



INDO AMERICAN JOURNAL OF PHARMACEUTICAL RESEARCH



AQUEOUS EXTRACT OF *ALBIZIA STIPULATA* BOIV. BARK - *IN VITRO* ANTIOXIDANT ACTIVITY STUDIES

Sujatha Jadi¹, Nagamallika Gorantla^{2*}, Manasa Bolishetty³, Rajendra Y⁴

¹St. Paul's College of Pharmacy, Nagarjuna Sagar Road, Turkayamjal, Hyderabad - 501510, Telangana, India.

²Sarada College of Pharmaceutical Sciences, Kondakavur, Guravaya Palem, Narsaraopet-522602, Andhra Pradesh, India.

³Samskruti College of Pharmacy, Kondapur, Ghatkesar, Hyderabad- 501301, Telangana, India.

⁴Gitam Institute of Pharmacy, Rushikonda, Vishakapatnam - 530045, Andhra Pradesh, India.

ARTICLE INFO

Article history

Received 04/08/2021

Available online

30/09/2021

Keywords

Antioxidant Property,
Albizia Stipulata Bark,
DPPH,
ABTS,
Superoxide Ion Radical Scavenging
Activities.

ABSTRACT

The objective of the present study was to determine the *in-vitro* antioxidant activity of aqueous extract of *Albizia stipulata* Boiv. bark. The antioxidant properties were evaluated by determining free radical scavenging activity against 2, 2-diphenyl-1-picrylhydrazyl (DPPH), 2, 2'-azino-bis(3-ethyl benzothiazoline-6-sulfonic acid) (ABTS), and Superoxide ion. The aqueous extract possessed an IC₅₀ value of 12.52 µg/ml for DPPH radical scavenging assay on comparing to standard Vitamin C (3.59 µg/ml), an IC₅₀ value of 3.39 µg/ml for ABTS radical scavenging assay when compared to standard vitamin C (2.32 µg/ml), and for Superoxide ion scavenging the IC₅₀ value was recorded as 13.60 µg/ml on compared to standard gallic acid (0.61 µg/ml). From the results in terms of radical scavenging activity against DPPH, ABTS, and Superoxide ion, *Albizia stipulata* Boiv. bark exhibited excellent antioxidant activity than standards. Hence, an aqueous extract of *Albizia stipulata* bark can be suggested for usage as an effective natural antioxidant in pharmaceutical and nutraceutical products.

Corresponding author

Nagamallika Gorantla

Associate Professor,
Sarada College of Pharmaceutical Sciences,
Kondakavur, Guravaya Palem,
Narsaraopet-522602,
mallika.gorantla@gmail.com

Please cite this article in press as **Nagamallika Gorantla et al.** Aqueous Extract of *Albizia Stipulata* Boiv. Bark - In Vitro Antioxidant Activity Studies. *Indo American Journal of Pharmaceutical Research*.2021;11(09).

Copy right © 2021 This is an Open Access article distributed under the terms of the Indo American journal of Pharmaceutical Research, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

INTRODUCTION

Oxidative stress in a cellular system is a biochemical abnormality produced by inequality between the absolute overload of oxidants or free radical moieties from the natural physiological and biochemical pathways and a successive diminution of antioxidant components in the body. It is engaged in the pathogenesis of a considerable number of chronic metabolic illnesses which include atherosclerosis, ischemia/reperfusion injury, chronic inflammatory diseases, renal failure, and diabetes mellitus [1]. Hence, the destructive effects of oxidative stress in several chronic metabolic disorders have obliged the scientific community to explore for antioxidative compounds that can inhibit the oxidation of oxidizable molecules in a chain reaction that could consequently be vital in the therapy and prevention of these disorders [2].

There are two important classifications of antioxidant agents to be specific synthetic, and natural. Generally, synthetic antioxidants are compounds with phenolic structures of different degrees of alkyl substitution, while natural antioxidants can be phenolic compounds (tocopherols, flavonoids, and phenolic acids), nitrogenous substances (alkaloids, chlorophyll subsidiaries, amino acids, and amines), or carotenoids and, also ascorbic acids [3, 4].

Unfortunately, although synthetic or chemical antioxidants, for example, butylated hydroxy anisole (BHA), butylated hydroxytoluene (BHT), propyl gallate (PG), and tertiary-butylhydroxytoluene exhibit potent free radical scavenging effects but, limitations on the use of these compounds because, they cause liver damage and carcinogenesis in laboratory animals [5-7]. Therefore, there is a necessity for the progress and consumption of more efficient antioxidants of natural origin.

Therapeutic plants have been widely used for the cure of a range of chronic metabolic disorders by traditional healers, and herbalists especially in Africa, where greater than 5400 medical shrubs have been stated to have over 16,300 therapeutic uses [8]. Compounds obtained from natural products have affected the drug discovery program. This is evident in several clinically active drugs that are either natural products or have a natural product pharmacophore [9]. Thus, in the latest years, the assessment of medicinal plants with possible antioxidant properties have got considerable attention due to the increasing interest in safe and non-toxic alternative antioxidants [10]. Consistent with we have searched the number of plants for antioxidant activity finally we have selected *Albizia* species as it is easily available, has antioxidant activity and has a long history of use in traditional medicine, particularly for the treatment of asthma, allergic disorders, inflammation, and reduced ulcer effect in patients. This plant is also used in Ayurveda for the treatment of bronchitis, asthma, leprosy, eczema, pruritus, paralysis [11], and also has been reported to possess anti-allergic, antioxidant, analgesic, anti-inflammatory, anticonvulsant, antiulcer, antimicrobial, and cytotoxic activities [12-17], antihistaminic, anti-spermatogenic activities [18,19], antidiabetic, various organ protective, central analgesic [20-21], anti-HIV-1 [23], memory enhancing, antidiarrheal, antispasmodic, and broncho dilatory [24] and anticancer activities [25].

Albizia is a large genus belonging to the family Leguminosae, subfamily Mimosoideae, which consists of incredibly important multipurpose tree legumes. It consists of approximately 150 species, tropical and subtropical trees, and shrubs with a short lifespan, and it is largely scattered all over Asia, including India, Mauritius, China, East Africa, South Africa, Australia, America, Mexico, West Indies, and Brazil [26].

Albizia stipulata Boiv Commonly called as nalla regi, bandi chindugu, Konda-chiragu and is a deciduous tree, up to 20m tall, crown broad, spreading, and flat-topped. The bark is pale grey or greenish-grey, smooth, horizontally furrowed. Leaves are 11-18 cm long, bipinnate, tomentose: petiole 4.5 cm, gland just below the middle. Flowers are pinkish-white, light yellow, or reddish. *Albizia stipulata* occurs naturally in India, Myanmar (Burma), Thailand, Indochina, China, Java, and the Lesser Sunda Island (Bali and Nusa Tenggara). Commonly seen in Anantagiri, Sunkarimetta, Borra caves, and Molachintapally. An extract of the wood has a repellent property to subterranean termites [27]. This plant was selected from the books "Flora of the presidency of Madras" Vol.1 Adlard & Sons Ltd., London. Rep. Ed.1997, Dehradun [28]. Biological and pharmacological actions of *Albizia stipulata* plant are anti-inflammatory, anti-ulcer activities from chloroform extract of bark [29] and antioxidant, antimicrobial activities from methanol extract of stem bark have been reported [30], which exposed that the bark has contained terpenoids as triterpenes, steroids, and flavonoids.

The objective of the present research is to study the antioxidative effects of aqueous extract of the bark of *Albizia stipulata* Boiv concerning free radical scavenging activity against DPPH, ABTS, and superoxide ion on comparing with standards, this study might help in reducing the oxidative stress-mediated chronic metabolic ailments, as well as bridging the traditional uses of this plant with the modern medicinal practices in the treatment of a vast array of chronic metabolic disorders.

MATERIALS AND METHODS

MATERIALS

CHEMICALS AND REAGENTS

Analytical grade chemicals and standards were used for the study. Gallic acid, ascorbic acid, 1,1-diphenyl-2-picrylhydrazyl (DPPH), 2,2'-azino-bis (3-ethyl benzothiazoline-6-sulfonic acid) (ABTS), 2-deoxy-D-ribose, potassium persulfate (K₂S₂O₈), ethanol, phosphate buffer, riboflavin, EDTA, and nitro blue tetrazolium (NBT) were procured from standard companies.

COLLECTION OF PLANT MATERIAL

The fresh bark of *Albizia stipulata* was collected in March 2011 from Papikondalu, East Godavari district, Andhra Pradesh. The plant sample was identified and authenticated by Dr. K.N. Reddy, Dept. of taxonomy, Laila Impex R&D Centre, Vijayawada. The voucher specimen No. of bark material was 3318 and was deposited in the raw drug museum. The plant material was immediately cleaned with distilled water, chopped into small pieces, and air-dried completely under shade until a constant weight was attained. The dried-up materials were grounded to a fine powder utilizing a mixer and collected in air-tight bags.

METHODS

PREPARATION OF EXTRACT

The powdered bark of *Albizia stipulata* was extracted with water, concentrated to dryness in vacuum at 40°C for 25 min using Rotary Evaporator (Buchi evaporator, India), and the weight of extract was found to be 10.32g.

PRELIMINARY PHYTOCHEMICAL ANALYSIS

Phytochemical screening was performed from the resultant aqueous extract of bark of *A. stipulata* boiv according to standard procedures [31,32] to identify the presence of various phytochemical constituents.

ANTIOXIDANT ACTIVITY

Diphenyl picrylhydrazyl radical scavenging method (DPPH)

The free radical scavenging activity of the aqueous extract was determined and compared to that of ascorbic by using a reported method [33]; To perform this assay, reaction mixtures were prepared comprising 1mL of DPPH solution (0.1 mmol/L, in 95% ethanol v/v) with various concentration of the extract. These solutions were shaken and incubated in the dark for 20 min at room temperature, and the absorbance was assessed at 517 nm against a blank, lacking the scavenger. The radical scavenging action of extract in the DPPH assay was measured as a decrease in the absorbance of DPPH and measured by applying the formula:

$$\% \text{ Scavenging activity} = (\text{Abs}_{\text{cont}} - \text{Abs}_{\text{sample}}) / \text{Abs}_{\text{cont}} \times 100$$

Where Abs_{cont} is absorbance of the control, and $\text{Abs}_{\text{sample}}$ is absorbance of the sample solution

2,2'-azino-bis (3-ethyl benzothiazoline-6-sulfonic acid) radical scavenging method (ABTS).

An ABTS radical-scavenging property of the extract was evaluated by the following reference method [34]. The ABTS + cation radical was formed by the response among 5 ml of 14 mM ABTS solution and 5 ml of 4.9 mM potassium persulfate ($\text{K}_2\text{S}_2\text{O}_8$) solution, keep aside at room temperature for 16 h. before use, this solution was diluted with ethanol to find an absorbance of 0.700 ± 0.020 at 734 nm. The plant extract at different concentrations with 1ml of ABTS solution were homogenized, and its absorbance was read at 734nm. Ethanol was taken as blank in each test, and all estimates were done after at least 6 min. in a parallel way, the reaction mixture of the standard was recorded by combining 950 μL of ABTS+ solution and 50 μL of BHT. Concerning the antiradical activity, ABTS scavenging capacity was expressed as IC_{50} ($\mu\text{g}/\text{ml}$). The inhibition level of ABTS radical was determined using the equation:

$$\% \text{ Scavenging activity} = (\text{Abs}_{\text{cont}} - \text{Abs}_{\text{sample}}) / \text{Abs}_{\text{cont}} \times 100$$

Superoxide ion Scavenging assay

Superoxide ion scavenging activity assay was completed as per the standard procedure [35]. The activity was compared with Gallic acid, taken as a positive standard. The reaction mixture contained 50mM phosphate buffer (pH 7.6), 20 μg riboflavin, 12mM EDTA and 0.1 mg/ml of NBT (nitro blue tetrazolium), all added in sequential order. The reaction was begun by illustrating the reaction mixture comprising a various concentration of sample extract for 90 sec and then measured the absorbance at 590nm.

$$\% \text{ Scavenging activity} = \text{Abs}_{\text{cont}} - \text{Abs}_{\text{sample}} / \text{Abs}_{\text{cont}} \times 100$$

RESULTS AND DISCUSSION

PHYTOCHEMICAL ANALYSIS

The phytochemical analysis of an aqueous extract from bark confirmed the existence of several secondary metabolites of biological and pharmacological importance such as alkaloids, flavonoids, quinones, coumarins, resins, saponin, carbohydrates, phenols, and tannins.

ANTIOXIDANT ACTIVITY

Plant phenols preferentially Polyphenols are one of the largest and varied classes of compounds, a considerable number of which arises naturally in a wide range of nourishment and plants. The flavonoids are the major and finest examined compounds amongst polyphenols. Several polyphenols are either being effectively developed or at present marketed as dietary supplements or potential herbal derived medicine. Even though these compounds play an indistinct role in nourishment, many of them have properties including antioxidant, anti-mutagenic, anti-cancer-causing, and anti-inflammatory impacts that may be useful in preventing disease and protecting the stability of the genome. Free radical scavenging property is a measure of the effectiveness of the antioxidant(s) present in a pure compound or a mixture. The rate of scavenging and IC_{50} values were computed for all models.

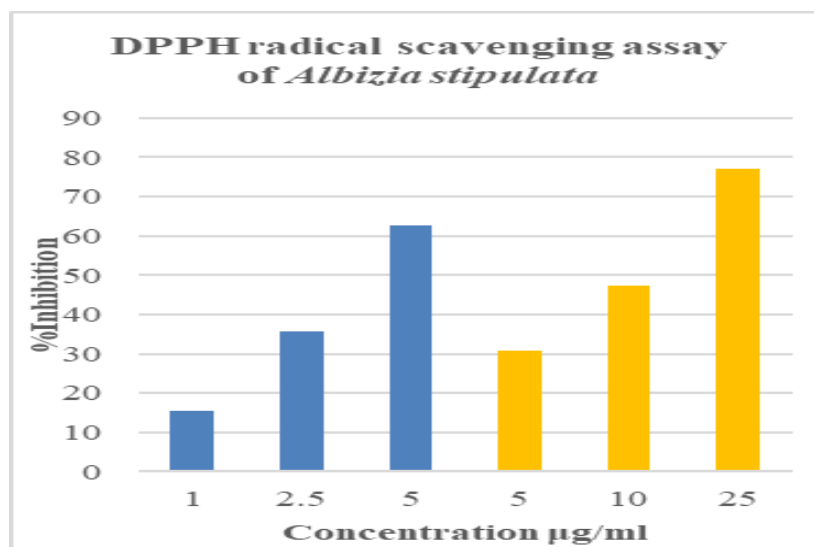
DPPH radical scavenging assay

The reactivity of aqueous extract of *Albizia stipulate* bark was studied with DPPH, a stable free radical. As DPPH gains one electron in the presence of a free radical scrounger, the absorption diminishes, and the subsequent discoloration is stoichiometrically related to the number of electrons picked up. *Albizia stipulate* bark aqueous extract possessed an IC_{50} value 12.52 $\mu\text{g}/\text{ml}$ and standard vitamin C is 3.59 $\mu\text{g}/\text{ml}$. The results are given in Table1, and radical scavenging activity is shown in Fig. 1.

Table No:1- DPPH radical scavenging assay of *Albizia stipulate*.

Test compound	Concentration (µg/ml)	% Inhibition of oxidation	IC ₅₀ (µg/ml)
ASBA	5	30.953±0.027	12.52
	10	77.136±0.027	
	25	47.346±0.029	
Vitamin-C	1	15.546±0.033	3.59
	2.5	362.64±0.029	
	5	5.63±0.030	

*% Inhibition is expressed as mean ± SEM (n=3).

Figure No:1- DPPH radical scavenging assay of extract of *Albizia stipulate*.

ABTS radical scavenging assay

The ABTS+ radical scavenging method, which utilizes a specific absorbance (734 nm) at a wavelength far-off from the visible region and involves a short reaction time, can be utilized as an index that mimics the antioxidant action of the test samples.

The aqueous bark extract of *Albizia stipulate* was observed to be successful in scavenging radicals and the rise was concentration subordinate. The inhibition of the concentrate is 3.39 µg/ml and standard vitamin C is observed to be 2.37 µg/ml. This demonstrates *A. stipulate* bark extract introduces a good capacity to scavenging the ABTS radical. The results are displayed in Table 2 and the scavenging activity of the extract is shown in Fig. 2.

Table No:2- ABTS radical scavenging assay of *Albizia stipulate*.

Test compound	Concentration(µg/ml)	% Inhibition of oxidation	IC ₅₀ (µg/ml)
ASBA	5	34.453±0.037	13.60
	10	41.24±0.029	
	25	72.646±0.029	
Vitamin-C	0.25	20.543±0.049	2.37
	0.5	38.93±0.030	
	0.75	38.93±0.030	

* Inhibition is expressed as mean ± SEM (n=3).

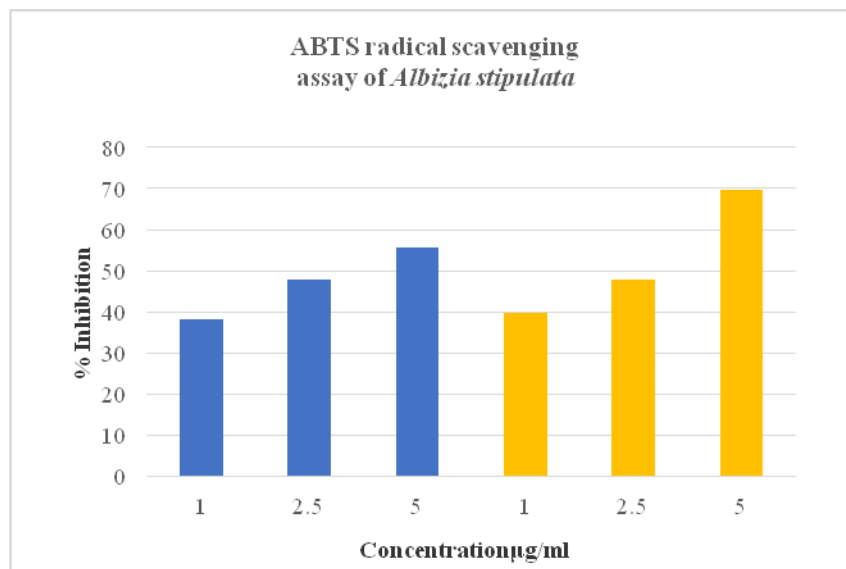


Figure No:2- ABTS radical scavenging assay of extract of *Albizia stipulate*.

Superoxide radical Scavenging Assay

In the phenazine methosulphate/Nicotinamide adenine dinucleotide-nitro blue tetrazolium (PMS/NADH-NBT) system, superoxide anion was produced by a nonenzymatic reaction of phenazine methosulphate in the presence of NADH and molecular oxygen.

NBT reduces into formazan by Superoxide anion at pH 7.8 at ambient temperature and formazan formation is monitored by spectrophotometry at 560 nm. The diminishing of absorbance at 560 nm with an antioxidant in this way demonstrates the utilization of superoxide anion in the reaction mixture.

The superoxide anion radical-scavenging action of the extract might be because of the presence of phenolic phytochemicals. The recorded IC₅₀ value for aqueous extract of *Albizia stipulata* bark is 13.60 µg/ml and for standard gallic acid it is found to 0.61 µg/ml. The increase in activity is because of an increase in the number of a phenolic hydroxyl group in the molecule. The results are depicted in Table 3 and superoxide ion scavenging activity of the extract is shown in Fig. 3.

Table No: 3- Superoxide radical scavenging assay of *Albizia stipulate*.

Test compound	Concentration (µg/ml)	% Inhibition of oxidation	IC ₅₀ (µg/ml)
ASBA	5	34.453±0.037	13.60
	10	41.24±0.029	
	25	72.646±0.029	
	0.25	20.543±0.049	0.61
Gallic acid	0.5	38.93±0.030	
	0.75	38.93±0.030	

* Inhibition is expressed as mean ± SEM (n=3).

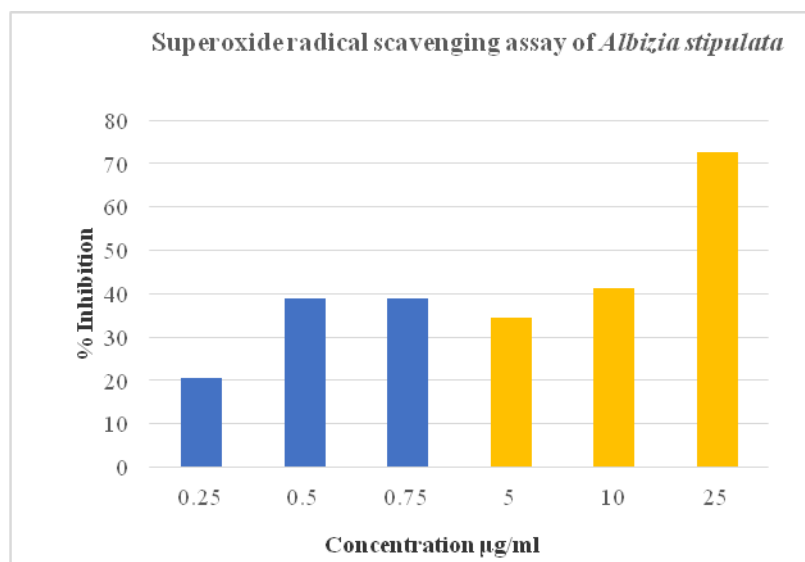


Figure No. : 3- Superoxide radical scavenging assay of extract of *Albizia stipulate*.

CONCLUSION

In the earlier couple of years, excitement for the discovery of new natural antioxidants has been intensified because oxidative stress has related to various autoimmune diseases. The use of synthetic antioxidants triggers issues of toxicity. Hence, Investigation for the source of natural antioxidants is gaining much importance. In this research, antioxidant activity of aqueous bark extract of *Albizia stipulata* Boiv. was screened and reported. Antioxidant property of extract was determined in the form of DPPH, superoxide, and ABTS radical scavenging activity by comparing with standard antioxidants. Aqueous bark extract possesses greater antioxidant activity compared to the standards and is due to the presence of flavonoids, glycosides, and poly hydroxy phenolic phytoconstituents. This study proves the rational origin for its use in traditional medicine for the treatment of stress-related chronic metabolic disorders such as cardiovascular diseases, atherosclerosis, aging, immune system disorders like rheumatoid joint inflammation, etc., in patients. Further phytochemical and pharmacological investigations are underway to characterize active constituents. This work, we believe, will recommend for future research.

ACKNOWLEDGEMENTS

The authors are grateful to the Scientists Dr. C. Venkateshwara Rao, who designed the research work, and Dr. K. N. Reddy, Dept. of taxonomy, Laila Impex R&D Centre, who assisted in the plant selection, Identification, and authentication. We are thankful to every individual who helped in the research work.

CONFLICTS OF INTEREST

The Laila Impex, Research and Development Centre had no association in the writing of the manuscript and the decision to submit the article for publication. The authors have indicated that they have no competing interests regarding the content of this article.

LIST OF ABBREVIATIONS

ASBA : *Albizia stipulata* Bark Aqueous Extract

SEM : Standard Error Mean

DPPH : 1,1-diphenyl-2-picrylhydrazyl ABTS: 2,2'-azino-bis (3-ethyl benzothiazoline-6-sulfonic acid)

REFERENCES

- Calabrese V, Cornelius C, Leso V, Trovato Salinaro A, Ventimiglia B, et al. Oxidative stress, glutathione status, sirtuin and cellular stress response in type 2 diabetes. *Biochim. Biophys. Acta.* 2012; 1822 (5): 729-736.
- Wright EJ, Scism-Bacon JL, Glass LC. Oxidative Stress in Type 2 Diabetes: The Role of Fasting and Post Prandial glycaemia. *Int J Clin. Pract.* 2006; 60 (3): 308-314.
- Larson RA. The antioxidants of higher plants. *Phytochemistry.* 1988; 27 (4): 969-978.
- Hudson BJ F. Ed. Food Antioxidants. Elsevier Applied Science, London, 1990.
- Saito M, Sakagami H, Fujisawa S. Cytotoxicity, and apoptosis induction by butylated hydroxy anisole (BHA) and butylated hydroxy toluene (BHT). *Anti-Cancer Res.* 2003; 23 (6C): 4693-4701.
- Subhasree B, Baskar R, Laxmi Keerthana R, Lijina Susan R, Rajasekaran P. Evaluation of antioxidant potential in selected green leafy vegetables. *Food Chem.* 2009; 115: 1213-1220.
- Djeridane A, Yousfi M, Brunel J M, Stocker P. Isolation, and Characterization of new steroid derivative as a powerful antioxidant from cleome arabica in screening in vitro antioxidant capacity of 18 Algerian medicinal plants. *Food Chem Toxicol.* 2010; 48(10): 2599-2606.
- Van Wyk BE. A broad review of commercially important southern African medicinal plants. *J Ethnopharmacol.* 2008;119: 342-355.
- Koehn FE, Carter GT. The evolving role of natural products in drug discovery. *Nat Rev Drug Disc.* 2005; 4(3): 206-220.
- Aliyu AB, Ibrahim MA, Musa AM, Bulus T, Oyewale AO. Phenolics content and antioxidant capacity of extracts and fractions of *Vernonia blumeoides* (Asteraceae). *Int J Biol Chem.* 2011; 5 (6): 352-359.
- Chulet rahul, Pradhan pankaj, Sharma K sarvan, Jhaharia K Mahesh. Phytochemical screening and antimicrobial activity of *Albizia lebbeck*. *J chem pharm res.* 2010; 2 (5): 476-484.
- Irwin HS, Barneby RC. The American Cassiinae: A Synoptical Revision of Leguminosae, tribe Cassieae, subtribe Cassiinae in the New Delhi World. *Memories of the New York Botanical Garden*, vol.1, Bronx, New York: New York Botanical Garden, 1982, pp. 258-260.
- Talent Chipiti, Mohammed Auwal Ibrahim, Neil Anthony Koobanally, Shahidul Islam MD. In vitro Antioxidant Activities of Leaf and Root Extracts of *Albizia Antunesiana* Harms. *Acta Pol. Pharm. Drug Research.* 2013; 70 (6): 1035-1043.
- Tahia K. Mohamed, Mahmoud I. Nassar, Ahmed H. Gaara, Walaa A. El-Kashak, Iñaki Brouard, Sayed A. El-Toumy. Secondary metabolites and bioactivities of *Albizia anthelmintica*. *Pharmacogn Res.* 2013; 5(2): 80-85.
- Jerin Tasnim, Anamika Saha, Shamim Ahmed, Nasim Sultana, Tanvir Muslim, Md. Azizur Rahman. Biological Studies of the Bark of *Albizia lebbeck* (L) benth. *Int J Pharm Sci Res.* 2014; 5 (11): 4969-4974.
- Nantiya Joycharat, Chancheera Boonma, Sonesay Thammavong, Boon-ek Yingyongnarongkul, Surasak Limsuwan, Supayang Piyawan Voravuthikunchai. Chemical constituents and biological activities of *Albizia myriophylla* wood. *Pharm Biol.* 2016; 54 (1): 62-73.
- Sunil Kumar Sirohi Navneet Goel, Nasib Singh. Influence of *Albizia lebbeck* Saponin and Its Fractions on In Vitro Gas Production Kinetics, Rumen Methanogenesis, and Rumen Fermentation Characteristics. *ISRN Vet. Sci.* Volume 2014; Article ID 498218: 10 pages.
- Nurul IS, Hiroyuki M, Shahriar M, Venkatesh P, Maeyama K, et al. *Albizia lebbeck* suppresses histamine signaling by the inhibition of histamine H1 receptor and histidine decarboxylase gene transcriptions. *Int Immuno pharmacol.* 2011; 11(11): 1766-1772.
- Gupta RS, Chaudhary R, Yadav RK, Verma SK, Dobhal MP. Effect of Saponins of *Albizia lebbeck* (L.) Benth bark on the reproductive system of male albino rats. *J Ethnopharmacol.* 2005; 96 (1-2): 31-36.
- Danish Ahmed, Vikas Kumar, Manju Sharma, Amita Verma. Target guided isolation, *in-vitro* antidiabetic, antioxidant activity and molecular docking studies of some flavonoids from *Albizia Lebbeck Benth.* Bark. *BMC Complement Altern Med.* 2014; 14 (1): 155-166.
- Danish Ahmed, Vikas Kumar, Amita Verma, Pushpraj S Gupta, Hemant Kumar, et al. Antidiabetic, renal/hepatic/pancreas/cardiac protective and antioxidant potential of methanol/dichloromethane extract of *Albizia Lebbeck Benth.* stem bark (ALEX) on streptozotocin induced diabetic rat: *BMC Complement Altern Med.* 2014;14(1): 243-259.
- Girish G. Meshram, Anil Kumar, Waseem Rizvi, Tripathi CD, Khan RA. Central analgesic activity of the aqueous and ethanolic extracts of the leaves of *Albizia lebbeck*. role of the GABAergic and serotonergic pathways. *Z. Naturforsch.* 2015; 70(1-2) c: 25-30.
- Pattarapan Panthong, Kingkan Bunluepuech, Nawong Boonnak, Prapaporn Chaniad, Somsak Pianwanit, et al. Anti-HIV-1 integrase activity and molecular docking of compounds from *Albizia procera* bark: *Pharm Biol.* 2015; 53(12):1861-1866.
- Aslam Khan, Najeer-ur-Rehman, Anwarul Hasaan Gulani, Zunirah Ahemd, Shaza-Al Massarani, et al. Possible Mechanism(s) Underlying the Anti diarrheal, Antispasmodic and Broncho dilatory Activities of the Pericarp of *Albizia lebbeck*: *Int J Pharmacol.* 2019;15(1): 56-65.
- Weiwei Cai, Yue Li, Qingqing Yi, Fengshan Xie, Bin Du, Lei Feng, Liying Qiu. Total saponins from *Albizia julibrissin* inhibit vascular endothelial growth factor-mediated angiogenesis in vitro and in vivo. *Mol Med Rep.* 2015; 11 (5): 3405-3413.
- Kokila Karupannan, Deepika Priyadarshini S, Sujatha Venugopal. Phytopharmacological properties of *Albizia* species. A review. *Int J Pharm Pharm Sci.* 2013; 5 (3): 70-73.
- Fabaceae/*Albizia chinensis*. htm ://www.asianplant.net.
- Pullaiah T, Sandhya Rani S. *Trees of Andhra Pradesh, India.* Published by, Regency publishers, New Delhi 1999; 235.

29. Arya Vikrant, Arya ML. A review on Anti-inflammatory plant barks. Int J Pharm Tech Res. 2011; 3(2): 899-108.
30. Tasnuva Sharmin, Farhana Islam, Mohammad A. Kaisar, Md. Abdullah Al-Mansur, Md. Al Amin Sikder, Mohammad A. Rashid. Chemical and Biological Investigations of *Albizia chinensis* (Osbeck.) Merr. J Phys Sci. 2014; 25 (2): 29-38.
31. Trease GE, Evans WC. A textbook of Pharmacognosy. 12th edition, Published by, Philadelphia: Bailliere Tindall publishers, London, 1989, 344, 539- 540.
32. Kokate CK, Purohit AP, Gokhale SB. Practical Pharmacognosy. Edn 6, Pune: Nirali Prakashan, Mumbai, 1997; pp.123-124.
33. Yamaguchi T, Takamura H, Matoba T, Terao J. HPLC Method for Evaluation of the Free Radical-scavenging Activity of Foods by Using 1,1-Diphenyl-2-picrylhydrazyl. Biosci Bio technol Biochem. 1998; 62 (6): 1201-1204
34. Re R, Pellegrini N, Proteggente A, Pannala A, Yang M, Rice-Evans C. Antioxidant activity applying an improved ABTS radical decolorization assay. Free Radic Biol Med. 1999; 26 (9-10): 1231-1237.
35. Beuchamp C, Fridovich I. Superoxide dismutase: Improved assays and assays applicable to acrylamide gel. Anal Bio chem. 1971; 44 (1): 276-287.



54878478451210801



Submit your next manuscript to **IAJPR** and take advantage of:

Convenient online manuscript submission

Access Online first

Double blind peer review policy

International recognition

No space constraints or color figure charges

Immediate publication on acceptance

Inclusion in **Scopus** and other full-text repositories

Redistributing your research freely

Submit your manuscript at: editorinchief@iajpr.com

