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A comprehensive review of the phytochemical and pharmacological potential of some selected species from Nandhaur landscape, Uttarakhand

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Abstract

Medicinal and Aromatic plant (MAP) species including Shrubs, herbs and trees are widely distributed along the Nandhaur landscape which is present in Nainital District of Uttarakhand. This region is well known for its flora and fauna biodiversity. Local and tribal communities of this region still use medicinal plants to cure various diseases and ailments. Research articles on the tree species have already been published by the researchers but there is no such study on shrubs and herbs. This review article is an attempt to study and analyze the pharmaceutical, ethnobotanical, and traditional uses of 28 plant species including the shrubs and herb species from Nandhaur landscape. With the help of a literature review, we highlighted the phytochemical constituents, and their botanical, vernacular names with modern and traditional uses. It will be beneficial to share traditional knowledge of these medicinal plant species with locals, researchers, and scientists by providing them with a thorough understanding of the region. As many plants species face extinction due to climate change, deforestation, and irregular harvesting practises, this comprehensive review will be critical for protecting cultural, traditional, and biodiversity conservation.

Keywords: Biodiversity, MAPs, Nandhaur landscape, phytochemical constituents, shrubs, and herbs

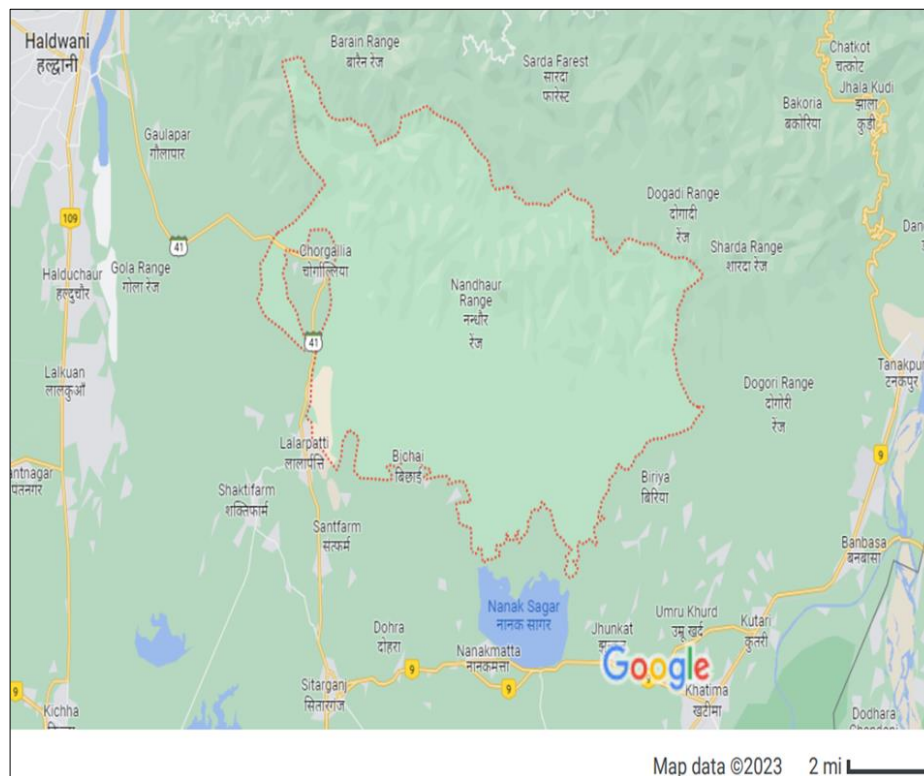
1. Introduction

India is renowned for having a diverse range of species. It is one of the nations with the most diversity in the globe. India is home to four of the world's 36 biodiversity hotspots, including the Himalayas, Western Ghats, Indo-Burma area, and Sundaland [1]. India's recognized biological diversity accounts for over 8% of the known worldwide biological diversity although making up just 2.4% of the world's total geographical area. In India, there are more than 6500 unique plant species that are still employed in traditional medical practises [2]. Except for Allopathy, all of India's officially recognised health systems—Ayurveda, Yoga, Unani, Siddha, Homeopathy, and Naturopathy include a significant portion of herbal medications. In India, more than 70% of people still use these non-allopathic systems of medicine [3]. Being a Himalayan state, Uttarakhand is renowned as India's natural reservoir and is rich in biodiversity. Due to its sub-tropical to alpine climate, range of soils, and landforms, it is a mega-biodiversity hot spot for a variety of wild and domesticated medicinal and fragrant plants [4]. The altitude in the state varies from 200 to 7817 metre above mean sea level. Within this altitudinal variation state, there are five Lith tectonically and physio graphically unique sub-divisions, including the Trans-Himalaya, the Lesser Himalaya, the Great Himalaya, and the Outer Himalaya, which includes the Tarai and Bhabhar. The highest elevations are covered by ice and snow. The lowlands along Uttar Pradesh's border are covered by the upper Gangetic plains, moist deciduous woods, and the drier Tarai savanna and grassland [5]. Some of the main cities in Uttarakhand, including Haldwani and Ramnagar, both in Nainital District, are located inside the Himalayan Bhabhar belt, an 8–10 km broad band that runs from East to West along the Himalayan foothills in the Shivalik's. Every year, studies expand on the chemical composition and properties of herbal medicines, which are associated with use of different plant extracts, essential oils, or compounds. 28 fragrant and therapeutic shrubs and herbs that are found in the Nandhaur valley area of Haldwani, Nainital; have been compiled in the current study. These species belong to different plant families including, Solanaceae, Apocynaceae, Berberidaceae, Rutaceae, Caesalpinaceae, Amaranthaceae, Asparagaceae, Tamaricaceae, Verbenaceae, Lythraceae, Tiliaceae, Acanthaceae, Lamiaceae, Verbenaceae, Malvaceae, Primulaceae, Asparagaceae, Oxalidaceae, Lamiaceae, Verbenaceae, Symplocaceae, Cannabaceae, and Magnoliaceae. This review paper encompasses a decade-

long literature review, with concise description of 28 shrubs and herbs species found in Nandhaur landscape of Haldwani, Nainital.

2. Methods

2.1 Description of the study area



2.2 Climate

In the northern section of Nainital, the climate is chilly in winter and moderate in summer, whereas in the southern half, it is hot in summer, cold in winter, and there is a lot of rain during the monsoon season. Haldwani lies in the southern part of District Nainital. It has a pleasant environment that is typically warm and temperate. The summers have a lot more rain than the winters do. This climate falls under the Köppen and Geiger classification of Cwa. The typical annual temperature in Haldwani is 22.7 °C (72.8 °F). There is around 1669 mm (65.7 inches) of rain here each year.

The present study on aromatic and medicinal shrubs and herbs was conducted in the Nandhaur valley of the Nainital district, which is located between 29°08'35.8"N and 79°46'36.5"E and is surrounded by the rivers Gola, Sharda, and Nandhaur. The study was specifically focused on the Nandhaur wildlife sanctuary and its surroundings.

2.3 Data collection

The primary data of the medicinal shrubs and herbs was collected from Nandhaur landscape between October 2022 to December 2022. Secondary sources of information (that is, Uttarakhand government websites, research papers, books, and articles) were also used for reference. Review of literature gathered information on the local/vernacular names of medicinal plants, habitat, region, plant parts used and medicinal uses (table 1).

Table 1: Vernacular/local names, habitat, region, plant parts used and medicinal uses of medicinal plants

S/No	Botanical Name	Family	Plant Common name	Habit	Plant Part Used	Region	Medicinal uses	References
1.	<i>Solanm Verbascifolium</i>	Solanaceae	African Garden egg vegetable	Shrub	Leaves	India	Antibacterial	[6,7]
2.	<i>Calotropis procera</i>	Apocynaceae	Giant milkweed	Shrub	Whole plant	Indian Subcontinent, S. America, Caribbean Islands, Australia, Hawaiian Islands, Mexico, Seychelles	Antibacterial Anthelmintic, Antihyperglycemic, Antipyretic, Analgesic, Antidepressant, Neuromuscular Blocking Activity, Used in Traditional Medicine for The Treatment of Leprosy, Ulcers, Tumours, Diseases of the Spleen Liver and Piles.	[8,9]
3.	<i>Carissa spinarum</i>	Apocynaceae	Wild Karonda	Shrub	Root, leaf, and fruits	India	Anthelmintic, Antimalarial, Antiarthritic, Anticonvulsant, Antidiabetic, Anti-Inflammatory, Antioxidant, Antimicrobial, Antileishmanial, Antinociceptive and Antioxidant.	[10, 11]
4.	<i>Nerium indicum</i>	Apocynaceae	Oleander	Shrub	Leaf, bark	Philippines, India, Nepal, and Bangladesh	Antibacterial, Antimitotic, Antifungal, Antiviral, Antioxidant, Antimalarial, Antidiabetic, Analgesic, Antiulcer,	[12, 13]

							Anti-Inflammatory and Anticancer	
5.	<i>Berberis</i> Species	Berberidaceae	Barberry	Shrubs and Small trees	Whole plant	India	<i>B. Vulgaris</i> Antihistaminic, Anticholinergic, Anti-Inflammatory and Anti-Nociceptive <i>B. Croatica</i> Antimicrobial Activity <i>B. Aristata</i> Anticancer, Anti-Osteoporotic <i>B. Koreana</i> Cytotoxic Activity <i>B. Heterophylla</i> Antimicrobial Activity	[14, 15]
6.	<i>Murraya koenigii</i>	Rutaceae	Curry leaf or karipatta	Shrub	Leaves, stem, bark, seeds, fruits	India	Anti-bacterial, Anti-fungal, Anti- protozoal, Anti-trichomonal, Anti-cancer, Anti-oxidant, Anti-diarrheal, Anti-ulcer, Anthelmintic, Antipyretic, Antidiabetic, Anti-tumour, Wound Healing	[16, 17]
7.	<i>Cassia tora</i>	Caesalpinaceae	Charota, Chakramarda	Shrub	Seeds, leaves	India, Sri lanka Northern Australia and Americas	Antioxidant, Antifungal, Antibacterial Antishigellosis, Antihyperlipidemic, Antidiabetic, Antimutagenic, Immunostimulatory, Spasmogenic, Antinociceptive and Anti-Inflammatory	[18, 19]
8.	<i>Crotalaria sericea/ Crotalaria juncea</i>	Fabaceae/ Leguminosae	Sunn hemp	Shrub	Whole Plant, Seeds	Bangladesh, Bhutan India	Hypolipidemic, Antioxidant, Antibacterial, Antifungal, Anti-diarrhoeal, Anti-inflammatory, Hepatoprotective, Antifertility, Antiulcerogenic.	[20, 21]
9.	<i>Achyranthes aspera</i>	Amaranthaceae	Chirchita	Shrub	Whole Plant, Seeds, Fruits, Flowers	India	Antimicrobial, Larvicidal, Antifertility, Anti cancerous, Immunostimulant, Hypoglycaemic, Hypolipidemic, Anti-inflammatory, Antioxidant, Anti asthmatic, Anti spasmodic, Anti-arthritic, Anti-dandruff, Wound healing, Analgesic, antipyretic and antinociceptive, Anti-obesity, Anti-diabetic, Anti-fertility.	[22, 23]
10.	<i>Asparagus adscendens/Asparagus racemosus</i>	Asparagaceae	Shatawari	Shrub	Root	India	Hepatoprotective, Antimicrobial, Immuno-Modulatory Antidepressant, Anti-Diarrhoeal, Antiulcerogenic Action, Antibacterial, Analgesic, Antioxidant	[24, 25]
11.	<i>Tamarix dioica</i>	Tamaricaceae	Jhau,	Shrub	Leaves	India, Pakistan, Afghanistan, Iran, India, Bangladesh, Bhutan, Nepal, and Myanmar	Antifungal, Antibacterial, Cytotoxic Activity	[26]
12.	<i>Callicarpa macrophylla</i>	Verbenaceae	Velvety Beauty Berry	Shrub	Stem	India, China, Bhutan, Myanmar, South East Asia, and Nepal	Antibacterial, Analgesic, Antipyretic, Anti-Arthritic Antifungal, Anti-Inflammatory	[27, 28]
13.	<i>Woodfordia fruticosa</i>	Lythraceae	Fire flame bush and Shiranjitea	Shrub	Flowers,	India, Malaysia, Indonesia, Sri Lanka, China, Japan, and Pakistan	Antimicrobial, Hepatoprotective, Antiulcer, Immunomodulatory, Antifertility, Antitumor, Analgesic, Anti-inflammatory, Antibacterial, Antihyperglycemic, Wound healing, Anthelmintic.	[29, 30]
14.	<i>Glycosmis pentaphylla</i>	Rutaceae	Orange Berry	Shrub	Leaves, stem bark	India	Anthelmintic, Hepatoprotective, Antibacterial, Antioxidant, Antipyretic, Antidiabetic, Antinociceptive, Antimicrobial	[31]
15.	<i>Grewia sapida</i>	Tiliaceae	Falsa	Shrubs	Leaves, stems, and root	India	Ulcerated Tongue, Colic, Wounds, Cholera and Dysentery	[32]
16.	<i>Adhatoda vasica</i>	Acanthaceae	Vasaka	Shrub	Whole Plant	India, Nepal, Pakistan, Myanmar, Sri Lanka, and Germany	Antibacterial, Oxytocic/ Abortifacient, Hypoglycaemic, Antitussive, Hepatoprotective, Antiulcer, Antitubercular,	[33, 34]
17.	<i>Colebrookea oppositifolia</i>	Lamiaceae	Bansa/ Bhaman	Shrub	Leaves, bark,	India, Pakistan	Anti-Inflammatory, Cardioprotective, Hepatoprotective, Anti-Inflammatory, Anthelmintic, Antifungal, Antioxidant, Antimicrobial, Antinociceptive, Cytotoxic Activity, Anticonvulsant, Antiulcer, Antimicrobial, Anti-Fertility, Antipyretic, Insecticidal	[35, 36]
18.	<i>Vitex negundo</i>	Verbenaceae	Sambhalu, Nirgundi, Five	Shrub or	Leaves, roots, bark,	India	Analgesic, Anti-inflammatory, Anti arthritic, Anticonvulsant, Antioxidant,	[37, 38, 39, 40]

			leaved chaste tree	Small Slender Tree	fruits, flowers, and seeds		Antifungal, Anti-microbial, Anti-Cancer	
19.	<i>Clerodendrum infortunatum</i>	Verbenaceae	Bhat	Shrub	Whole plant	India,	Antimicrobial, Anthelmintic, Wound Healing, Antioxidant, Analgesic, Anticonvulsant, Antidiabetic	[41, 42]
20.	<i>Helicteres isora</i>	Malvaceae	Avartani	Tree	Fruit, stem bark, seed, roo	India	Antioxidant, Anticancer, Antibacterial, Antiplasmid, Anti-Diarrheal, Antinociceptive, Antimicrobial, Wound Healing Potential	[43, 44]
21.	<i>Ardisia solanacea</i>	Primulaceae	wild berry	Shrub	Leaf, bark	South Asia, China, South East Asia	Antibacterial, Antifungal, Antioxidant	[45, 46]
22.	<i>Asparagus racemosus</i>	Asparagaceae	Shatavari	Shrub	Root	India	Antitussive, Antiulcer, Antibacterial, Antiprotozoal, Antihepatotoxic, Antineoplastic, Antioxidant, Antilithiatic, Anti-inflammatory, Antidepressant, Antiabortifacient	[47, 48]
23.	<i>Biophytum reinwardtii</i>	Oxalidaceae	Lajjalu	Miniature tree	Whole plant	India	Antioxidant, Anticancer	[49]
24.	<i>Clerodendrum viscosum</i>	Lamiaceae	Bhargi, Bharangi	Shrub or small tree	Whole plant	India	Anti-Inflammatory, Anti-Pyretic, Vermifuge Anti-Inflammatory, Anti-Tumour, Antibacterial, Anti-Snake Venom	[50, 51]
25.	<i>Lantana camara</i>	Verbenaceae	Wild sage	Shrub	Whole plant, seeds, fruits	India	Antibacterial, Antioxidant, Antipyretic, Insecticidal, Antimicrobial, Wound Healing, Antiulcerogenic, Anti-Inflammatory, Analgesic	[52, 53]
26.	<i>Symplocos paniculata</i>	Symplocaceae	Asiatic sweet leaf or sapphire berry	Tree	Leaves, bark	India	Anticancer, Antioxidant, Anti-Poisonous, Antimicrobial, Anti-Diabetic, Anti-Inflammatory	[54]
27.	<i>Cannabis sativa</i>	Cannabaceae	Bhang	Shrub	Leaves	India	Treatment of chronic pain, Glaucoma, Nausea, Cancer, Parkinson	[55]
28.	<i>Magnolia spp.</i>	Magnoliaceae	Champa	Tree	Bark, root	China, America, India	Anti-Cancer, Anti-Stress, Anti-Anxiety, Antidepressant, Antioxidant, Anti-Inflammatory, Hepatoprotective, Antimicrobial. Treatment of Rheumatism, Pleurisy, Cough	[56, 57]

2.4 Phytochemical constituents: Literature review revealed that these species contain alkaloids, terpenoids, flavonoids, tannin, saponin etc. which are summarised in table2.

Table 2: Chemical Constituents of selected plants in table1

S/No	Botanical name	Chemical constituents	References
1.	<i>Solanum Verbascifolium</i>	Acetamide, Acetohydroxamic acid, Pyridine, Diethyl Phthalate, 1-Nonadecene, 1-Dodecanol, Phytol, γ -Sitosterol, 9, 12, 15-Octadecatrienoic acid, methyl ester, 1-Naphthoic acid, germacrene D, caryophyllene, 1- β -ethenyl- α -methyl-2 β , 4- β -bis (1-methylethenyl)-cyclohexane, γ -elemene, α -cubebene and isodene.	[58, 59]
2.	<i>Calotropis procera</i>	5-Hydroxy-3, 7-dimethoxyflavone-4'-O- β -glucopyranoside, Isorhamnetin 3-O- β -D-rutinoside, Isoquercitrin, Stigmasterol, β -Sitosterol, Isoloneolone, Calactin, 15- β -Hydroxycalactin, Calotoxin, α -Amyrin, β -Amyrin, Taraxasterol, Oleanolic acid and α -Amyrin acetate.	[60]
3.	<i>Carissa spinarum</i>	2-Methoxyphenol, 2-Hydroxyacetophenone, Creosol, 4-Ethyl-2-methoxyphenol, 2-Methoxy-4-vinylphenol, 2, 6-Dimethoxyphenol, trans-Isoeugenol, 3, 5-Dimethoxy-4- hydroxytoluene, Tetradecanal, 5-tert-Butylpyrogallol, 3', 5'-Dimethoxy acetophenone, Guaiacylacetone, Methoxyeugenol, 4-Propenylsyringol, α -Cyperone.	[61]
4.	<i>Nerium indicum</i>	Neriin, oleandrin, scopoletin and scopoli, α -amyrin, β -sitosterol, kaempferol, odoroside, betulinic acid, oleanolic acid.	[62]
5.	<i>Berberis vulgaris</i>	α -Carotene, β -Carotene, Lutein, Zeaxanthin, Chrysoxanthin, Flavoxanthin, Auroxanthin, Capsanthin, Peonodin, Cyanidin, Delphinidin,	[63]
	<i>Berberis aristata</i>	Berbamine, Berberine, oxycanthine, epiberberine, palmatine, dehydrocaroline, jatrorrhizine, karachinedihydrokarachine, taximaline, oxyberberine, aromoline, columbamine.	[64]
6.	<i>Murrayakoenigii</i>	3-Carene, caryophyllene, α -thujene, allyl (methoxy) dimethylsilane, β -myrcene, α -terpinene, γ -terpinene, cis-sabinenehydrate, 4- terpineol, β -elemene, α -caryophyllene, γ -elemene, caryophyllene oxide and 3-phenylbutyrophe-none.	[65]
7.	<i>Cassia tora</i>	Rhein, emodine, physion, chrysophanol (marker), Obtusin, chrysoobtusin, chryso-obtusin-2-O- β -D-glucoside, obtusifolin and chryso-obtusifolin-2-O- β -D-glucoside, Kaempferol-3- diglucoside, rubrofusarin -6- β -gentiobioside and 8- Hydroxy-3-methyl anthraquinone -1- β -gentiobioside.	[66]
8.	<i>Crotalaria Sericea or Crotalaria juncea</i>	Riddelline, seneciophylline, senecionine, trichodesmine, chodesmine alkaloids, galactose-specific lectin, and cardiogenin 3-O- [r]-d-xylopyranoside	[67]
9.	<i>Achyranthes aspera</i>	Dihydroxyhenpentacontan-4-one, tritriacontanol, pentatriacontanol, cyclohexylheptacosan-7-ol, 16-hydroxy-26-methylheptacosan-2-one, 4-methylheptatriacont-1-en-10-ol, tetracontanol-2 pentatriacontan, 6-pentatriacontanone, hexatriacontane and triacontane	[68]
10.	<i>Asparagus</i>	2- Furancarboxaldehyde, 1,2- Dithiolane-3-carboxylic acid [synonyms: Tetranorlipoic acid], 1,6-Anhydro-	[69]

	<i>adscendens/Asparagus racemosus</i>	β -d-talopyranase, Tetradecanic acid, n-Hexadecanic acid, Oleic acid, 4 H Pyran- 4 One, 2,3 dihydro – 3,5 dihydroxy – 6 methyl and 9,12- Octadecadienoic acid.	
11.	<i>Tamarix dioica</i>	1-Hexadecene, hexahydrofarnesyl acetone, octadecane, dodecanoic acid, E-15-heptadecenal, docosane, 2-methoxy-4-vinylphenol, 1-tetradecene, tetracosane, 1-docosene, hexadecane, nonanal, nonanoic acid, dihydroactindiolide, and cyclotetracosane, whereas the major constituents in leaves were 2-methoxy-4-vinylphenol, dihydroactindiolide, megastigmatrienone, 1-hexadecene, β -lonone, safranal, vitispirane, <i>trans</i> -geranylacetone, and hexahydrofarnesyl acetone.	[70]
12.	<i>Callicarpa macrophylla</i>	14 α , 18-dihydroxy-7, 15-isopimaradiene, isopimaradiene-3 β ,18-diol, 14 α -hydroxyisopimaric acid, 7 α -hydroxysandaracopimaric acid, 8(14), 15-sandaracopimaradiene-7 α ,18-diol, 5-hydroxy-3', 4', 3, 7-tetramethoxyflavone, 3, 5-dihydroxy-3', 4', 7-trimethoxyflavone, 5,7-dihydroxy-3', 4', 3-trimethoxyflavone, 3',4', 5-trihydroxy-3,7-dimethoxyflavone, 5,4'-dihydroxy-7-methoxyflavone, 3,5,7-trihydroxy4'-methoxyflavone, naringenin, and 5, 4'-dihydroxy-7,3'-dimethoxyflavone.	[71]
13.	<i>Woodfordia fruticosa</i>	Ctacosanol and β -sitosterol, lupeol, betulin, betulinic acid, oleanolic acid and ursolic acid, Ellagic acid, norbergenin,3-rhamnoside,3- β –L-arabinoside, 3-O- α -D-xylopyranos, 3-O- α -L-arabinopyranoside, 3-O- β -D-xylopyranoside, 3-O-(6" –galloyl)- β -D-glucopyranoside, 3-O-(6"-galloyl)- β -D-galactopyranoside, 3-O- β -D-galactosidepresent, 3-O- α -L-arabinopyranoside, 3-O-(6"-galloyl) β -D-galactopyranoside, naringenin 7-glucoside, kaempferol 3-O-glucoside, 1, 2, 3, 6-tetra-O-galloyl- β -D-glucose, 1, 2, 4, 6-tetra-O-galloyl- β -D-glucose, 1, 2, 3, 4, 5-penta-O, galloyl- β -D-glucose, tellimagrandin, gemin D, heterophyllin A and oenothien B	[72]
14.	<i>Glycosmis pentaphylla</i>	Phytol, Bicyclo[5.2.0]nonane, 2-methylene-4, 8, 8-trimethyl-4-vinyl, 1,19-Eicosadiene, 1,6-Cyclodecadiene, 1- methyl-5-methylene-8-(1-methylethyl), Caryophyllene oxide, (-)-Spathulenol, Bicyclogermacrene. Bicyclo [4.4.0] dec-1-ene, 2-isopropyl-5-methyl-9-methylene, Epiglobulol, (-)-Globulol, Naphthalene, 1, 2, 3, 5, 6, 8a-hexahydro-4, 7-dimethyl-1-(1- methylethyl)-(1S-cis), 1H Indene, Ledol, Cyclohexane, 1-ethenyl -1-methyl -2, 4-bis (1- methylethenyl)-, [1S-(1.alpha., 2.beta.,4.beta.)], Santolina triene, Toluene, Humulene, gamma.-Elemene, 2-Pyrrolidinone and Cyclohexane, 1-ethenyl-1-methyl-2-(1-methylethenyl)-4- (1-methylethylidene), terpinen-4-ol, 2-undecanone, 2-undecano, undecanol, 2-dodecanone, 2-tridecanone, 2-tridecanol, dodecanoic (lauric) acid, Spathulenol, tridecanol, globulol, Viridifloro, α -pinene, sabinene, β -pinene, octanal, myrcene, p-cymene 1, 8-cineole, β -phellandrene limonene, γ -terpinene, octanol, <i>trans</i> -linalool oxide (furanoid), <i>cis</i> -linalool oxide (furanoid).	[73, 74]
15.	<i>Grewia sapida</i>	Alkaloids, Saponins, Cardiac glycosides, Steroids (Terpenoids), Anthraquinones, Coumarins, Phenols, Tannins, Flavonoids, Carbohydrates, Proteins, Phlobatannins, Lignin.	[75]
16.	<i>Adhatoda vasica</i>	1, 2, 3, trimethyl benzene, borneol, ethanonaphthalene, 1, 1, 4- trimethyl-5, 6-dimethylenedecahydro naphthalene, 2-tert-butyl-1, 4- dimethoxy benzene, bicyclo[jundec-4-ene, 4, 11-trimethyl-8-methylene, hexa- methyl dewar benzene, alphacaryophyllene, cycloproplejazulene, caryophyllene oxide and 2-naphthalenemethanol. A-Pinene, Sabinene, β -Pinene, o-Cymene, D-Limonene, α -Curcumene, Cineole, 1-Terpene-4-ol, α -Citral, 3-Thujanone, Limonene oxide.	[76, 77]
17.	<i>Colebrookea oppositifolia</i>	Eugenol, luteoline-7-glucoside, Quercetin, Phytol, n-Hexadecanoic acid, 9, 12, 15 Octadecatrienoic acid, 2-Dodecen-1-ny succinic anhydride, and Octanoic acid, Negletein-6- β -d-glucopyranoside, 5, 7, 2'-trihydroxyfavone 2'-O- β -d-glucopyranoside, chrysin, Negletein, Ladanein, Acteoside, Gossypin, Quercetin and Ferulic acid, Courmaric acid and 4', 5, 6, 7-tetramethoxy favones.	[78]
18.	<i>Vitex negundo</i>	δ -Guaiene, guaia-3, 7- dienecaryophyllene epoxide, ethyl-hexadecenoate; α -selinene, germacren-4-ol; caryophyllene epoxide, (E)- nerolidol, β -selinene, α -cedrene, germacrene D, hexadecanoic acid, p-cymene and valencene, viridiflorol, β -caryophyllene, sabinene, 4-terpineol, γ -terpinene, caryophyllene oxide, 1-oceten-3-ol, and globulol	[79]
19.	<i>Clerodendrum infortunatum</i>	1-Octen-3-ol, <i>trans</i> -3-hexenol, 1-hexanol, (3E)-hexen-1-ol acetate, 3-octanone, phenylacetaldehyde, linalool, methyl salicylate, (E)- β -damascenone, (E)- β -ionone and isophorone	[80]
20.	<i>Helicteres isora</i>	Formic acid, 1-methylethyl ester, 1-Butanol,2- methyl, Hexadecanoic acid, 1-Octen-3-ol, Heptadecen-(8) - carbonic acid-(1), Octadecnoic acid, Berberine.	[81]
21.	<i>Ardisia solanacea</i>	Aristolone, 3-hydroxy-3, 7, 11, 15-tetramethylhexadecanoic acid, silylat, α -amyrin and α -amyrenone, 4, 6, 6-trimethyl-2-(3-methylbuta-1,3-dienyl)-3-oxatricyclo octane, 3-hydroxy-3, 7, 11, 15-tetramethylhexadecanoic acid silylat and palmitic acid, β -sitosterol, gallic acid, Quercetin, Myricetin, (-)-5-(1,2-Dihydroxypentyl) benzene-1, 3-diol.	[82, 83]
22.	<i>Asparagus racemosus</i>	Iso Agatha Resinol, Gobicusin, Asparacosin, Muzanzagenin, Racemoside, Shatavarins, Asparanin, Immunoside, Sarsasapogenin, Diosgenin, Sitosterol, Filiasparoside, Shatavaroside, Shatavaroside Asparagamine glucopyranoside, Cyanidine-3-galatoside, Kaempferol, Quercetin, Rutin, Hyperoside, Quercetin-3-glucuronide	[84, 85]
23.	<i>Biophytum reinwardtii</i>	Ethyl palmitate, lupeol, β -sitosterol and linoleic acid.	[86]
24.	<i>Clerodendrum viscosum</i>	Acetamide,N, N-carbonylbis-, 4-Pyranone, 2, 3-dihydro-, α -D-Galactofuranoside, methyl 2, 3, 5, 6-tetra-O-methyl-, Glycerin, Xylitol, N, N-Dimethylglycine, 4H-Pyran-4-one, 2, 3-dihydro-3, 5-dihydroxy-6-methyl-, Benzofuran, 2, 3-dihydro-, 5-Hydroxymethylfurfural, 2(1H)Pyrimidinone,1-methyl-, 2,4-Dihydroxy-5,6-dimethylpyrimidine, 3-Deoxy-d-mannoic lactone, 1, 3-Methylene-darabitol, Orcinol, n-Hexadecanoic acid, Isopropyliden, Antisal, Tyranon, 3-Methyl-2-heptanone, γ -Acetopropanol, N-Cyanomethyl-N-methylacetamide, β -Myrcene, 4H-1, 3-oxazin, p-Cymene, β -Linalol, γ -Terpinene, Terpinen-4-ol, 2-Cyclohexen-1-one, 2- <i>trans</i> - β -Ocimene, Tert-butyl-p-benzoquinone, β -Cubebene, 3-Allyl methoxy phenol, 2,6-Dimethyl acetate, Caryophyllene, 2-Methoxy-4-(2-pronpenyl) acetate, Humulene, Estragole, ω -Dicarbobenzoxy-L-arginine	[87, 88]
25.	<i>Lantana camara</i>	<i>cis</i> -3-Hexeno, n-Heptanol, α -Thujene, α -Pinen, Camphene, Sabinene, β -Pinene, Myrcene, p-Cymene, Borneol, Terpinen-4-ol, germacrene-D, γ -elemene, β -caryophyllene, β -elemene, α -copaene, α -cadinene, 1,8-cineole, bicyclogermacrene and α -humulene	[89, 90]

26.	<i>Symplocos paniculata</i>	Palmitic acid, Stearic acid, Oleic acid, Linoleic acid, Linolenic acid, 4-(8-hydroxyethyl) cyclohexan-1-oic acid, androst-5(6)-ene 17-one 3 β -O-(β -D-glucopyranoside), 9 β , 25-cyclo 3 β -O-(β -D-glucopyranosyl)-echynocystic acid, 9 β ,19-cyclo 24-methylcholan-5,22-diene 3 β -O- { β -D-glucopyranosyl α -L-rhamnopyranoside}, 30-ethyl 2 α , 16 α -dihydroxy 3 β -O-(β -D-glucopyranosyl) hopan-24-oic acid, 32, 33, 34-trimethyl-bacteriohopan-16-ene 3-O- β -D-glucopyranoside and flavone	[91, 92]
27.	<i>Cannabis sativa</i>	Ethyl palmitate, Ethyl linoleate, Ethyl elaidate, Ethyl stearate, Oleamide, Stigmasta-3,5,22- triene, Stigmasta-3,5-diene, Campesterol, Stigmasterol, β -Sitosterol, Stigmastanol, Fucosterol, β -Amyrone, 4-Campstene-3-one, β -Amyrin, Stigmasta-4, 22-dien-3-one, Glutininol, Stigmast-4-ene-3-one, Epifriedelinol, Friedelin	[93]
28.	<i>Magnolia spp.</i>	Bornyl-acetate, Camphene, Caryophyllene epoxide, Eudesmols Bark α -Eudesmol, β -Eudesmol, γ -Eudesmol, Cryptomeridiol, α -Pinene, β -Pinene, Polyphenol Bornyl-magnoliol, Caffeic acid, Cyanidin, Quercetin, Kaempferol, Magnolol, Anonaine, Liriodenine, Magnocurarine, Magnoflorine, Michelalbine and Salicifoline	[94]

3. Results and Discussion

In this study it was found that medicinal plants are used to treat a wide range of ailments due to presence of their phytochemical constituents. Nevertheless, to preserve the traditional uses of these indigenous medicinal plants and to conserve them before the ethnobotanical knowledge is lost, we recommended that the medicinal plants are documented and scientifically screened for their validation. By harnessing the power of nature, we can continue to explore and unlock the untapped potential of these plants to improve human resource. The identification and isolation of specific bioactive compounds, elucidation of their mechanisms of action, and exploration of their synergistic effects are areas that require more in-depth investigation. Overall, this review paper plays a crucial role in the research process by providing a comprehensive data of existing knowledge and contributing to the development of new treatments using herbal medicines from Uttarakhand, India.

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5. Conflict of Interest

The authors declare that they have no conflict of interest.

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