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Survey of aromatic plants in Kalakkadu Panchayath, Tirunelveli District, Tamil Nadu, India

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Abstract
The current study was carried out in Kalakkadu panchayath to identify the major aromatic plant species in the wild. The study area is in Tirunelveli District, which is located in the southern tip of peninsular India and has a rich diversity of plants scattered across the district's hills and hillocks. However, published data on the survey of aromatic plants in Kalakkadu Panchayath, Tirunelveli district, Tamilnadu are scant, and reports on the survey of aromatic plants in the selected area are scarce. As a result, the current research was conducted to survey the aromatic plants of Kalakkadu Panchayath, Tirunelveli District, and Tamil Nadu. The study discovered 33 aromatic plant species from 28 genera and 21 families.The primary source of aromatic plant in terms of the number of species is Trees (9), Shrubs (10), herbs (11) and Climbers (3). The higher number of species falls in the Lamiaceae (5) family followed by Piperacea (3), Oleaceae (2), Zingiberacea (2), Rutaceae (2), Liliaceae (2). Familes like Rosaceae, Solanaceae, Poaceae, Euphorbiaceae, Anacardiaceae, Lythraceae, Pandanaceae, Santalaceae, Apiaceae, Meliaceae are represented with single species. Lamiaceae is the dominant family. Of the various plant parts which are having aromatic nature leaves of 10 plant species, followed by root/rhizomes/tubers of 2 plant species, whole plant of 12 plant one species, fruit of 2 species, bark of plant species, flowers of 1 plant species, show aromatic properties. Within the documented data, 29 species are dicots and 4 species are monocots. Among these 33 plants, 17 plants emanate musky (perfume) like odor, 2 plants emanate, putid smell, 8 plants for pungent odor, 4 plants emanate floral like odor, 2 plants for peppermint like odor emanated from different parts of the plants. There is an obvious need to investigate aromatic medicinal plants of sustainable genetic resource utilization, which will also add new aspects to medicinal and aromatic plant garden management. The conservation of valuable aromatic medicinal plants would increase the wealth of the forest and, as a result, the nation.

Keywords: conservation, documented, emanate, lamiaceae and pungent

Introduction
Aromatic plants are distinguished by their pleasant, distinct fragment smell. The fragrance of these plants is due to their essential oil content. Essential oils are complex natural mixtures of volatile secondary metabolites, primarily mono and sesquiterpenes, as well as carbohydrates, phenols, alcohols, ethers, aldehydes, and ketones. Aromatic plants have odorous volatile substances that appear as essential oil, gum, exudates, balsam, and oleoresin in one or more parts of the plant, namely the root, wood, bark, stem, foliage, flower, and fruit (Joshi, 2013).
The study area is in Tirunelveli District, which is located in the southern tip of peninsular India and has a rich diversity of plants scattered across the district's hills and hillocks. However, published data on the survey of aromatic plants in Kalakkadu panchayath, Tirunelveli district, Tamilnadu are limited, and reports on the survey of aromatic plants in the selected area are scarce. As a result, the current research was conducted to survey the aromatic plants of Kalakkadu Panchayath, Tirunelveli District, and Tamil Nadu.

Materials and Methods
The field survey was conducted from October to April 2021-2022 to collect information (during different seasons) from various locations in Kalakkadu panchayath, Tirunelveli District. Residents were interviewed to gather information on aromatic plants.
We have collected aromatic plants for medicinal purposes in order to adapt aroma identification by using physical methods, such as squeezing plant parts and inhaling through the nose and used to cure various ailments. Because the nostrils of the human nose contain a number of factory receptor neurons that function as sensory signalling cells to detect odours. Personal interviews were used to collect all of the plants, and the information gathered was recorded in a field note book. Taking photographs in the field and creating a digital herbarium with floras (Gamble and Fischer, 1915-1935).

Detection of Odor

The classical olfactory method is the current state of the art method for detecting odour emission. This method of odour assessment is based on a sensory panel made up of a group of people known as panellists who have a 95 percent chance of having average odour sensitivity. However, physiological differences in the panel members' smelling ability result in subjective results. Furthermore, the olfactory is very expensive and requires precise understanding in an experienced odour laboratory in order to produce reliable results.

Analysis of Odor

The physical method can be used to analyse the odour. In the field survey, panellists are collected, and plant parts are squeezed by hand to inhale the odour through the nose. Based on this concept, different categorizations of primary odours have been proposed, which can be recognised into seven types, namely musky (Perfume), putid (Rotten eggs), pungent (Vinegar), camphoraceous (Moth Balls), ethereal (Dry cleaning fluid), floral (Rose (2010). The odour and medicinal properties of aromatic plants were also discussed with knowledgeable people in the study area. All information gathered was also recorded in the field note book.

Results and Discussion

The study revealed 33 aromatic plant species belonging to 28 genera and 21 families in the Kalakkadu Panchayath, Tirunelveli District. The availability status and indigenous uses of the plant family and local name have been presented in Table 1. The primary source of aromatic plant in terms of the number of species, Trees (9), Shrubs (10), herbs (11) and Climbers (3) (Fig. 2). The higher number of species falls in the Lamiaceae (5) family followed by Piperacea (3), Oleaceae (2), Zingiberacea (2), Rutaceae (2), Liliaceae (2). Familes like Rosaceae, Solanaceae, Poaceae, Euphorbiaceae, Anacardiaceae, Lythraceae, Pandanaceae, Santalaceae, Apiaceae, Meliaceae are represented with single species. Lamiaceae is the dominant family. Of the various plant parts which are having aromatic nature leaves of 10 plant species, followed by root/rhizomes/tubers of 2 plant species, whole plant of 12 plant one species, fruit of 2 species, bark of 2 plant species, flowers of 4 plant species and wood of 1 species, show aromatic properties (Fig.: 3).Within the documented data, 29 species are dicots and 4 species are monocots (Fig: 1).The information regarding the medicinal properties in curing various diseases collected from the study area is given in (Table: 2).

These aromatic plants can use for human is various applications. Aromatic plant like *Santalum album*, *Lawsonia inermis* and *curcuma longa* are used as natural dye yielding plants. Natural dyes obtained from the plants are used in handlooms and in natural drawings and paintings. Natural health drinks prepared from the species like *Hemidesmus indicus*, *Citrus medica*, *Emblica officinalis*, *Mangifera indica*, *Psidium guajava*, *Punica granatum* and *Zingiber officinale* give cooling effect to the body in summer and the active principle isolated from these plants are now using as a flavours compound in soft drink and as an additives in ice creams & in other foods. The species of *Jasminum* have flowers with pleasant sweet smell which have potential ornamental importance in countries like India.

Species like *Citrus* yield oils and along with the characteristic of this plant produce fruits of commercial value (pickle preparation). The oils obtained from the *Ocimum* species are used in body massage, Pharmaceutical preparation and in several cosmetic manufacturing industries like soap shampoo, paste of in perfume industries.

Species like *Curcuma*, *Piper*, *Zingiber* are used as spice in house hold purpose of they have great economic importance. Flowers of *Rosa* species, *Polyanthes* are used to make garlands. Regular usage of *Aloe vera*, *Centella asiatica*, *Vetiveria zizanoides*, *Hemidesmus indicus*, *Murraya koenigii*, *Piper longum*, *Piper nigrum*, *Piper betel*, *Ocimum sanctum*, *Santalum album*, *Zingiber officinale*, *Psidium guajava* etc are well reported in earlier literature and were recorded from the tribes for curing various ailments, as pesticides, preservatives as oils, and for giving aroma or flavour to foods in the form of powder, paste, decoction, as oils etc.

Some of the important medicinal plants species has played a major role in ethanobotany such as *Ocimum sanctum*, *Leucas aspera*, *Piper longum*, *Murraya koenigii* (Kiruba and Geetha, 2006). Reported that *Aloe vera*, *Azadirachta indica*, *Piper longum*, *Ocimum Sanctum*, *Vetivera zizanoides* are highly contributed in medicinal properties of tribal people in Kanyakumari district of western Ghats. According to Geetha *et al*., 2016, plants such as *Aloe vera*, *Azadirachta indica*, are mostly used by the Malayali tribals in Kolli hills of Namakal district.

Flowering and fruiting are the most important stages in a plant's life cycle. Aromatic plants' life cycles were accelerated by seasonal flowering and fruiting. It will ensure their proper distribution and diversity in that region. The study discovered that the majority of aromatic species flower and fruit during the winter-to-summer transition. The seasonal variations in flowering and fruiting observed in this study did not correspond to previous observations (Ali and Dixit, 1986). This could be due to changes in climatic conditions, as environmental factors regulate various phenological characteristics of plant species. Eleven of the aromatic plants collected are wild, twenty-one are cultivated, and one is ornamental.

According to the findings of this study, the area has a high diversity of wild aromatic plants. Species like *Aloe vera* L., *Annona squamosa* L. *Azadirachta indica* A.Juss, *Centella asiatica* (L.) Urban, *Citrus medica* L., *Curcuma longa* L., *Emblica officinalis* G., *Hemidesmus indicus* (L.) R. Br., *Jasminum grandiflroum* L., *Jasminum officinale* L., *Lawsonia inermis* L., *Leucas aspera* Spreng, *Mangifera indica* L., *Melaleuca citrina* (Curtis) Dum. Cours, *Murraya koenigii* (L.) R. Br., *Ocimum basilicum* L. *Ocimum sanctum* L., *Ocimum tenuflorum* L., *Pandanus amaryllifolius* Roxb., *Piper betle* L., *Piper nigrum* L., *Piper longum* L., *Plectranthus amboinicus* (Lour.) Spreng., *Polianthes tuberosa* L., *Psidium guajava* L., *Punica granatum* L., *Rosa* sps,

Santalum album L., *Solanum nigrum* L., *Vetiveria zizanoides* L., *Zingiber officinale* Roscoe are reported. The residents revealed a rich presence of many of those species in the area in the past, which has now been restricted to specific patches. If immediate steps for their sustainable utilization and conservation are not taken, these species in the area may become threatened.

During the survey, it was discovered that the local people of the area rely heavily on wild plant resources for aromatic purposes. They go to Kalakkadu (study area) frequently to collect aromatic plants. Plant parts used for decoction, medicinal purposes, and cosmetic supplements included leaves, fruits, flowers, bark, soft wood, root, rhizome, and whole plants. The time and frequency with which various plants and plant parts were collected varied from plant to plant, depending on their availability. Methods of preparation and uses are classified as medicinal, ornamental, decoction, and eaten raw.

Among these 33 plants, 17 plants emanate musky (perfume) like odor, 2 plants emanate, putid smell, 8 plants for pungent odor, 4 plants emanate floral like odor, 2 plants for peppermint like odor emanated from different parts of the plants (Fig: 5). In plants emanate floral, musky of pepper mint like odor are highly useful for medicinal as well as perfumery works of pharmaceutical industries. The remaining plants emanate ethereal, putid, pungent of camphoraceous odor will be useful in the preparation of pesticide of insecticide purposes: In this direction the potentiality of all these aromatic medicinal plants have been screened by using modern scientific methods to evaluate the active compounds present in these plants. The environmental factors also play very important role in the changes of odor intensity. In varying season, the intensity of the odor is distinct even in the less odorous plants. In summer, the detection of odor types and its intensity is not accurate, because of the stress in plants will decline the essential oil secretion is also affect on the determination of the intensity of odor through physical method.

The discussions with the residents revealed that the aromatic plant resources are used as common household medicine and contribute significantly to the medicinal security of the people in the area. As a result, extensive education about their importance and assessment of their medicinal value are required in order to serve as a direct or indirect source of aromatic plants to the local inhabitants. This may bring to light one or more new aromatic plants from the wild for our country's ever-growing population.

Plants contain complex chemical components such as alkaloids, terpenoids, phenols, and aldehydes. Essential oils are extracted from plants and used for a variety of therapeutic purposes resulting from chemical combinations of these components, including those used as insect and pest repellants. As a result, it stands to reason that the source of essential oils. Depending on the plant, the plant may have similar properties. Scientists and botanists are still unsure how plants' complex structure works to repel insects (Karen et al., 2009). Essential oils are typically extracted from one or more plant parts, such as flowers, leaves, stems, bark, wood, roots, seeds, fruits, rhizomes, gums, or oleoresin exudations. The aromatic and medicinal plants found in nature are the property of the government. There are numerous approaches to identifying medicinal and aromatic plants. In general, they can be divided into two categories: traditional methods and modern approaches. Traditional methods are less expensive, non-destructive, and non-invasive, but they rely heavily on the skill and expertise of the individuals involved. Modern approaches may be invasive or destructive in the sense that some specimen may be lost during analysis and will not be recovered (Poduri, 2013).

Aromatic plants, as well as their extracts and essential oils, contain a wide range of functional bioactive compounds. In association with alkaloids, a complex mixture of lipophilic compounds, essential oils, and possibly terpenoids, flavonoids, and fatly acids was detected. These findings agreed with other photochemical data (Rodrigues et al., 2003). Aromatic plants and their extracts, on the other hand, should be standardised and properly controlled in their extraction and composition. To confirm the efficacy of the extracts, in vitro studies using standardized extracts should be completed prior to in vivo experimental research.

Furthermore, the system based on human sensory is unsuitable for continuous monitoring (Yuweno and Lammers, 2004). According to Wor and Valerie (1991), it is believed that the aroma of plants is the key to controlling unwanted insects, pests, and critters in the garden. Whatever the scientific reason for plant and natural pest control, many gardeners believe in the concept and have success in controlling pests. Naturally wild aromatic plants are those that grow in their natural habitats with or without emitting fragrance. Excessive exploitation of wild scented plants may endanger certain species (Samydurai et al., 2012). Medically, these plants are extremely beneficial, but they have yet to be commercially exploited. Science is involved in the multipurpose utilisation of aromatic plants, which may result in a decrease in species abundance and, eventually, local extinction (Panday and Thripathi, 2010). These plants also contained essential oils. Due to a lack of quality and quantity, pharmaceutical industries also disregard these plants for commercially isolating essential oil. Traditional people still use these plants to treat certain ailments and to keep insects, pests, bedbugs, and mosquitoes at bay. To assess the current state of production, utilisation, and conservation of these wild aromatic medicinal plants in and around the study area, as well as to identify future conservation needs and development opportunities. In some cases, a species' population size is inherently low, and anthropogenic pressure in the form of grazing trampling and extraction methods results in population decline (Uniyal et al., 2002). Cultivation is an effective conservation method that ensures a consistent supply (Javed et al., 2013). The study's findings are expected to be useful for decision-makers and those responsible for the management of medicinal and aromatic plants in order to promote a better understanding of the conditions required for the sustainable use of these plants in national parks (Centinkaya, 2010). In this study, we raise awareness among producers about the value of wild aromatic medicinal plants in order to promote cultivation, with a particular emphasis on small-scale farmers.

Table 1: Survey of Aromatic Plants in the Selected Study Area

S. No	Name of the Plants	Family	Local Name
1	*Allium cepa* L.	Liliaceae	Onion
2	*Aloe vera* L.	Liliaceae	Kathalai
3	*Annona squamosa* L.	Annonaceae	Seetha phal
4	*Azadirachta indica* A. Juss	Meliaceae	Neem
5	*Centella asiatica* (L.) Urban	Apiaceae	Vallari
6	*Citrus medica* L.	Rutaceae	Bitter orange
7	*Curcuma longa* L.	Zingiberaceae	Manjal
8	*Hemidesmus indicus* (L.) R. Br.	Apocynaceae	Nannari
9	*Jasminum grandiflorum* L.	Oleaceae	Pitchi
10	*Jasminum officinale* L.	Oleaceae	Jasmine
11	*Lawsonia inermis* L.	Lythraceae	Maruthani
12	*Leucas aspera* Spreng.	Lamiaceae	Thumbai
13	*Mangifera indica* L.	Anacardiaceae	Mango
14	*Melaleuca citrina* (Curtis) Dum. Cours.	Myrtaceae	Bottle brush
15	*Murraya koenigii* (L.) R. Br.	Rutaceae	Curry leaf
16	*Nerium oleander* L.	Apocynaceae	Aralli
17	*Ocimum basilicum* L.	Lamiaceae	Thiruneechu pacchali
18	*Ocimum americanum*L.	Lamiaceae	Naithulasi
19	*Ocimum tenuiflorum* L.	Lamiaceae	Karunthulasi
20	*Pandanus amaryllifolius* Roxb.	Pandanaceae	Rambai
21	*Piper betle* L.	Piperaceae	Vethalai
22	*Piper longum* L.	Piperaceae	Thippili
23	*Piper nigrum* L.	Piperaceae	Milagu
24	*Phyllanthus emblica* L.	Euphorbiaceae	Nelli
25	*Plectranthus amboinicus* (Lour.) Spreng.	Lamiaceae	Karpuravalli
26	*Polyanthes tuberosa* L.	Asparagaceae	Chambanki
27	*Psidium guajava* L.	Myrtaceae	Guava
28	*Punica granatum* L.	Punicaceae	Mathulai
29	*Rosa indica* L.	Rosaceae	Rose
30	*Santalum album* L.	Santalaceae	Sandal
31	*Solanum nigrum* L.	Solanaceae	Manathakkali
32	*Vetiveria zizanoides* L.	Poaceae	Vetiver
33	*Zingiber officinale* Roscoe.	Zingiberaceae	Ginger

Table 2: Medicinal uses of Collected Aromatic Plants in the Study Area

S. No	Botanical Name	Family	Medicinal Uses
1	*Allium cepa* L.	Lillaceae	Onions have many possible health heart, disease and cancer benefits including the risk of obesity
2	*Aloe vera* L.	Liliaceae	For hair, ear, as facial cleanser
3	*Annona squamosal* L.	Annonaceae	The squeezed leaf juice is applied externally to expel maggots from wounds
4	*Azadirachta indica* A. Juss	Meliaceae	Neem leaf is used for, eye disorders, Stomach upset, skin ulcers, etc.
5	*Centella asiatica* (L.) Urban	Apiaceae	Vallarai a blood purifier used for treating high blood pressure and said to promote longevity.
6	*Citrus aurantium* L.	Rutaceae	The fruits are made into pickles. The leaf paste is applied for Abscess and boils.
7	*Curcuma longa* L.	Zingiberaceae	Turmeric boiled in milk and sugar that helps smoothening throat, treat respiratory ailments
8	*Emblica officinalis* G.	Euphorbiaceae	As antioxidant, tonic and cosmetics
9	*Hemidesmus indicus* (L.) R. Br.	Apocynaceae	The water boiled decoction with asbestos is used for hemorrhages in women, Hepatopathy, nephropathy, leucoderma and vomiting.
10	*Jasminum grandiflorum* L.	Oleaceae	The flowers are also used to treat headaches. The leaves are chewed as a remedy for ulcers or eruptions in the mouth.
11	*Jasminum officinale* L.	Oleaceae	In cosmetics
12	*Lawsonia inermis* L.	Myrtales	The plant is famous for its anticancer and anti inflammatory activities.
13	*Leucasaspera Spreng*	Lamiaceae	Chronic skin eruption, psoriasis and cough

14	*Mangifera indica* L.	Anacardiaceae	These leaves help to lower the blood pressure as they have hypotensive properties.
15	*Melaleuca citrina (Curtis) Dum cours*	Myrtaceae	The dried leaves are burned and the smoke spread to repel insects and pests in cattle yard.
16	*Murraya koenigii* (L.) Sprenge	Rutaceae	As diuretic, carminative
17	*Nerium oleander* L.	Apocynaceae	Skin related problems, Snake bites, joint pains, leprosy, Lancer, ulcers etc.
18	*Ocimum basilicum* L.	Lamiaceae	Stomach problems, such as spasms, loss of appetite, intestinal gas, diarrhoea and constipation
19	*Ocimum sanctum* L.	Lamiaceae	Stomach ache, head ache, leucoderma asthma, bronchitis and skin diseases
20	*Ocimum tenuiflorum* L.	Lamiaceae	Traditional medicinal purpose and for its essential oil. It is widely used as a herbal tea.
21	*Pandanus amaryllifolius* Roxb.	Pandanaceae	Leaf extracts have been thought to reduce fever, relieve indigestion and flatulence, and act as a cardio tonic
22	*Piper betle* L.	Piperaceae	Helps in treating diabetes. It is believed that the components present in betel leaves can reduce the level of sugar in the blood and treating diabetes
23	*Piper longum* L.	Piperaceae	Diarrhoea, indigestion, jaundice, piles and malarial fever
24	*Piper nigrum* L.	Piperaceae	Jaundice, piles, malarial fever, cold fever, head ache and cough
25	*Plectranthus amboinicus* (Lour.) Spreng.	Lamiaceae	Cough, fever and liver tonic
26	*Polianthes tuberosa* L.	Asparagaceae	The extract obtained from plant parts in used in perfumery
27	*Psidium guajava* L.	Myrtaceae	The leaf extracts are used in treatment of acne
28	*Punica granatum* L.	Punicaceae	The antioxidant in pomegranate juice can help remove free radicals, project cells from damage, and reduce inflammation
29	*Rosa indica* L.	Rosaceae	In cosmetics
30	*Santalum album* L.	Santalaceae	Sandal wood oil has been used as an antiseptic and astringent, and for the treatment of headache, stomach ache and urinary disorders.
31	*Solanum nigrum* L.	Solanaceae	Skin diseases, rheumatism, ear and eye diseases
32	*Vetiveria zizanoides* L.	Poaceae	As febrifuge, diaphoretic and stomach ache
33	*Zingiber officinale* Roscoe.	Zingiberaceae	It contains antioxidant properties that prevent free radical damage and protect against aging.

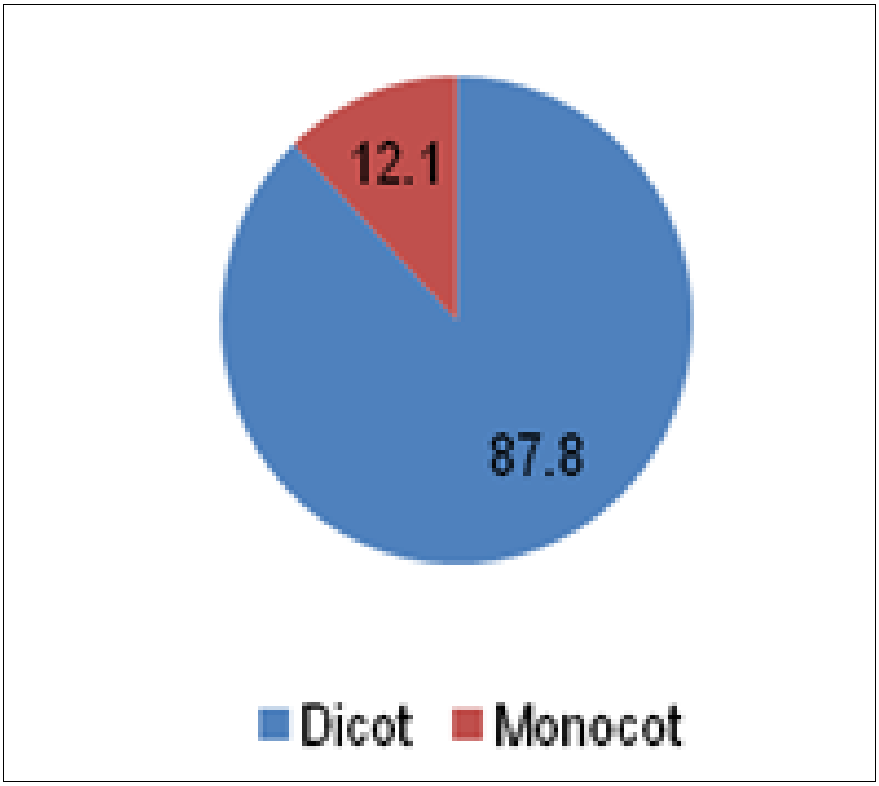

Fig 1: Cotyledon wise distribution of aromatic plants in a study area.

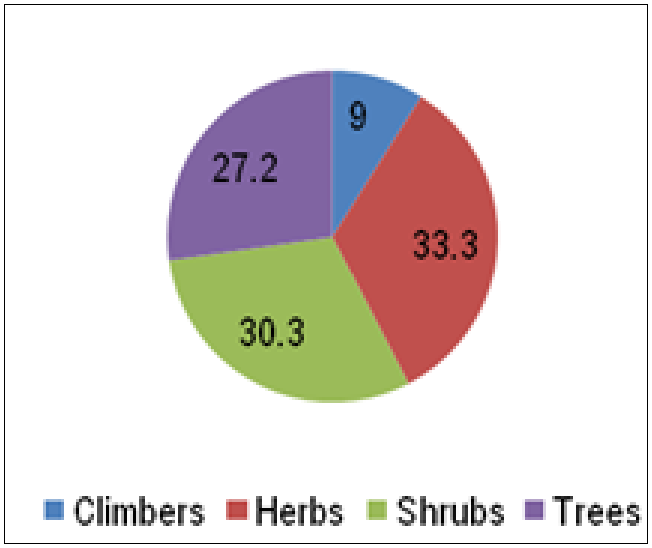

Fig 2: Habit wise distribution of plant species in the study area

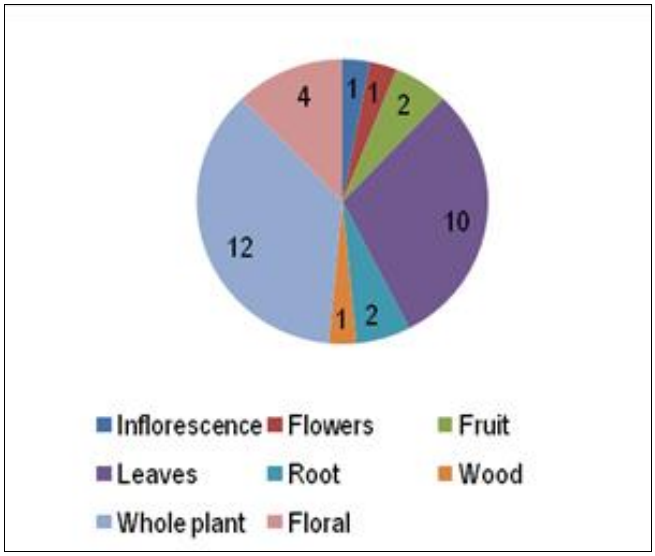

Fig 3: Preparation method of the plant in the study area

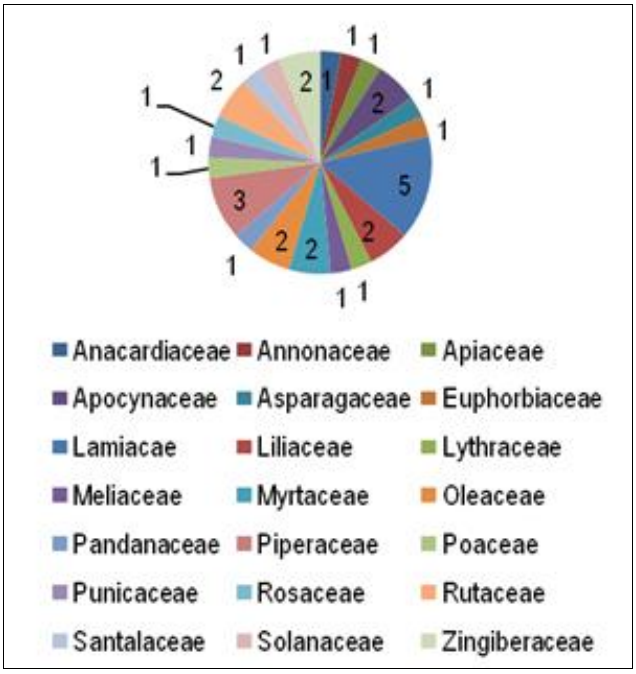

Fig 4: Dominant families and least observed during the study area

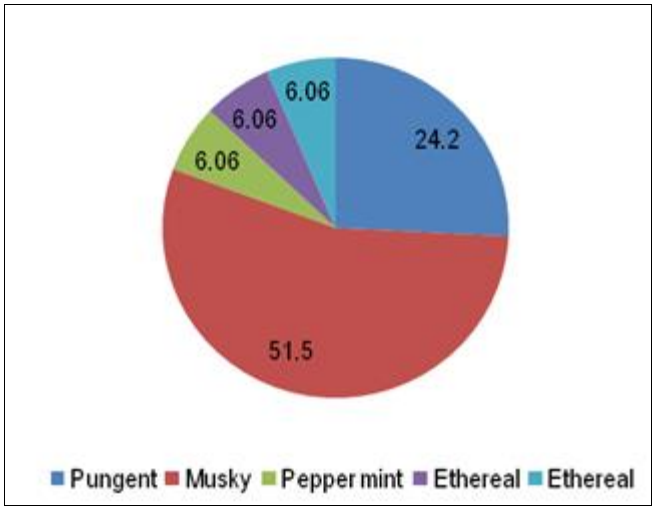

Fig 5: Survey of aromatic plants and its odor type

Conclusion

The current study's findings indicate that the aromatic flora found in the study area plays an important role in the day-to-day functioning of the residents of Nanguneri Panchayath. Traditional knowledge and bio resources must be preserved. There is an urgent need to document tribal knowledge on aromatic plants, or it will be lost forever. Methods for starting sustainable cultivation and modern harvesting programmes to collect plants will be developed. Furthermore, these investigations may lead to the discovery of novel bioactive molecules and provide leads in the search for new potential drugs. To validate the efficacy of indigenous herbal medicines, these plants must be evaluated for phytochemical analyses and ethnopharmacological screenings. Finally, there is an obvious need to investigate aromatic medicinal plants of sustainable genetic resource utilisation, which will also add new aspects to medicinal and aromatic plant garden management. The conservation of valuable aromatic medicinal plants would increase the wealth of the forest and, as a result, the nation.

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