, Furman KD, Kline DL, Allan SA, Barnard DR (2005). J. Med. Entomol. 42:306-311.
3. Curtis CF, Lines JD, Ijumba J, Callaghan A, Hill N, Karimzad MA (1987). Med Vet Entomol. 1:109-119.

4. Dremova VP, Markina VV, Kamennov NA(1971). *Int. Pest. Cont.* 13:13-16.
5. Fradin MS, Day JF 2002. *N. Engl. J Med.* 347:13-18.
6. Goodyer L, Behrens RH (1998). *Am. J Trop. Med Hyg.* 59:323-324.
7. Goodyer LI, Croft AM, Frances SP, Hill N, Moore SJ, Onyango SP, Debboun M(2010) . *J Travel Med.* 17:1708-8305.
8. Harrewijn P, Minks AK, Mollema C (1995). *Chemoecology.* 5:55-73.
9. Jacobson M, Crosby BG (1971). *Naturally occurring insecticides.* Ny Marcel Dekker Lue, USA, 210 p.
10. Kala, CP, Farooquee NA, Dhar U (2004). *Biodiversity and Conservation.* 13: 453-469.
11. Koul O, Walia S, Dhaliwal GS (2008). *Biopesticide International.* 4(1): 63-84
12. Kumar A, Kumar R, Kaur J (2012). *Asian Journal of Pharmaceutical and Clinical Research.* 5(3): 9-12.
13. Michel K, Kafatos FC (2005). *Insect Biochemistry and Molecular Biology.* 35(7): 677-689.
14. Mudrigal RV, Knapp FE, Sigafus R, Smith (Jr) CR. (1979), *Mosquito News.* 39: 536-40.
15. Muller GC, Junnila A, Kravchenko VD, Revay EE, Butlers J , Schlein Y(2008). *J. Am Mosq. Control Assoc ,* 24:150-153
16. Nerio LS, Olivero-Verbel J, Stashenko E (2010). *Bioresource Technology.* 101(1): 372-378.
17. Noosidum A, Prabaripai A, Chareonviriyaphap T, Chandrapatya A (2008). *J .Vector. Ecol.* 33:305-312.
18. Paluch G, Grodnitzky J, Bartholomay L, Coats J (2009). *J .Agric Food Chem.* 57:7618-7625
19. Polsomboon S, Grieco JP, Achee NL, Chauhan KR, Tanasinchayakul S, Pothikasikorn J, Chareonviriyaphap T(2008). *J. Am Mosq. Control. Assoc.* 24:513-519.
20. Sakulku U, Nuchuchua O, Uawongyart N, Puttipipatkachorn S, Sootitawantawat A, Ruktanonchai U(2009). *Int J Pharm.* 372:105-111.
21. Singh N, Mishra AK, Saxena A(1996). *Indian J Malariol.* 33:99-102.
22. Tawatsin A, Wratten SD, Scott RR, Thavara U, Techadamrongsin Y(2001). *J Vector Ecol.* 26:76-82.
23. Teketee RW, Campbell CC (2010). *Malar J .* 9:299.
24. Tolle MA (2009). *Curr Probl Pediatr Adolesc Health Care.*39 (4): 97-140.
25. Tripathi AK, Upadhyay S, Bhuiyan M, Bhattacharya PR (2009). *Journal of Pharmacognosy and Phytotherapy.* 1(5): 52-63.
26. Trongtokit Y, Rongsriyam Y, Komalamisra N, Apiwathnasorn C(2005). *Phytother Res.* 19:303-309.
27. Trongtokit Y, Rongsriyam Y, Komalamisra N, Krisadaphong P, Apiwathnasorn C (2004). *Asian J. Trop Med Public Health .*35:325-333.
28. Vishwanathan AS, Basavaraju R (2010). *European Journal of Biological Sciences.* 3(1): 30- 42.
29. Wang Z, Song J, Chen J, Song Z, Shang S, Jiang Z , Han Z (2008). 18(9): 2854-2859.
30. Saxena HO, Brahmam M. (1994-1996). *Flora of Orissa(Vol. 1-4).*Orissa Forest Development Corporation, Bhubaneswar, Orissa.