Ethnobotanical Survey Of Anti-Mycotic Plants Indigenous To Tamil Nadu

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ABSTRACT:
Fungal infections pose a significant global health threat, driven by increasing drug resistance, limited efficacy, and adverse effects of conventional antifungal therapies. Medicinal plants provide a promising alternative due to their bioactive phytochemicals and broad-spectrum antifungal activity. Plants such as *Acalypha indica, Allium sativum, Azadirachta indica, Curcuma longa, Lawsonia inermis, Citrus limon,* etc., exhibit potent antifungal effects against pathogens fungal species like *Candida albicans,Trichophyton rubrum, Aspergillus niger. etc.* Key phytoconstituents, including allicin, curcumin, lupeol, flavonoids, and alkaloids, target fungal cell walls, membranes, and enzymatic pathways. These compounds also show synergistic potential with antimycotic drugs, offering enhanced efficacy while mitigating resistance. The minimal toxicity, reduced side effects, and eco-friendly nature of these plant-based agents underscore their therapeutic potential. In this review we are going to discuss about a few indigenous plants of Tamil Nadu that have potent antifungal properties which can be used for further analysis for alternatives to antifungal drugs that have high toxicity, low efficacy and resistance to the current medications. Future studies should prioritize the characterizationand isolation of active compounds to understand their specific antifungal mechanisms and identify synergistic combinations. Research into standardizing extraction methods and developing formulations is critical for ensuring consistent potency and clinical applicability. Preclinical and clinical studies are needed to evaluate the safety, efficacy, and pharmacokinetics of these natural agents. Additionally, the exploration of bioengineering approaches to enhance phytochemical production and testing these agents in combination therapies could further lead to development of modern medicine. Leveraging these advancements can pave the way for innovative, sustainable antifungal treatments to address the growing burden of fungal infections.

Keywords: Medicinal plants, antimycotic plants, antifungal phytochemicals, traditional plants, fungal pathogens, fungal infections

1. Introduction:

According to the World Health Organization (1998), infectious diseases are a major source of morbidity and mortality globally and pose a serious threat to health. Even though human medicine has advanced significantly, infectious diseases still exist (1). It is caused by fungus, and other microorganisms continue to pose a serious risk to public health. This lack of access to medication and the rise in widespread drug resistance make the effects much more severe in underdeveloped nations (2). Pathogenic fungal infections are becoming more widely acknowledged as a growing public health concern(3,4). Due to an increase in the number of immunocompromised people, including organ transplant recipients, cancer patients, and HIV patients, fungal infections have become more common in recent years(5). When the immune system of their human hosts is weakened, certain commensal fungus, such Candida species, can infect them(6). These issues are also connected to toxicity during extended use of several antifungal medications and antibiotic resistance(7). Fungal infections can be treated with a variety of synthetic and natural product-based medications, although their efficacy varies drug interactions with fluconazole (8–11). Moreover, it has been shown for a number of years that fungi have developed resistance to the majority of medications (12). Amphotericin B, referred to as the "gold standard," has limited use due to nephrotoxicity and issues with infusion(13,14). Furthermore, the introduction of safe, innovative, and efficient antifungal medications is highlighted by the low efficacy, side effects, and resistance to the current medications. Numerous secondary metabolites, many of which have antifungal properties, are produced by plants. Similarly, a wide variety of plant extracts, many of which have been tested for *in vitro* antimycotic activity, have been used in traditional

medicine to treat fungal infections. Since plants can defend themselves against fungal infections (15). They seem like a promising source of antifungal chemicals. Traditional medical systems have also documented using medicinal herbs to treat mycoses in humans and animals. They are also thought to be a useful source for the development of novel antifungal medications (16). The use of therapeutic plants in the conventional medical system has been documented and reported in numerous literatures (17). Various aromatic and medicinal plants have rich antimicrobial compounds, which could be used as an alternative in the treatment for bacterial and fungal infections(18). In this review we are going to discuss about a few indigenous plants of Tamil Naduthat have potent antifungal properties which can be used for further analysis for alternatives to antifungal drugs that have high toxicity, low efficacy, and resistance to the current medications.

2. Antifungal plants:

One of South India's most botanized regions is Tamil Nadu, where the usage of plants is still very important, a wealth of information about how to use them to treat various illnesses is abundant. Numerous researchers in Tamil Nadu have investigated the plant's therapeutic qualities. This paper reviews specifically about the plants having anti-mycotic properties.

***2.1 Acalypha indica**:*

Acalypha indica is commonly called Indian copperleaf. It belongs to the Euphorbiaceae family(19,20). Its vernacular names are Kuppivaeni, Kuppaimeni (Tamil), Kuppichettu, Muripindi, Kuppinta, (Telugu), and Kuppamani (Malayalam)(21–23).*Acalypha indica* is a herb grown in tropical dry deciduous forest and plains, In India, it is distributed in Karnataka, Kerala, Madhya Pradesh, Uttar Pradesh, Punjab, Rajasthan, Lakshadweep (20,24).*Acalypha indica* has various therapeutic properties like anti-diabetes, rheumatism, skin problems, anti-inflammation, anthelmintic, anti-cancer, antimicrobial, arthritis, gout, and anti-venom, and it is used to treat headaches, obesity, epilepsy, asthma, and pneumonia(24–27). Phytochemicals present in the roots of *Acalypha indica* are mycophenolic acid, octadecanoic acid, strychnine, oxtriphylline, C16 sphinganine, evoxine, indospicine, mimosine, retusoquinone, oxymorphone, ramipril glucuronide, diamorphine, normeperidine, N-acetylsphingosine, dimethylglycine, dehydrovariabilin, phendimetrazine, mexiletine, quinine, peucenin, 25-hydroxycholesterol, edrophonium, penbutolol, dihydrodeoxystreptomycin, harderoporphyrin, zearalenone, anandamide, penbutolol, phytosphingosine, and evoxine, and *Acalypha indica*leaves contains lupeol, squalene, and dl-alpha. Tocopherol beta-curcumene, Kaempferol, 2-[2-[2-ethylcyclopropyl)m ethyl]cyclopropyl] methyl, Phytol, Cysteine, E-2-Hexenyl benzoate, 3',5'-dimethoxyacetophenone, benzoic acid, and bis(2-ethylhexyl) phthalate 4-Amino-3-methoxypyrazolo[3,4-d] pyrimidine, Campesterol gamma- Sitosterol 2-Methoxy-4-vinylphenol, n-Hexadecanoic acid, cyclopentaneundecanoic acid, 2Hydroxymethyl[1]5- (1-hydroxy-1-isopropyl) -2- cyclohexen-1-one 1,6,10-Dodecatriene, 7,11-dimethyl-3-methylene(28,29). Methanolic and ethanolic extracts of *Acalypha indica* effectively show activity against *Aspergillus niger*and*Candida albicans*. Chloroform extract shows activity against *Candida kefyr*. The acetone extract of *Acalypha indica*have activity against *Candida kefyr*, *Candida tropicalis, and Candida albicans*(27). Flavonoids and alkaloids present in the *Acalypha indica* is responsible for its antifungal activity (30).

2.2 Allium sativum:

Allium sativum is commonly known as garlic, which belongs to the family of Amaryllidaceae (31). It is widely distributed in Kerala, Tamil Nadu, and Arunachal Pradesh (32). *Allium sativum* is one of the most important spices, which is often known as a stinking rose (33). Fresh garlic contains numerous nutrients, vitamins and minerals, such as carbohydrates, proteins, vitamin B1, vitamin B6, vitamin C, calcium, copper, manganese, selenium, phosphorus, and trace elements. Phytochemicals isolated from *Allium sativum* bulbs are alliin, allicin, diallyl trisulfide,E-Ajoene,diallyl sulfide, Z-Ajoene, 2-Vinyl-4H-1,3-dithiin, diallyl disulfide, allyl methyl sulfide, minerals, vitamin B, and flavonoids (34–36). Allicin, diallyl trisulfide, and ajoene are the major chemical constituents present in the garlic (37). *Allium sativum* has many health benefits as caused by the presence of allicin, such as antimicrobial, anticancer, cholesterol-lowering, antioxidant and blood-thinning properties (38).Alliin is transformed by the allinase enzyme into allicin after breaking or cutting the parenchyma cells of garlic(39). Fresh aqueous extract of *Allium sativum* shows potent activity against *A.niger, A.nidulans, A.fumigatus and A.terreus*. This antifungal activity as caused by the presence of allicin and alliin-related compounds(40,41).

2.3 Azadirachta indica:

The evergreen tree *Azadirachta indica*, often known as neem, grows quickly and can withstand both drought and extreme heat. It is indigenous to nations like Bangladesh, Pakistan, and India (42–44). Neem is the member of Meliaceae family. It grows in tropical and semi-tropical climates and is indigenous to India and Burma(45,46).In some regions of the Asian subcontinent, it is consumed as a vegetable, but it has been used

as traditional medicine for the wide range of human infections and diseases. Neem components have been demonstrated to have sedative, anti-inflammatory, antifungal, anthelmintic, antibacterial, anti-angiogenic, antiviral, anti-diabetic, anti-cancer, antioxidant and contraceptive properties(47–52).The Indian tradition has acknowledged the benefits of neem for 1000 of years. Every portion of the neem tree has some therapeutic use(45). Neem leaf, oil and seed kernel extracts work well against Trichophyton, Trichosporon, Candida, Microsporum, Geotricum, and Epidermophyton,among other human fungi.It has previously been observed that extracts of several neem components have strong antimycotic action(53).Compounds that include sulfur, like cyclic trisulphide and tetrasulphide, which were extracted from the steam distillation of mature, fresh neem leaves, exhibit antifungal properties(54).

2.4.Azima tetracantha:
Azima tetracantha is known as kundali. It belongs to the family of Salvodoraceae(55). Its vernacular names are Mulsangu (Tamil),Mundra Kampa, Tella Uppili, Puttupodha, Mursangu, Uppara podha (Telugu), Essanku, Yeshenku, Sankukuppi (Malayalam). *Azima tetracantha* is a shrub found in the foothills of the deciduous forests and tropical dry deciduous forests in Andhra Pradesh, Karnataka, Odisha, Kerala and Tamil Nadu. In Tamil Nadu, it is found in Villupuram district and Tiruvannamalai district(56).It is used in the treat diarrhea, phthisis, asthma, cough, and smallpox. The stem bark decoction is considered antiperiodic, expectorant and astringent(57). The phytochemicals found in the plant are the dimeric piperidine alkaloids azacarpaine,azimine, triterpenoids, neoascorbinogen, carpaineand glucosinolates, as well as new fatty acids. Its leaves also contain isorhamnetin-3-O-rutinoside, carpine, azecarpin and azimine. From *A.tetracantha* leaves, β-sitosterol, glutinol, lupeol, and friedelin are extracted(58,59). The hexane extract of leaves shows antifungal activity *in vitro*. Friedelin present in the extract is responsible for antifungal activity. It can be considered a potential candidate of drug effective against pathogenic fungi-caused infective disease(59).

2.5 Bauhinia tomentosa*:*
Bauhinia tomentosa, commonly called as Yellow Bell Bauhinia, St. Thomas Tree, and Yellow Orchid Bauhinia Belongs to the family of Fabaceae (60,61). Its vernacular names are Mani mandara (Kannada), Kaanchini, Kanchini (Tamil), Manjamanaram, Kanchanapoovu, Kanjenapoovu, Kanjanam, Kanchanamaram (Malayalam),Mandaramu, Kanchini (Telugu)(61–63). *Bauhinia tomentosa* is a shrub found occasionally along riverbanks of Kerala,Tamil Nadu, Karnataka, Odisha, Andhra Pradesh and West Bengal. In Tamil Nadu, it is found in Cuddalore district, Dharmapuri district, Villupuram district, Vellore district and Tiruvannamalai district(61). *Bauhinia tometosa* is traditionally used as an anthelmintic, diuretic, and externally applied on abscesses and skin conditions(64). It contains amino acids, proteins, fatty acids, minerals, lectins, protocatechuic acid, phytohemagglutinins, rutin, quercetin and isoquercetin(62).The methanol leaf extract of*Bauhinia tomentosa*shows significant antifungal activity(65,66).Studies suggest that leaf alcoholic extracts contain kaempferol-7-O-rhamnoside, kaempferol-3-O-glucoside, quercetin-3-O-glucoside and quercetin-3-O-rutinoside(67).

2.6 Cassia auriculata*:*
*Cassia auriculata*is a shrub known as Tanners Cassia or Tanners Senna,it is a member of Caesalpiniaceae family. Caesalpiniaceae is often treated as a subfamily of the large family Leguminosae. In Tamil, it is often known as "Avaram" (68–71). It is found throughout hot deciduous woods of India and wild dry regions of Rajasthan, Tamil Nadu, Madhya Pradesh, and other parts of India(70). For diabetes patients, tea prepared from the flower of *cassia auriculata* was prescribed. Pod husk of *cassia auriculata* contains chrysophanol, nonacosane, nonacosan-6-one, emodin, and rubiadin(72,73). The phytochemical in *Cassia auriculata*leaves was identified by GC-MS analysis and they are of 1,2,3,4-Tetrahydroisoquinolin-6-ol-1-carboxylic acid (1.98%), 13-Octadecenal (2.18%), n-Hexadecanoic acid (3.21%), resorcinol (11.80%), α-Tocopherol-β-D-mannoside (14.22%), and 3-O-Methyl-d-glucose (48.50%)(69). The alcoholic extract of *Cassia auriculata* showed maximum antifungal activity against*Candida albicans* and *Aspergillus niger*(74).

2.7 Citrus limon:
Citrus limon is also known as lemon or lime. *Citrus limon* is the memberofRutaceaefamily(75). *Citrus limon* is a small evergreen tree generally produced in temperate climates (76). In India, it is distributed in Karnataka, Kerala, Maharashtra, Tamil Nadu, Jharkhand, Sikkim, Arunachal Pradesh, Meghalaya, Assam, Nagaland, Punjab, Mizoram, Manipur and Tripura. Its vernacular names are Nimma (Telugu),Malai Elumichai, Kolumichai (Tamil), Kadu limbe, Gaja limbe (Kannada) and Cherunaregam, Ilumbichinaregam, Oduchukuthinaregam (Malayalam)(77). The pulp and peels of the fruit are known for their nutritional, flavor and medicinal values. The secondary metabolites present in the flavedo and albedo of the peels are responsible for medicinal activity, such as phenolic compounds, monoterpenes (limonene) and citric acid, etc. (78–80). In 100% of total *Citrus limon* essential oil, 45 constituents were identified. In these components, the

major constituent is limonene (43.07%). It also contains β-pinene (12.61%), gamma terpinene (11.48%), α-terpineol (7.20%), α-pinene (3.39%), linalool (1.08%), myrcene (1.87%), geraniol (1.48%), cis-α-bergamotene (1.38%), α-terpinolene (2.37%) and α-terpinene (1.32%)(81). The essential oils of *Citrus limon* show antimycotic activity against the various fungi such as *P.verrucosum, A.niger*, *P.chrysogenum* and *A.flavus*(82).The methanolic extract of *Citrus limon* has *in vitro* fungicidal property (83).

2.8 Coriandrum sativum:
Coriandrum sativum, commonly known as coriander and dhanya. *Coriandrum sativum* is a member of the Umbelliferae family(84,85). Its vernacular names are Dhaniyalu (Telugu), Kotthambari (Tamil), Malli, Kothambalari (Malayalam), and Kotthambari (Kannada)(84,86–89). It is a well-known plant distributed in Tamil Nadu, Karnataka, Andhra Pradesh, Rajasthan, Madhya Pradesh, and Uttar Pradesh(84,90). Coriander reports various therapeutic activities, such as sedative-hypnotic activity, hepatoprotective activity, anti-diabetic activity, antioxidant activity, antifertility, anti-ulcer activity, and treating indigestion, bloating, acidity, vomiting, rheumatism, and diarrhea(91–100). *Coriandrum sativum* contains various chemical constituents, including essential oils, phenolics, alkaloids, flavonoids, terpenoids, reducing sugars, sterols,glycosides, fatty acids, and tannins(87,99,101,102). Essential oil of *C.sativum* contains oxygenated monoterpenes and monoterpene hydrocarbons. The major compound present in essential oil is d-linalool (19.8-82%), followed by α-pinene (10.5%), γ-terpinene (9.0%), geranyl acetate (4.0%), camphor (3.0%), and geraniol (1.9%)(103–105). The alcohol constituents of coriander oil have more antifungal activity(106). Essential oil of coriander shows activity against *C. tropicalis*and*C. albicans*. The synergistic effect was observed between coriander essential oil and amphotericin B against *C. tropicalis* and *C. albicans*(98).

2.9 Curcuma longa*:*
Curcuma longa is commonly known as turmeric. It is a well-known indigenous plant that belongs to the Zingiberaceae family (107). In India, turmeric is referred to as the Indian golden spice (108). Its vernacular names are Haldi (Hindi), Manjal (Tamil), Arishina, Haladi (Kannada), Halad, Haldi (Marathi), Pasupu (Telugu), and Manjal (Malayalam). In India, it is distributed in Kerala, Maharashtra, Odisha, Arunachal Pradesh and Tamil Nadu (109,110). It has various medicinal properties such as wound healing, anti-inflammatory, antiallergic, anticancer, hepatoprotective, antispasmodic and anti-HIV properties(111–116). It is also used for treating infections, fever, cough, dysentery, skin diseases, gastritis, chest congestion, hypertension, hypercholesterolemia, menstrual disorder, jaundice, liver problems, diabetic wounds, urinary tract infections and rheumatoid arthritis(117–119). From essential oils of turmeric, more than a hundred chemical compounds are identified. The fundamental constituents are α-turmerone, ar-turmerone, β-turmerone, α-zingiberene, terpinolene, ar-curcumene, santalenone, (Z)-β-ocimene, β-caryophyllene, (Z)-β-farnesene, β-selinene, (E)-γ-atlantone, curlone, α-santalene, β-sesquiphellandrene, β-bisabolene, α-phellandrene, humulene oxide, caryophyllene oxide and 1,8-cineole(120). Essential oils from Indian turmeric rhizome contain α-turmerone, β-elemene, β-sesquiphellandrene, α-farnesene, 1,8-cineole, (Z, Z)-farnesol, β-caryophyllene, ar-turmerone and camphor(121–123). An *in-vitro*evaluation study was conducted on the action of turmeric against C. albicans. This study suggests the natural constituent of *Curcuma longa* inhibits the growth of *C.albicans* and it also shows synergy with fluconazole. Comparing curcumin and fluconazole, curcumin has more potent antifungal activity(124,125).

2.10. Elettaria cardamomum:
Elettaria cardamomum is commonly called as cardamom. It is the member of Zingiberaceae family. Due to its aroma and flavor, It is also called as queen of spices (126–128). In world, *Elettaria cardamomum* is the third most expensive spice (129). *Elettaria cardamomum* has various therapeutic activities such as analgesic, anticarcinogenic, anti-inflammatory, antioxidant, antifungal, antiviral, antidiabetic and to treat , influenza, depression, dysentery, bronchitis, gallbladder problems(130–135). Essential oil of *Elettaria cardamomum* contains various phytochemicals. In that the major constituents are α-terpinyl acetate (29.9-61.3%), linalool (0.4-11.0%), 1,8-cineole (15.2-49.4%), α-terpineol (0.8-13.2%), p-cresol (0.9-9.0%) and Limonene (0.9-9.4%). The minor constituents are α-thujene, α-terpinolene, Nerolidol, terpinen-4-ol, α-citral, β-citral, α-pinene, β-pinene , geranyl acetate, α-terpinene, γ-cadinene, 3-carene, myrcene, and cis-sabinene hydrate(135,136). Acetone extract of *Elettaria cardamomum* seeds show activity against *Candida albicans*. Essential oil of *Elettaria cardamomum* show fungicidal activities against *A.niger, A.oryzae, A.solani andA.flavus*. Phytochemicals like 1,8-cineole, linalool, limonene, sabinene, eucalyptol, sabinene, etc. may be responsible for antifungal activities(137–140).

2.11. Ficus racemosa:
Ficus racemosa is commonly known as fig. It is the member of Moraceae family. It is known by several vernacular names, including Atthimara (Kannada), Umber (Marathi), Atthi, Atthi-al (Malayalam), Atti, Bodda

(Telugu), and Aththi (Tamil) (141). *Ficus racemosa* is reported to have various traditional properties, such as having vermicidal, antipyretic, antispasmodic, antiseptic, expectorant, diuretic laxative, anti-inflammatory and anti-diarrhea. It is also used to treat cardiovascular, gastrointestinal, respiratory, liver and spleen diseases (142–148). *Ficus racemosa* is a tree that grows in tropical semi-evergreen forests and plains. In India, it is distributed in Andhra Pradesh, Karnataka, Kerala, Maharashtra, Odisha, Tamil Nadu, Jharkhand, Madhya Pradesh, Uttarakhand, Sikkim, Himachal Pradesh, Arunachal Pradesh, Meghalaya, Assam, Nagaland, Delhi, Uttar Pradesh, Punjab, Jammu and Kashmir, Mizoram, Manipur and Tripura(141). *Ficus racemosa* contains sterols, tannins, alkaloids, triterpenoids and flavonoids. There are various phytochemicals present in various parts of plants, such as gluanol acetate, leucopel-argonidin-3-O-β-D-glucopyranoside, lupeol, leucocyanidin-3-O-β-D-glucopyrancoside, β-sitosterol, α-amyrin acetate, stigmasterol, lupeol acetate, tiglic acid, taraxasterol and friedelin(149–152). The extract of *Ficus racemosa* by methylene chloride: hexane (1:1). It shows activity against Fusarium species*, Corynesporacassiicola*, *Colletotrichum gloeosporioides*, Curvularia species, and Alternaria species. Psoralen present in *ficus racemosa* are responsible for antifungal activity(153).

2.12. Lawsonia inermis:
The *Lawsonia inermis* Commonly referred to as henna, it is a member of Lythraceae family. It is a shrub-like tree that grows up to 6 meters, and it is cultivated in arid tropical and subtropical regions. Gorante, Madhurangi (Kannada), Gorintachettu, Goranti (Telugu), Mailanchi, Mylanchi, and Pontalasi (Malayalam) are some of the colloquial names for henna. In India, It is distributed in Andhra Pradesh, Kerala, Maharashtra, Uttar Pradesh, Punjab, Rajasthan and Tamil Nadu(154). *Lawsonia inermis* is traditionally used as a hair dye, hair tonic, to treat burn wounds, jaundice and liver illnesses, and itchy skin conditions, and to promote wound healing(155–157). In henna, all the parts contain many phytochemical constituents, such as alkaloids, steroids, phenolic compounds like coumarins, flavonoids, tannins, naphthalenes, naphthoquinones, xanthones, lignans, and alkylphenones, and terpenes compounds, including non-volatile terpenoids and volatile terpenoids(158). Ethanol, ethyl acetate, and hexane extracts from *Lawsonia inermis* show excellent activity against *Trichophyton mentagrophytes* and *Tinea rubrum*(158,159). Polar leaf extracts of henna show potent antifungal activity(160).

2.13. Moringa oleifera:
Moringa oleifera is commonly known as drumstick. It belongs to the moringaceae family (161,162). Its vernacular names are Muringa, Moringa, Sigru (Malayalam); Munaga, Mulaga, Tella munaga (Telugu); Moringa, Murungai (Tamil); Sojna, Sainjna (Hindi); and ShevgaNugge mara (Kannada)(162). Traditional uses of the plant include diuretics, expectorants, stimulants, and antispasmodics. The taste of fresh root is vesicant and bitter, similar to horseradish. It is used internally as an antilithic, diuretic, and stimulant. Gum is mucilaginous and tasteless. Seeds are stimulating and bitter. Additionally, bark has antifungal, antibacterial, and emmenagogue properties. Flowers have cholagogue, stimulant, tonic, and diuretic properties, and they can help to improve bile flow. Additionally, the plant has antibacterial and cardiac circulatory tonic properties. According to reports, this plant's leaves have a number of biological properties, such as hypocholesterolaemia, antidiabetic, and hypertensive effects(163). According to research, the *Moringa oleifera* plant contains phytochemical elements such as proteins, carbohydrates, glycosides, alkaloids, flavonoids, saponins, tannins, and terpenoids. *Candida tropicalis*and *Saccharomyces cerevisiaeare* inhibited by *Moringa oleifera*. When it came to *Saccharomyces cerevisiae*, *Moringa oleifera* water and ethanol extract generated the biggest zone of inhibition(164).

2.14. Murrayakoenigii:
Murrayakoenigii is known as curry leaf. *Murrayakoenigii* belongs to the Rutaceae family (165–168). It is a small tropical tree or evergreen bush found in India. *Murrayakoenigii* is distributed in Maharashtra, Tamil Nadu,Jharkhand, Mizoram, Madhya Pradesh,Uttarakhand, Sikkim, Himachal Pradesh,Odisha, Kerala, Andhra Pradesh, Jammu and Kashmir, ArunachalPradesh, Meghalaya, Assam, Nagaland, Delhi, Manipur and Tripura(165,168,169). Its vernacular names are Khadilimb, Karipatta (Marathi), Karuveppilai (Tamil), Karivepu, Karuveppu, Veppila (Malayalam), Karivempu, Karuveppilai, Kari Bevu, Bevare (Kannada) and Karuvepaku, Karepaku (Telugu)(165,170). *Murrayakoenigii*is used asfebrifuge,anti-inflammatory, antiemetic, blood purifier,antidiarrheal, depressant, body aches, kidney trouble, and vomiting remedy. It also has significant anti-diabetic, antioxidant, antimicrobial, and anti-inflammatory properties(166,171–177). Curry leaves contains chemical constituents like tannins, flavonoids, saponins,alkaloids,glycosidesand triterpenoids/steroids. The major chemical constituents present in the essential oil of *Murrayakoenigii* leaf are 3-carene, β-pinene, α-pinene, β-elemene, linalool, eucalyptol, α-eudesmol, p-cymene, γ-terpinene, α-amorphene, carvone, allo[1]ocimene, Sabinene, γ-terpinene, linalyl acetate, myrcene, β-eudesmol, limonene, α-terpineol, (Z)-β-ocimene, (E)-β[1]ocimene and α-thujene(178,179). *M.koenigii* leaf essential oil has good

antifungal activity. Fungicidal activity of essential oil of *M.koenigii* leaf is due to the presence of mono and sesquiterpenoid constituents(180).

***2.15. Ocimum basilicum**:*
Ocimum basilicum is commonly called basil. It belongs to the Lamiaceae family. It comes from India and is distributed all around the country. Its vernacular names are Tulasi, Tirunirrippachai (Tamil), Tulsi-chettu (Telugu), Pachcha/sivatulasi (Malayalam), Amli, and Huli (Kannada) (181). Basil is useful for toothache, earache, cephalalgia, gouty joints, fever, otitis, snake bite, and headaches. It also helps with digestion(182). The main phytochemicals present in basils are fatty acids (arachidonic acid, linoleic acid, stearic acid, palmitic acid, myristic acid, oleic acid, α-linolenic acid, lauric acid, and capric acid), antioxidants (p-hydroxybenzoic, caffeic, rutin, rosmarinic acids, chlorogenic, quercetin, vanillic, and apigenin), and phenolic compounds(183–186). The essential oils of *Ocimum basilicum* are eugenol, methyl chavicol, α-pinene, β-pinene, 1,8 cineole, borneol, linalool, geraniol, β-caryophyllene, ocimene, and n-cinnamate(187–189). Six strains of *Eurotiumamstelodami,Aspergillus flavus,Cladosporium herbarum, Alternaria species., Botrytis cinerea, and Eurotiumchevalieri* were used to investigate the antimycotic activity of the *Ocimum basilicum* oils. The essential oils of *Ocimum basilicum* showed significant antifungal activity(190,191).

2.16. Phyllanthus emblica:
Phyllanthus emblica is commonly known as Amla. It belongs to the family of Euphorbiaceae. Other common names of *Emblica officinalis* are Emblic Myrobalan and Indian Gooseberry. Its vernacular names are Nelli (Tamil), Bettadanellikaayi (Kannada), Amla (Marathi), Amalakamu (Telugu), and Amalakam, Nelli (Malayalam). The synonym of *Phyllanthus emblica* is *Emblica officinalis*(192,193). It is grown for commercial purposes in the Indian state of Uttar Pradesh. It is also grown in Madhya Pradesh, Rajasthan, and Tamil Nadu (193,194). Dried fruit treats diarrhoea, diabetes, dysentery, and haemorrhage and has antibacterial properties. The fruits of *Phyllanthus emblica* have antimicrobial properties such as antibacterial, antifungal, and antiviral properties (195). Alkaloids, benzenoid derivatives, diterpenes, furano-lactones, flavonoids, and sterols are among the many compounds found in varying concentrations in E. officinalis. It has analgesic, antipyretic, anticancer, antioxidant, antivenom, antitussive, antibacterial, antitumor, antiulcerogenic, hepatoprotective, cytoprotective, and antidiarrheal effects (196–199). Chemical components found in amla are hydrolysable tannins (Emblicanin A and B), alkaloids (phyllantine), phenolic compounds (gallic acid, methyl gallate), amino acids (glutamic acid), carbohydrates (pectin), vitamins (ascorbic acid), flavonoids (quercetin, kaempferol), and organic acids (citric acid)(200). Both bacterial and fungal diseases could be treated with *Emblica officinalis*. The methanolic extract of *Emblica officinalis* showed little antifungal activity, whereas the aqueous extract showed strong antifungal activity at low concentrations(192,201).

***2.17. Piper betle**:*
Piper betle is known as betel leaf and is a member of the Piperaceae family (202). Bengal, Bihar, Orissa, Andhra Pradesh, Karnataka, Uttar Pradesh, and Tamil Nadu are the Indian states where the plant may be found(202–204). Betel leaves are known as Vettila, Vettilakkoti (Malayalam); Vetrilai (Tamil); Vilya, Veeleya, and Villayadel (Kannada)(202,205). Betel leaf is used for bad breath,conjunctivitis, boils,constipation, abscesses, headache, hysteria, itches, mastitis, mastoiditis, leucorrhea, otorrhea, ringworm, gum swelling, rheumatism, abrasion, cuts and injuries, etc.(203). The chemical constituents are 2-methoxy-4-2-propenyl, eugenol (18.27%), 5-(2-propenyl)-1,3-benzodioxol (25.67%), and acetate-phenol (8.0%). The phytochemicals present in *piper betle* are chavicol (53.1%) and chavibetol acetate (15.5%). Other components are chavibetol methyl ester (methyl eugenol 0.48%), eugenol, estragole, camphene, ally pyrocatechol diacetate, 1,8-cineole, α-pinene, α-limonene, safrole, γ-lactone, β-pinene, dotriacontanoic acid, ally pyrocatechol monoacetate, and allyl catechol(205–207). Betel oil contains several terpenoids and terpenes. *C. stellatoidia,C. glabrata, C. parapsilosis, C. tropicalis,C.krusei, C. pseudotropicalis, and C. albicanswere*tested against betel leaf oil, and betel oil inhibited candida development. Eugenol and estragole are phytochemicals with fungicidal properties(208–210).

***2.18. Punica granatum**:*
Punica granatum is known as pomegranate. *Punica granatum* is a tree that belongs to the family of Punicaceae(211). *Punica granatum* fruits are edible and vitamin-rich. It is distributed throughout Karnataka, Kerala, Tamil Nadu, West Bengal, Delhi and Uttar Pradesh (212). Juice of *Punica granatum* contains 85.4% water, 10.6% total sugars, 1.4% pectin and 0.2-1.0% polyphenols (213,214). About 80% of the oil is made up of conjugate doctadecatrienoic fatty acids, with a high concentration of cis 9, trans 11, and cis 13 punicic acid, itself about 7% of Pomegranate seed oil. Seed oil contains over 95% of the fatty acid components, of which triacylglycerols are 99%(215,216). The peels of wild-crafted fruits contain more flavonoids and tannins than those of cultivated fruits(217). Punicalagin isolated from *Punica granatum* peels shows activity against

Candida parapsilosis and Candida albicans. The synergistic effect is showed between punicalagin and fluconazole (218).

2.19. Trigonella foenum-graecum:
Trigonella foenum-graecum is commonly called as Fenugreek.It is belongs to the family Leguminosae (219). Its Vernacular names are Ventayam(Tamil), Pesara (Telugu), uluva, Ulathyam (Malayalam), Menthulu (Kannada) (220,221). In India it is distributed in Punjab, Madhya Pradesh, Gujarat, Uttar Pradesh, Maharashtra and Rajasthan(222,223). Fenugreek has various medicinal uses such as antidiabetic agent, lactation aid, digestive aid, galactogogue, antioxidant property and antimicrobial activity(224–231). Leaves of fenugreek composite of moisture (86.1%), protein (4.4%), fiber (1.1%),minerals (1.5%), carbohydrates(6%) and fat (0.9%,). Iron, zinc, riboflavin, phosphorous, vitamin C, thiamine, Calcium, niacin and carotene are the Vitamins and minerals present in the leaves of fenugreek(232). Fenugreek contains phytochemicals like Alkaloids, amino acids, saponins, steroidal, flavonoids, fibers and proteins such as trimethylamine, carpaine, neurin, trigonelline, betain, choline, gentianine, isoleucine, histidine, 4-hydroxyisoleucine, lysine, leucine, arginine, L-tryptophan, trigofoenosidesAeG, graecunins, fenugrin B, yamogenin, fenugreekine, diosgenin, smilagenin, isovitexin, rutin, gum, quercetin, vitexin, neutral detergent fiber and coumarin(233–235). Aerial parts of *T.foenum-graecum* extract using different solvents including methanol, ethyl acetate and petroleum ether shows antifungal activity against *Fusarium graminearum, Botrytis cinerea, Alternaria species, Rhizoctonia solani*and *Pythium aphanidermatum.* Fenugreek leaves methanolic extract shows more antifungal activity(227,236).

2.20. Vitex negundo:
Vitex negundo is commonly known as the five-leaved chaste tree. It belongs to the verbenaceae family(237,238). Its vernacular names are Biḷinekki (Kannada), Nirgudi (Marathi), Notchi, Nochchi (Tamil), Vavili (Telugu), and Karinochi (Malayalam). In India, it is distributed in Andhra Pradesh, Telangana, Karnataka, Kerala, Maharashtra, Odisha, Tamil Nadu, Jharkhand, Uttarakhand, Sikkim, Himachal Pradesh, Arunachal Pradesh, Mizoram, Meghalaya, Assam, Nagaland, Uttar Pradesh, Punjab, Jammu and Kashmir, Andaman and Nicobar Islands, Manipur, Tripura, Lakshadweep. In Tamil Nadu it is distributed in Coimbatore district, Dindigul district, Dharmapuri district, Kanchipuram (Chengalpattu-CGP) district, Karur district, Krishnagiri district, Madurai district, Namakkal district, Pudukkottai district, Sivaganga district, Salem district, Tiruchirappalli district, Tiruvannamalai district, Villupuram district, and Vellore district(239,240).*Vitex negundo* is used traditionally for various purposes such as anti-nociceptive (analgesic), antipyretic, anti-inflammatory, anti-rheumatic, antihyperglycemic, smooth muscle relaxant, hepatoprotective, and antidiarrheal(241–244). *Vitex negundo* contains phytochemicals like phenylpropanoids, steroids, flavonoids, phenylnaphthalene-type lignans, furanofuran lignans, S-phenylindene-type lignan, sesquiterpenoids, Triterpinoids, Coumarin and Irioids(245–250). *Vitex negundo* exhibited significant activity against *Cryptococcus neoformans, Aspergillus niger, Trichophyton mentagrophytes, Alternaria alternata, Curvularialunata,and Candida albicans*(251,252). Essential oil from seeds of *Vitex negundo* shows activity against C. albicans. Diterpenoid and furanofuran lignan derivatives are the phytochemicals from *Vitex negundo* that may be responsible for its antifungal activity. These phytochemicals are effective against *C. neoformans, C. albicans, Aspergillus fumigatus and Trichophyton rubrum*(241,248,253).

3. Discussion:
The growing prevalence of fungal infections, coupled with the rise of antimycotic drug resistance and associated toxicity underscores the need for alternative therapeutic solutions. Natural antifungal compounds derived from medicinal plants offer significant potential as alternatives to conventional allopathic antifungal agents. Various plants are notable for their antifungal properties attributed to their rich phytochemical composition. Some of the plants are *Acalypha indica, Allium sativum, Azadirachta indica, Curcuma longa, Citrus limon, Lawsonia inermis, Moringa oleifera, Murrayakoenigii, Ocimum basilicum, Phyllanthus emblica, Trigonella foenum-graecum, Vitex negundo, etc. Acalypha indica*, demonstrates significant antimycotic activity against various fungal species. Key phytochemicals, such as lupeol, squalene, and flavonoids, contribute to its antifungal potential. Its methanolic and ethanolic extracts have been particularly effective *in-vitro*. *Allium sativum* is rich in bioactive compounds such as allicin, diallyl sulfide, and ajoene. These compounds disrupt fungal cell walls and membranes, inhibit the growth of *Aspergillus niger, A.nidulans*, and *Candida albicans*. Its efficacy highlights its potential as a natural antifungal agent. *Azadirachta indica* has long been recognized for its antifungal properties. Itsactive compounds such as cyclic trisulfide and tetrasulfide inhibit fungi like Trichophyton, Epidermophyton, and *Candida albicans*. Neem leaf and oil extracts show significant antimycotic activity, demonstrating its versatility as a therapeutic agent. *Curcuma longa* contains curcumin, which exhibits potent antifungal activity, particularly against *Candida albicans*. Studies suggest that curcumin can act synergistically with fluconazole to enhance its antifungal effects. This synergy

emphasizes its potential role in combination therapies. *Citrus limon* peels and essential oils contain limonene, β-pinene, and citric acid, which exhibit strong antimycotic activity against Aspergillus and Penicillium species. Methanolic extracts of *Citrus limon* also demonstrate fungicidal properties. *Lawsonia inermis* leaves contain coumarins, flavonoids, and naphthoquinones, which exhibit potent antifungal effects against *Tinea rubrum*and*Trichophyton mentagrophytes*. ethyl acetateand Ethanolextracts of *Lawsonia inermis* have demonstrated excellent *in vitro* antifungal activity *Moringa oleifera* is rich in alkaloids, flavonoids, and tannins. Its water and ethanol extracts inhibit *Saccharomyces cerevisiae* and *Candida tropicalis*, highlighting its broad-spectrum antifungal potential. *Murrayakoenigii* leaf extracts are rich in mono- and sesquiterpenoids such as β-pinene, linalool, and γ-terpinene, which contribute to its antifungal activity. Essential oils from Murrayakoenigii effectively inhibit the growth of *C.albicans* and other fungi. *Ocimum basilicum* contains essential oils like eugenol, methyl chavicol, and linalool, which exhibit strong antifungal properties. The oils have been effective against Alternaria species, *Aspergillus flavus*, and *Cladosporium herbarum*. Fenugreek leaves contain alkaloids, flavonoids, and diosgenin, which exhibit antifungal activity against Fusarium, Botrytis, and Rhizoctonia species. Its methanolic extracts are most effective. *Phyllanthus emblica* contains emblicanin A and B, gallic acid, and quercetin, which possess strong antifungal and antimicrobial properties. Aqueous extracts of amla are particularly effective against fungal infections. *Vitex negundo* is rich in phenylpropanoids, flavonoids, and lignans, which show significant activity against *Aspergillus niger, Candida albicans,* and *Trichophyton rubrum*. Its essential oils from the seeds enhance its fungicidal properties.

These phytoconstituents, with their diverse modes of action, offer a broad-spectrum approach to combating fungal infections while minimizing the adverse effects seen with synthetic drugs. The integration of plant-derived antifungal agents into therapeutic regimens presents a promising approach, particularly in light of their minimal toxicity, reduced drug interactions, and sustainable sourcing. However, variability in the efficacy of plant extracts due to environmental and genetic factors warrants standardized extraction and formulation techniques. The plant's phytochemical diversity and antifungal efficacy highlight the potential of natural compounds as effective alternatives to synthetic antifungal drugs. However, challenges like standardization of extracts and understanding synergistic mechanisms need to be addressed for clinical application.

4. Conclusion:

Natural antifungal compounds derived from medicinal plants hold immense promise as sustainable and effective alternatives to conventional antifungal drugs. The antifungal activity demonstrated by plants such as *Acalypha indica, Allium sativum, Azadirachta indica, Curcuma longa, Citrus limon, Lawsonia inermis, Moringa oleifera, Murrayakoenigii, Ocimum basilicum, Phyllanthus emblica, Trigonella foenum-graecum,* and *Vitex negundo* demonstrate significant potential in combating fungal infections. These plants are rich in bioactive phytochemicals such as flavonoids, alkaloids, curcumin, allicin, limonene, and phenolic compounds, which exhibit broad-spectrum antifungal properties.

Future research should focus on isolating and characterizing the active compounds from these plants to identify their specific mechanisms of action. It should also explore synergistic effects between these natural compounds and existing antifungal drugs to reduce resistance and enhance efficacy. Additionally, developing standardized extraction methods and formulations is essential to ensure consistent potency and reliability in clinical applications. Extensive preclinical and clinical studies are needed to validate the safety, efficacy, and side effects of these plant-based antifungal agents.

By leveraging the rich bioactivity of medicinal plants, we can develop innovative antifungal therapies that are not only effective but also safer and environmentally sustainable. This approach provides a promising alternative to conventional antifungal treatments and aligns with the global need for accessible and low-toxicity healthcare solutions to address the increasing burden of fungal infections.

REFERENCE:

1. Organization WH. The World health report : 1998 : Life in the 21st century : a vision for all : report of the Director-General. World Health Organization; 1998. p. Figures and maps extracted from the World Health R.
2. Okeke IN, Laxminarayan R, Bhutta ZA, Duse AG, Jenkins P, O'Brien TF, et al. Antimicrobial resistance in developing countries. Part I: recent trends and current status. Lancet Infect Dis. 2005 Aug;5(8):481–93.
3. Wu TC. On the development of antifungal agents: perspective of the U.S. Food and Drug Administration. Clin Infect Dis an Off Publ Infect Dis Soc Am. 1994 Aug;19 Suppl 1:S54-8.
4. Walsh TJ, Gonzalez C, Lyman CA, Chanock SJ, Pizzo PA. Invasive fungal infections in children: recent advances in diagnosis and treatment. Adv Pediatr Infect Dis. 1996;11:187–290.
5. Portillo A, Vila R, Freixa B, Adzet T, Cañigueral S. Antifungal activity of Paraguayan plants used in traditional medicine. J Ethnopharmacol. 2001 Jun;76(1):93–8.
6. Cannon RD, Holmes AR, Mason AB, Monk BC. Oral Candida: clearance, colonization, or candidiasis? J

Dent Res. 1995 May;74(5):1152–61.
7. Giordani R, Trebaux J, Masi M, Regli P. Enhanced antifungal activity of ketoconazole by Euphorbia characias latex against Candida albicans. J Ethnopharmacol. 2001 Nov;78(1):1–5.
8. Lazar JD, Wilner KD. Drug interactions with fluconazole. Rev Infect Dis. 1990;12 Suppl 3:S327-33.
9. Gearhart MO. Worsening of liver function with fluconazole and review of azole antifungal hepatotoxicity. Ann Pharmacother. 1994 Oct;28(10):1177–81.
10. Reyhanoglu G, Smith T. Irinotecan. In Treasure Island (FL); 2024.
11. Goa KL, Barradell LB. Fluconazole. An update of its pharmacodynamic and pharmacokinetic properties and therapeutic use in major superficial and systemic mycoses in immunocompromised patients. Drugs. 1995 Oct;50(4):658–90.
12. Cuenca-Estrella M, Mellado E, Díaz-Guerra TM, Monzón A, Rodríguez-Tudela JL. Susceptibility of fluconazole-resistant clinical isolates of Candida spp. to echinocandin LY303366, itraconazole and amphotericin B. J Antimicrob Chemother. 2000 Sep;46(3):475–7.
13. Grasela THJ, Goodwin SD, Walawander MK, Cramer RL, Fuhs DW, Moriarty VP. Prospective surveillance of intravenous amphotericin B use patterns. Pharmacotherapy. 1990;10(5):341–8.
14. Fanos V, Cataldi L. Amphotericin B-induced nephrotoxicity: a review. J Chemother. 2000 Dec;12(6):463–70.
15. Gurgel LA, Sidrim JJC, Martins DT, Cechinel Filho V, Rao VS. In vitro antifungal activity of dragon's blood from Croton urucurana against dermatophytes. J Ethnopharmacol. 2005 Feb;97(2):409–12.
16. Wanzala W, Zessin KH, Kyule NM, Baumann MPO, Mathias E, Hassanali A. Ethnoveterinary medicine: A critical review of its evolution, perception, understanding and the way forward. Livest Res Rural Dev. 2005;17.
17. Cox PA. The promise of Gerard's Herball: new drugs from old books. Endeavour [Internet]. 1998;22(2):51–3. Available from: https://www.sciencedirect.com/science/article/pii/S0160932798011119
18. Ramasamy S, Manoharan AC. Antibacterial effect of volatile components of selected medicinal plants against human pathogens. 2004;6:209–10.
19. Integrated Taxonomic Information System, Acalypha indica. In 2015. Available from: https://www.itis.gov/servlet/SingleRpt/SingleRpt?search_topic=TSN&search_value=28185#null
20. Sankara Rao; K.; Deepak Kumar. India Flora Online. In 2024. Available from: https://indiaflora-ces.iisc.ac.in/herbsheet.php?id=110&cat=13
21. Dineshkumar B, Vigneshkumar P, Bhuvaneshwaran SP, Mitra A. Phyto-pharmacology of Acalypha indica: A Review. Int J Biosci Altern Holist Med. 2010;1(2):27–32.
22. Walter TM. Review of Acalypha indica, Linn in traditional Siddha medicine.
23. Ranju G, Sutar N, Saroj KP, Vishesh KP, Shailendr P. In vitro anthelmintic activity of Acalypha indica leaves extracts. Int J Res Ayurveda Pharm. 2011;2:247–9.
24. Sahukari R, Jyothi P, Bhasha D, Subbaiah V, Singamala H, Reddy K. A comprehensive Review on Traditional Knowledge, Phytochemistry and Pharmacological Properties of Acalypha indica L. Pharmacogn Rev. 2021;15:2021.
25. Zahidin NS, Saidin S, Zulkifli RM, Muhamad II, Ya'akob H, Nur H. A review of Acalypha indica L. (Euphorbiaceae) as traditional medicinal plant and its therapeutic potential. J Ethnopharmacol. 2017 Jul;207:146–73.
26. Article R, Venkateshwarlu G. FOLKLORE USES OF ACALYPHA INDICA IN AYURVEDA SYSTEM. 2017;6(12):248–50.
27. Chekuri S, B A, JSompaga S, Panjala S, Rani R. Evaluation of Anti Microbial and Anti Fungal Activity of Acalyphaindica L., Leaf Extract. Int J Pharmacogn Phytochem Res. 2018;10.
28. Rajkumar P, Sundari S, Selvaraj S, Natarajan A, Suganya R, Jayaprakash R, et al. GC-MS, Phytochemical Analysis and In Silico Approaches of a Medicinal Plant Acalypha indica. Bangladesh J Sci Res. 2022;14:671–84.
29. Sivalingam AM. GC-MS ANALYSIS OF BIOACTIVE COMPOUNDS PRESENT IN ETHANOLIC LEAF EXTRACT Acalypha indica. 2021;16–22.
30. P. S. Pharmacological screening of datura metel and acalypha indica for its antifungal activity against pathogenic fungi. Int J Pharm Sci Heal care. 2011;1.
31. Singh B, Dipankar A, Chandra Shekhar, Kumar, Vimal Singh, Sopal Prakash, et al. Effect of organic manures and inorganic fertilizers on growth, yield and its attributing traits in garlic (Allium sativum L.). J Pharmacogn Phytochem [Internet]. 2019;8(3):587–90. Available from: http://nhb.gov.in.
32. Sankara Rao, K. DK. India Flora Online. Allium sativum. In 2024. Available from: https://indiaflora-ces.iisc.ac.in/herbsheet.php?id=410&cat=13
33. Simon JE, Chadwick AF, Craker LE. Herbs: An Indexed Bibliography, 1971-1980: the Scientific Literature on Selected Herbs, and Aromatic and Medicinal Plants of the Temperate Zone [Internet]. Elsevier; 1984. Available from: https://books.google.co.in/books?id=XZ8H0AEACAAJ

34. Mikail HG. Phytochemical screening, elemental analysis and acute toxicity of aqueous extract of Allium sativum L. bulbs in experimental rabbits. J Med Plants Res [Internet]. 2010;4:322–6. Available from: https://api.semanticscholar.org/CorpusID:85556984
35. Chekki RZ, Snoussi A, Hamrouni I, Bouzouita N. Chemical composition, antibacterial and antioxidant activities of Tunisian garlic (Allium sativum) essential oil and ethanol extract. Mediterr J Chem [Internet]. 2014;3:947–56. Available from: https://api.semanticscholar.org/CorpusID:42634742
36. Al-Snafi A. PHARMACOLOGICAL EFFECTS OF ALLIUM SPECIES GROWN IN IRAQ. AN OVERVIEW. Int J Pharm Heal care Res. 2013;1:132–47.
37. Saif S, Hanif MA, Rehman R, Riaz M. Chapter 23 - Garlic. In: Hanif MA, Nawaz H, Khan MM, Byrne HJ, editors. Medicinal Plants of South Asia [Internet]. Elsevier; 2020. p. 301–15. Available from: https://www.sciencedirect.com/science/article/pii/B9780081026595000239
38. Heinrich P, Larry D. Garlic: The Science and Therapeutic Application of Allium Sativum L. and Related Species. In 1996. Available from: https://api.semanticscholar.org/CorpusID:82767483
39. Zeng Y, Li Y, Yang J, Pu X, Du J, Yang X, et al. Therapeutic Role of Functional Components in Alliums for Preventive Chronic Disease in Human Being. Evid Based Complement Alternat Med. 2017;2017:9402849.
40. Hughes BG, Lawson LD. Antimicrobial effects of Allium sativum L. (garlic), Allium ampeloprasum L. (elephant garlic), and Allium cepa L. (onion), garlic compounds and commercial garlic supplement products. Phyther Res [Internet]. 1991;5. Available from: https://api.semanticscholar.org/CorpusID:83588911
41. Fenwick GR, Hanley AB. The genus Allium--Part 1. Crit Rev Food Sci Nutr. 1985;22(3):199–271.
42. Schmutterer H. Properties and potential of natural pesticides from the neem tree, Azadirachta indica. Annu Rev Entomol. 1990;35:271–97.
43. Radwanski SA, Wickens GE. Vegetative fallows and potential value of the neem tree (Azadirachta indica) in the tropics. Econ Bot [Internet]. 1981;35(4):398–414. Available from: https://doi.org/10.1007/BF02858590
44. Paul R, Prasad M, Sah NK. Anticancer biology of Azadirachta indica L (neem): a mini review. Cancer Biol Ther. 2011 Sep;12(6):467–76.
45. Health MOF, Welfare F. the Ayurvedic Pharmacopoeia.
46. Sankara Rao, K. DK. India Flora Online. Azadirachta indica. In 2024. Available from: https://indiaflora-ces.iisc.ac.in/herbsheet.php?id=1227&cat=13
47. Puri HS. Neem: The Divine Tree Azadirachta indica [Internet]. CRC Press; 1999. (ISSN). Available from: https://books.google.co.in/books?id=T94o70RSFGgC
48. Veitch GE, Boyer A, Ley S V. The azadirachtin story. Angew Chem Int Ed Engl. 2008;47(49):9402–29.
49. Patel SM, Nagulapalli Venkata KC, Bhattacharyya P, Sethi G, Bishayee A. Potential of neem (Azadirachta indica L.) for prevention and treatment of oncologic diseases. Semin Cancer Biol. 2016 Oct;40–41:100–15.
50. Omóbòwálé TO, Oyagbemi AA, Adejumobi OA, Orherhe EV, Amid AS, Adedapo AA, et al. Preconditioning with Azadirachta indica ameliorates cardiorenal dysfunction through reduction in oxidative stress and extracellular signal regulated protein kinase signalling. J Ayurveda Integr Med. 2016;7(4):209–17.
51. Arumugam A, Agullo P, Boopalan T, Nandy S, Lopez R, Gutierrez C, et al. Neem leaf extract inhibits mammary carcinogenesis by altering cell proliferation, apoptosis, and angiogenesis. Cancer Biol Ther. 2014 Jan;15(1):26–34.
52. Asif M. A Review on Spermicidal Activities of Azadirachta indica. Online. 2013;1(5):62–80.
53. 2007. Azadirachta indica, Apotent biotesticide and medicinal plant. A review.pdf.
54. Pant, N., Garg, H.S, Madhusudanan, K.P. and Bhakuni DS. Sulfurous compounds from Azadirachta indica leaves. Fitoterapia [Internet]. 1986;302–4. Available from: https://www.scirp.org/reference/ReferencesPapers?ReferenceID=1962258
55. Hiremath VT, Taranath TC. Traditional Phytotherapy for Snake bites by Tribes of Chitradurga District, Karnataka, India. Ethnobot Leafl. 2010;14(01):120–45.
56. Sankara Rao, K. DK. India Flora Online. *Azima tetracantha*. In 2024. Available from: https://indiaflora-ces.iisc.ac.in/herbsheet.php?id=1229&cat=13#:~:text=Vernacular name %3A&text=Mulsangu (Tamil),Kundali (Sanskrit)
57. Reddy MB, Reddy KR, Reddy MN. Ethnobotany of Cuddapah District, Andhra Pradesh, India. In 1991. Available from: https://api.semanticscholar.org/CorpusID:86204409
58. Janardhan B, Shrikanth VM, Mirajkar KK, More SS. In vitro screening and evaluation of antivenom phytochemicals from Azima tetracantha Lam. leaves against Bungarus caeruleus and Vipera russelli. J Venom Anim Toxins Incl Trop Dis. 2014 Apr;20(1):12.
59. Duraipandiyan V, Gnanasekar M, Ignacimuthu S. Antifungal activity of triterpenoid isolated from *Azima*

tetracantha leaves. Folia Histochem Cytobiol. 2010 Jan;48(2):311–3.
60. Philippine Medicinal Plants. Bauhinia tomentosa Linn. In. Available from: https://www.stuartxchange.org/Baho-baho.html
61. Sankara Rao, K. DK. India Flora Online. Bauhinia tomentosa. In 2024. Available from: https://indiaflora-ces.iisc.ac.in/herbsheet.php?id=1328&cat=13
62. Dugasani S, Balijepalli MK, Tandra S, Pichika MR. Antimicrobial activity of Bauhinia tomentosa and Bauhinia vahlii roots. Pharmacogn Mag. 2010 Jul;6(23):204–7.
63. Quiroga EN, Sampietro AR, Vattuone MA. Screening antifungal activities of selected medicinal plants. J Ethnopharmacol. 2001 Jan;74(1):89–96.
64. Anju J V, Manodeep C, Jagdish K. BAUHINIA TOMENTOSA: A PHYTOPHARMACOLOGICAL REVIEW. In 2012. Available from: https://api.semanticscholar.org/CorpusID:212611714
65. Pamila UA. Pharmacognostical And Antimicrobial Analysis Of Leaf And Flower Of Bauhinia Tomentosa L . 2018;5(9):9–11.
66. Bardhan A. Identification of antifungal principle from leaf extracts of Bauhinia scandens L. J Mycopathol Res. 2023;61:207–10.
67. Aderogba M, Mcgaw L, Eloff J. Cytotoxicity Study Of Antioxidant Flavonoids From Bauhinia Tomentosa Leaf Extract. Niger J Nat Prod Med. 2008;12:66 – 70.
68. Senna auriculata. In: Wikipedia [Internet]. 2024. Available from: https://en.wikipedia.org/wiki/Senna_auriculata
69. Deshpande H, Bhalsing S. Recent advances in the phytochemistry of some medicinally important Cassia species: A Review. Int J pharma Med Biol Sci. 2013;2(3):60–78.
70. Nille G, Ramachandra Reddy K. A Phytopharmacological Review of Plant – Cassia auriculata. Int J Pharm Biol Arch. 2016;6:1–9.
71. Thulasi G, Amsaveni V. Antibacterial Activity of Cassia auriculata Against ESBL Producing E . coli from UTI Patients. In 2013. Available from: https://api.semanticscholar.org/CorpusID:165155061
72. Doshi G, Shidhaye S, Aggarwal G, Pillai P, Bhalerao A, Desai S. Antibacterial potential of Cassia auriculata flowers. J Microbiol Biotechnol Res. 2011;1.
73. Yoganandam P. "Aavarai Kudineer"- A Potent Polyherbal Siddha Formulation for Management of Diabetes Mellitus. Int J Pharm Dev Technol. 2014;2(1):45–61.
74. Raja D, Jeganathan N, Manavalan R. In vitro antimicrobial activity and phytochemical analysis of Cassia auriculata Linn. Int Curr Pharm J. 2013;2.
75. Ali J, Das B, Saikia T. ANTIMICROBIAL ACTIVITY OF LEMON PEEL (CITRUS LIMON) EXTRACT. Int J Curr Pharm Res. 2017;9:79.
76. Hojjati M, Barzegar H. Chemical Composition and Biological Activities of Lemon (Citrus limon) Leaf Essential Oil. Nutr Food Sci Res. 2017;4:15–24.
77. Sankara Rao, K. DK. India Flora Online. Citrus limon. In 2024. Available from: https://indiaflora-ces.iisc.ac.in/herbsheet.php?id=2634&cat=13
78. Lv X, Zhao S, Ning Z, Zeng H, Shu Y, Tao O, et al. Citrus fruits as a treasure trove of active natural metabolites that potentially provide benefits for human health. Chem Cent J. 2015;9:68.
79. Zou Z, Xi W, Hu Y, Nie C, Zhou Z. Antioxidant activity of Citrus fruits. Food Chem. 2016 Apr;196:885–96.
80. Patil B, Jayaprakasha G, Murthy K. Beyond vitamin C: the diverse, complex health-promoting properties of citrus fruits. Citrus Res Technol. 2017;38.
81. Jain N. Evaluation of Citrus lemon essential oil for its chemical and biological properties against fungi causing dermatophytic infection in human beings. Analytical Chemistry letter.2017 7(3); 402-409. Anal Chem Lett. 2017;7:402–9.
82. Viuda-Martos M, Ruiz-Navajas Y, Fernández-López J, Pérez-Álvarez J. Antifungal activity of lemon (Citrus lemon L.), mandarin (Citrus reticulata L.), grapefruit (Citrus paradisi L.) and orange (Citrus sinensis L.) essential oils. Food Control [Internet]. 2008;19(12):1130–8. Available from: https://www.sciencedirect.com/science/article/pii/S0956713507002629
83. Hu P, Navinraj S, N MB, Uma D, Nakkeeran S. In vitro evaluation of antifungal activity of lemon peels (Citrus limon L . Osbeck) extract against agriculturally important soil-borne plant pathogenic fungi. 2022;11(7):569–73.
84. Momin AH, Acharya SS, Gajjar A V. Coriandrum Sativum-Review of Advances in Phytopharmacology. Ijpsr [Internet]. 2012;3(5):5. Available from: www.ijpsr.com
85. Coriandrum sativum. In. Available from: https://plants.ces.ncsu.edu/plants/coriandrum-sativum/
86. Duke JA. Handbook of Medicinal Herbs [Internet]. CRC Press; 2002. Available from: https://books.google.co.in/books?id=B_XLBQAAQBAJ
87. (author A, Heller J, Engels J. Coriander. Coriandrum sativum L. 1996.
88. Shahwar MK, El-Ghorab AH, Anjum FM, Butt MS, Hussain S, Nadeem M. Characterization of coriander

(Coriandrum sativum L.) seeds and leaves: Volatile and non volatile extracts. Int J Food Prop. 2012;15(4):736–47.
89. Nimish LP, Sanjay BK, Nayna MB, Jaimik DR. Phytopharmacological properties of coriander sativum as a potential medicinal tree: An overview. J Appl Pharm Sci. 2011;1:20–5.
90. Sharma MM, Sharma RK. 12 - Coriander. In: Peter K V, editor. Handbook of Herbs and Spices (Second Edition) [Internet]. Second Edi. Woodhead Publishing; 2012. p. 216–49. (Woodhead Publishing Series in Food Science, Technology and Nutrition). Available from: https://www.sciencedirect.com/science/article/pii/B9780857090393500128
91. Ceska O, Chaudhary SK, Warrington P, Ashwood-Smith MJ, Bushnell GW, Poultont GA. Coriandrin, a novel highly photoactive compound isolated from Coriandrum sativum. Phytochemistry [Internet]. 1988;27(7):2083–7. Available from: https://www.sciencedirect.com/science/article/pii/0031942288801018
92. Al-Mofleh IA, Alhaider AA, Mossa JS, Al-Sohaibani MO, Rafatullah S, Qureshi S. Protection of gastric mucosal damage by Coriandrum sativum L. pretreatment in Wistar albino rats. Environ Toxicol Pharmacol. 2006 Jul;22(1):64–9.
93. Singh YN. Traditional medicine in Fiji: some herbal folk cures used by Fiji Indians. J Ethnopharmacol. 1986 Jan;15(1):57–88.
94. Wangensteen H, Samuelsen AB, Malterud KE. Antioxidant activity in extracts from coriander. Food Chem [Internet]. 2004;88(2):293–7. Available from: https://www.sciencedirect.com/science/article/pii/S0308814604001219
95. Matasyoh JC, Maiyo ZC, Ngure RM, Chepkorir R. Chemical composition and antimicrobial activity of the essential oil of Coriandrum sativum. Food Chem [Internet]. 2009;113(2):526–9. Available from: https://www.sciencedirect.com/science/article/pii/S0308814608009424
96. Eguale T, Tilahun G, Debella A, Feleke A, Makonnen E. In vitro and in vivo anthelmintic activity of crude extracts of Coriandrum sativum against Haemonchus contortus. J Ethnopharmacol. 2007 Apr;110(3):428–33.
97. Dhanapakiam P, Joseph JM, Ramaswamy VK, Moorthi M, Kumar AS. The cholesterol lowering property of coriander seeds (Coriandrum sativum): mechanism of action. J Environ Biol. 2008 Jan;29(1):53–6.
98. Silva F, Ferreira S, Duarte A, Mendonça DI, Domingues FC. Antifungal activity of Coriandrum sativum essential oil, its mode of action against Candida species and potential synergism with amphotericin B. Phytomedicine. 2011 Dec;19(1):42–7.
99. Pandey A, Bigoniya P, Raj V, Patel KK. Pharmacological screening of Coriandrum sativum Linn. for hepatoprotective activity. J Pharm Bioallied Sci. 2011 Jul;3(3):435–41.
100. Rondon FCM, Bevilaqua CML, Accioly MP, Morais SM, Andrade-Junior HF, Machado LKA, et al. In vitro effect of Aloe vera, Coriandrum sativum and Ricinus communis fractions on Leishmania infantum and on murine monocytic cells. Vet Parasitol. 2011 Jun;178(3–4):235–40.
101. Sreelatha S, Inbavalli R. Antioxidant, antihyperglycemic, and antihyperlipidemic effects of Coriandrum sativum leaf and stem in alloxan-induced diabetic rats. J Food Sci. 2012 Jul;77(7):T119-23.
102. Kanchan, Chauhan PK, Jaryal M, Kumari K, Singh M. Phytochemical and in vitro antioxidant potential of aqueous leaf extracts of Brassica juncea and Coriandrum sativum. Int J Pharm Sci Res [Internet]. 2012; Available from: https://api.semanticscholar.org/CorpusID:267445339
103. Anitescu G, Doneanu CE, Rădulescu V. Isolation of Coriander Oil: Comparison Between Steam Distillation and Supercritical CO2 Extraction. Flavour Fragr J [Internet]. 1997;12:173–6. Available from: https://api.semanticscholar.org/CorpusID:55456063
104. Telci I, Toncer O, Sahbaz N. Yield, Essential Oil Content and Composition of Coriandrum sativum Varieties (var. vulgare Alef and var. microcarpum DC.) Grown in Two Different Locations. J Essent Oil Res - J ESSENT OIL RES. 2006;18:189–93.
105. Bhuiyan M, Begum J, Sultana M. Chemical composition of leaf and seed essential oil of Coriandrum sativum L. from Bangladesh. Bangladesh J Pharmacol. 2009;
106. Begnami AF, Duarte MCT, Furletti V, Rehder VLG. Antimicrobial potential of Coriandrum sativum L. against different Candida species in vitro. Food Chem [Internet]. 2010;118(1):74–7. Available from: https://www.sciencedirect.com/science/article/pii/S030881460900541X
107. Chandarana H, Baluja SH, Chanda S V. Comparison of Antibacterial Activities of Selected Species of Zingiberaceae Family and Some Synthetic Compounds. Turkish J Biol [Internet]. 2005;29:83–97. Available from: https://api.semanticscholar.org/CorpusID:86630988
108. Mankad A, Pandya D, Joshi B. Comparative study of Phytochemical Screening and Antibacterial Activity of Curcuma longa (L.) and Curcuma aromatica (Salib.). J Med Plants Stud. 2018;6:145–8.
109. Sankara Rao, K. DK. India Flora Online. Curcuma longa. 2024; Available from: https://indiaflora-ces.iisc.ac.in/herbsheet.php?id=3289&cat=13
110. Prasad S, Aggarwal BB. Turmeric, the Golden Spice: From Traditional Medicine to Modern Medicine. In:

Benzie IFF, Wachtel-Galor S, editors. Boca Raton (FL); 2011.
111. Pelletier R, Peter J, Antin C, Gonzalez C, Wood L, Walsh TJ. Emergence of resistance of Candida albicans to clotrimazole in human immunodeficiency virus-infected children: in vitro and clinical correlations. J Clin Microbiol. 2000 Apr;38(4):1563–8.
112. Gupta A, Mahajan S, Sharma R. Evaluation of antimicrobial activity of Curcuma longa rhizome extract against Staphylococcus aureus. Biotechnol reports (Amsterdam, Netherlands). 2015 Jun;6:51–5.
113. Sa G, Das T, Banerjee S, Banerjee Chakraborty J. Curcumin: From Exotic Spice to Modern Anticancer Drug. Al Ameen J Med Sci. 2010;3.
114. Chattopadhyay I, Biswas K, Bandyopadhyay U, Banerjee R. Turmeric and Curcumin: Biological actions and medicinal applications. Curr Sci. 2003;87.
115. Jacob A, Wu R, Zhou M, Wang P. Mechanism of the Anti-inflammatory Effect of Curcumin: PPAR-gamma Activation. PPAR Res. 2007;2007:89369.
116. Lu WD, Qin Y, Yang C, Li L, Fu ZX. Effect of curcumin on human colon cancer multidrug resistance in vitro and in vivo. Clinics (Sao Paulo). 2013 May;68(5):694–701.
117. Awasthi PK, Dixit SC. Chemical composition of Curcuma Longa leaves and rhizome oil from the plains of Northern India. J Young Pharm. 2009;1.
118. Essien EE, Newby JS, Walker TM, Setzer WN, Ekundayo O. Chemotaxonomic Characterization and in-Vitro Antimicrobial and Cytotoxic Activities of the Leaf Essential Oil of Curcuma longa Grown in Southern Nigeria. Med (Basel, Switzerland). 2015 Dec;2(4):340–9.
119. Alqaseer K, Ghaleb Idreess H, Saed E, Radhi O, Shnain W, Falah M, et al. Turmeric: An important medicinal plant in the treatment of many diseases: A review Study. Kufa J Nurs Sci. 2023;13.
120. Braga MEM, Leal PF, Carvalho JE, Meireles MAA. Comparison of yield, composition, and antioxidant activity of turmeric (Curcuma longa L.) extracts obtained using various techniques. J Agric Food Chem. 2003 Oct;51(22):6604–11.
121. Angel GR, Menon N, Vimala B, Nambisan B. Essential oil composition of eight starchy Curcuma species. Ind Crops Prod [Internet]. 2014;60:233–8. Available from: https://www.sciencedirect.com/science/article/pii/S0926669014003616
122. Pande C, Chanotiya CS. Constituents of the leaf oil of curcuma longa L. from uttaranchal. J Essent Oil Res. 2006;18(2):166–7.
123. Parveen Z, Nawaz S, Siddique S, Shahzad K. Composition and Antimicrobial Activity of the Essential Oil from Leaves of Curcuma longa L. Kasur Variety. Indian J Pharm Sci. 2013 Jan;75(1):117–22.
124. Murugesh J, Annigeri RG, Mangala GK, Mythily PH, Chandrakala J. Evaluation of the antifungal efficacy of different concentrations of Curcuma longa on Candida albicans: An in vitro study. J Oral Maxillofac Pathol. 2019;23(2):305.
125. Martins CVB, da Silva DL, Neres ATM, Magalhães TFF, Watanabe GA, Modolo L V, et al. Curcumin as a promising antifungal of clinical interest. J Antimicrob Chemother. 2009 Feb;63(2):337–9.
126. Va P, Prasath D. Cardamom. In 2012. p. 131–70.
127. Madhusoodanan KJ, Rao YS. 10 - Cardamom (large). In: Peter K V, editor. Handbook of Herbs and Spices [Internet]. Woodhead Publishing; 2001. p. 134–42. (Woodhead Publishing Series in Food Science, Technology and Nutrition). Available from: https://www.sciencedirect.com/science/article/pii/B9781855735620500149
128. Ravindran PN, Madhusoodanan KJ. Cardamom: The Genus Elettaria [Internet]. CRC Press; 2002. (Medicinal and Aromatic Plants - Industrial Profiles). Available from: https://books.google.co.in/books?id=tnH1bFGKuRoC
129. Bhat NV, Goudar PVK. Small Cardamom Cultivation in India. In 2020. Available from: https://api.semanticscholar.org/CorpusID:225925810
130. Sengupta A, Bhattacharjee S. Cardamom (Elettaria cardamomum) and Its Active Constituent, I,8-cineole. In 2009. p. 65–85.
131. Sengottuvelu S. Chapter 34 - Cardamom (Elettaria cardamomum Linn. Maton) Seeds in Health. In: Preedy VR, Watson RR, Patel VB, editors. Nuts and Seeds in Health and Disease Prevention [Internet]. San Diego: Academic Press; 2011. p. 285–91. Available from: https://www.sciencedirect.com/science/article/pii/B9780123756886100349
132. Menon A. Studies on the Volatiles of Cardamom (Elleteria cardamomum). J Food Sci Technol. 2000;37:406–8.
133. Marongiu B, Piras A, Porcedda S. Comparative analysis of the oil and supercritical CO2 extract of Elettaria cardamomum (L). Maton. J Agric Food Chem. 2004;52(20):6278–82.
134. Sharma SD, Sharma J, Kaur G, Rai L. Therapeutic uses of Elettaria cardomum. In 2011. Available from: https://api.semanticscholar.org/CorpusID:74032677
135. Ashokkumar K, Murugan M, Dhanya MK, Warkentin TD. Botany, traditional uses, phytochemistry and biological activities of cardamom [Elettaria cardamomum (L.) Maton] - A critical review. J

Ethnopharmacol. 2020 Jan;246:112244.
136. Ashokkumar K, Sampathrajan V, Murugan M, Dhanya MK, Gunasekaran A, Aiswarya S, et al. Essential Oil Profile Diversity in Cardamom Accessions From Southern India. Front Sustain Food Syst. 2021;639619.
137. Ahmed H, Ashraf M, Ramadhani A, Erwa I, Adam O, Ishag O, et al. Phytochemical Screening, Chemical Composition and Antimicrobial Activity of Cinnamon verum Bark. Int Res J Pure Appl Chem. 2020;21:36–43.
138. Ağaoğlu S, Dostbil N, Alemdar S. Antimicrobial Effect of Seed Extract of Cardamom (Elettarıa cardamomum Maton). YÜ Vet Fak Derg. 2006;16(2):99–101.
139. Juwitaningsih T, Jahro I, Sari S. Evaluation of North Sumatera Cardamom seed (Amomum compactum) Extract as Antibacterial and Anticancer. J Phys Conf Ser. 2020;1485:12019.
140. Younus N. Cardamom (Elettaria cardamomum) Seeds Extract as Antimicrobial and Wound Healing Agent. E3S Web Conf. 2023;391.
141. Sankara Rao, K. DK. India Flora Online. Fiscus racemosa. In 2024. Available from: https://indiaflora-ces.iisc.ac.in/herbsheet.php?id=110&cat=13
142. Idolo M, Motti R, Mazzoleni S. Ethnobotanical and phytomedicinal knowledge in a long-history protected area, the Abruzzo, Lazio and Molise National Park (Italian Apennines). J Ethnopharmacol. 2010 Feb;127(2):379–95.
143. Veberic R, Colaric M, Stampar F. Phenolic acids and flavonoids of fig fruit (Ficus carica L.) in the northern Mediterranean region. Food Chem [Internet]. 2008;106(1):153–7. Available from: https://www.sciencedirect.com/science/article/pii/S0308814607005201
144. Mandal SC, Maity TK, Das J, Pal M, Saha BP. Hepatoprotective activity of Ficus racemosa leaf extract on liver damage caused by carbon tetrachloride in rats. Phytother Res. 1999 Aug;13(5):430–2.
145. Khan N, Sultana S. Chemomodulatory effect of Ficus racemosa extract against chemically induced renal carcinogenesis and oxidative damage response in Wistar rats. Life Sci. 2005 Jul;77(11):1194–210.
146. Bhaskara Rao R, Murugesan T, Sinha S, Saha BP, Pal M, Mandal SC. Glucose lowering efficacy of Ficus racemosa bark extract in normal and alloxan diabetic rats. Phytother Res. 2002 Sep;16(6):590–2.
147. Solomon A, Golubowicz S, Yablowicz Z, Grossman S, Bergman M, Gottlieb HE, et al. Antioxidant activities and anthocyanin content of fresh fruits of common fig (Ficus carica L.). J Agric Food Chem. 2006 Oct;54(20):7717–23.
148. Mandal SC, Saha BP, Pal M. Studies on antibacterial activity of Ficus racemosa Linn. leaf extract. Phytother Res. 2000 Jun;14(4):278–80.
149. Bose TK, J K, Das P, Joy PP. Tropical Horticulture Volume 2. 2001.
150. Joseph B, Raj J. Phytopharmacological and phytochemical properties of three ficus species-An overview. Int J Pharma Bio Sci. 2010;1.
151. Babu K, Sabesan G, Rai S. Comparative pharmacognostic studies on the barks of four Ficus species. Turk J Botany. 2010;34:215–24.
152. Paarakh P. Ficus racemosa Linn.–An overview. Indian J Nat Prod Resour. 2014;8:84–90.
153. Actmty A, Ficus OF, Leaf R, Of E, Active THE, Deraniyagala CSA. ANTIFUNGAL ACTMTY OF FICUS RACEMOSA LEAF EXTRACT AND ISOLATION OF THE ACTIVE COMPOUND S.A. DERANIYAGALA', R.L.C. WIJESUNDERA2and O.V.D.S.J. WEERASENA2 *. 1998;26(I):19–26.
154. Sankara Rao, K. DK. India Flora Online. Lawsonia inermis. In 2024. Available from: https://indiaflora-ces.iisc.ac.in/herbsheet.php?id=7042&cat=13
155. Prasad BR. Assessment of ethno-medicinal plants from Chamundi Hill, Mysore. J Med plant Res. 2011;5:5200–2.
156. Poongodi A, Thilagavathi S, Veerasamy A, Rajendran A. Observations on some ethnomedicinal plants in Sathyamangalam forests of Erode district, Tamil Nadu, India. J Med plant Res. 2010;5.
157. Wadankar G, Malode S, Sarambekar S. Traditionally used medicinal plants for ound healing in the Washim district, Maharashtra (India). Int J PharmTech Res. 2011;3:2080–4.
158. Badoni Semwal R, Semwal DK, Combrinck S, Cartwright-Jones C, Viljoen A. Lawsonia inermis L. (henna): ethnobotanical, phytochemical and pharmacological aspects. J Ethnopharmacol. 2014 Aug;155(1):80–103.
159. Natarajan V, Mahendraraja S, Menon T. Anti dermatophytic activities of Lawsonia alba. Biomedicine. 2000;20:243–5.
160. Gul F, Shinwari Z, Afzal I. SCREENING OF INDIGENOUS KNOWLEDGE OF HERBAL REMEDIES FOR SKIN DISEASES AMONG LOCAL COMMUNITIES OF NORTH WEST PUNJAB, PAKISTAN. Pakistan J Bot. 2012;44:1609–16.
161. Rastogi T, Bhutda V, Moon K, Aswar P, Khadabadi S. Comparative Studies on Anthelmintic Activity of Moringa Oleifera and Vitex Negundo. Asian J Res Chem. 2009;2.
162. Sankara Rao, K. DK. India Flora Online. Moringa oleifera. In 2024. Available from: https://indiaflora-

ces.iisc.ac.in/herbsheet.php?id=8052&cat=13
163. Nadkarni KM, Nadkarni AK. Dr. K. M. Nadkarni's Indian Materia Medica: With Ayurvedic, Unani-tibbi, Siddha, Allopathic, Homeopathic, Naturopathic \& Home Remedies, Appendices \& Indexes [Internet]. Popular Prakashan; 2007. Available from: https://books.google.co.in/books?id=RA4Npohz4CEC
164. Patel P, Patel N, Dhara P, Desai S, Meshram D. Phytochemical analysis and antifungal activity of moringa oleifera. Int J Pharm Pharm Sci. 2014;6:144–7.
165. Sankara Rao, K. DK. India Flora Online. Murraya koenigii. 2024; Available from: https://indiaflora-ces.iisc.ac.in/herbsheet.php?id=8115&cat=13
166. Mabberley DJ. Mabberley's Plant-book: A Portable Dictionary of Plants, their Classification and Uses. 4th ed. Cambridge University Press; 2017.
167. Jain V, Momin M, Laddha K. Murraya Koenigii: An Updated Review. Int J Ayurvedic Herb Med. 2012;2:607–27.
168. Dr. Supriya KumarBhattacharjee. HANDBOOK OF MEDICINAL PLANTS. Vol. 003. Pointer Publishers;
169. Adewunmi CO, Agbedahunsi JM, Adebajo AC, Aladesanmi AJ, Murphy N, Wando J. Ethno-veterinary medicine: screening of Nigerian medicinal plants for trypanocidal properties. J Ethnopharmacol. 2001 Sep;77(1):19–24.
170. Nayak A, Mandal S, Banerji A, Banerji J. Review on chemistry and pharmacology of Murraya koenigii Spreng (Rutaceae). J Chem Pharm Res [Internet]. 2010;2(2):286–99. Available from: http://jocpr.com/vol2-iss2-2010/JOCPR-2-2-286-299.pdf
171. Adebajo A, Olayiwola G, Verspohl J, Iwalewa EO, Omisore O, Bergenthal D, et al. Evaluation of the ethnomedical Claims of Murraya koenigii. Pharm Biol. 2004;42:610–20.
172. Rajeswara Rao BR, Rajput DK, Mallavarapu GR. Chemical diversity in curry leaf (Murraya koenigii) essential oils. Food Chem [Internet]. 2011;126(3):989–94. Available from: https://www.sciencedirect.com/science/article/pii/S0308814610015244
173. Ponnusamy S, Ravindran R, Zinjarde S, Bhargava S, Ravi Kumar A. Evaluation of traditional Indian antidiabetic medicinal plants for human pancreatic amylase inhibitory effect in vitro. Evid Based Complement Alternat Med. 2011;2011.
174. Rana VS, Juyal JP, Rashmi, Amparo Blazquez M. Chemical constituents of the volatile oil of Murraya koenigii leaves. Int J Aromather [Internet]. 2004;14(1):23–5. Available from: https://www.sciencedirect.com/science/article/pii/S0962456203001437
175. Chakrabarty M, Nath A, Khasnobis S, Chakrabarty M, Konda Y, Harigaya Y, et al. Carbazole alkaloids from Murraya koenigii. Phytochemistry. 1997 Oct;46(4):751–5.
176. Nutan MTH, Hasnat A, Rashid MA. Antibacterial and cytotoxic activities of Murraya koenigii. Fitoterapia [Internet]. 1998;69:173–5. Available from: https://api.semanticscholar.org/CorpusID:89305850
177. Iyer UM, Mani U V. Studies on the effect of curry leaves supplementation (Murraya Koenigi) on lipid profile, glycated proteins and amino acids in non-insulin-dependent diabetic patients. Plant Foods Hum Nutr. 1990 Oct;40(4):275–82.
178. Sari UP, Reveny J, Sinaga SM. Antifungal activity testing of curry leaf ethanol extract on the growth of Pityrosporum ovale and Candida albicans fungus. Int J Basic \& Clin Pharmacol [Internet]. 2023; Available from: https://api.semanticscholar.org/CorpusID:267429118
179. Tripathi Y, Anjum N, Rana A. Chemical Composition and In vitro Antifungal and Antioxidant Activities of Essential Oil from Murraya koenigii (L.) Spreng. Leaves. Asian J Biomed Pharm Sci. 2018;8:6–13.
180. Marei GIK, Abdel Rasoul MA, Abdelgaleil SAM. Comparative antifungal activities and biochemical effects of monoterpenes on plant pathogenic fungi. Pestic Biochem Physiol [Internet]. 2012;103(1):56–61. Available from: https://www.sciencedirect.com/science/article/pii/S0048357512000375
181. Spices Board India [Internet]. Basil. Available from: https://www.indianspices.com/spice-catalog/basil
182. Kirtikar KR, R K, Basu \&, D B. Indian Medicinal Plants. 8 Vols. [Internet]. International Book Distributors; 1935. Available from: https://books.google.co.in/books?id=vrxLAAAACAAJ
183. Javanmardi J, Khalighi A, Kashi A, Bais HP, Vivanco JM. Chemical characterization of basil (Ocimum basilicum L.) found in local accessions and used in traditional medicines in Iran. J Agric Food Chem. 2002 Oct;50(21):5878–83.
184. Teofilović B, Grujić-Letić N, Golo\vcorbin-Kon S, Stojanović SĐ, Vastag GG, Gad\vzurić SB. Experimental and chemometric study of antioxidant capacity of basil (Ocimum basilicum) extracts. Ind Crops Prod [Internet]. 2017;100:176–82. Available from: https://api.semanticscholar.org/CorpusID:99162106
185. Castronuovo D, Russo D, Libonati R, Faraone I, Candido V, Picuno P, et al. Influence of shading treatment on yield, morphological traits and phenolic profile of sweet basil (Ocimum basilicum L.). Sci Hortic (Amsterdam) [Internet]. 2019;254:91–8. Available from: https://www.sciencedirect.com/science/article/pii/S0304423819303346
186. Kivilompolo M, Hyötyläinen T. Comprehensive two-dimensional liquid chromatography in analysis of

Lamiaceae herbs: characterisation and quantification of antioxidant phenolic acids. J Chromatogr A. 2007 Mar;1145(1–2):155–64.
187. Gang DR, Wang J, Dudareva N, Nam KH, Simon JE, Lewinsohn E, et al. An investigation of the storage and biosynthesis of phenylpropenes in sweet basil. Plant Physiol. 2001 Feb;125(2):539–55.
188. Grayer RJ, Kite GC, Goldstone FJ, Bryan SE, Paton A, Putievsky E. Infraspecific taxonomy and essential oil chemotypes in sweet basil, Ocimum basilicum. Phytochemistry. 1996 Nov;43(5):1033–9.
189. Taie H, Salama DZ, Samir R. Potential Activity of Basil Plants as a Source of Antioxidants and Anticancer Agents as Affected by Organic and Bio-organic Fertilization. Not Bot Horti Agrobot Cluj-Napoca. 2010;38:119–27.
190. Jakowienko P, Wojcik-Stopczynska B, Jadczak D. Antifungal Activity of Essential Oils from Two Varieties of Sweet Basil (Ocimum basilicum L.). Veg Crop Res Bull. 2011;74.
191. Samson RA. Introduction to Food- and Airborne Fungi [Internet]. Centraalbureau voor Schimmelcultures; 2000. Available from: https://books.google.co.in/books?id=IppFAQAAIAAJ
192. Khan K. Role of Emblica officinalis in Medicine - A Review. Bot Res Int. 2009;
193. Sankara Rao, K. DK. India Flora Online. Phyllanthus emblica. In 2024. Available from: https://indiaflora-ces.iisc.ac.in/herbsheet.php?id=9183&cat=13
194. Kumar K, Bhowmik D, Dutta A, Yadav A, Paswan S, Srivastava S, et al. Recent Trends in Potential Traditional Indian Herbs Emblica Officinalis and Its Medicinal Importance. J Pharmacogn Phytochem. 2012;1.
195. Warrier PK, Nambiar VPK, Ramankutty C. Indian Medicinal Plants: A Compendium of 500 Species [Internet]. Orient Longman; 1993. (Indian Medicinal Plants: A Compendium of 500 Species). Available from: https://books.google.co.in/books?id=Rk_vt0KqzMEC
196. Makhija I, Khamar D. Anti-snake venom properties of medicinal plants. Der Pharm Lett. 2010;2:399–411.
197. Gutiérrez SP, Sánchez MAZ, Gonzlález CP, García LA. Antidiarrhoeal activity of different plants used in traditional medicine. African J Biotechnol. 2007;6(25):2988–94.
198. Scartezzini P, Antognoni F, Raggi MA, Poli F, Sabbioni C. Vitamin C content and antioxidant activity of the fruit and of the Ayurvedic preparation of Emblica officinalis Gaertn. J Ethnopharmacol. 2006 Mar;104(1–2):113–8.
199. Krishnaveni M, Mirunalini S. Amla - The role of ayurvedic therapeutic herb in cancer. Asian J Pharm Clin Res. 2011;4:13–7.
200. Dasaroju S, Gottumukkala K. Current trends in the research of Emblica officinalis (Amla): A pharmacological perspective. Int J Pharm Sci Rev Res. 2014;24:150–9.
201. Al-Samman AMMA, Kahkashan, Siddique NA. Gas Chromatography{\textendash}Mass Spectrometry (GC-MS/MS) Analysis, Ultrasonic Assisted Extraction, Antibacterial and Antifungal Activity of Emblica officinalis Fruit Extract. Pharmacogn J. 2019 Feb;11:315–23.
202. Sankara Rao, K. DK. India Flora online. Piper betle. In 2024. Available from: https://indiaflora-ces.iisc.ac.in/herbsheet.php?id=9279&cat=13
203. Guha P. Betel Leaf: The Neglected Green Gold of India. J Hum Ecol. 2006;19:87–93.
204. Arambewela L, Kumaratunga KGA, Dias K. Studies on Piper Betle of Sri Lanka. J Natl Sci Found Sri Lanka. 2010;33.
205. Fazal F, Mane PP, Rai MP, Thilakchand KR, Bhat HP, Kamble PS, et al. The phytochemistry, traditional uses and pharmacology of Piper Betel. linn (Betel Leaf): A pan-asiatic medicinal plant. Chin J Integr Med. 2014 Aug;
206. Rai KK, Umekar M, Trivedi R. REVIEW ON BETEL LEAF USED IN VARIOUS AILMENTS. 2019;
207. Umar R, Ismail S, Sanusi N 'Adani, Rohin TDMAK, Zahary MN. Chemical composition and the potential biological activities of Piper betel–a Review. 2018;
208. Rai MP, Thilakchand KR, Palatty PL, Rao P, Rao S, Bhat HP, et al. Piper betel Linn (betel vine), the maligned Southeast Asian medicinal plant possesses cancer preventive effects: time to reconsider the wronged opinion. Asian Pac J Cancer Prev. 2011;12(9):2149–56.
209. Zielińska S, Matkowski A. Phytochemistry and bioactivity of aromatic and medicinal plants from the genus Agastache (Lamiaceae). Phytochem Rev. 2014;13(2):391–416.
210. Kaypetch R, Thaweboon S. Antifungal Property of Piper betle Leaf Oil against Oral Candida Species. MATEC Web Conf. 2018;242:1021.
211. Rongai D, Pulcini P, Lernia G, Nota P, Preka P, Milano F. Punicalagin Content and Antifungal Activity of Different Pomegranate (Punica ganatum L.) Genotypes. Horticulturae. 2019;5:52.
212. Sankara Rao, K. DK. India Flora Online. Punica granatum. In 2024. Available from: https://indiaflora-ces.iisc.ac.in/herbsheet.php?id=9971&cat=13
213. Robert P, Gorena T, Romero N, Sepulveda E, Chavez J, Saenz C. Encapsulation of polyphenols and anthocyanins from pomegranate (Punica granatum) by spray drying. Int J Food Sci Technol.

2010;45:1386–94.
214. Waheed S, Siddique N, Rahman A, Zaidi J, Ahmad sha'ari. INAA for dietary assessment of essential and other trace elements in fourteen fruits harvested and consumed in Pakistan. J Radioanal Nucl Chem. 2004;260:523–31.
215. Hopkins CY, Chisholm MJ. A survey of the conjugated fatty acids of seed oils. J Am Oil Chem Soc [Internet]. 1968;45(3):176–82. Available from: https://doi.org/10.1007/BF02915346
216. Cahoon EB, Ripp KG, Hall SE, Kinney AJ. Formation of Conjugated Δ8,Δ10-Double Bonds by Δ12-Oleic-acid Desaturase-related Enzymes: BIOSYNTHETIC ORIGIN OF CALENDIC ACID*. J Biol Chem [Internet]. 2001;276(4):2637–43. Available from: https://www.sciencedirect.com/science/article/pii/S0021925818466112
217. Özkal N, Dinç S. Valuation of The Pomegranate (Punica granatum L.) Peels From The Standpoint of Pharmacy. J Fac Pharm Ankara Univ. 1993;22(1):21–29.
218. Endo EH, Cortez DAG, Ueda-Nakamura T, Nakamura CV, Dias Filho BP. Potent antifungal activity of extracts and pure compound isolated from pomegranate peels and synergism with fluconazole against Candida albicans. Res Microbiol. 2010 Sep;161(7):534–40.
219. Srinivasan K. Fenugreek (Trigonella foenum-graecum): A Review of Health Beneficial Physiological Effects. Food Rev Int - FOOD REV INT. 2006;22:203–24.
220. Ahmad A, Alghamdi SS, Mahmood K, Afzal M. Fenugreek a multipurpose crop: Potentialities and improvements. Saudi J Biol Sci [Internet]. 2016;23(2):300–10. Available from: https://www.sciencedirect.com/science/article/pii/S1319562X15002107
221. Fenugreek production in India. In: Wikipedia [Internet]. Available from: https://en.wikipedia.org/wiki/Fenugreek_production_in_India
222. Sankara Rao, K. DK. India Flora Online. Trigonella foenum. In 2024.
223. Spices Board India [Internet]. Fenugreek. Available from: https://www.indianspices.com/spice-catalog/fenugreek
224. Mandal P, Gupta S. Improvement of antioxidant activity and related compounds in fenugreek sprouts through nitric oxide priming. Int J Pharm Sci Rev Res. 2014;26:249–57.
225. Thammanna GSS, Ramadas DD, ramakrishna H, Srinivas L. Free radical scavenging activity of lutein - isolated from methi leaves (Trigonella foenum graecum). Int J Pharm Pharm Sci. 2010;2:113–7.
226. Mitra A, Bhattacharya D, Roy B. Dose-dependent effects of Fenugreek composite in Diabetes with dyslipidemia. Internet J Food Saf. 2006;8.
227. Haouala R, Hawala S, El-Ayeb A, Khanfir R, Boughanmi N. Aqueous and organic extracts of Trigonella foenum-graecum L. inhibit the mycelia growth of fungi. J Environ Sci (China). 2008;20(12):1453–7.
228. Yasmin H, Kaisar M, Moklesur M, Sarker MMR, Rahman MS, Rashid M. Preliminary Anti-bacterial Activity of Some Indigenous Plants of Bangladesh. Dhaka Univ J Pharm Sci. 2009;8.
229. Nahar N, Rahman M, Rahman S, M. M. GC-MS Analysis and Antibacterial Activity of Trigonella foenumgraecum Against Bacterial Pathogens. Free Radicals Antioxidants. 2016;6:109–14.
230. Subhashini N, Nagarajan G, Kavimani S. Anti-inflammatory and In vitro Antioxidant Property of Trigonella foenum graecum Seeds. J Pharmacol Toxicol. 2011;6:371–80.
231. Shabbeer S, Sobolewski M, Anchoori RK, Kachhap S, Hidalgo M, Jimeno A, et al. Fenugreek: a naturally occurring edible spice as an anticancer agent. Cancer Biol Ther. 2009 Feb;8(3):272–8.
232. Rao A V. Herbal Cure for Common Diseases [Internet]. Diamond Pocket Books Pvt Ltd; 2016. Available from: https://books.google.co.in/books?id=lRoXDQAAQBAJ
233. Surya A, Anchalee S, Saikat B, Ooraikul B, Basu T. Improvement in the nutraceutical properties of fenugreek (Trigonella foenum-graecum L.). Songklanakarin J Sci Technol. 2006;28(1).
234. Sowmya P, Rajyalakshmi P. Hypocholesterolemic effect of germinated fenugreek seeds in human subjects. Plant Foods Hum Nutr. 1999;53(4):359–65.
235. yadav R, Kaushik R. A study of phytochemical constituents and pharmacological actions of Trigonella foenum-graecum: A review. Int J Pharmacy&Technology. 2011;3:1022–8.
236. Dharajiya D, Jasani H, Khatrani T, Kapuria M, Pachchigar K, Patel P. Evaluation of antibacterial and antifungal activity of fenugreek (Trigonella foenum-graecum) extracts. Int J Pharm Pharm Sci. 2016;8:212–7.
237. Vishwanathan AS, Ramaiah B. A Review on Vitex negundo L. – A Medicinally Important Plant. eJournal Biol Sci. 2010;3:30–42.
238. Bano U, Jabin A, Ahmed A, Siddiqui M. THERAPEUTIC USES OF VITEX NIGUNDO. 2015;4.
239. Nadkarni. 2015.112096.Indian-Materia-Medica-Voli. 1976.
240. Sankara Rao, K. DK. India Flora Online. Vitex negundo. In 2024.
241. Zheng CJ, Li HQ, Ren SC, Xu CL, Rahman K, Qin LP, et al. Phytochemical and Pharmacological Profile of Vitex negundo. Phytother Res. 2015 May;29(5):633–47.
242. Gupta M, Mazumder UK, Bhawal SR. CNS activity of Vitex negundo Linn. in mice. Indian J Exp Biol.

1999 Feb;37(2):143–6.
243. Tandon VR. Medicinal uses and biological activities of Vitex negundo. Nat Prod Radiance. 2005;4(3):162–5.
244. Dharmasiri MG, Jayakody JRAC, Galhena G, Liyanage SSP, Ratnasooriya WD. Anti-inflammatory and analgesic activities of mature fresh leaves of Vitex negundo. J Ethnopharmacol. 2003 Aug;87(2–3):199–206.
245. Sundaram R, Naresh R, Ranadevan R, Shanthi P, Sachdanandam P. Effect of iridoid glucoside on streptozotocin induced diabetic rats and its role in regulating carbohydrate metabolic enzymes. Eur J Pharmacol. 2012 Jan;674(2–3):460–7.
246. Chowdhury N, Islam W, Khalequzzaman M. Biological activities of isolated compounds from Vitex negundo leaf. J Bio-Science. 2011;18.
247. Zheng CJ, Pu J, Zhang H, Han T, Rahman K, Qin LP. Sesquiterpenoids and norterpenoids from Vitex negundo. Fitoterapia [Internet]. 2012;83(1):49–54. Available from: https://www.sciencedirect.com/science/article/pii/S0367326X11002322
248. Zheng CJ, Lan XP, Cheng RB, Huang BK, Han T, Zhang QY, et al. Furanofuran lignans from Vitex negundo seeds. Phytochem Lett [Internet]. 2011;4(3):298–300. Available from: https://www.sciencedirect.com/science/article/pii/S1874390011000784
249. Noel MG, Dayrit FM. Triterpenes in the Callus Culture of Vitex negundo L. Philipp J Sci [Internet]. 2005;134(1):5–19. Available from: http://philjournalsci.dost.gov.ph/vol134no1/tripertenes in the callus culture of vitex negundo.html
250. Chawla AS, Sharma AK, Handa SS, Dhar KL. Chemical investigation and anti-inflammatory activity of Vitex negundo seeds. J Nat Prod. 1992 Feb;55(2):163–7.
251. Aswar PB, Khadabadi SS, Kuchekar BS, Rajurkar RM, Saboo S, Javarkar RD. In-Vitro Evaluation of Anti-Bacterial and Anti-Fungal Activity of Vitex nigundo (Verbenaceae). Ethnobot Leafl [Internet]. 2009;2009:13. Available from: https://api.semanticscholar.org/CorpusID:55789296
252. Guleria S, Kumar A. Antifungal activity of some Himalayan medicinal plants using direct autography. J Cell Mol Biol. 2006;5:95–8.
253. Zheng CJ, Lan XP, Wang Y, Huang BK, Han T, Zhang QY, et al. A new labdane diterpene from Vitex negundo. Pharm Biol. 2012 Jun;50(6):687–90.