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PHYTOCHEMICAL AND PHARMACOLOGICAL PROPERTIES OF ACACIA FARNESIANA: A COMPREHENSIVE REVIEW

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ABSTRACT

Acacia farnesiana (Sweet Acacia) is a small tree or shrub known for its bright yellow, fragrant flowers and is native to several Indian states including Maharashtra, Gujarat, Andhra Pradesh, and Karnataka.[1,2] Various parts of the plant—pods, leaves, and bark—contain bioactive compounds such as gallic acid, ellagic acid derivatives, flavonoids (e.g., kaempferol and diosmetin), and tannins.[3,4,5] Its essential oil includes methyl salicylate, anisaldehyde, and geraniol, while pods contain diterpene glycosides and sulfur-containing amino acids.[6,7] Protein extracts from seeds exhibit anti-inflammatory and analgesic activities.[8,9] Methanolic bark extracts have shown significant cytotoxic, thrombolytic, membrane-stabilizing, and antibacterial activities.[10,11] The plant demonstrates notable antioxidant and antimicrobial properties, with minimum inhibitory concentrations (MICs) of 0.8 mg/mL and 2.5 mg/mL against Bacillus subtilis and Saccharomyces cerevisiae, respectively.[12,13] Its traditional and therapeutic applications span antidiabetic, antiulcer, antipyretic, and antimicrobial uses, including against tuberculosis and dysentery.[14,15,16]

KEYWORDS: Acacia farnesiana, antioxidant activity, anti-inflammatory, antibacterial, phytochemistry, tuberculosis, dysentery.

1. INTRODUCTION

Acacia farnesiana, commonly known as Sweet Acacia or Babul, belongs to the Fabaceae family, subfamily Mimosoideae.[1,2] It thrives in sandy soils and riverbeds across Indian

regions such as Maharashtra, Gujarat, Andhra Pradesh, and Karnataka.[3,4] This small tree or shrub features fragrant yellow flowers and has significant ethnobotanical relevance.[5,6]

Phytochemical investigations have revealed the presence of compounds such as tannins, flavonoids (kaempferol, diosmetin, naringenin), gallic acid, ellagic acid, methyl gallate, diterpenes, and alkaloids.[7,8,9,10] These contribute to diverse biological activities ranging from antimicrobial to antidiabetic effects.[11,12,13]

The essential oil of the plant contains methyl salicylate, anisaldehyde, and geraniol, while seeds yield diterpene glycosides like farnesiaside.[14,15] The plant's parts demonstrate antioxidant, anti-inflammatory, antibacterial, antiulcer, antipyretic, and bronchodilator properties, thus supporting its use in managing chronic diseases and infections.[16,17,18,19]

2. Drug Profile

- **Drug Name**: Acacia farnesiana[20]
- **Synonyms**: Naringetol, Salipurpol[21,22]
- **Category**: Antioxidant, Anti-inflammatory[23,23]
- **Subcategory**: Medicinal Natural Product (MNP)[25]
- **Molecular Formula**: $C_{15}H_{12}O_5$[26]
- **Mono-Isotopic Mass**: 272.068 g/mol[27]
- **IUPAC Name**: (5,7-Dihydroxy-2-(4-hydroxyphenyl)chroman-4-one)[28]
- **Log P**: 2.4.[29]

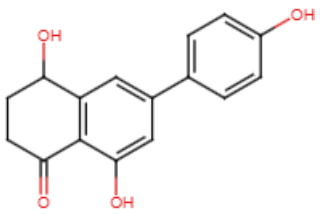

Figure 1: structure of Naringenin.

3. Morphological Characteristics

- **Growth Habit**: Small tree or shrub with a rounded crown, 4.5–9 meters tall.[30,31]
- **Leaves**: Bipinnate with small, oval leaflets arranged feather-like.[32,33]
- **Flowers**: Golden-yellow, aromatic, blooming from October to March.[34,35]

- **Fruits**: Cylindrical, dark brown pods.[36]
- **Seeds**: Hard-coated, oval, and dark brown.[37]
- **Branches**: Thorny with smooth green bark in young trees that becomes scaly and brown with age.[38,39]

Figure 2: Tree of Sweet acacia.

Figure 3: Leaves of Sweet acacia.

Figure 4: Flower of sweet acacia.

Figure 5: Fruit of Sweet acacia.

Figure 6: Seeds of Sweet acacia.

Figure 7: Branches of Sweet acacia.

4. Microscopic Analysis

Microscopic examination is performed by mounting powdered plant material in glycerin or chloral hydrate.[40,41] Specific tests include:

- **Iodine Test**: Blue-black color indicating starch.[42]
- **Phloroglucinol-HCl**: Red color confirms lignin[43]
- **HCl Test**: Effervescence or crystal formation indicates calcium oxalate.[44]

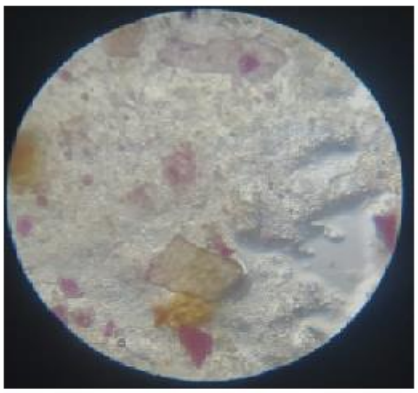

Figure 8: Detection of Starch grains.

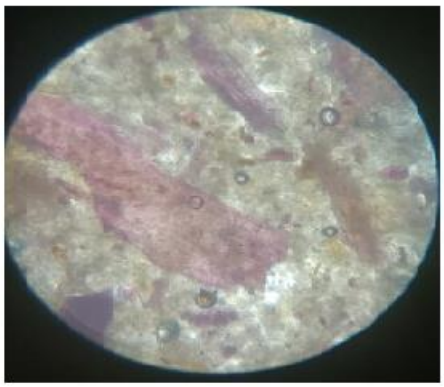

Figure 9: Identification of Lignin.

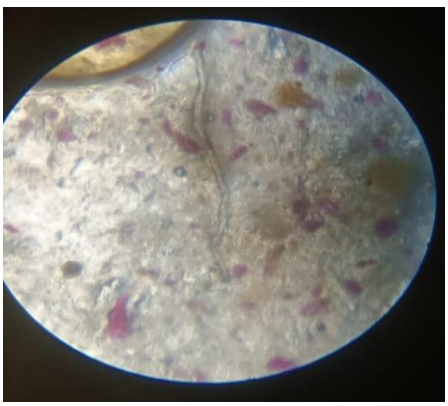

Figure 10: Identification of calcium crystals.

5. Phytochemical Constituents

The plant is rich in:

- **Flavonoids**: Kaempferol, diosmetin, aromadendrin, apigenin derivatives.[15,22,27]
- **Tannins**: Present in bark, leaves, and pods.[14,23]
- **Polyphenols**: Gallic acid, ellagic acid, methyl gallate.[18,24,30]
- **Essential Oils**: Methyl salicylate, anisaldehyde, geraniol.[19,33]
- **Diterpenes**: Farnesiaside and others.[21,29]
- **Amino Acids**: Lysine, arginine, glycine, histidine.[25,26]
- **Sulfur Compounds**: N-acetyl-L-djenkolic acid.[31]

6. Phytochemical Analysis (with Table no.1)

Phytochemical	Test Name	Observation	Result
Alkaloids	Dragendorff's Test[46]	Reddish precipitate	Present
	Mayer's Test[47]	Creamy white precipitate	Present
	Wagner's Test[48]	Reddish-brown precipitate	Present
Flavonoids	Shinoda Test[49]	Pink coloration	Present
	Sulphuric Acid Test[50]	Deep yellow color	Present
	Lead Acetate Test[51]	Yellow precipitate	Present
Glycosides	Keller-Killiani Test[52]	Reddish-brown layer and bluish green upper layer	Present
Proteins	Millon's Test[53]	White precipitate	Present
Steroids	Salkowski's Test[54]	Red coloration in lower layer	Present
	Liebermann-Burchard Test[55]	Brown ring and green coloration in upper layer	Present
Tannins	Ferric Chloride Test[56]	Blue-green precipitate	Present
	Acetic Acid Test[56]	Red precipitate	Present

7. Pharmacological Activities (Expanded with Analysis and Future Perspectives)

A. Antimicrobial and Antifungal Activity

The antimicrobial potential of Acacia farnesiana has been extensively studied through various in vitro assays. Ethanolic extracts prepared using Soxhlet extraction with petroleum ether, dichloromethane, and ethanol demonstrated significant antibacterial activity. Specifically, Bacillus subtilis (ATCC 6633) exhibited a minimum inhibitory concentration (MIC) of 0.8 mg/mL, highlighting its high susceptibility.[45,46] In contrast, Staphylococcus aureus and Escherichia coli presented MIC values greater than 1.0 mg/mL, suggesting reduced sensitivity, especially in Gram-negative strains.[47,48]

The greater efficacy against Gram-positive bacteria may be due to their simpler cell wall structures, which allow easier penetration of phytochemicals. For fungi, ethanolic extracts exhibited moderate activity against Saccharomyces cerevisiae (MIC = 2.5 mg/mL) but were ineffective against Candida albicans.[49] This suggests that antifungal properties may be

influenced by volatile constituents, often removed during ethanol extraction. The residual antimicrobial effect is likely due to non-volatile flavonoids such as quercetin and morin.[50,51]

Comparative Perspective: While the antibacterial activity is notable, it is relatively modest compared to standard antibiotics like gentamicin (MIC = 0.05 mg/mL).[52] However, A. farnesiana extracts could serve as complementary agents in antimicrobial therapy.[53]

B. Antioxidant Activity

Ethanolic extracts of A. farnesiana demonstrated strong antioxidant activity through DPPH, nitric oxide scavenging, and iron chelation assays. The dose-dependent response is attributed to the presence of polyphenolic compounds including quercetin, kaempferol, and naringenin.[54,55] These compounds neutralize reactive oxygen species (ROS) by donating electrons or hydrogen atoms.

Therapeutic Implication: Antioxidants play a critical role in preventing oxidative damage implicated in aging, cancer, diabetes, and neurodegenerative diseases. The robust activity of A. farnesiana suggests it may offer protective benefits in such conditions.[56,57]

C. Antitubercular and Antidiarrheal Activity

Hexanic and aqueous extracts from the fruits demonstrated MIC values of 100 µg/mL against multidrug-resistant (MDR) Mycobacterium tuberculosis strain G122.[58,59] Methyl gallate and its triacetylated derivative displayed even stronger activity, likely due to enhanced lipophilicity, which facilitates cell wall penetration.[60]

The plant also exhibited significant antidiarrheal effects. Methanolic and aqueous extracts inhibited pathogenic bacteria responsible for dysentery, such as Shigella flexneri and Yersinia enterocolitica.[61,62] The active constituents are presumed to be glycosides and polyphenols.[63]

Clinical Relevance: These findings support the traditional use of A. farnesiana in managing tuberculosis and gastrointestinal infections. Further work is needed to isolate and characterize the most active compounds for drug development.[64]

D. Antiulcer Activity

Methanolic leaf extracts significantly reduced ulcer indices in rat models of gastric ulceration.[65] The effect was comparable to ranitidine and attributed to enhanced mucus secretion, suppression of acid production, and antioxidant protection.[66]

Flavonoids such as quercetin and kaempferol act as gastroprotective agents by increasing mucosal defense and inhibiting inflammatory mediators. Elevated hexosamine and glycoprotein levels in treated tissues support this protective mechanism.[67,68]

Potential Applications: A. farnesiana could serve as a natural alternative for patients with peptic ulcers, especially where synthetic drugs cause adverse effects.[69]

E. Anti-inflammatory Activity

The anti-inflammatory efficacy of ethanolic extracts was confirmed through carrageenan-induced paw edema and cotton pellet-induced granuloma models.[70,71] Significant inhibition of inflammation suggests downregulation of pro-inflammatory cytokines (e.g., TNF-α, IL-6).[72]

Flavonoids and diterpenes, including farnesirane A and B, may act via inhibition of prostaglandin synthesis, suppression of COX-2, and stabilization of lysosomal membranes.[73,74] A glycosidal fraction from unripe pods also demonstrated smooth muscle relaxation and anti-inflammatory activity.[75]

Comparative View: The anti-inflammatory potential, although moderate compared to NSAIDs, offers the advantage of reduced gastrointestinal toxicity.[76]

F. Antihyperglycemic Activity

In alloxan-induced diabetic rats, aqueous extracts of A. farnesiana significantly lowered blood glucose levels.[77] The hypoglycemic effect appeared independent of insulin and may involve enhanced glucose uptake, delayed intestinal absorption, or improved insulin sensitivity.[78]

Flavonoids and saponins are suspected to modulate key enzymes in carbohydrate metabolism (e.g., α-glucosidase).[79] No observable toxic effects were reported in the experimental models.[80]

Implications for Diabetes Management: The extract may be developed as a complementary or alternative therapy for Type 2 diabetes, especially in regions lacking access to synthetic medications.[81]

Future Perspectives

- Mechanism of Action: Further molecular studies are needed to confirm the pathways through which A. farnesiana exerts its pharmacological effects.[82]
- Toxicity and Safety Profiling: Long-term in vivo studies and clinical trials are necessary to assess safety margins and establish dosage guidelines.[83]
- Standardization and Formulation: Development of standardized herbal formulations can enhance reproducibility and regulatory approval.[84]
- Synergistic Studies: Investigating the synergistic potential of A. farnesiana with standard drugs may offer new avenues for combination therapies.[85]

8. CONCLUSION

Acacia farnesiana demonstrates a wide array of therapeutic potentials supported by its rich phytochemical profile. Its antioxidant, antimicrobial, anti-inflammatory, antiulcer, and antidiabetic effects highlight its relevance in both traditional and modern medicine.[86-90] Scientific validation of its traditional uses supports its development into safe and effective formulations for treating infections, inflammation, ulcers, and metabolic disorders. Future research should focus on standardization, compound isolation, and clinical validation.[91-95]

9. REFERENCE

1. Ramli, S., Harada, K. I., & Ruangrungsi, N. Antioxidant, antimicrobial and cytotoxicity activities of Acacia farnesiana (L.) Willd. Leaves ethanolic extract. Pharmacognosy Journal, 2011; 3(23): 50–58. https://doi.org/10.5530/pj.2011.23.8
2. Sharmin, T., & Mahazabin, S. N. SCREENING OF BIOLOGICAL ACTIVITIES OF ACACIA FARNESIANA (GUYABABLA), A MEDICINAL PLANT OF BANGLADESH. https://doi.org/10.13140/RG.2.2.18633.44647 2018.
3. KumarM, S. (n.d.). A Comprehensive Review on Phytochemical Evaluation and Pharmacological Activity of Acacia Farnesiana. International Journal of Pharmaceutical Research and Applications, 8: 1527. https://doi.org/10.35629/7781-080415271542.
4. Kheawfu, K., Puttipan, R., Mueller, M., Janngeon, K., Unger, F. M., Viernstein, H., & Okonogi, S. Anti-inflammatory, antibacterial, and antioxidant activities of Thai medicinal plants. https://www.researchgate.net/publication/285244741 2015.
5. K. Kadam, R., v. Khairnar, P., R. Chakote, V., & U. Shinde, M. Study of Alcoholic Extract of Acacia Farnesiana (L.) Willd Pods. Journal of University of Shanghai for Science and Technology, 2021; 23(2): https://doi.org/10.51201/Jusst12648.

6. Leal, L. S. S., Silva, R. O., Araujo, T. S. L., Silva, V. G., Barbosa, A. L. R., Medeiros, J. V. R., Oliveira, J. S., & Ventura, C. A. Anti-inflammatory and antinociceptive effect of proteins extracted from Acacia farnesiana seeds. Brazilian Journal of Medicinal Plants, 2016; 18(1): 38–47. https://doi.org/10.1590/1983-084X/15_018.
7. Biradar, S. R., & Rachetti, B. D. (n.d.). Extraction of some secondary metabolites & Thin layer chromatography from different parts of Acacia farnesiana L. In IOSR Journal of Pharmacy and Biological Sciences IOSR-JPBS 7(5): www.iosrjournals.orgwww.iosrjournals.org.
8. Biradar, S., & Rachetti, B. (n.d.). Qualitative Analysis of Legume Pericarp (Pod Wall) and Seeds of Acacia Farnesiana L. In IOSR Journal of Pharmacy and Biological Sciences IOSR-JPBS 6(3): www.iosrjournals.orgwww.iosrjournals.org.
9. H Saleema, N., R Abdelhalimb, A., M Alghou, A., & H. Abdel-Rhman, S. In-vitro antimicrobial activity of Acacia farnesiana & Rosmarinus officinalis crude extract and isolated compounds against foodborne pathogens. International Journal of Management Studies and Social Science Research, 2023; 05(03): 420–426. https://doi.org/10.56293/ijmsssr.2022.4653.
10. İbrahim Erkovan, H., Clarke, P. J., & Whalley, R. D. B. A review on General Description of Vachellia farnesiana (L.) Wight & Arn. Atatürk Univ., J. of the Agricultural Faculty, 2016; 47(1): 71–76.
11. Hernández-García, E., García, A., Garza-González, E., Avalos-Alanís, F. G., Rivas-Galindo, V. M., Rodríguez-Rodríguez, J., Alcantar-Rosales, V. M., Delgadillo-Puga, C., & del Rayo Camacho-Corona, M. Chemical composition of Acacia farnesiana (L) wild fruits and its activity against Mycobacterium tuberculosis and dysentery bacteria. Journal of Ethnopharmacology, 2019 230: 74–80. https://doi.org/10.1016/j.jep.2018.10.031.
12. Hasib, M. S., Bari, M. S., Chowdhury, A., Hossain, M. A., & Rashid, M. A. Vachellia farnesiana (L.) Wight & Arn. Growing in Bangladesh Exerts In-vitro Antioxidant and In-vivo Analgesic and Anti-diarrheal Activities. Bangladesh Pharmaceutical Journal, 2020; 23(2): 181–186. https://doi.org/10.3329/bpj.v23i2.48339
13. Mulisa, E., Asres, K., & Engidawork, E. Evaluation of wound healing and anti-inflammatory activity of the rhizomes of Rumex abyssinicus J. (Polygonaceae) in mice. BMC Complementary and Alternative Medicine, 2015; 15(1): https://doi.org/10.1186/s12906-015-0878-y.
14. Divya Shinde, S. S. Patil, S. J. Wakode, Shweta Patil A Comprehensive Review on Vachellia farnesiana (Acacia farnesiana). (n.d.). www.ijppr.humanjournals.com 2023.

15. Delgadillo-Puga, C., Sánchez-Castillo, D. R., Cariño-Cervantes, Y. Y., Torre-Villalvazo, I., Tovar-Palacio, C., Vásquez-Reyes, S., Furuzawa-Carballeda, J., Acevedo-Carabantes, J. A., Camacho-Corona, M. del R., Guzmán-Mar, J. L., Cisneros-Zevallos, L., Tovar, A. R., Rebollar-Vega, R., Hernández-Montes, G., Ulloa-Aguirre, A., Palacios-Gonzalez, B., & Noriega, L. G. Vachellia farnesiana Pods or a Polyphenolic Extract Derived from Them Exert Immunomodulatory, Metabolic, Renoprotective, and Prebiotic Effects in Mice Fed a High-Fat Diet. International Journal of Molecular Sciences, 2023; 24(9): https://doi.org/10.3390/ijms24097984.
16. Trivedi CP, Modi NT, Sarin RK, Rao SS. Bronchodilator and anti inflammatory effect of glycosidal fraction of Acacia farnesiana. Indian Journal of Physiology and Pharmacology, 1986; 30(3): 267-268.
17. Lin AS, Lin CR, Du YC, Lubken T, Chiang MY, Chen IH et al. Acasiane A and B and farnesirane A and B, diterpene derivatives from the roots of Acacia farnesiana. Planta Medica., 2009; 75(3): 256-261.
18. Misar A, Mujumdar AM. Antidiarrhoeal activity of methanolic extract of Acacia farnesiana bark. Asian Journal of Chemistry, 2011; 23(4): 1767-1770.
19. Hukkeri VI, Savadi RV, Tippimath CD, Karadi RV, Jaiprakash B. Anti inflammatory activity of leaves of Acacia farnesiana Willd. Indian drug, 2002, 39(12): 664-666.
20. Evangelia, P., Constantinos, V., Maria, C., & Olga, T. Study of volatile components of Acacia farnesiana Willd. Flowers. Records of Natural Products, 2017; 11(5): 474–478. https://doi.org/10.25135/rnp.60.17.03.015.
21. E. Demole, P. Enggist and M. Stoll On the odorous constituents of the absolute essence of cassie (Acacia farnesiana Willd.), Helv. Chim. Acta, 1969; 52: 24-32.
22. A. El-Hamidi and I. Sidrak The investigation of Acacia farnesiana essential oil, Planta Med., 1970; 18: 98-100.
23. C.S. Letizia, J. Cocchiara, G.A. Wellington, C. Funk and A.M. Api Cassie absolute (Acacia farnesiana L.) Willd, Food Chem. Toxicol, 2000; 38: S27-S29.
24. Balkrishna, A., Thakur, P., Singh, S., Dev, S. N. C., & Varshney, A. Mechanistic paradigms of natural plant metabolites as remedial candidates for systemic lupus erythromatosus. In Cells, 2020; 9(4): Multidisciplinary Digital Publishing Institute (MDPI). https://doi.org/10.3390/cells9041049.
25. Abrantes, V. E. F., Matias Da Rocha, B. A., Batista Da Nóbrega, R., Silva-Filho, J. C., Teixeira, C. S., Cavada, B. S., Gadelha, C. A. D. A., Ferreira, S. H., Figueiredo, J. G., Santi-Gadelha, T., & Delatorre, P. Molecular modeling of lectin-like protein from Acacia

farnesiana reveals a possible anti-inflammatory mechanism in carrageenan-induced inflammation. BioMed Research International, 2013; 2013: https://doi.org/10.1155/2013/253483.

26. Santi-Gadelha, T., Rocha, B. A. M., Oliveira, C. C., Aragão, K. S., Marinho, E. S., Gadelha, C. A. A., Toyama, M. H., Pinto, V. P. T., Nagano, C. S., Delatorre, P., Martins, J. L., Galvani, F. R., Sampaio, A. H., Debray, H., & Cavada, B. S. Purification of a PHA-Like chitin-binding protein from Acacia farnesiana seeds: A time-dependent oligomerization protein. Applied Biochemistry and Biotechnology, 2008; 150(1): 97–111. https://doi.org/10.1007/s12010-008-8144-0.
27. Goud Busineni, J., Dhanasree, B., Jayasimha Goud, B., & Nizamuddin Basha, S. (n.d.). ANTI ULCER ACTIVITY OF ACACIA FARNESIANA (L.) (AROMA) A LESSER KNOWN FOLK-MEDICINAL PLANT Dwarakanath V*et al Int J Pharm Bio Sci ANTI ULCER ACTIVITY OF ACACIA FARNESIANA (L.) (AROMA) A LESSER KNOWN FOLK-MEDICINAL PLANT. In International Journal of Pharmacy and Biological Sciences. www.ijpbs.comorwww.ijpbsonline.com.
28. Sp, D., Shrivastava B, & Ns, B. (n.d.). A Review on Acacia species of therapeutics importance. International Journal of Pharmaceutical and Biological Science Archive Index Copernicus Value: 65: 90. www.ijpba.in.
29. Kingsley, R. B., Aravinth, S., Jesuraj, V., Brindha, P., & Subramoniam, A. (n.d.). Anti-Diabetes Activity Of Acacia farnesiana (L.) Willd In Alloxan Diabetic Rats. In International Journal of PharmTech Research CODEN 5(1).
30. Acacia farnesiana (PROSEA). Plant Resources of South-East Asia. Sp. pl. ed. 4, 4: 1083 (1806).
31. Acasiane A and B and Farnesirane A and B, Diterpene Derivatives From the Roots of Acacia farnesiana / Plantamedica / 2009; 75(3): 256-261.
32. Extracts of Acacia farnesiana and Artemisia ludoviciana inhibit growth, enterotoxin production and adhesion of Vibrio cholerae / Santos Garcia et al / World Journal of Microbiology and Biotechnology, July 2006; 22(7): 669.
33. Kingsley, B., Kayarohanam, S., Brindha, P., & Subramoniam, A. Pharmacodynamic studies on the isolated active fraction of Acacia farnesiana (L.) willd. Pharmacognosy Magazine, 2014; 10(38): 283. https://doi.org/10.4103/0973-1296.133277.
34. BRONCHODILATOR AND ANTI-INFLAMMATORY EFFECT OF GLYCOSIDAL FRACTION OF ACACIA FARNESIANA. (n.d.).

35. Bronchodila tor and anti-inflamma tory effect of glycosidal fraction of acacia farnesiana / c. p. trivedi. n. t. modi. r. k. sarin and s. s. rao. / Physio!. Pharmac., July September 1986 Ind. J. / Letter to the Editor 25.
36. Delgadillo Puga, C., Cuchillo Hilario, M., Espinosa Mendoza, J. G., Medina Campos, O., Molina Jijón, E., Díaz Martínez, M., Álvarez Izazaga, M. A., Ledesma Solano, J. Á., & Pedraza Chaverri, J. Antioxidant activity and protection against oxidative-induced damage of Acacia shaffneri and Acacia farnesiana pods extracts: In vitro and in vivo assays. BMC Complementary and Alternative Medicine, 2015; 15(1): https://doi.org/10.1186/s12906-015-0959-y.
37. Barakal HH, Souleman AM, Hussein SAM, Ibrahiem OA, Nawwar NAM, Flavonoid galloyl glucosides from pods of Acacia fernesiana, phytochemistry, 1999; 51: 139-142.
38. Sahu NP, Achari B, Banerjee S.Dihydroxy methoxyflavone from seeds of Acacia fernesiana. phytochemistry, 38: 1425-1426, 1998.
39. Oyen, L. P. A.., & Nguyễn, X. D. (1999). Essential-oil plants. Backhuys Publishers.
40. Rama Devi S and Prasad MNV.Tannins and related polyphenols from ten common Acacia species of India, Biores, Technol., 36: 189-192, 1991.
41. Sara Gabr, Stefanie Nikles, Eva Maria Prerschy Wenzing, Karin Ardjiomand-Woelkart et.al "Characterization and optimization of phenolics extracts from Acacia species in relevance to their anti-inflammatory activity, Biochemical systematic and ecology, 2018; 78: 21-30.
42. Thirupal Reddy B, Varaprasad Bobba Rala and D. Ali Moulali. Antimicrobial screening of Acacia farnesiana (L) willd. Ind. J. Bot. Res., 2008; 4(2): 249-251.
43. Sahu N.P., Koike K, Banerjee S, Achari B, Jia Z, Nikaido T. A novel diterpene glycoside from the seeds of Acacia farnesiana. Tetrahedron Letters, 1997; 38: 8405-8408.
44. Arid Zone Trees, Acacia smallii (Acacia farnesiana), sweet acacia. Accessed on 10/11/07 from http://www.fdc.arizona.edu/
45. Queensland Government, Natural Resources and Water Department, Land protection, Mimosa bush, Acacia farnesiana. Accessed on 10/11/07 from http://www.nrw.qld.gov.au/factsheets/pdf/pest/pp35.pdf.
46. Parrotta J A. U.S. Department of Agriculture, Forest Service, Acacia farnesiana (L.) Willd. – sweet acacia. Accessed on /11/07from http://www.fs.fed.us/global/iitf/pdf/shrubs/Acacia%20farnesiana.pdf.

47. Department of Agriculture, Forest Service, Fact Sheet ST-5, November 1993; Acacia farnesiana, Sweet Acacia. Accessed on 10/11/07 from http://hort.ufl.edu/trees/ACAFARA.pdf.
48. Miller J. University of Iowa, farnesiana var. farnesiana Accessed on 10/11/07 from http://ccg.biology.uiowa.edu/jmiller/factsheets/Vachellia/farnesiana_ var._farnesiana.htm.
49. Ecology & Evolutionary Biology Greenhouses, University of Connecticut, Acacia farnesiana (L.) Willd. Accessed on 10/11/07 from http://florawww.eeb. uconn.edu/acc_num/198500174.html.
50. La Face D. Contribution to the knowledge of the concrete essence of gaggia farnese (Acacia farnesiana Willd.). Helv. Chim. Acta, 1950; 33: 249-56.
51. Ehret C, Maupetit P, Petrzilka M. New components from cassie absolute (Acacia farnesiana Willd.). Rivista Italiana EPPOS, (No. Spec., Journ. Int. Huiles Essent., 9th, 1990; 348-64, 1991.
52. Abd El-Wahab SM, Wassel GM, Aboutabl EA, Ammar NM, Afifi MS. Investigation of mucilage of the pods of Acacia nilotica L. Willd and Acacia farnesiana L. Willd growing in Egypt. Egyptian J. Pharm. Sci., 1992; 33: 319-25.
53. Thieme H and Khogali A. Isolation of apigenin-6,8-bis(C-β-D-glucopyranoside) from leaves of Acacia farnesiana. Pharmazie, 1974; 29: 352.
54. Gmelin R, Kjaer A, Olesen Larsen P. N-acetyl-L-djenkolic acid, a novel amino acid isolated from Acacia farnesiana Willd. Phytochemistry, 1962; 1: 233-236.
55. Seigler DS, Conn EE, Dunn JE, Janzen DH. Cyanogenesis in Acacia farnesiana. Phytochemistry, 1979; 18: 1389-1390.
56. Janzen DH, Doerner ST, Conn EE. Seasonal constancy of intra-population variation of HCN content of costa rican Acacia farnesiana foliage. Phytochemistry, 1980; 19: 2022-2023.
57. Bureau of Plant Industry, Department of Agriculture, Republic of the Philippines. Acacia farnesiana (Linn) Willd.- Aroma. Accessed on 10/11/07 from http://www.bpi.da.gov.ph/Publications/mp/pdf/a/aroma.pdf.
58. García S, Alarcón G, Rodríguez C, Heredia N. Extracts of Acacia farnesiana and Artemisia ludoviciana inhibit growth, enterotoxin production and adhesion of Vibrio cholerae. World J. Microbiol. Biotechnol., 2006; 22: 669–674.

59. Wassel GM; Abd El-Wahab SM, Aboutabl EA, Ammar NM, Afifi MS. Phytochemical examination and biological studies of Acacia nilotica L. Willd and Acacia farnesiana L. Willd growing in Egypt. Egypt. J. Pharm. Sci., 1992; 33: 327-40.
60. Wilbur J. Final report of the safety assessment of Acacia catechu gum, Acacia concinna fruit extract, Acacia dealbata leaf extract, Acacia dealbata leaf wax, Acacia decurrens extract, Acacia farnesiana extract, Acacia farnesiana flower wax, Acacia farnesiana gum, Acacia senegal extract, Acacia senegal gum, and Acacia senegal gum extract. Int. J. Toxicol., 2005; 24(Suppl. 3): 75-118.
61. Hannachi, H., Elfalleh, W., Ennajeh, I., Laajel, M., Khouja, M. L., Ferchichi, A., & Nasri, N. Chemicals profiling and antioxidants activities of acacia seeds. Journal of Medicinal Plant Research, 2011; 5(31): 6869–6875. https://doi.org/10.5897/JMPR11.1390.
62. Bouchenak-Khelladi, Y., Maurin, O., Hurter, J., & van der Bank, M. The evolutionary history and biogeography of Mimosoideae (Leguminosae): An emphasis on African acacias. Molecular Phylogenetics and Evolution, 2010; 57(2): 495–508. https://doi.org/10.1016/j.ympev.2010.07.019.
63. Rasul, M. G. Conventional Extraction Methods Use in Medicinal Plants, their Advantages and Disadvantages. In International Journal of Basic Sciences and Applied Computing, 2018.
64. Techniques Adopted for Extraction of Natural Products Extraction Methods: Maceration, Percolation, Soxhlet Extraction, Turbo distillation, Supercritical Fluid Extraction. International Journal of Advanced Research in Chemical Science, 2019; 6(4): https://doi.org/10.20431/2349-0403.0604001.
65. Maslin, B. R., Miller, J. T., & Seigler, D. S. Overview of the generic status of Acacia (Leguminosae: Mimosoideae). In Australian Systematic Botany, 2003; 16(1): 1–18). https://doi.org/10.1071/SB02008.
66. Clarke, H. D., Seigler, D. S., & Ebinger, J. E. (n.d.). Acacia farnesiana (Fabaceae: Mimosoideae) and Related Species from Mexico, the Southwestern. In Source: Systematic Botany 14(4).
67. Clarke HD, Downie SR, Seigler DS Implications of chloroplast DNA restriction site variation for systematics of Acacia (Fabaceae: Mimosoideae). Systematic Botany, 2000; 25: 618–632.
68. Miller JT, Bayer RJ (2000) Molecular phylogenetics of Acacia (Fabaceae: Mimosoideae) based on chloroplast trnK/matK and nuclear histone H3-D sequences. In ‘Advances in

legume systematics, 9'. (Eds PS Herendeen, A Bruneau) 180–200. (Royal Botanic Gardens: Kew, London).

69. Miller JT, Bayer RJ Molecular phylogenetics of Acacia (Fabaceae: Mimosoideae) based on the chloroplast matK coding sequence and flanking trnK intron spacer region. American Journal of Botany, 2001; 88: 697–705.
70. Guinet P Geographic patterns of the main pollen characters in the genus Acacia (Leguminosae), with particular reference to subgenus Phyllodineae. In 'Pollen and spores: form and functions'. (Eds S Blackmore, IK Ferguson) 297–311 (Academic Press: London) 1986.
71. Guinet P The genus Acacia (Leguminosae, Mimosoideae): its affinities as borne out by its pollen characters. Plant Systematics and Evolution Supplement 1990; 5: 81–90.
72. Guinet P, Vassal J Hypotheses on the differentiation of the major groups in the genus Acacia (Leguminosae). Kew Bulletin 1978; 32: 509–527.
73. Maslin BR, Stirton CH Generic and infrageneric classification in Acacia (Leguminosae: Mimosoideae): a list of critical species on which to build a comparative data set. Bulletin of the International Group for the Study of Mimosoideae, 1998; 20: 22–44.
74. Murphy DJ, Udovicic F, Ladiges PY Phylogenetic analysis of Australian Acacia (Leguminosae: Mimosoideae) by using sequence variations of an intron and two intergenic spacers of chloroplast DNA. Australian Systematic Botany 2000; 13: 745–754.
75. Murphy DJ, Miller JT, Bayer RJ, Ladiges PY Molecular phylogeny of Acacia subgenus Phyllodineae (Mimosoideae: Leguminoseae) based on DNA sequences of the internal transcribed spacer region. Australian Systematic Botany, 2003; 16: 19–26.
76. Pedley L Derivation and dispersal of Acacia (Leguminosae), with particular reference to Australia, and the recognition of Senegalia and Racosperma. Botanical Journal of the Linnean Society, 1986; 92: 219–254.
77. Polhill RM Classification of the Leguminosae. In 'Phytochemical dictionary of the Leguminosae, vol 1. Plants and their constituents'. (Eds FA Bisby, J Buckingham, JB Harborne) 1994; 35–36. (Chapman & Hall: London).
78. Thulin M, Hassan AS A new species of Acacia (Leguminosae) from the Horn of Africa. Nordic Journal of Botany, 1996; 16: 303–306.
79. Thulin M, Tardelli M A new species of Acacia (Leguminosae, Mimosoideae) from Somalia. Willdenowia 1988; 17: 125–128.
80. Thulin M New or noteworthy species of Leguminosae in NE tropical Africa. Nordic Journal of Botany, 1989; 8: 457–488.

81. HANNACHI, H. et al. Chemicals profiling and antioxidants activities of Acacia seeds. Journal of Medicinal Plants Research, 2011; 5: 6869-6875.
82. Chowdhury, A.R., Banerji, R., Misra, G., Nigam, S.K., Botanical, N., Short Communication Chemical Composition of Acacia Seeds & The Lipid Composition of Karaka Seeds, 1983; 60: 1893–1894.
83. De la Cruz, S., Rodríguez, E., Dávalos, H.N., Astudillo-Vázquez, A., Acute toxicity and decreased peristalsis in mice caused by Taxodium mucronatum and Acacia farnesiana extracts. Rev. Latinoam. Química, 2012; 40: 19–25.
84. Dominguez, X.A., Farias Martinez, H., Isolation of pinitol from huizache (Acacia farnesiana) flowers. Cienc. (Mexico City), 1967; 25: 107–8.
85. Klancnik A, Piskernik S, Jersek B, Mozina SM. Evaluation of diffusion and dilution methods to determine the antibacterial activity of plant extracts. Journal of Microbiological Methods, 2010, 81: 121-126.
86. Oliveira D.F, Pereira A.C, Figueiredo H.C.P, Douglas A. Carvalho D.A, Silva G, Nunes A.S, Alves D.S, Carvalho H.W.P. Antibacterial activity of plant extracts from Brazillian southeast region. Fitoterapia, 2007; 78(2): 142-145.
87. de Rijke E, Out P, Niessen W.M.A, Ariese F, Gooijer C, Brinkman. Analytical separation and detection methods of flavonoid. Journal of chromatography A. 2006; 1112: 31-63.
88. Berker K.I, Güçlü K, Tor I, Apak R. Comparative evaluation of Fe(III) reducing power-based antioxidant capacity assays in the presence of phenanthroline, bathophenanthroline, tripyridyltriazine (FRAP), and ferricyanide reagents. Talanta. 2007; 72: 1157-1165.
89. Sharmin T, Rahman MS, Opu MAH, Hossain MA. Evaluation of three medicinal plants of Bangladesh for thrombolytic potentials. Int J Adv Res Rev., 2016; 1(9): 99-102.
90. Sharma Kavita, Mahato Neelima, Lee Yong Rok "Extraction, characterization and biological activity of citrus flavonoids", 2018; 1-11.
91. Deshmukh sp, Shrivastava B and Bhajipale NS. A review on Acacia species of therapeutics importances, Jully-August; 2018; 6(4): 24-34.
92. Konrad Habelt and Fritz Pittner. A rapid method for the determination of naringin, pruning and naringenin applied to the assay of naringinase. Analytical biochemistry, 1983; 134: 393-397.
93. mathi R, Tamizharasi S. and Sivakumar T. Bio- Dynamic activity of naringenin-A review. ISSN, August 2015; 4(8): 234-236.
94. Chung Ting-Wen, Li Shiming, Lin Chi-Chien, Tsai Sen-Wei, "Antinocipative and anti inflammatory effects of citrus flavonone naringenin, 2019; 32(2): 81-85.

95. Jain R, Jain SK. Screening of in vitro cytotoxic activity of some medicinal plants used traditionally to treat cancer in Chhattisgarh state, India. Asian Pac J Trop Biomed, 2011; 1: S147-S150.
96. Akinmoladun AC, Obuotor EM, Farombi EO.. Evaluation of antioxidant and free radical scavenging capacities of some nigerian indigenous medicinal plants. J Med Food, 2010; 13: 444-51.
97. Bruce R. Maslin, Boon Chuan Ho, Hang Sun, Lin Bai. Revision of senegalia in china and notes on introduced species of Acacia, Acaciella, Senegalia and Vachellia (leguminosae: mimosoideae), plant diversity. 2019; 09. 001.
98. Jeevam RA, Bhakshu L Venkata R (2004). In vitro antimicrobial activity of certain medicinal plants from Eastern Ghats, India, used for skin diseases. J. Ethnopharm., 90: 353-357.
99. Harborne JB, Phytochemical methods: A Guide to Modern techniques of plants Analysis. Chapman and Hall London, UK. 1998.
100. Obdoni BO and Ochuko PO. "Phytochemical studies and comparative efficacy of the crude extracts of some Homostatic plants in Edo and Delta States of Nigeria" Global J. Pure Appl. Sci., 2001; 8: 203-208.
101. Brand-Williams, W., Cuvelier, M.E. and Berset, C.L.W.T. Use of a free radical method to evaluate antioxidant activity. LWT-FOOD Sci. Technol., 1995; 28: 25 30.
102. Saurabh Rajvaidhya, B.P. Nagori, G.K. Singh et al., A Review on Acacia Arabica - An Indian Medicinal Plant. IJPSR, 2012; 3(7): 1995-2005.
103. Parmar NS, Shikha Parmar. Anti-ulcer potential of flavonoids. Indian J Physiology and Pharmacology, 1998; 42: 343-51.
104. Tripathi KD. Essentials of Medical Pharmacology, 6th edition New Delhi, Jaypee publication; 2008: 808.