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Original Research Article

Incense and Insect Repellent Plants of Darjeeling Himalaya, West Bengal, India

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Abstract: Incense is an aromatic biological substance that releases fragrant smoke or fumes when burned and used for appealing and aesthetic purposes as well as some other use like repelling insects. Darjeeling Himalayan region is rich in diversified flora and varied tribal communities having rich traditional knowledge. They still prefer to use their traditional knowledge to exploit the available plant resources for religious purposes as well as making traditional incense and insect repellent substances. Being rich in traditional knowledge system, different aspect of ethnobotany and indigenous knowledge of different communities of this area were studied by different workers. Lack of complete, concrete and compact study on incense and insect repellent plants of this zone and the related aspects encouraged the present dissertation which was designed to enumerate the botanicals used as incense and insect repellent agents by the people of Darjeeling. Standard methodology for ethnobotanical survey including field visit, market survey, visit to the religious places, interviews with monks, knowledgeable elderly person etc were followed to collect the data. A total of 58 species belonging to 52 genera and 26 families covering dicots, monocots and gymnosperms which played an important role in the daily life of the tribals and the locals. The study pointed towards the threats to some of the incense and insect repellent species and recommends further detailed and more intensive study to investigate their proper uses and potential as more effective and environment friendly incense and insect repellent products, population structure and ecological status of those species for their protection and conservation.

Keywords: Darjeeling, ethnobotany, ethnoreligious plants, incense, insect repellents, traditional knowledge

Introduction

Incense is an aromatic biological substance that releases fragrant smoke or fumes when burned and used for several purposes like appealing and aesthetic reasons, aromatherapy, meditation and ceremonies (Hyams, 2004). Generally, it is composed of aromatic plant materials, often combined with essential oils (Cunningham, 2009) and the forms taken by incense differ with the underlying culture, and have changed with advances in technology as well as increasing number of use (Oller, 2000-2002). Incense has a long history, dating back to ancient times and burning of incense is one of the important parts of worship in every community (Shrestha, 2020).

Darjeeling Himalaya is contiguous with Himalaya Hotspot of Biodiversity Conservation and has a great variety of rich flora and vegetation including a huge percentage of Rare, Endemic and Threatened taxa. Thus, it is well known to the plant lovers and explorers (Das, 2011). Darjeeling hills is a beautiful place of different communities, cultures, religions, traditions and languages and is populated by a large number

of ethnic groups like Lepchas, Bhutias, Rai, Sherpa, Tamang, Mangar, Gurung, Chhetri, Pradhan, Subba and Kagatay etc (Rai and Bhujel, 1999). Thus, the enriched plant resources and diversified ethnic communities along with their century old traditions made Darjeeling Himalayan region a unique ecological as well as ethno-ecological landscape.

Though the modern facilities are available in urban as well as some rural areas of Darjeeling but local population of far-flung places still prefer to use their traditional knowledge to exploit the available plant resources for their livelihood especially for healthcare and religious purposes of which one of the important examples is making traditional incense and insect repellent substances. For example, fresh and dried leaves and twigs of *Artemisia spp.* locally known as Titeypaati, are burn on the way after the dead person of the Grorkha and Lepcha communities is carried away. The plant is mixed with burning coal on the road along which the dead body is carried and the carriers of the coffin touch the burning plant with their feet (Rai and Bhujel, 2007).

Being rich in traditional knowledge system, different aspects of ethnobotany and indigenous knowledge of different communities of this area were studied by different workers (Yonzone *et al.* 1981; Yonzone and Mondal. 1982; Yonzone *et al.* 1984; Yonzone *et al.* 1985; Yonzone *et al.* 1996, Yonzone and Yonzone, 1999; Mandal and Yonzone. 2020; Chhetri *et al.* 2005; Rai and Bhujel. 2007) but no such concrete and compact study was made on incense and insect repellent plants of this zone. Thus, the present study was designed to enumerate the various plants used as incense and insect repellent agents by the people of Darjeeling and to collect information on their traditional way of using those plants along with their vernacular and botanical names, mode of uses, associated religious faith, source and availability, and their ecological status etc.

Study Area

Darjeeling Himalaya is an important part of Singalila Range of the Eastern Himalaya and located between 26°31´05´´ N – 72°13´10´´ N latitude and 87°59´30´´ – 88°53´00´´ E longitude and covers Darjeeling district except the Siliguri subdivision and the entire Kalimpong district and extends over 2417.3sq km. Due to its geographical location, relief and wide altitudinal variations (300 m to 3700 m above sea level) the Darjeeling Himalaya shows its own climatic peculiarities and exhibits a typical monsoon climate, having wet summers and dry winters (Cajee, 2018). Three distinct climatic zones, viz. tropical, temperate and sub-alpine are found in Darjeeling region. In the entire Darjeeling Himalaya a high relative humidity prevails and that remains uniformly distributed throughout the year. Soil of upland is usually red and gritty while that of the plains are dark and more fertile (Chatterjee, 1997). A variety of physiographic, climatic and edaphic conditions led to development of diversified flora and vegetation. Five major types of vegetation-viz. tropical vegetation, sub-tropical forests, temperate vegetation, sub-alpine vegetation and alpine vegetation have been recognized by different worker along with their sub types. Bhujel (1996) divided tropical vegetation into four sub types: a. Riverain forest b. Sal forest c. Dry mixed forest d. Wet mixed forest. Kanai (1963) and Grierson & Long (1983) classified the temperate forest of the region into three subtypes: a.Temperate Deciduous forest, b. Evergreen Oak forest and c. Cold temperate vegetation which can be broadly classified as Mixed temperate forest of the upper hill region and Rhododendron – Hemlock forest.

Methodology

To collect information on incense and insect repellent plants in the present study the methodology suggested and adopted by Jain (1981 & 1987), Rai *et al.* (1998), Rai and Bhujel (1999) were followed. Whenever the questionnaire is used to collect data, the same was prepared by following Jain & Mudgal (1991). Most of the religious places – monasteries, temples, churches, graveyards, mosque/masjid in Darjeeling town, Sonada and Siliguri were visited and the Monks, Priests, Fathers and the other concerned people were interviewed to know about the botanicals which they use as incense, mode of effective uses of incense botanicals etc. The surroundings of these religious places were also visited to investigate whether

the plants are cultivated or just purchased from the markets. Organised markets as well as the rural *haats* in the study area were also visited; the stall selling the incense plants/plant materials were spotted and the shopkeepers also were interviewed. Different religious and social ceremonies where the incense materials are used were also attended to know the exact use and way of uses of those plants and associated faith and belief. Interview of rural knowledgeable old people was also performed mainly to collect information on insect repellent plants as well as traditional incense.

The botanicals which were found to be used were collected from the concerned people and/or places brought to the Taxonomy and Ecology Laboratory of Department of Botany, Darjeeling Govt. College, and whenever required the voucher specimens were prepared and preserved using standard methodology (Jain & Rao (1977). Some of the plant materials were collected in powdered form or cut into small pieces, either singly or as mixtures of more than two materials and they were preserved in a zip lock pouch after proper labelling.

Identification of specimens was done in Taxonomy and Ecology Laboratory of Darjeeling Government College as well as Lloyd Botanic Garden, Darjeeling consulting available literature and by matching with the pre-identified specimens and the voucher specimens were deposited in the Herbarium of the Darjeeling Govt. College. RET elements were recognized following the IUCN guidelines for determination of different classes of threatened plants (IUCN, 2014)

Result

Present study recorded a total of 58 species belonging to 52 genera and 26 families covering dicots, monocots and gymnosperms (Table 1). Out of these 58 botanicals, 34 species were dicotyledonous plants under 31 genera and 18 families; 11 species were from monocotyledonous group belonging to 11 genera and 6 families; whereas remaining 13 species from 10 gymnospermic genera under 2 families. Lamiaceae of angiosperms and Cupressaceae from gymnosperms represented highest number of species – 7 species each, followed by Pinaceae and Asteraceae both having 6 species.

Table 1. List of recorded botanicals used as incense and insect repellent agents with their scientific names, families, habit, parts used, mode of use and conservation status [**Abbreviation used: NT** - Near Threatened; **LC**-Least Concerned; **CR**-Critically endangered; **VU**-Vulnerable; **EN**-Endangered; **NE**-Not Evaluated; **DD**-Data deficient; **G5**- Globally secure.]

Sl. No.	Scientific Name [Family] & Local Name	Habit	Parts Used	Mode of Use	Conservation Status
1	*Abies spectabilis* (D.Don) Mirb. [Pinaceae] – Shang	Tree	Dried leaves and branches	Used as incense during prayer and puja	NT
2	*Ageratum conyzoides* L. [Asteraceae]	Herb	Whole plant (dried, fumigant)	Mosquito repellent	G5
3	*Allium sativum* L. [Amaryllidaceae] – Lahsun, Rasun	Herb	Bulb and leaves (crushed)	Repels mosquitoes and house flies	-
4	*Anaphalis triplinervis* (Sims) ex C.B. Clarke [Asteraceae] – Buki phul	Herb	Dried plant	Used in puja	-
5	*Artemesia vulgaris* L. [Asteraceae] – Titapati	Shrub	Twigs (burned with coal)	Used in puja	-
6	*Artemisia indica* Willd. [Asteraceae] – Titapati	Shrub	Dried leaves and flowers	Used in puja/chinta ritual	LC
7	*Azadirachta indica* A. Juss. [Meliaceae] – Neem	Tree	Fresh/dried leaves and twigs (burned)	Incense, mosquito repellent	LC
8	*Blumea balsamifera* (L.) DC. [Asteraceae] – Sambong	Herb	Leaves	Mosquito repellent	LC
9	*Canarium bengalense* Roxb. [Burseraceae] – Gokul	Tree	Oleoresin	Incense sticks and dhuno	NE (Locally Rare)

10	*Cannabis sativum* L. [Moraceae] – Ganja	Shrub	Leaves and flowers (burned with coal)	Used in Saraswati Puja & Shivaratri	NE
11	*Cedrus deodara* (Roxb. ex D.Don) G.Don [Pinaceae] – Devdar	Tree	Dried leaves	Used in puja	LC
12	*Chamaecyparis lawsoniana* (A. Murray bis) Parl. [Cupressaceae] – Dhupi	Tree	Wood	Used in Buddhist puja	NT
13	*Chromolaena odorata* (L.) R.M.King & H.Rob. [Asteraceae]	Shrub	Leaves (burned)	Fumigant	G5
14	*Cinnamomum tamala* (Buch-Ham.) T.Nees & C.H.Ebrem. [Lauraceae] – Tejpati	Tree	Leaves and bark	Aromatic incense	LC
15	*Clausena excavata* Burm.f. [Rutaceae]	Shrub	Dried leaves (burned)	Mosquito repellent	-
16	*Clerodendrum japonicum* (Thunb.) Sweet [Lamiaceae]	Shrub	Dried leaves/shoot (burned)	Mosquito repellent	LC
17	*Cocos nucifera* L. [Arecaceae] – Nariwal	Tree	Epicarp of fruit	Used in hawan	-
18	*Cryptomeria japonica* (Thunb. ex L.f.) D.Don [Cupressaceae] – Dhupi	Tree	Dried leaves	Daily puja	NT
19	× *Hesperotropsis ovensii* (A.F.Mitch.) Garland & Gerry Moore [Cupressaceae] – Dhupi	Tree	Dried leaves	Used in prayer	-
20	*Cupressus torulosa* D.Don ex Lamb [Cupressaceae] – Dhupi	Tree	Dried leaves	Used in puja/festivals	LC
21	*Curcuma longa* L. [Zingiberaceae] – Haldi	Herb	Powdered rhizome (burned)	Fumigant	DD
22	*Cymbopogon citratus* (DC.) Stapf [Poaceae] – Lemon grass	Herb	Whole plant extract	External insect repellent	NE
23	*Cyperus rotundus* L. [Cyperaceae] – Mutha	Herb	Rhizome/whole plant	Fumigant/insect repellent	-
24	*Datura metel* L. [Solanaceae] – Dhutura, Dhotrey	Shrub	Dried leaves and twigs	Repellent	-
25	*Datura stramonium* L. [Solanaceae] – Datura	Shrub	Fruit	Shiva puja, drives away evil	NE
26	*Dysphania ambrosioides* (L.) Mosyakin & Clemants [Amaranthaceae]	Herb	Whole plant	Repellent	NE
27	*Eucalyptus tereticornis* Sm. [Myrtaceae]	Tree	Dried leaves	Aromatic fumigant	LC
28	*Glycosmis pentaphylla* (Retz.) DC [Rutaceae]	Shrub	Dried leaves/twigs	Fumigant	LC
29	*Gmelina arborea* Roxb. [Lamiaceae] – Gamar/Gamari	Tree	Leaves, twigs, wood	Burned with neem/saldhup	LC
30	*Hordeum vulgare* L. [Poaceae] – Jauw	Herb	Seeds	Used in charu (puja)	LC
31	*Hyptis suaveolens* (L.) Poit. [Lamiaceae] – Kukur sunga, bon tulsi	Herb	Whole plant	Fumigant	NE
32	*Juniperus recurva* Buch-Ham. ex D.Don [Cupressaceae] – Sukpa	Tree	Dried leaves	Daily prayer and puja	LC
33	*Juniperus squamata* Buch-Ham. ex D.Don [Cupressaceae] – Dhupi	Shrub	Dried leaves	Used in puja	LC
34	*Justicia adhatoda* L. [Acanthaceae] – Vasak/Bashak	Shrub	Dried leaves	Mosquito repellent	LC
35	*Kaempferia rotunda* L. [Zingiberaceae] – Bhui Champa	Herb	Dried rhizome	Fumigant	LE
36	*Lantana camara* L. [Lamiaceae]	Shrub	Dried leaves/twigs	Fumigant	G5
37	*Lippia alba* (Mill.) N.E.Br. ex Bitton & P.Wilson [Verbenaceae]	Shrub	Dried leaves/twigs	Fumigant	-
38	*Melia azedarach* L. [Meliaceae]	Tree	Leaf extract/dried leaves/wood	Repellent & puja use	LC
39	*Nicotiana tabacum* L. [Solanaceae] – Tamuk/Tamak	Herb	Whole plant	Fumigant	-
40	*Nardostachys jatamansi* (D.Don) DC. [Valerianaceae] – Jatamansi	Herb	Root	Incense for Naag puja	CR

41	*Ocimum gratissimum* L. [Lamiaceae] – Ram tulsi	Shrub	Leaf extract	External insect repellent	-
42	*Ocimum tenuiflorum* L. [Lamiaceae] – Tulsi	Sub-shrub	Leaf extract	External insect repellent	-
43	*Oryza sativa* L. [Poaceae] – Dhan	Herb	Fruit	Used in charu (hawan)	NE
44	*Pinus roxburghii* Sarg. [Pinaceae] – Chirpine	Tree	Dried leaves and bark	Used in charu	LC
45	*Pinus wallichiana* A. B. Jacks. [Pinaceae] – Diyalo	Tree	Dried leaves and bark	Used in charu	LC
46	*Polygonum hydropiper* L. [Polygonaceae]	Herb	Dried shoot	Repellent	LC
47	*Populus ciliata* Wall. ex Royle [Salicaceae] – Malagiri	Tree	Wood	Used in puja	-
48	*Rhododendron anthopogon* D. Don [Ericaceae] – Sunpate	Shrub	Almost all parts	Puja & funeral rituals	LC
49	*Rhododendron lepidotum* Wall ex G. Don [Ericaceae] – Gurass	Shrub	Dried leaves/branches	Used in puja	-
50	*Santalum album* L. [Santalaceae] – Chandan	Tree	Wood	Used in hawans	VU
51	*Sesamum indicum* L. [Pedaliaceae] – Kalo til	Shrub	Seeds	Used in hawan	-
52	*Shorea robusta* Gaertn. [Dipterocarpaceae] – Sal	Tree	Wood powder	Used in prayer	-
53	*Thuja occidentalis* L. [Cupressaceae] – Shang	Tree	Dried leaves	Used in puja	LC
54	*Tsuga dumosa* (D. Don) Eichler [Pinaceae] – Dhupi	Tree	Dried leaves	Used in shang	LC
55	*Tsuga heterophylla* (Raf.) Sarg. [Pinaceae] – Vairungpati	Tree	Almost all parts	Used in shang	LC
56	*Valeriana jatamansii* Wall. [Valerianaceae] – Naagdhup	Herb	Root	Used to worship Naag devta	-
57	*Vitex negundo* L. [Lamiaceae] – Nishinda	Shrub/small tree	Dried leaves/twigs	Burned with neem leaves	LC
58	*Zingiber officinale* Roscoe [Zingiberaceae] – Aduah	Rhizomatous herb	Rhizome	Air freshener during Rai Puja	-

Solanaceae, Zingiberacea and Poaceae represented 3 species each. Other families like Meliaceae, Burseraceae, Moraceae, Rutaceae, Arecaceae, Amaranthaceae, Acanthaceae etc were represented by single species only.

Recorded incense and insect repellent materials belonged to all the three habit groups – tree, shrub and herbs; and the list was dominated by trees (23 species) followed by shrubs (18 species) and herbs (17 species). Leaves, leafy twigs, bulbs, rhizome, roots, wood, flowers, fruits, resins as well as the whole plants were found to be used either in fresh or dried condition. In case of herbaceous species, the whole plant or in some cases leafy twigs were used as incense or insect repellent or both. Dried wood or wood chips, resins, leaves or leafy twigs are the mostly used parts for tree species whereas the leafy twigs or leaves are the frequently used botanicals. Though the recorded botanicals were from different taxonomic groups like gymnosperms, monocots, dicots; and various habit groups – tree, shrubs, herbs etc, but they all are aromatic in nature and thus release characteristic odour or fragrance on burning or crushing and that make them suitable for incense and insect repellent agents.

The recorded botanicals which were used as incense were burnt either singly or as mixture of two or more; and to burn them slowly for prolong period as well as to produce aromatic fume they were blended with coconut husk, wood chips, cow-dung cake, charcoal etc in a specially devised container made up of alluminium called *saangur* or *pokey*. The incense materials are very closely and inseparably linked with different rituals of the tribes of Himalayan belt like – birth, marriage, death (Bhujel and Rai, 2007); worship or *pujaa* where they are burnt to generate fragrant fumes called *saang* or *dhunaa* that acts as air purifier and make the ambience pleasant and soothing. As per the belief of the users, it helps to remove and eliminate the demons and negative energy and to invite the spirit and divinity which ensure the welfare of humanity. The activities of burning incense botanicals are a kind or regular activities, and part of their rich tradition and traditional knowledge system of different ethnic communities in this Himalayan belt.

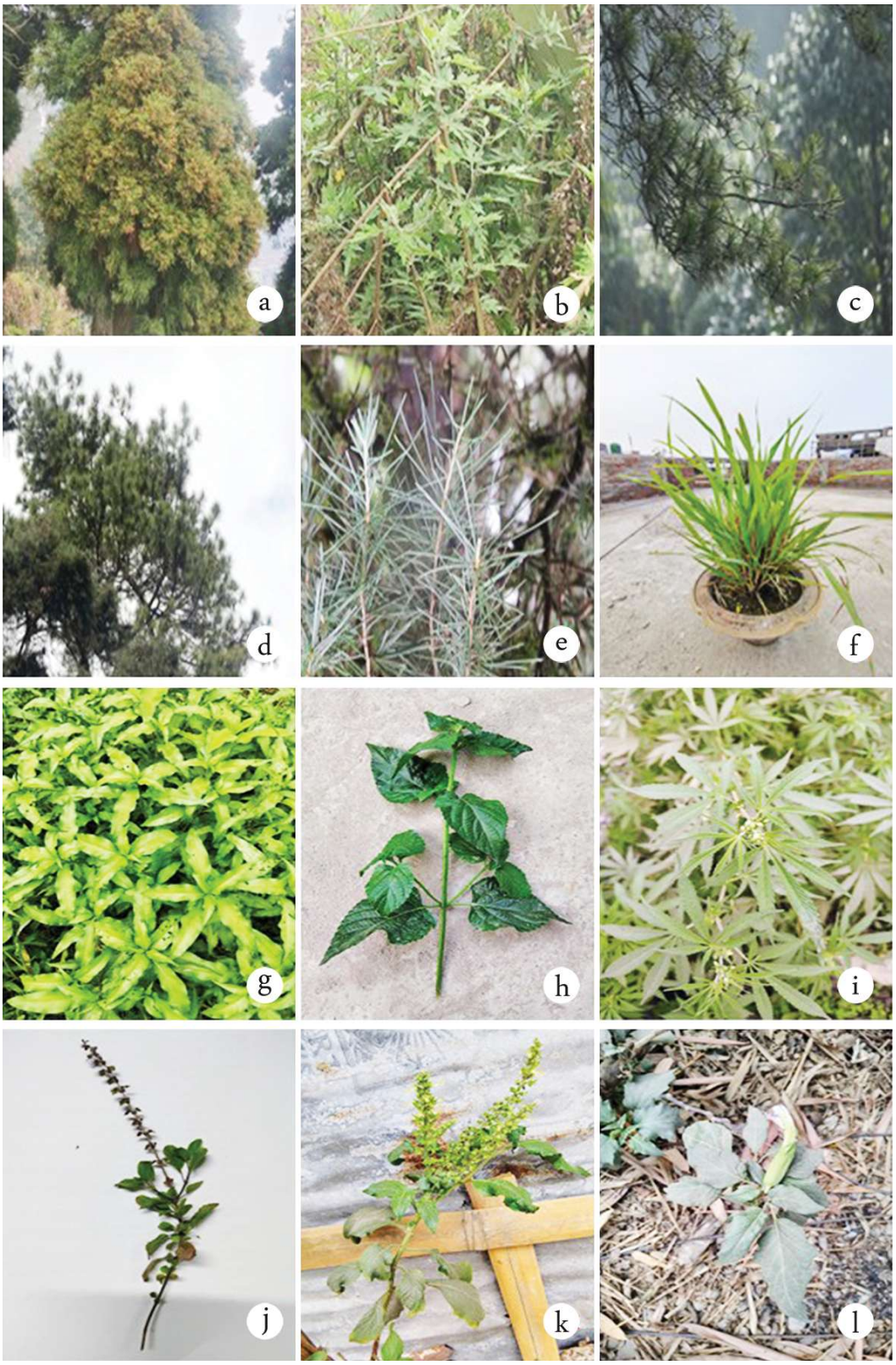

Fig. 1. (a-l): Some of the incense and insect repellent plants [**a**-*Cryptomaria japonica*; **b**-*Artemisia vulgaris*; **c**- *Pinus roxburghii;* **d**- *Pinus wallichiana*; **e**- *Cedrus deodara*; **f**-*Cymbopogon citratus;* **g**-*Persicaria hydropiper;* **h**- *Lantana camara;* **i**- *Cannabis sativum*; **j**- *Ocimum tenuiflorum*; **k**- *Ocimum gratissimum;* **l**-*Datura metel*]

Fig. 2. (a-j): Some of the incense and insect repellent plants [**a**-*Cinnamomum tamala*; **b**-*Justicia adhatoda*; **c** - *Melia azedarach*; **d**- *Gmelina arborea*; **e**- *Azadirachta indica*; **f**-*Santalum album*; **g**- *Vitex negundo*; **h**- Saangur or pokey, the alluminium container for burning saang or dhuna; **i**- *Kaempferia rotunda*; **j**- *Chromolaena odorata*]

Majority of the botanicals like fresh twigs and dried wood chips of different gymnosperms, dried or fresh whole plant of aromatic angiospermic herbs, twigs or leaves of shrubs, aromatic woods of trees are burnt singly or in the form of mixture to produce smoke that repels insects and pests and refresh the environment; Some rhizomes with aromatic essential oil as for example *Zingiber officinale*, *Valeriana jatamansii*, *Kaempferia rotunda* etc or bulbs and leaves of *Allium sativum* are crushed and kept at the corner of the house or sometimes made into aqueous solution and sprayed to keep away the insects. Some of the botanicals are applied in the exposed body parts to repel the insect and to treat the insect bite. Notably almost all the plant materials recorded during this survey were found to be used as insect repellents as well as incense.

Present survey also emphasized on the source and availability of the incense and insect repellent botanicals and found that (i) in rural areas the users generally collect the botanicals from their surrounding vegetation and or forest, nearby tea gardens, agricultural fields or from their home/kitchen gardens. The elderly knowledgeable people who are concerned with the uses and rapidly increasing unavailability of those important botanicals has started growing them in their home or kitchen garden (ii) in the urban and sub-urban areas the plant materials are purchased from organized markets as well as from the rural *haats* either in the form of packaged dried mix of several botanicals in the name of *saang*, *charu, dhup or dhunaa etc.* or in the form of fresh twigs or leaves etc.

Those packaged mix of botanical contained dried leaves, twigs, wood chips, and fruits of some *Rhododendron* spp., Gymnosperms etc from high altitude area. Interviews with the seller/shopkeepers revealed that those packaged *saang* containing high altitude Rhododendrons, Gymnosperms and other plants were collected from different Reserved and Protected Forests, Wildlife Sanctuaries and National Parks including Senchal Wildlife Sanctuary, and Singalila National Park by the needy people and deliver to the sellers directly or through some porter/middle man. Thus, it indicated the unlawful collection and illegal trading on those forest produces from different protected forests.

During the present survey global status of threats to the species recorded to be used as incense and insect repellent materials, were determined using IUCN Red list. They were found to belong to almost all the categories of threats. *Nardostachys jatamsansi* was found to be Critically Endangered, *Kaempferia rotunda* as Endangered, *Abies spectabilis, Chamaecyparis lawsoniana* and *Cryptomeria japonica* as Near Threatened, *Santalum album* as Vulnerable and others belonged to Least Concerned, Not Evaluated or Data Deficient categories.

Discussion

The Darjeeling Himalayan region's temperate-subtropical climate creates a prolific environment for diverse insect populations, particularly during the monsoon. The consistent use of 58 species for both incense and pest control is not merely a cultural artifact but a practical response to these ecological conditions. Families such as Lamiaceae, Cupressaceae, and Asteraceae are globally recognized for their high concentrations of volatile essential oils like terpenes, phenols, and ketones (Regnault-Roger *et al.* 2012); and when burned as *saang* or *dhunaa*, these compounds act as potent neurotoxins or deterrents to mosquitoes and houseflies. This kind of dual use - spiritual purification and physical protection, suggests a highly evolved system of Traditional Ecological Knowledge where religious purity and public health are inseparably connected.

The deep-seated belief that aromatic fumes eliminate "demons" or "negative energy" highlights the psychological and social importance of these botanicals. As noted by Bhujel and Rai (2007), the use of specific botanicals in birth and death rituals suggests that these plants serve as cultural markers of transition.

Interviews with sellers, buyers, Monks and Pandits, and elderly knowledgeable persons it was well understood that availability of the major components of incense and insect-repellent biomaterials like high altitude Rhododendrons, some gymnosperms, aromatic herbs are decreasing day by day leading to their price hiking and sifting of demands from herbal incense to the herbal based semi synthetic or synthetic incense

and insect repellent agents. Thus, a significant shift was observed from subsistence gathering to commercial exploitation. In urban centres, the reliance on pre-packaged mixtures (*saang* and *charu*) has detached the consumer from the source. This commercialization has two major consequences: firstly, the rise in prices for authentic botanicals has led to the inclusion of semi-synthetic or lower-quality substitutes in market-bought incense; and secondly, perhaps the most alarming finding is the organized "unlawful collection" from Senchal Wildlife Sanctuary and Singalila National Park. The involvement of middlemen and porters indicates that the demand for ritual plants is driving a concealed economy that bypasses protected area regulations.

The study highlights some critical discrepancies between global IUCN rankings and local field observations. For example, *Cryptomeria japonica* is categorized as "Near Threatened" (NT) globally, yet it dominates the Darjeeling landscape due to its widespread historical monoculture plantations. Conversely, species like *Rhododendron anthopogon* and *R. lepidotum* are listed as "Least Concern" (LC) globally, but the interviews with local collectors suggest their populations are thinning rapidly due to over-extraction.

The presence of Critically Endangered (CR) species like *Nardostachys jatamansi* and locally Endangered (EN) species like *Kaempferia rotunda* in commercial incense mixes require immediate intervention. As these plants are harvested for their roots or rhizomes, the extraction process is inherently destructive, preventing natural regeneration and thinning the population density. To prevent the erosion of both biodiversity and traditional culture, the study suggests a shift toward Ex-situ conservation. The practice of "kitchen gardening" observed among rural elders should be dignified into community-based nurseries. Furthermore, the pharmacological validation of these insect-repellent plants could lead to the development of eco-friendly, bio-pesticides, providing an alternative income source for the "needy people" currently engaged in illegal forest extraction.

In conclusion this study confirms that a rich and functional tradition of utilizing aromatic plants in Darjeeling Himalayan region and the identification of 58 species across 26 families highlights a profound botanical knowledge system that serves both the spiritual and practical needs of ethnic communities. These plants are not merely resources but are deeply embedded in the cultural fabric of the region, from birth, marriage and death rituals to daily pest management.

The findings also reveal a critical intersection between traditional use and modern conservation crises. The dependence on high-altitude species, combined with the shift toward commercialized "packaged" incense, has led to significant ecological pressure. The unlawful collection from protected areas such as Singalila National Park and Senchal Wildlife Sanctuary underscores the urgent need for a more regulated and sustainable supply chain.

Furthermore, the presence of Critically Endangered (CR) and locally Endangered (EN) species like *Nardostachys jatamansi* and *Kaempferia rotunda* in local markets is alarming. Because these species are often harvested for their roots and rhizomes, their extraction is inherently destructive and threatens the long-term survival of these taxa in the wild.

Thus, the present study recommends domesticated cultivation encouraging the "kitchen garden" model for ritual plants to reduce the pressure on wild populations and provide a sustainable source for local communities; enforcement of Protected Areas for strengthening the monitoring of illegal trade routes from National Parks and Wildlife Sanctuaries; phytochemical valorisation to the development of eco-friendly, locally-sourced bio-pesticides, creating a "green economy" for rural inhabitants; and Educational Outreach and sensitizing both sellers and consumers about the threat status of species and ultimately to conserve the floristic, ecological and cultural diversity of this part of Himalaya Hotspot of Biodiversity Conservation, in an integral form.

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