Journal of Contemporary Issues in Business and Government Vol. 27, No. 3, 2021
https://cibg.org.au/

P-ISSN: 2204-1990; E-ISSN: 1323-6903
DOI: 10.47750/cibg.2021.27.03.022

The Antibactrial and Antifungal Activity of Salix Aegypitica L Root and Leave Extraction

SHNO ABDALQADIR SOFI [1], MAAROOF RASUL ABDALRAHMAN [2*]

[1]Department of nursing, Koya Technical Institute, Erbil Polytechnic University, Iraq
[2]Department of Medical Laboratory Technic, Koya Technical Institute, Erbil Polytechnic University, Iraq
*Corresponding author

Abstract: Musk Willow is also known as Salix aegyptiaca L. In the Middle East, especially in Iran, S. aegyptiaca extracts and essential oils are important areas in drug production with some pharmacological activities. S. aegyptiaca has long been used in herbal medicine to treat anemia and vertigo, as well as a cardiotonic and a fragrance additive in the preparation of local candies. Recently, it was discovered that S. aegyptiaca has antioxidant, anxiolytic, and hypocholesterolemic properties. The leaves of this plant contain high levels of phenols and flavonoids such as gallic acid, caffeic acid, myricetin, catechin, quercetin, and salicin. The major constituents of the essential oil in leaves of S. aegyptiaca were classified as 1,4-dimethoxybenzene, phenylethyl alcohol, carvone, citronellol, methyleugenol, eugenol, n-tetradecane, and 4-methoxyacetophenone. This plant has become both food and medicine in Iran due to its ease of selection, widespread distribution, and remarkable biological activities. This review provides in-depth analysis of the botanical, chemical, and pharmacological aspects of Aedes aegyptiaca.

Keywords: Antibactrial, Antifungal, Salix aegypitica L, Medicinal plant

INTRODUCTION

Foodborne diseases have had a major impact on environmental sustainability and health around the world. Natural preservatives are becoming more common among consumers as an alternative to toxic chemical preservatives. Antimicrobial compounds contained in plant extracts must be thoroughly characterized for their endo potential as biocontrol or biopreservative agents. Comprehensive papers focused on plant extracts as antimicrobial agents for use in preservation and control foodborne pathogens in foods. Plants that are high in phytochemical compounds like polyphenols, flavonoids, saponins, alkaloids, and others in their various parts (leaves, bark, bulbs, seeds, wood, and branches) have a wide range of applications as antioxidants and antimicrobials, as well as pharmaceutical and biopesticide properties [1–6]. In humid conditions, several mold species, including Fusarium, Paecilomyces, Rhizoctonia, Penicillium, Aspergillus, Alternaria, and Trichoderma, can colonize and cause pigmentation in, colored spores on, and discoloration of various wood and wood-based products [7–10]. Molds generate cellulose hydrolyzing enzymes [11], xylanase enzymes [12], and b-xylosidases, which hydrolyze hemicelluloses [13]. Natural products can be used as a surface experiment application to fortify in-service wood against mold growth [14–16].

Plant pathogenic fungi are the most common infectious agents, causing changes at all stages of growth, including post-harvest. A large range of fungal genera affect the consistency of fruits and vegetables, causing issues with appearance, nutritional value, organoleptic features, and shelf life [17]. Furthermore, because of the production of mycotoxins or allergens, fungi are often indirectly responsible for allergic or toxic disorders in consumers. Synthetic fungicides are used to combat phytopathogenic fungi in most cases; however, due to the adverse effects of pesticides on human health and the environment, their use is becoming increasingly restricted [18]. The emergence of pathogens resistant to the products used, as well as the growing demand for production and regulations on the use of agrochemicals, justifies the quest for novel active molecules and new control strategies.

The plant kingdom has supplied a number of compounds with proven therapeutic properties, such as analgesics, anti-inflammatories, asthma medicines, and others, since antiquity. Plant extracts' antimicrobial properties have been published more frequently in recent years from various parts of the world [19]. Plant extracts extracted from conventional medicinal plants, for example, are used by a significant portion of the South American population to treat a number of infectious diseases. Plants from the genus Pterocaulon, also known as "quitoco," are widely used in veterinary medicine in southern Brazil to treat animal problems that are generally referred to as "mycoses" [20]. Several studies have shown that various plant tissues, such as roots, leaves, seeds, and flowers, have inhibitory properties against bacteria, fungi, and insects in laboratory tests [21]. There is currently

no evidence of the medicinal plants under investigation's antimicrobial properties against phytopathogen fungi [22].

Plants contain a wide variety of bioactive molecules, making them a valuable source of various medicines. The majority of today's medicines are derived from natural sources or semi-synthetic versions of natural products used in conventional medical systems. [23]. As a result, screening conventional natural products is a pragmatic approach to drug development. About 20% of all plants on the planet have been exposed to pharmaceutical or biological research, and the majority of new antibiotics on the market are derived from natural or semi-synthetic sources [24]. Medicinal plants are finding their way into pharmaceuticals, cosmetics, and neutraceuticals. In pharmaceutical field medicinal plants are mostly used for the wide range of substances present in plants which have been used to treat chronic as well as infectious diseases [25]. Long before mankind discovered the presence of microbes, it was widely known that some plants had healing properties, and that they contained what we now call antimicrobial concepts. Plants have been used to treat common infectious diseases since antiquity, and some of these conventional medicines are still used in the routine treatment of various diseases [26].

Drug safety is still a huge global problem, so the medications currently in use to combat infectious diseases are a source of concern. The majority of synthetic drugs have side effects, and the majority of microbes have gained resistance to them [27]. Antimicrobial compounds from possible plants should be investigated to help solve this issue. These plant-based medications are less toxic, have fewer side effects, and are therefore less costly. They are effective in the treatment of infectious diseases while also lacking many of the side effects that synthetic antimicrobials are notorious for [28].

Medicinal plants, according to the World Health Organization (WHO), are the best source of a variety of drugs [29]. Many ethnic groups use a range of plant species to treat a variety of ailments ranging from mild illnesses to dysentery, skin disorders, asthma, malaria, and a slew of other conditions [30]. Plant-based antimicrobials represent a vast untapped source of medicines, and further research into them is urgently needed. Plant-derived antimicrobials have immense therapeutic potential. Antimicrobials extracted from plants have a long history of delivering much-needed novel therapeutics [31]. Plants constantly interact with the rapidly changing and potentially damaging external environmental factors. Being organisms devoid of mobility, plants have evolved elaborate alternative defense strategies, which involve an enormous variety of chemical metabolites as tools to overcome stress conditions. Plants' ability to conduct combinatorial chemistry by combining, matching, and evolving gene products needed for secondary metabolite biosynthetic pathways results in an infinite pool of chemical compounds, which humans have taken advantage of. This idea is widely abused by humans' use of plants in both traditional and modern medicinal systems. The current study backs up the most recent systematic data on the antimicrobial function of herbal medicines and their chemical constituents. On the research databases Medline, Scopus, Science direct, Springer connect, Wiley, Oxford journal, and Google scholar, we selected peer-reviewed papers on herbal medicines and their phytochemical action. The following keywords were used to search for the literature inside the databases are phytochemicals, plant extract, natural product and antimicrobial [32].

Traditional medicinal plants

In areas where the use of plants is still important, a wealth of information about how to use plants against various illnesses is likely to accumulate. Several researchers in Tamilnadu investigated the medicinal properties of those plants. Since the younger generation is not interested in carrying on the traditional knowledge, it is important to document information about medicinal plants from traditional healers in order to preserve the knowledge of plant use. Table 1 [32] lists a number of medicinal plants that traditional healers use for their antimicrobial properties. Hereby, the mentioned plants are taken from references which are already included in ethnobotanical surveys [33-39]. This paper reviews specifically about the plants having antimicrobial properties. Traditional ethnomedicine is gaining popularity, which may lead to the discovery of new therapeutic agents. Since the plant contains antimicrobial components, it may be useful in the development of pharmaceuticals for the treatment of diseases. Plants with antimicrobial ability should be checked against a range of microbes to validate their efficacy. Researchers are constantly looking to conventional medicine for new leads in the development of better cancer, viral, and microbial infection medicines. A large number of researchers from all over the world have investigated the activity of plant extracts on bacteria and fungi. Oral culture passed down the various plants to be used and the methods of application for specific ailments. Plants with antimicrobial potential should be checked against a range of microbes to validate their efficacy [40]. Table 2 [32] lists the antimicrobial properties of plants that have been clinically evaluated.

Table 1

Medicinal plants used for the treatment of antimicrobial disease.

Botanical name	Family	Local name	Parts	Mode of action/aliments
Acacia nilotica	Mimosaceae	Karuvelam	St	Young stem is used as toothbrush. Toothache
Achyranthes aspera	Amaranthaceae	Nayuruvi	L	Decoction of leaf is used for skin eruption.
Acorus calamus	Araceae	Vasambu	Rh	Dried rhizome is given orally for throat infection.
Aegele marmelos	Rutaceae	Vilvam	L	Juice of leaf extract applied for eye disease.
Aerva lanata	Amaranthaceae	Sirupeelai	WP	Juice of whole plant is taken orally for cough, sore throat
Ageratum conyzoides	Asteraceae	Sethupunthalai	L	Leaves paste mixed with common salt is applied on affected part in skin diseases and itches
Alangium salvifolium	Alangiaceae	Alangimaram	F	Fruit juice is used for eye disease; Leaf pastes is applied externally skin disease
Andrographis alata	Acanthaceae	Periyanangai	L	Fresh leaves juice given orally twice a day for fever; Leaves juice given orally for four to six days for diarrhoea
Andrographis echioides	Acanthaceae	Gopuram thangi	L	Leaf paste is applied externally on cuts and wounds
Andrographis paniculata	Acanthaceae	Nilavembu	L	Leaf paste is applied externally for skin diseases
Andrographis serpyllifolia	Acanthaceae	Siyankodi	L	Decoction of leaves is used to treat fever
Annona squamosa	Annonaceae	Sitapalam	L	Leaf extract is taken orally for diarrhea
Aristolochia bracteolate	Aristolochiaceae	Aaduthinnapalai	L	Leaf paste is externally used for skin disease
Azadirachta indica	Meliaceae	Vembu	L	Leaf paste applied externally with some other medicinal plants for skin diseases
Calotropis gigantean	Asclepiadaceae	Erukku	Lx	Milky latex is applied on the wounds on leg
Carissa carandas	Apocynaceae	Kalakka	L	Decoction of leaves given for fever
Carissa carandas	Apocynaceae	Kalakka	L	Decoction of leaves given for fever
Curcuma longa	Zingiberaceae	Manjal	Rh	Rhizome extract is used for itches, skin eruption
Cynodan dactylon	Poaceae	Arugampul	R	Root decoction is given to treat fever
Euphorbia hirta	Euphorbiaceae	Amanpacharisi	Lx, L	Latex is applied externally for pimples; Leaves mixed with common salt and cow's milk is used todysentery and treat diarrhea
Justicia adhotada	Acanthaceae	Adathoda	L	Leaf juice given orally for dysentery
Leucas aspera	Lamiaceae	Thumbai	L	Fresh leaf juice mixed with turmeric powder is applied externally for throat infections
Mangifera indica	Anacardiaceae	Mamaram	B	Decoction of bark used for diarrhea
Mimusops elengi	Sapotaceae	Magizham	L	Leaves are boiled with water and decoction used as a cleansing agent for mouth to cure disease of gums and teeth.
Plectranthus coleoides	Lamiaceae	Omavalli chedi	L	Leaf paste applied once in two days and burns
Psidium guajava	Myrtaceae	Koyya	L	Leaves are used to treat dysentery
Scantalum album	Santalaceae	Santhana maram	St	Shoot paste on applied externally for skin disease
Sesbania grandiflora	Fabaceae	Agatthi	L	Juice of leaves is mixed with coconut milk and the mixture is applied topically for skin eruption
Solanum surattense	Solanaceae	Kandankathiri	F	Fruit paste given orally twice a day for one week for tooth ache
Sphaeranthus indicus	Asteraceae	Kottaikkaratai	Sd	Seeds are ground into place and applied topically for skin disease
Tribulus terrertris	Zygophyllaceae	Nerunchi	WP	Decoction of the whole plant is taken internally for urinary disorder
Tridax procumbens	Asteraceae	Vettukayapoondu	L	Leaf paste is used externally used to treat cuts and wounds
Vitex negundo	Verbenaceae	Nochi	L	Leaf used to treat cold
Zingeber offcinalsis	Zingiberaceae	Inji	Rh	Juice of rhizome with honey is taken internally to improve digestion and relieve giddiness

Abbreviations: Parts used = L: Leaves, F: Fruit, St: Stem, S: Shoot, R: Root, WP: Whole plant, Lx: Latex, Rh: Rhizome, Sd: Seed.

Table 2
Antimicrobial screening performed on various medicinal plants.

Botanical name	Family	Tamil name	Parts used	Extracts	Organism inhibited			Reference
					Gram positive	Gram negative	Fungi	
Achyranthes aspera	Amaranthaceae	Nayuruvi	R	C,M	*Staphylococcus aureus*	*Escherichia coli, Bacillus subtiliss Proteus vulgeris*	Nil	[23]
Alternanthera sessile	Amaranthaceae	Ponnaganni	v	E	*Streptococcus pyogenes*	*Salmonella typhi*	Nil	[24]
Aristolochia indica	Aristolochiaceae	Isvara mulli	L	E	Nil	Nil	*A. niger A. flavus A. fumigatus*	[25]
Azadirachta indica	Meliaceae	Vembu	L	M	*Micrococcus luteus*	*Proteus vulgeris*	Nil	[26]
Capsicum frutescens	Solanaceae	Milaga	F	E	Nil	*Pseudomonas aeruginosa*	Nil	[27]
Cinnamomun zeylanicum	Lauraceae	Lavangapattai	L, B.	P E , C , EA, A, E.	Nil	Nil	*A. solani C. lunat*	[28]
Clerodendrum inerme L	Verbenaceae	Peechangu	L	M	*Staphylococcus aureus*	Nil	*A. niger*	[29]
Cola acuminate	Sterculiaceae	v	S	A,M	*Staphylococcus aureus*	Nil	*C. albicans*	[30]
Dahlia pinnata	Asteraceae	Deri	L	C	Nil	*Enterobacter arerogenes, Pseudomonas aeruginosa*	Nil	[31]
Eclipta prostrata L	Asteraceae	Karisilanganni	L	E	Nil	*Salmonella typhi*	Nil	[32]
Euphorbia hirta	Euphorbiaceae Amman	Pacharisi	WP	v	*Staphylococcus aureus*	*Escherichia coli*	Nil	[33]
Oxystelam esculentum	Asclepiadaceae	Uchippalai	L	EA	Nil	*Escherichia coli*	Nil	[34]
Ocimum sanctum	Lamiaceae	Tulasi	WP	M	*Staphylococcus aureus, Staphylococcus saprophytic*	Nil	Nil	[35]
Plumeria alba	Apocynaceae	Perumallari	P	M	Nil	*Escherichia coli*	Nil	[36]
Polyalthia cerascides	Annonaceae	Nedunar	SB	DCM	*Corynebacterium dipthieriae*		Nil	[37]
Plumeria ruba	Apocynaceae	Perungalli	L	A , E , C,EA	*Staphylococcusepidermidis*	*Escherichia coli*	Nil	[38]
Piper nigrum	Piperacea	Milagu	B	A, DCM	*Staphylococcus aureu, Streptococcus fecalis*	*Pseudomonas aeruginosa, Bacillus cereus Escherichia coli, Salmonella typhi*	Nil	[39]
Phyllanthus amarus	Euphorbiaceae	Keelanelli	L	E	Nil	*Salmonella typhi*	Nil	[40]
Spinifex littoreus	Poaceae	Vettiver	G	A	Nil	Nil	Dermatophytes	[41]
Terminalia chebula	Combretaceae	Kaddukai	F	E	*Staphylococcus aureus, Staphylococcus epidermidis*	*Salmonella typhi Pseudomonas aeruginosa Bacillus subtillis*	Nil	[42]

Abbreviations: Parts used = L: Leaves, G: Grass, F: Fruit, SB: Stem bark, S: Shoot, R: Root, WP: Whole plant, Lx: Latex, Rh: Rhizome.
Extracts= A: Aqueous, C: Chloroform, E: Ethanol, E: Ethyl acetate, M: Methanol, PE: Petroleum ether, DCM: Dichloromethane.

Bioactive compounds

Plants have medicinal value because they contain phytochemicals, which are chemical compounds that have a particular physiological action on the human body. In herbal and homeopathic drugs, these phytochemicals were used to treat the disease [41]. There are non-nutritive compounds with disease-preventive or defensive properties [42]. As a result, there is a need to screen medicinal plants for bioactive compounds as a base for further pharmacological research. Several active principles of many medicinal plants have been isolated and used as useful drugs in modern medical systems thanks to developments in phytochemical techniques.

Alkaloids, flavonoids, tannins, and phenolic compounds are the most common bioactive compounds [43]. These are the primary raw materials used in the manufacture of pharmaceuticals [44]. For protection against aggressor agents, particularly microorganisms, most plants contain several antimicrobial compounds [45]. The bioactive compounds isolated from medicinal plants are mentioned in Table 3 [32].

Table 3
Bioactive compounds obtained from medicinal plants.

Botanical name	Family	Local name	Bioactive compound	Organisms inhibited
Acacia nilotica	Fabaceae	Karuvelai	Alkaloids	*Staphylococcus aureus*
Artocarpus communis	Moraceae	Seemapila	AtoninE, 2-[(3,5-dihydroxy)-(Z)-4-(3-methylbut-1-etnyl)	*Pseudomonas aeruginosa*
Ageratum fastigiatum	Asteraceae	Poompul	β-caryophyllene, Phenyl] benzofuran-6-ol	*Staphylococcus mutans, Staphylococcus aureus, Staphylococcus faecalis Escherichia coli*
Allium sativam	Liliaceae	puntu	Allicin	*Candida*
Camellia sinensis	Theaceae	Thayilar	Catechin	*Staphylococcus mutans*
Cassia alata	Fabaceae	Seemaiagathi	4-butylamine10-,cannabinoid dronabinol ,methyl-6-hydroxy	*Staphylococcus aureus, Escherichia coli, Pseudomonas aeruginosa, Candida albicans*
Cassia fistula	Fabaceae	Sarakkonrai	4-hyd roxy benzoic acid hydr ate	*Trichophyton mentagraphytes, Epidermophyton floccosum*
Cinnamomun zeylanicu m	Lauraceae	Lavangapattai	Cinnamaldehyde	*Helicobacter pylori*
Cinnamomun inerme	Lauraceae	Kattukkaruvapattai	[5-(1,5-dimethyl-2-4-hexenyl) -methyl phenol]	*Staphylococcus aureus, Escherichia coli*
Hybanthus enneasperm us	Violaceae	Orithazh thamari	Flavonoids, Tannins	*Proteus, Vibrio cholera*
Mentha piperita	Lamiaceae	Puthina	1,1-diphenyl-2-picrylhydrazyl - hydrate	*Staphylococcus aureus, Escherichia coli, Candida albicans*
Matricaria chamomilla	Asteraceae	Mookuthipoo	Phenolic acid	*Salmonella typhimurium*
Ocimum basilicum	Lamiaceae	Thiruninttru pachilai	Terpenoids	*Salmonella*
Polyalthia cerasoides	Annonaceae	Nedunari	N-(4-hydroxy-β-phenethyl-4-hydroxycinnamide)	*Corynebacterium diptrtheriae*
Piper nigrum	Piperaceae	Milagu	Piperine	*Lactobacillus, Escherichia coli, Micrococcus*
Senna petersiana	Fabaceae	Vagaai	Luteolin (Flavonoid)	*Bacillus cereus and Staphylococcus aureus*
Tricnoderrma indicum	Boraginaceae	Kasi thumbai	Lanast-5-en-3β-D-glucopyranosyl-21(24)-oilde	*Staphylococcus aureus*
Tecoma stans	Bignoniaceae	Swarna pattai	Phenoilc compound	*Staphylococcus aureus*

CONCLUSION

According to this report, the 70 medicinal plants contain antimicrobial compounds that could be used as antimicrobial agents. It is also the most beneficial for scientists, academic scholars, and scientific firms to conduct additional research on the isolation and detection of active compounds that can be developed into antimicrobial drugs.

REFERENCES

1. Wu, C.Y.; Chen, R.; Wang, X.S.; Shen, B.; Yue, W.; Wu, Q. Antioxidant and Anti-Fatigue Activities of Phenolic Extract from the Seed Coat of Euryale ferox Salisb. and Identification of Three Phenolic Compounds by LC-ESI-MS/MS. Molecules **2013**, 18, 11003–11021
2. Dai, J.; Mumper, R.J. Plant phenolics: Extraction, analysis and their antioxidant and anticancer properties. Molecules **2010**, 15, 7313–7352.
3. EL-Hefny, M.; Ashmawy, N.A.; Salem, M.Z.M.; Salem, A.Z.M. Antibacterial activity of the phytochemicals characterized extracts of Callistemon viminalis, Eucalyptus camaldulensis and Conyza dioscoridis against the growth of some phytopathogenic bacteria. Microb. Pathogen. **2017**, 113, 348–356.
4. Ashmawy, N.A.; Salem, M.Z.M.; EL-Hefny, M.; Abd El-Kareem, M.S.M.; El-Shanhorey, N.A.; Mohamed, A.A.; Salem, A.Z.M. Antibacterial activity of the bioactive compounds identified in three woody plants against some pathogenic bacteria. Microb. Pathogen. **2018**, 121, 331–340.
5. Salem, M.Z.M.; El-Hefny, M.; Ali, H.M.; Elansary, H.O.; Nasser, R.A.; El-Settawy, A.A.A.; El Shanhorey, N.; Ashmawy, N.A.; Salem, A.Z.M. Antibacterial activity of extracted bioactive molecules of Schinus terebinthifolius ripened fruits against some pathogenic bacteria. Microb. Pathogen. **2018**, 120, 119–127.
6. Salem, M.Z.M.; Elansary, H.O.; Ali, H.M.; El-Settawy, A.A.; Elshikh, M.S.; Abdel-Salam, E.M.; Skalicka-Wo´zniak, K. Bioactivity of essential oils extracted from Cupressus macrocarpa branchlets and Corymbia citriodora leaves grown in Egypt. BMC Complem. Altern. Med. **2018**, 18, 23–29.
7. Andersen, B.; Frisvad, J.C.; Søndergaard, I.; Rasmussen, I.S.; Larsen, L.S. Associations between fungal species and water-damaged building materials. Appl. Environ. Microb. **2011**, 77, 4180–4188.

8. Xu, X.; Lee, S.;Wu, Y.;Wu, Q. Borate-treated strand board from southern wood species: Resistance against decay and mold fungi. BioResources **2013**, 8, 104–114.
9. Lee, Y.M.; Lee, H.; Jang, Y.; Cho, Y.; Kim, G.-H.; Kim, J.-J. Phylogenetic analysis of major molds inhabiting woods. Part 4. Genus Alternaria. Holzforschung **2014**, 68, 247–251.
10. Salem, M.Z.M. EDX measurements and SEM examination of surface of some imported woods inoculated by three mold fungi. Measurement **2016**, 86, 301–309.
11. Sohail, M.; Ahmad, A.; Khan, S.A. Production of cellulases from Alternaria sp. MS28 and their partial characterization. Pak. J. Bot. **2011**, 43, 3001–3006. Molecules **2019**, 24, 700 11 of 14
12. De Vries, R.P.; Visser, J. Aspergillus enzymes involved in degradation of plant cell wall polysaccharides. Microbiol. Mol. Biol. R. **2001**, 65, 497–522.
13. Kubicek, C.P. Enzymology of hemicellulose degradation. In Fungi and Lignocellulosic Biomass; JohnWiley & Sons, Inc.: Ames, IA, USA, 2012; pp. 69–97.
14. Mansour, M.M.A.; Salem, M.Z.M. Evaluation of wood treated with some natural extracts and Paraloid B-72 against the fungus Trichoderma harzianum: Wood elemental composition, in-vitro and application evidence. Int. Biodeter. Biodegr. **2015**, 100, 62–69.
15. Mansour, M.M.A.; Abdel-Megeed, A.; Nasser, R.A.; Salem, M.Z.M. Comparative evaluation of some woody tree methanolic extracts and Paraloid B-72 against phytopathogenic mold fungi Alternaria tenuissima and Fusarium culmorum. BioResources **2015**, 10, 2570–2584.
16. Mansour, M.M.A.; Salem, M.Z.M.; Khamis, M.H.; Ali, H.M. Natural durability of Citharexylum spinosum and Morus alba woods against three mold fungi. BioResources **2015**, 10, 5330–5344.
17. Agrios, G.N. 2004. Losses caused by plant diseases. p. 29-45. Plant Pathology. Elsevier, Oxford, UK.
18. Harris, C.A., M.J. Renfrew, and M.W. Woolridge. 2001. Assessing the risk of pesticide residues to consumers: recent and future developments. Food Additives and Contamination 18:1124-1129.
19. Cowan, M.M. 1999. Plant products as antimicrobial agents. Clinical Microbiology Reviews 10:564-582.
20. Demo, M.S., and M. Oliva. 2008. Antimicrobial activity of medicinal plants from South America. p. 152-164. In Watson, R.R., and V.R. Preedy (eds.) Botanical edicine in clinical practice. CABI International, Wallingford, UK.
21. Davicino, R., M.A. Mattar, Y.A. Casali, S. Graciela, E. Margarita, and B. Micalizzi. 2007. Antifungal activity of plant extracts used in folk medicine in Argentina. Revista Peruana de Biología 14:247-251.
22. Dellavalle, P. D., Cabrera, A., Alem, D., Larrañaga, P., Ferreira, F., & Rizza, M. D. 2011. Antifungal activity of medicinal plant extracts against phytopathogenic fungus Alternaria spp. Chilean journal of agricultural research, 71(2), 231-239.
23. Sukanya SL, Sudisha J, Hariprasad P, Niranjana SR, Prakash HS, Fathima SK. Antimicrobial activity of leaf extracts of Indian medicinal plants against clinical and phytopathogenic bacteria. Afr J Bio 2009; 8(23): 6677- 6682.
24. Mothana RA, Lindequist U. Antimicrobial activity of some medicinal plants of the island Soqotra. J Ethnopharmacol 2005; 96(1-2): 177-181.
25. Okigbo RN, Anuagasi CL, Amadi JE. Advances in selected medicinal and aromatic plants indigenous to Africa. J Med Plant Res 2009; 3(2): 86-95.
26. Rios JL, Recio MC. Medicinal plants and antimicrobial activity. J Ethnopharmacol 2005; 100:80-84.
27. Chanda S, Rakholiya K. Combination therapy: Synergism between natural plant extracts and antibiotics against infectious diseases. Microbiol Book Series 2011; 520-529.
28. Harishchandra MR, Rajan PR, Singh Satyendrakumar RP. Study of krimighna effect of nimba (Azadiracta indica A.Juss.) Patra as rakshoghna dhoopan by culture and sensitivity method W.S.R. to pyogenic bacteria. IRJP 2012; 3(6):142-146.
29. Nascimento GF, Lacatelli J, Freitas PC, Silva GL. Antibacterial activity of plant extracts and phytochemicals on antibiotic-resistant bacteria. Brazilian J Microbiol 2000; 31(4): 886-891.
30. Dahanukar SA, Kulkarni RA, Rege NN. Pharmacology of medicinal plants and natural products. Ind J Pharmacol 2000; 32: 81-118.
31. Silva MSP, Brandao DO, Chaves TP, Filho ALNF, Costa EMDB, Santos VL, et al. Study bioprospecting of medicinal plant extracts of the semiarid Northeast: Contribution to the control of oral microorganisms. Evi-Based Comp Alt Med2012; 2012: 1-6.
32. Munuswamy, Hemalatha, Thirumalai Thirunavukkarasu, Saranya Rajamani, Erusan Kuppan Elumalai, and David Ernest. "A review on antimicrobial efficacy of some traditional medicinal plants in Tamilnadu." Journal of Acute Disease 2, no. 2 (2013): 99-105.
33. Bhaskar A, Samant LR. Traditional medication of Pachamalai Hills, Tamilnadu, India. Global J Pharmacol 2012; 6 (1): 47-51.
34. Duraipandiyan V, Ignacimuthu S. Antifungal activity of traditional medicinal plants from Tamil Nadu, India. Asian Pac J Trop Biomed 2011; 1(2): S204 - S215.

35. Alagesaboopathi C. Ethnobotanical studies on useful plants of Kanjamalai Hills of Salem district of Tamil Nadu, Southern India. Arch App Sci Res 2011; 3 (5): 532-539.
36. Rajadurai M, Vidhya VG, Ramya M, Bhaskar A. Ethnomedicinal plants used by the traditional healers of Pachamalai Hills, Tamilnadu, India. Ethno-Med 2009; 3(1): 39-41.
37. Beverly CD, Sudarsanam G. Ethnomedicinal plant knowledge and practice of people of Javadhu hills in Tamilnadu. Asian Pac J Trop Biomed 2011; 1(1): S79-S81.
38. Ignacimuthu S, Ayyanar M, Sivaraman SK. Ethnobotanical investigations among tribes in Madurai District of Tamil Nadu (India). J Ethnobiol Ethnomed 2006: 2.
39. Hema DN, Mahomoodally MF. Ethnopharmacological survey of native remedies commonly used against infectious diseases in the tropical island of Mauritius. J Ethnopharmacol 2012; 143(2): 548-564.
40. Chitravadivu C, Manian S, Kalaichelvi K. Antimicrobial studies on selected medicinal plants, Erode region, Tamilnadu, India. Middle-East J Sci Res 2009; 4 (3): 147-152.
41. Chitravadivu C, Manian S, Kalaichelvi K. Antimicrobial studies on selected medicinal plants, Erode region, Tamilnadu, India. Middle-East J Sci Res 2009; 4 (3): 147-152.
42. Ahmed F, Urooj A. Glucose-lowering, hepatoprotective and hypolipidemic activities of stem bark of Ficus racemosa in streptozotocin induced diabetic rats. J Young Pharm 2009;1(2): 160-164.
43. Purkayastha S, Dahiya P. Phytochemical analysis and antibacterial efficacy of babchi oil (Psoralea corylifolia) against multi-drug resistant clinical isolates. International Conference on Bioscience, Biochemistry and Bioinformatics. IPCBEE 2012; 3(1): 64-68.
44. Tullanithi KM, Sharmila B, Gnanendra TS. Preliminary phytochemical analysis and antimicrobial activity of Achyranthes aspera Linn. Int J Bio Tech 2010: 1(3): 35-38.
45. Silva NCC, Júnior AF. Biological properties of medicinal plants: a review of their antimicrobial activity. J Veno Ani Tox Inclu Trop Dis 2010; 16(3): 402-431.