IJPPR
INTERNATIONAL JOURNAL OF PHARMACY & PHARMACEUTICAL RESEARCH
An official Publication of Human Journals
ISSN 2349-7203
HUMAN

Human Journals
Review Article
June 2023 Vol.:27, Issue:3

A Comprehensive Review on *Vachellia farnesiana (Acacia farnesiana)*

IJPPR
INTERNATIONAL JOURNAL OF PHARMACY & PHARMACEUTICAL RESEARCH
An official Publication of Human Journals
ISSN 2349-7203
HUMAN

Divya Shinde*, S. S. Patil, S. J. Wakode, Shweta Patil

MSS Maharashtra College Of Pharmacy, Nilanga Dist-Latur- Maharashtra, India

Submitted: 24 May 2023
Accepted: 31 May 2023
Published: 30 June 2023

HUMAN JOURNALS
www.ijppr.humanjournals.com

Keywords: Flavonoid, naringenin, bioactive compounds and successive Soxhlet extraction

ABSTRACT

The aim of this study was to identify the bioactive compound from the alcoholic extract of Acacia farnesiana leguminosae pods through the implementation of preliminary phytochemical testing or thin layer chromatography, as well as quantify the total phenolic content using the Folin-Ciocalteu reagent method. Acacia farnesiana pod powder that had been milled and shade-dried was extracted using a soxhlet apparatus with petroleum ether, chloroform, and alcohol. Due to the higher yield of the alcoholic compound in comparison to the other two extracts, this extract was used for the identification of the bioactive compound in the Leguminosae pods. Naringenin was identified from the alcoholic extract via TLC, and the total phenolic content in the alcoholic extract was determined to be 22% (w/w). Therefore, the current investigation is thus concerned with the qualitative analysis of the alcoholic extract of the legume pericarp (pod wall) of Acacia farnesiana L**.** In this, we examine different phytochemicals that are helpful for preventing or treating certain ailments. TLC procedure used for determining the amount of naringenin in the active Acacia farnesiana pod extracts. It has been determined that bean pods have the highest levels of phenolics or phytoconstituents.

INTRODUCTION:

The pharmacological activities of the plants have been confirmed through biological research of plant extracts. The decreasing capacity, radical scavenging, and antioxidants are known to have metal chelating characteristics that help to reduce and stop the production of free radicals. The abilities of plant extract to kill or hinder the growth of bacteria are of interest for the creation of antimicrobial agents, whilst the properties have been directly or indirectly preventing disease and deterioration of food. Therefore, such research adds value and offers knowledge that is scientific, validating the utility of the plant used in ethnomedicine. Besides determining the pharmacological characteristics of plant extracts, research on the toxicity to ensure the safety of the extract, a plant's property is essential. Solvents and extraction techniques, as well as the many techniques available to assess antioxidant and antibacterial activity, have all contributed to the diversity of effects of plant extracts that have been observed. Polyphenols have been proposed as the cause of the powerful biological activity of extracts made with methanol and ethanol in research that is often reported.

A member of the Leguminosae (Fabacea) subfamily Mimosoideae is the plant Acacia farnesiana. It is well known that it is grown for its bloom, which is used in the creation of the perfume Cassie.The plant is also well-known for its ethnopharmacological characteristics, and several academic research has already been done on it. For instance, the glycosidal fraction of A. farnesiana has been shown to have bronchodilator and anti-inflammatory properties. The root is thought to have anti-venom properties, and diterpene and flavonoid chemicals were previously identified from the root extract. The root is thought to have anti-venom properties, and diterpene and flavonoid chemicals were previously identified from the root extract. The bark of Acacia farnesiana showed antidiarrheal and antibacterial efficacy against common pathogens that cause diarrhea in vitro. Castor oil and magnesium sulphate were used to induce diarrhea has been previously reported that the ethanolic extract of the leaves has anti-inflammatory properties that have been tested using carrageenan-induced paw oedema for acute inflammation and cotton pellet-induced granulation for chronic inflammation models. This study's goal was to investigate the antioxidant, antibacterial, and cytotoxic properties of an ethanolic extract of Acacia farnesiana leaves in addition to earlier research. The quantification of phenolic content by Folin ciocalteu reagent, and characterization of the extract by high performance liquid chromatography

coupled with photodiode array (HPLC-PDA) and mass spectrometry (LC/MS) was also carried out.

DISTRIBUTION AND HABITATS:

The pantropical distribution of Vachellia farnesiana suggests that it was brought from the Old World (Isely, 1966).It occurs throughout the New World starting in southern Arizona, Texas, and South Florida and moving through Mexico, Central America, the Bahamas, and the West Indies (Clarka et al. 1989).The early successional species Vachellia farnesiana is widely dispersed and can be found in very dry settings over much of the tropical and subtropical region of the New World (Bush and Van Anken 1995).

PLANT PROFILE

Synonyms: Sweet acacia, Vachellia Farnesiana.

Biological source: It consists of Acacia farnesiana bushes and tiny trees, which are members of the Leguminosae family.

Geographical source: India is home to the Acacia farnesiana, which is also native to tropical Burma, Sri Lanka, Saudi Arabia, Egypt, and Africa. It can be found primarily in Maharashtra, Gujarat, Andhra Pradesh, and Karnataka in India.

Fig no.1 Acacia farnesiana plant

Description:

Acacia farnesiana is a spreading shrub that is typically 1.5–4 metres tall, with a smooth or finely fissured grey-brown bark, leaves with petioles 0.2-2 cm long, hairy mainly above, with a round to elongated gland, occasionally with a sugary gland apex, and interjugal

glands lacking. globose heads, 33–95 flowers, yellow or orange, 1–3 leaf apex, hairy, 3-–30mm long peduncles. Pods are cigar-shaped, straight to severely curved, terete, turgid, 1.5-8.5 cm long, 8-17 mm wide, dark brown to blakish, glabrous, and have seeds that are transverse or obliquely oriented that are separated by pith.

Chemical constituent:

The seeds of A. farnesiana are a rich source of amino acids, including lysine, arginine, glycine, and histidine, among others. The pods of this plant also contain a variety of polyphenols, including gallic acid, ellagic acid, m-digalic acid, methyl gallate, kaempferol, and naringenin.

Uses:

Bark: Bark has antiseptic and demulcent properties.

Typhoid is treated using a decoction of the bark, which is also used as a bath. Applying the bark's juice topically can heal swellings, bleeding gums, and other conditions.

Roots: Chewing on roots has been used as a remedy for sore throats. The root is prepared as a medicine for tuberculosis. Diarrhoea has been treated using a decoction of the gum from the trunk.

Flowers: They have been used as an emetic, stomachic, stimulant, and antispasmodic. After giving delivery, mothers in Java take them. Dyspepsia and neuroses are treated with an infusion. A decoction is administered as an injection to treat leucorrhea and is used to treat a prolapsed rectum. The distillation method is used to create the scent cassie from the flowers.

Leaves: leaves are gonorrhea-treating. To cure wounds, the powdered, dried leaves have been administered externally. Young leaves are then applied as a poiltice to cure ulcers and sores after the leaves have been decocted and used as a wash.

Pods: It has purgative properties. The green seedpods have a sharp flavour. In addition to being used to treat the skin and mucous membranes, a de-coction has been utilised to cure dysentery. The pods have been infused to treat uterorrhagia, diarrhea, leucorrhea, conjunctivitis, and sore throats.

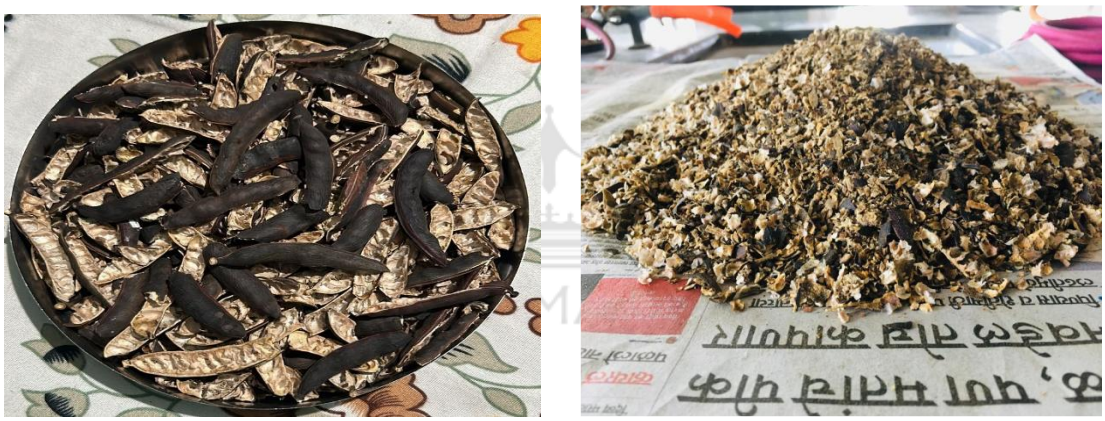
MATERIAL AND METHOD:

Identification of plant materials

Acacia farnesiana L. Willd, also known as Devbabul locally, was found in Lavang, Solapur district, Maharashtra, in the month of August. Botanical Survey Of India, Western Regional Centre, Koregaon Road, Pune, verified a specimen.

Preparation of extracts:

Using a soxhlet apparatus, the coarsely powdered, air-dried fruits of Acacia farnesiana were consecutively extracted with benzene, chloroform, and methanol. The various extracts were combined with a rotatory evaporator and dried completely over a water bath to get the crude extract.



Drying and grinding of plant material of Acacia farnesiana pods:

The pods from the A. farnesiana plant were harvested, sun-dried, and suect-ed for coarse grinding.

Morphological character determination of Acacia farnesiana:

While morphology is the description of that shape when the material is known to occur in a specific form, morphology is the study of the form of an objective. Colour, odour, taste, form, and size are morphological and organoleptic characteristics that have been studied and analysed botanically.

Physicochemical study

Determining the Ash value of Acacia farnesiana pods:

Three separate methods are used to measure the total ash, acid-insoluble ash, and water-soluble ash that remains following the burning of medicinal plant material.

Determining the Total Ash value of Acacia farnesiana pods:

Material required: Furnace, silica crucible, pod powder, and weighing scale are necessary materials. Approximately 2 g of air-dried powder medication should be weighed and placed in a tempered silica crucible. The temperature was gradually raised to a maximum of 450°C while still burning the material softly at first until it was carbon-free. It was weighed and put in a desiccator to cool. Calculations were made to determine the amount of w/wof ash in relation to the air-dried plant material.

Determining of Acid-insoluble ash of Acacia farnesiana pods

Material required: Furnace, silica crucible, weighing scale, ashless filter paper, 2M HCL, and AF powder are the materials needed.

Procedure:

The whole ash was heated for 5 minutes with 25 ml of 2M HCL, then the insoluble material was filtered and collected on ash-free filter paper. It was then rinsed with water before being fired in a tared crucible for 15 minutes at a temperature of no more than 450°C. It was weighed and kept in a desiccator for cooling. Calculations were made to determine the acid-insoluble ash percentage as a proportion of the air-dried plant material.

Determining of Water-soluble ash of Acacia farnesiana pods:

Material required: Silica crucible, ashless filter paper, weighing scale, AF pod powder, hot water.

Procedure: The total ash was then heated for five minutes with 25ml of diluted water, cooled, and the insoluble material was collected on an ash-free filter paper. The total ash was then washed with hot water and ignited for 15 minutes at a temperature of no higher than 450°C. subtracts the ash's insoluble weight. With reference to the air-dried plant material,

the proportion of water-soluble ash was estimated.

Extraction of pods of Acacia farnesiana.

Soxhlet extraction:

Material required: Petroleum ether, chloroform, alcohol, per plates, rotary evaporator, heating element, RBF, and soxhlet equipment.

Principle:

Extraction is done using a Soxhlet extractor. The fat extractor continually extracts the solid material by pure solvent using the solvent re-flux and syphon principle, which saves solvent and increases extraction efficiency. In order to improve the surface area of solid-liquid contact, the solid material is ground before extraction. The solid substance is next put into an extractor. A solvent is contained in the bottom flask, which is attached to a flux condenser. The solvent is heated to boiling point in the bottom flask, vaporized through the extractor's branch pipe, and then brought into contact with the solid for extraction. The solvent holding the extract is syphoned back when the solvent surface rises over the siphon's highest point. The flask is used repeatedly, such as with a pure solvent, to extract a portion of the solid substance, and the extracted material is then concentrated in the flask.

Procedure: The pods of Acacia farnesiana were shade-dried at room temperature, and 50 g of coarse powder from each batch was successively extracted with petroleum ether, chloroform, and alcohol, in that order, in order of increasing polarity. Using a Rotary evaporator, the extract was concentrated under reduced pressure. The percentage yield was determined after the remedial extract had dried.

Preparation of alcoholic extract

The pods took three to four days to sun dry. The dried pods (50g) were ground to a coarse powder using a mixer, and repeated soxhlet extractions using petroleum ether, chloroform, and alcohol were then carried out. The alcoholic extract was dried in a rotary evaporator after being filtered through Whatmann filter paper.

Chemicals: Naringenin, a biomarker, was bought from Sigma Aldrich, and science direct chemicals in Nashik, India, sold LR-grade chemicals such alcohol, chloroform, and petroleum ether.

Phytochemical screening of Acacia farnesiana pods alcoholic extract

1. Preliminary phytochemical screening: After dissolving one gram of alcohol extract in alcohol in a test tube, the subsequent tests were carried out.

A. Test for alkaloids

• Dragendroff's test: Add a few drops of Drangendroff's reagent to the extract solution; scarlet precipitate indicates the presence of alkaloid.

• **Mayer's test:** Add a few drops of Mayer's reagent to the extract solution to check for the presence of an alkaloid in the creamy white precipitate.

Wagner's test: To the extract solution, add few drops of Wagner's reagent, reddish brown precipitate indicates presence of an alkaloid.

B. Test for flavonoids:

• **Shinoda test:** 2 ml of solution was taken in test tube and to it magnesium powder and few drops of conc. HCL were added which gives pink colour, indicates presence of flavones.

• **Sulphuric acid test**: Sulphuric acid (66% or 80%) was added to a 2 ml solution in a test tube, and the resultant rich yellow colour shows the presence of flavones.

• **Lead acetate solution**: 2 ml solution was taken in test tube and to it add small quantity of lead acetate solution which gives yellow colour precipitate, indicates presence of flavones.

C. Test for glycosides:

• **Keller-killiani test**: In a test tube, 2 ml of solution was added along with glacial acetic acid, 1 drop of ferric chloride, and conc. The presence of glycoside is indicated by the H2SO4 reddish brown colour that develops at the junction of the two liquid layers and the upper layer's appearance of blue-green colour. D. Examine the proteins.

• **Million's test**: Extact solution + 2 ml of Million's reagent white precipitate appears, which turn red upon gentle heating, indicates presence of protein.

D. Test for steroids:

• **Salkowski's test**: Treat the extract with chloroform, add a few drops of concentrated sulfuric acid, shake the mixture, and let it stand for a while. When the upper layer turns red, this indicates the presence of steroids, while the lower layer forms a yellow hue, which shows the presence of terpenoids.

Libermann-Burchard test: A brown ring forms at the junction of the two layers, the upper layer turns green, indicating the presence of sterols, and the formation of a deep red colour indicates the presence of triterpenoids after the extract has been treated with a few drops of acetic anhydride, boiled, and cooled.

E. Test for Tannis:

• **Ferric chloride test**: Extract solution gives blue-green colour precipitate with $FeCl_3$.

• **Acetic acid test:** Extract solution gives red colour precipitate with acetic acid.

Medicinal properties

Anti-Inflammatory / Cytotoxicity:

The study produced three recognised diterpenes, eight flavonoids, and four new diterpenes: acasiane B, farnesirane A, and farnesirane B. Some of the compounds showed mild anti-inflammatory effect, while others showed cytotoxicity to human cancer cell lines.

Vibrio cholera inhibition:

The ethanolic extracts of Artemisia farnesiana and Artemisia ludoviciana significantly reduced the bacterial growth of Cholera vibrio strains, according to a study of 32 medicinal plants. The effects on enterotoxin generation and adhesion were also examined.

Antihyperglycemic Activity:

An aqueous extract's active component was tested for anti-hyperglycemic efficacy in rats with diabetes brought on by alloxan. Promising anti-diabetic action was found in the results.

There were no obvious harmful effects in the active portion. A study looked at the anti-hyperglycemic potential of Acacia farnesiana extracts. The amount of blood sugar was dramatically reduced by a water extract. The soluble fraction had some activity. The findings point to a direct stimulatory effect of the active fraction on glucose absorption without insulin's participation, which may be the primary mechanism.

Antiulcer / Adsorbent:

Acacia farnersiana methanol leaf extract was tested for its ability to treat rat models of ulceration. Results demonstrated that when compared to control Ranitidine, the methanol extract significantly reduced the ulcer index.

Bronchodilator / Anti-Inflammatory:

A study shows that a glycosidal fraction isolated from unripe Acacia farnesiana pods has the ability to relax smooth muscle and have anti-inflammatory properties. The results demonstrated a direct relaxation effect on bronchial muscles and an inhibition of inflammation brought on by formaldehyde and carrageenan.

Antioxidant / Protection Against Oxidative Induced Damage:

When this flora is ingested, the antioxidant protection of acacia pod extracts (Acacia shaffneri and Acacia farnesiana) suggests that antioxidant components and protective effects may be transferred to animal products (milk, meal, and byproducts) from acacia pods.

Antibacterial/ Antioxidant / AntiInflammatory:

All of the studied extracts from the five plants Acacia farnesiana, S. alata, S. grandiflora, S. cumini, and T. divaricata shown antioxidant and antibacterial activity in the study of ethanolic extracts of these plants. As shown by a decrease in interleukin (IL)-6 release and/or tumor necrosis factor (TNF)-a production, all extracts had anti-inflammatory effects.

CONCLUSION:

The Vachellia Farnesiana plant as a whole possesses a number of advantageous pharmacological and biological traits. The most effective medicinal components were the bark, flowers, and pods of Vachellia farnesiana.This summary will be useful to new researchers.

REFERENCES

1. H. Ibrahim Erkovan, Peter j. Clarke, Ralpha D.B.Whalley. A review on general description of Vachellia farnesiana (L) wight and Arn. J.of the agricultural faculty,47(1):71-76, 2016.
2. Deshmukh sp, Shrivastava B and Bhajipale NS. A review on Acacia species of therapeutics importances. vol.6, issue 4,; Jully-August;2018;24-34.
3. Nurul Iman Suansa, Hamad A, Al-Mefarrej.Ameliorative effect of shade on seedling growth. American journal of plant sciences, 2019,10,12-23.
4. Sumit Kumar, Naringenin: present status and its future prospective Int.J.Pharm. Phytopharmacol. Res. 2015, 5(1):18-26.
5. Sumathi R, Tamizharasi S. and Sivakumar T. Bio- Dynamic activity of naringenin-A review. ISSN vol 4, issue 8, PP 234-236 August 2015.
6. Mauricio M. Victor, Jorge M. David, Maria C. K. Sakukuma, Elivana L. Franca and Anna V. J. Nunes. A simple and efficient process for the extraction of naringin from grapefruit peel waste gps-2017-0112.
7. Sanjay Biradar, Bhagyashri Rachetti. Qualitative analysis of legume pericarp (pod wall) and seeds of Acacia farnesiana L. vol 6, issue B, May-Jun 2013, PP 43-46.
8. Konrad Habelt and Fritz Pittner. A rapid method for the determination of naringin , pruning and naringenin applied to the assay of naringinase. Analytical biochemistry 134, 393-397(1983).
9. Salfarina Ramli, Ken-ichi Harada, Nijsiri Ruangrungsi. Antioxidant, antimicrobial and cytotoxicity acticities of Acacia farnesiana (L) willd leaves ethanolic extract. Pharmacognosy journal july 2011 vol 3, issue 23.
10. Thirupal Reddy B, Varaprasad Bobba Rala and D. Ali Moulali. Antimicrobial screening of Acacia farnesiana (L) willd. Ind. J. Bot. Res. 2008 vol 4 (2): 249-251.
11. 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.
12.Rudrappa Nandeesh, Sachidananda Vijayakumar, Abhinandan Munnolli, Ambika Alreddy. Bioactive phenolic fraction of Citrus maxima abate lipopolysaccharide-induced sickness behavior and anorexia in mice: In-silico molecular docking and dynamic studies of biomarkers against NF-Kb, Biomedine and Pharmacotherapy journal 2018, 1535-1545.
13. Perwez Alam, Mohammad K. Parvez, Ahmed H. ARBAB and Mohammed S. Al- (2017) Dosari, "Quantitative analysis of quercetin rutin, naringenin or gallic acid by using validated RP-and NP-HPTLC methods for the quality control of anti-HBV and active extract of guiera senegalensis, vol. 55, No.1, 1317-1323.
14. Chung Ting-Wen, Li Shiming, Lin Chi-Chien, Tsai Sen-Wei, (2019) " Antinocipative and antiinflammatory effects of citrus flavonone naringenin 32(2); 81-85.
15. Sharma Kavita, Mahato Neelima, Lee Yong Rok (2018) " Extraction, characterization and biological activity of citrus flavonoids", 1-11.
16. Cordenonsi Leticia M., Sponchiado Rafaela M., Campanharo Sarah C., Garcia Cassia V. (et.al) (2017) "Study of flavonoids present in pomelo (citrus maxima) by Dsc, UV-VIS, IR, 1H and 13C NMR and MS" 01, 31-37.
17. Rajamani Sumathi, Tamilarazi Sengadon, Radhakrishanan Arun, Shanmukhan Nikhitha (2018) " Pharmacokinetic and tissue distribution of naringenin and naringenin nanosuspension, 12(4) S1201-207.
18. Khoddami Ali, Meredith A., Roberts Thomas H., (2013) " Techniques for analysis of plant phenolic compounds",18, 2328-2375.
19. Sara Gabr, Stefanie Nikles, Eva Maria Prerschy Wenzing, Karin Ardjiomand-Woelkart et.al (2018) "Characterization and optimization of phenolics extracts from Acacia species in relevance to their anti-inflammatory activity, Biochemica systematic and ecology 78, 21-30.
20. Jadhav Aruna P, kareparamban Joseph A, Nikam Pravin H, Kadam Vilasrao J (2012), "Spectrophotometric estimation of Ferulic acid from Ferula asafetida by Folin- Ciocalteu's Reagent" Der Pharmacia Sinica, 3(6): 680-684.
21.Indian Council of Forestry Research and Education, Dehradun. Babul (Acacia nilotica).Dehradun, Forest Research Institute. 33p.

22. Joy PP, Thomas J, Mathew S, Skaria P. Medicinal plants, Kerala Agricultural University Publications; Kerala, India,1998, 3.
23. K.M. Old, T.K. Vercoe, R.B. Floyd, M.J. Wingfield,J. Roux and S. Neser,Acacia spp.FAO/IPGRI Technical Guidelines for the Safe Movement of Germplasm No. 20
24. Mann A, Gbate M, Umar A. Medicinal and economic plants. Jube Evans books and publication, Bida, Nigeria. 2003, 160.
25. Nadkarni KM. The Indian Plants and Drugs. New Delhi: Shrishti Book Distributors2005; 4:5.
26. Singh BN, Singh BR, Sarma BK, Singh HB (2009b). Potential chemoprevention of Nnitrosodiethylamine-induced hepatocarcinogenesis by polyphenolics from Acacia niloticabark. Chem-Biol. Interact., 181: 20-28.
27. Baravkar AA, Kale RN, Patil RN, Sawant SD (2008). Pharmaceutical and biological evaluation of formulated cream of methanolic extract of Acacia niloticaleaves. Res. J. Pharm. Technol., 1(4): 481-483.
28. Gilani AH, Shaheen F, Zaman M, Janbaz KH, Shah BH, Akhtar MS (1999). Studies oantihypertensive and antispasmodic activities of methanol extract of Acacia niloticapods. Phytother. Res., 13: 665-669.
29. T. Kalaivani and L. Mathew, "Free radical scavenging activity from leaves of Acacia nilotica(L.) Wild. exDelile, an Indian medicinal tree," Food and Chemical Toxicology, vol. 48, no. 1, pp. 298–305, 2010.
30. D. S. Seigler, "Phytochemistry of Acacia sensulato," Biochemical Systematics and Ecology, vol. 31, no. 8, pp. 845–873, 2003.
31. Kalaivani T, Rajasekaran C, Suthindhiran K, Mathew L (2010b). Free radical scavenging, cytotoxic and hemolytic activities from leaves of Acacia nilotica(l.) wild. ex. delile subsp. indica (benth.) brenan. Evid. Based Complement. Alternat. Med., 2011: 274741.
32. Banso A (2009). Phytochemical and antibacterial investigation of bark extracts of Acacia nilotica. J. Med. Plants Res., 3: 082-085.
33. Singh BN, Singh BR, Singh, RL, Prakash D, Sarma BK, Singh HB (2009a). Antioxidant and anti-quorum sensing activities of green pod of Acacia niloticaL. Food Chem. Toxicol., 47: 778-786.
34. Mitra S, Sundaram R (2007). Antioxidant activity of ethyl acetate soluble fraction of Acacia arabicabark in rats. Indian J. Pharmacol., 39(1): 33-38.
35. Amos S, Akah PA, Odukwe CJ, Gamaniel KS, Wambede C (1999). The pharmacological effects of an aqueous extract from Acacia niloticaseeds. Phytother. Res., 13: 683-685.
36. Gilani AH, Shaheen F, Zaman M, Janbaz KH, Shah BH, Akhtar MS (1999). Studies on antihypertensive and antispasmodic activities of methanol extract of Acacia niloticapods. Phytother. Res., 13: 665-669.
37. El-Tahir A, Satti GM, Khalid SA (1999). Antiplasmodial activity of selected sudanese medicinal plants with emphasis on Acacia nilotica. Phytother. Res., 13: 474-478.n.
38.Azeemoddin G, Jagan Mohan Rao S, ThirumalaRao SD. J Food SciTechnol 1988; 25: 158.
39. Padmavathy P, Shobha SJ. Food SciTechnol 1987; 24: 180-2. 49. Ojo OA and Fagade OE. African Journal of Biotechnology 2002; 1 (1): 23-27.
40. Anonymous. Leucaenaleucocephala - the Most Widely Used Forage Tree Legume". FAO. 40. Orwa. Leucaenaleucocephala. Agroforestree Database. World Agroforestry Centre. 2009
41. Alabi DA and Alausa AA. World Journal of Agricultural Sciences 2006; 2 (1): 115-118.
42. Deodhar UP, Paradkar AR, Purohit AP. Drug DevInd Pharm 1998; 24 (6): 577-582.
43. Verma PRP, Balkishen R. Journal of Scientific and Industrial Research 2007; 66: 550-557.
44. Gamal-Eldeen AM, Amer H, Helmy WA, Ragab HM, Talaat RM. Indian J Pharm Sci 2007; 69: 805-11.
45. Irene MV, Robert MTG, Rosette CG. Phytotherapy Research 1997; 11 (8): 615- 617.
46.Ademola IO, Akanbi AI, Idowu SO. Pharmaceutical Biology 2005; 43(7): 599- 604. 58. 47.Syamsudin RS, Partomuan S. European Journal of Scientific Research 2010; (3): 384-391. 59. [48].Idowu SO, Adeyemo MA, Ogbonna UI. Journal of Biological Engineering 2009; 3: 1