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Phytochemical analysis and antioxidant potential of *Albizia lebbek* (L.) seedsDivya Devi, Sushila Singh[♦], Monika Moond, Pinki Matoria, Sachin Kumari, Kamaljeet Saini and Rajni Kant Sharma

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Abstract

The plant *Albizia lebbek* (L.) belongs to family Fabaceae, subfamily-Mimosaceae. They have historically been used to treat a variety of ailments, including asthma, arthritis, inflammatory conditions, infertility, diarrhea, dysentery, tuberculosis, leprosy, paralysis, and helminth infections. The purpose of study was to investigate the phytochemicals and antioxidant potential of *A. lebbek* seeds. The proximate composition of seeds, i.e., moisture, ash, crude fat, crude fiber, crude protein and total carbohydrates were estimated as per cent w/w. The quantitative mineral analysis revealed that the seeds had iron, zinc, manganese and copper content. The phytochemical analysis of seeds was carried out using methanol, aqueous and ethyl acetate extracts. The antioxidant activity was determined by DPPH free radical scavenging method and phosphomolybdenum assay. The antioxidant potential of seed extract was compared with standard ascorbic acid. Therefore, these findings indicated that *A. lebbek* seeds are rich source of phytochemicals and minerals which could be exploited for both pharmacological and health benefits.

1. Introduction

People have always looked for ways to treat various ailments and relieve inflammation with drugs. In every period and century since the rise of humankind and advanced civilizations, the therapeutic benefits of several medicinal plants were discovered, recognized and passed down to succeeding generations (Petrovska, 2012; Sachin *et al.*, 2022; Goel *et al.*, 2022). Plants are still utilized as a traditional method of treatment against several ailments in the current era of medicine. By producing specific compounds or secondary metabolites that are non-nutritive but effective in defense mechanisms, plants can protect themselves from pathogenic bacteria, dangerous insects and unfavourable environmental changes. These compounds are referred to as phytochemicals (Bansal and Priyadarsini, 2021; Suman *et al.*, 2022). Due to the presence of phytochemical components, medicinal plants are helpful for both treating and curing human ailments. Medicinal plants, vegetables, leaves and roots contain naturally occurring phytochemicals that contain defense mechanisms and protect against a variety of diseases (Goel *et al.*, 2022). Based on their roles in plant metabolism, phytochemicals are divided into two categories: primary metabolites and secondary metabolites. Proteins, chlorophyll, and simple sugars are examples of primary metabolites, whereas alkaloids, terpenoids, and phenolic compounds are examples of secondary metabolites (Devi *et al.*, 2020; Wadood *et al.*, 2013; Aggarwal *et al.*, 2022). The biological effects of medicinal plants, such as their antimicrobial, antimalarial, hypoglycemic, antioxidant, antidiabetic, anticarcinogenic, anti-inflammatory, antileprosy and anticholinergic properties, were greatly influenced by these secondary metabolites (Yadav *et al.*, 2014; Nehra *et al.*, 2022; Devi *et al.*, 2022).

Among medicinal plants, *A. lebbek*, belongs to family Fabaceae, subfamily-Mimosaceae and the genus *Albizia* which comprises approximately 150 species. It is an unarmed deciduous woody tree that typically grows to a height of 12 to 21 meters. It has pale bark and young shoots that are glabrous (Zia-Ul-Haq *et al.*, 2013). It is a native of the deciduous and sub-deciduous forests of India, Burma, Bangladesh and Sri Lanka. It is a tropical and subtropical tree (Hassan *et al.*, 2007). It is commonly known as Siris, East Indian walnut or Indian Siris; Shiris in Hindi; Lebbek tree in English; Sitapushpa, Sukapriya, Bhandi, Mrdupushpa in Sanskrit (Pathak *et al.*, 2009; Pandey and Chaudhary, 2018). Brown, flat, orbicular or elliptic, $8^{-10} \times 6^{-7}$ mm, and transversely arranged with 6-12 in each pod are the characteristics of the seeds. Pods are narrow-oblong, $15^{-26} \times 3^{-5}$ cm, papery, leathery, flat, and neither inflated or constricted between seeds (Orwa *et al.*, 2009). Seeds are used for the treatment of piles, diarrhea and swelling (Zia-Ul-Haq *et al.*, 2013). Extracts from the plant *A. lebbek* are used to treat leprosy, wounds, asthma, urticaria, migraines, and worm infections (Pandey and Chaudhary, 2018). Elshiekh *et al.* (2020) evaluated antimicrobial and antioxidant activity of *A. lebbek* seed extract and reported petroleum ether seed extract had high activity against *Escherichia coli*. The seed extract had lower antioxidant activity as compared with standard (Propyl gallate). This study's primary goal is to assess the phytochemical content and antioxidant potential of methanol, aqueous and ethyl acetate extract of *A. lebbek* seeds.

2. Materials and Methods

2.1 Collection of plant material

Seeds of *Albizia lebbek* (L.) were collected from Research farm, Department of Forestry, Chaudhary Charan Singh Haryana Agricultural University Hisar, Haryana. The plant was identified and authenticated by botanist, Dr. N.J. Sarana, Associate Professor, Department of Botany, University of Rajasthan, India by voucher

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specimen number - RUBL 19894. Before processing, the plant materials were kept under the shade at room temperature. The proposed studies were conducted in the Department of Chemistry, Chaudhary Charan Singh Haryana Agricultural University Hisar, Haryana.



Figure 1: Seeds of *Albizia lebeck* (L.).

2.2 Chemicals

Various experimental procedures used chemicals of the highest purity that were conveniently available. All chemicals and standards were purchased from Himedia Laboratories Private Limited Mumbai, Sigma Aldrich and SISCO Research Laboratories.

2.3 Proximate composition

The proximate composition (Moisture, Ash, Crude Fat, Crude Fiber, Crude Protein and Total Carbohydrates) of *A. lebeck* seeds were determined in triplicates as per standard techniques of Association of Official Analytical Chemists (AOAC).

Method of AOAC, (1995) was used to estimate moisture and ash content. Maynard method (1970) was used to estimate crude fiber. The nitrogen content was determined using the Micro-Kjeldahl method AOAC, (1990). By multiplying % of N with 6.25 factor, crude protein was determined.

2.4 Mineral content

Method of Jackson (1973) and Ruig (1986) was used for the determination of mineral content. Fe, Zn, Mn, and Cu minerals in acid digested plant samples were quantified using an atomic absorption spectrometer. Based on the AAS principle, when atoms of metallic elements (Fe, Zn, Mn, and Cu) are exposed to certain wavelength radiations, they become excited and absorb energy while typically existing in the ground state under normal circumstances. A particular metallic element lamp is used for each element. Radiation absorption is directly proportional to the concentration of atoms of that element. The radiation absorbed by atoms is independent of temperature and wavelength of radiation.

2.5 Phytochemical analysis

2.5.1 Preparation of methanol, aqueous and ethyl acetate extracts of *A. lebeck* seeds

A. lebeck seeds (10 g) were ground up and placed in a thimble before being placed in a standard Soxhlet apparatus with a 500 ml round bottom flask. Each solvent (methanol, aqueous, and ethyl acetate) was added in amounts of about 300 ml up to 1.5 syphons. At boiling temperature, the corresponding solvent was used for extraction. After the solvent has completely filled the chamber and has some phytochemicals that have been dissolved in it, the syphon

mechanism starts to work. In the round bottom flask, this extract was emptied. After completing seven to eight cycles with methanol, aqueous and ethyl acetate as solvents, the process was maintained for 5-6 h using a siphon mechanism. Each filtered solvent's volume was measured after extraction. These extracts' total sugar, total reducing sugar, total phenolics, total flavonoids, DPPH free radical scavenging activity, and total antioxidant capacity were all measured using the phosphomolybdenum assay (Prieto *et al.*, 1999).

2.5.2 Total sugars

Total sugars were determined by modified method of Dubois *et al.* (1956). 2.0 ml of phenol solution was added to 1 ml of seed extract. Then 5.0 ml of concentrated H_2SO_4 was added to the reaction mixture, and the solution was allowed to cool for 30 min. The reaction mixture's absorbance at 490 nm was measured using a UV-Vis double beam spectrophotometer in comparison to a blank that was made using the same method but with the appropriate solvent in place of the extract.

2.5.3 Reducing sugars

Nelson (1944) method further modified by Somogyi (1952) was used for determination of reducing sugars. Alkaline copper reagent was added to 1 ml of seed extract. The solution was thoroughly mixed, covered with aluminum foil and heated for 20-25 min in a hot water bath. After then, let it cool at room temperature. Add 1 ml of the arsenomolybdate reagent, the solution was diluted with distilled water to a final volume of 10 ml. The reaction mixture's absorption at 520 nm was measured using a UV-Vis double beam spectrophotometer in comparison to a blank prepared using the same method but using a respective solvent in place of the extract.

2.5.4 Non-reducing sugars

The difference between total sugars and reducing sugars was used to calculate non-reducing sugars (Basra *et al.*, 2005).

2.5.5 Total phenolics

Using the Folin Ciocalteu method (Singleton and Rossi, 1965), the total phenolics were calculated and expressed as milligrams of gallic acid equivalent per gram (mg GAE/g). Each extract was diluted to a volume of 1 ml with 1 ml of 1 mol/l Folin-Ciocalteu reagent, 2 ml of Na_2CO_3 (20%, w/v), and 10 ml of distilled water. After standing for 8 min, this mixture underwent a 10 min centrifugation at 6000 rpm. The absorbance of the supernatant solution was measured at 730 nm using a UV-VIS double beam spectrophotometer (Model UV 1900 Shimadzu). Similar to extracts, blank was made, but it contained the appropriate solvent instead of extracts.

2.5.6 Total flavonoids

According to Ribarova and Atanassova (2005), total flavonoids were quantified using an aluminium chloride colorimetric assay and expressed as milligrams (mg CE/g) of catechin equivalents per gram. 1 ml of each extract was mixed thoroughly with 4 ml of distilled water, 0.3 ml of 5% $NaNO_2$, and 0.3 ml of 10% $AlCl_3$ solution after 5 min. Immediately, 2 ml of 1 M NaOH was added, and the volume was then increased to 10 ml using distilled water. Utilizing a UV-VIS double beam spectrophotometer, the solution's absorbance at 510 nm was measured in comparison to a blank after being thoroughly mixed (Model UV 1900 Shimadzu). Similar to how the standard solution of catechin was prepared, the blank version contained the appropriate solvent.

2.5.7 Tannins

The tannin content was estimated using the Vanillin-HCl method of Burns (1971) as the catechin equivalent. 200 mg of powdered *A. lebeck* stem bark, leaves, and seeds were placed in a 25 ml test tube along with 10 ml of methanol. The tubes were sealed with pith corks. It was left to stand at 25°C to 32°C overnight after sometimes stirring the contents of the tubes. It was then centrifuged for about 10 min at 3000 rpm. Five millilitres of the vanillin-HCl reagent were then poured into one millilitre of clear supernatant solution in a test tube. The test tube solution should next be incubated for 25 min at 27°C to 30°C. Using a UV-VIS double beam spectrophotometer Model UV 1900 (Shimadzu), the absorbance of the brownish red colour generated after some time was measured at 525 nm in comparison to a blank containing methanol. A standard curve of catechin was developed from 10-100 g/ml concentration in methanol against the absorbance at 525 nm in order to quantify the quantity of tannin represented as mg CE/g.

2.5.8 Alkaloids

Method of Harborne (1973) was used for estimation of alkaloid content. About 2.5 g of the powdered samples of *A. lebeck*'s stem bark, leaves, and seeds were placed in a 250 ml beaker, to which 100 ml of 10% acetic acid in ethanol was added. The mixture was then covered and let to stand for 4 h. After filtering the mixture, the extract was concentrated using a water bath to reach one fourth of its initial volume. Concentrated ammonium hydroxide was added to the extract dropwise until the precipitation was completed. The precipitate was obtained by settling down the whole solution, and it was subsequently cleaned with diluted ammonium hydroxide before being filtered. Later, the alkaloid from the residue was dried and weighed. The percentage of alkaloids were calculated as follows:

$$\text{Alkaloid (\%)} = \frac{\text{Weight of alkaloid}}{\text{Weight of sample}} \times 100$$

2.6 Antioxidant potential

2.6.1 Evaluation of DPPH free radical scavenging activity

DPPH free radical scavenging activity was evaluated using Hatano *et al.* (1988) method with suitable modifications. Each extract was lyophilized to obtain the dry mass and then, solutions of different concentrations were prepared by dissolving the dry mass in respective solvent. A test tube containing 1 ml of each extract at the specified

concentration was then filled with 2.0 ml of DPPH (0.1 mM in methanol), which was thoroughly mixed for 5 min. The absorbance of the extract and control was measured at 517 nm using a UV-VIS double beam spectrophotometer (Model UV 1900, Shimadzu) against a blank containing the appropriate solvent following incubation of the reaction mixture in the dark for 30 min at room temperature. The DPPH free radical scavenging activity (%) and extract concentration (g/ml) were plotted on a graph. The IC_{50} was calculated by using the formula from the equation $ax^2 + bx + c = 0$, IC_{50} was calculated by:

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

where,

$$x = IC_{50} (\mu\text{g/ml})$$

2.6.2 Total antioxidant capacity

Using the phosphomolybdenum assay (Prieto *et al.*, 1999) with the necessary modifications, the total antioxidant capacity was measured and expressed in milligrams (mg AAE/g) of ascorbic acid equivalents per gram. 3 ml of phosphomolybdenum reagent were added to 0.3 ml of each extract solution in glass vials before the solution was thoroughly mixed and the lids were placed on top. For 90 min, these vials were incubated at 95°C. The solution's absorbance was then measured at 695 nm using a UV-VIS double beam spectrophotometer (Model UV 1900, Shimadzu) against a blank after the contents of the vials had time to cool. A blank was created in a similar manner, but it contained the appropriate solvent in place of the standard ascorbic acid solution.

2.7 Statistical analysis

The sample was taken in triplicate for statistical analysis. The data of proximate composition, phytochemicals were expressed as mean standard error (\pm SE) using SPSS (Statistical Package for Social Sciences) version 23. Utilizing Microsoft Excel, the regression analysis of the IC_{50} values for antioxidant activity was assessed.

3. Results

3.1 Proximate composition

The data of proximate composition of *A. lebeck* seeds is presented in Table 1.

Table 1: Proximate composition of *A. lebeck* seeds

Proximate composition (% w/w)					
Moisture	Ash	Crude fat	Crude fiber	Crude protein	Total carbohydrates
3.88 \pm 0.13	4.47 \pm 0.20	8.81 \pm 0.54	6.53 \pm 0.36	29.48 \pm 0.93	46.83 \pm 0.85

3.2 Mineral content

The data of minerals iron (Fe), Zinc (Zn), manganese (Mn) and copper (Cu) is presented in Table 2.

Table 2: Mineral content of *A. lebeck* seeds

Mineral content (ppm)			
Fe	Zn	Mn	Cu
2.68 \pm 0.06	7.53 \pm 0.04	0.40 \pm 0.01	2.81 \pm 0.03

3.3 Phytochemical analysis

The phytochemical analysis of *A. lebbek* seeds showed presence of sugars, phenolics, flavonoids, tannins and alkaloids. The data of

phytochemical constituents in different solvents of *A. lebbek* seeds is presented in Table 3.

Table 3: Phytochemical constituents of *A. lebbek* seeds

S.No.	Extracts	Phytochemicals				
		Total sugars (mg/g)	Reducing sugars (mg/g)	Non-reducing sugar (mg/g)	Total phenolics (mg CE/g)	Total flavonoids (mg GAE/g)
1.	Methanol	12.67 ± 1.46	4.79 ± 0.32	7.88 ± 1.76	3.64 ± 0.03	1.09 ± 0.05
2.	Aqueous	21.60 ± 1.87	9.93 ± 0.80	11.67 ± 1.80	9.09 ± 0.42	4.52 ± 0.06
3.	Ethyl acetate	1.30 ± 0.06	0.70 ± 0.02	0.60 ± 0.04	1.41 ± 0.02	0.40 ± 0.04

Table 4: Tannins and alkaloids of *A. lebbek* seeds

Plant part	Tannins(mg CE/g)	Alkaloids (%)
Seeds	5.99 ± 0.24	0.76 ± 0.06

3.4 Antioxidant potential

Antioxidant potential of *A. lebbek* seeds was evaluated by DPPH free radical scavenging activity and total antioxidant capacity using phosphomolybdenum assay.

3.4.1 Evaluation of DPPH free radical scavenging activity

With an increase in extract concentration, DPPH free radical scavenging activity also rises in percentage. The DPPH free radical scavenging

activity of ascorbic acid was 92.51 % at 200 µg/ml followed, by 88.21, 74.18, 61.42, 48.12 and 28.54 % at 180, 160, 140, 120 and 100 µg/ml concentration, respectively. Ascorbic acid had an IC₅₀ of 144.33 µg/ml. Aqueous extract demonstrated the seeds' highest level of DPPH free radical scavenging activity, followed by methanol and ethyl acetate. The DPPH free radical scavenging activity (%) and IC₅₀ value (µg/ml) of various *A. lebbek* seed extracts are shown in Table 5.

Table 5: DPPH free radical scavenging activity (%) at various concentrations (µg/ml) and IC₅₀ value (µg/ml) of different extracts of *A. lebbek* seeds

S.No.	Conc. (µg/ml)	DPPH free radical scavenging activity (%)						IC ₅₀ (µg/ml)
		2000	1500	800	400	200	100	
1.	Aqueous extract	71.07	69.55	47.41	32.58	13.14	6.89	900.00

S.No.	Conc. (µg/ml)	DPPH free radical scavenging activity (%)						IC ₅₀ (µg/ml)
		5000	2500	1000	500	250	100	
2.	Methanol extract	88.01	66.89	21.51	9.74	3.08	1.34	2411.76
3.	Ethyl acetate extract	78.61	57.23	26.72	11.54	4.28	2.35	1833.3

3.4.2 Total antioxidant capacity

The total antioxidant capacity of seed extract was estimated with the help of a standard curve using ascorbic acid. Table 6 lists the total

antioxidant capacity of seed extracts from *A. lebbek*. Aqueous extract had the highest total antioxidant capacity, followed by methanol extract and ethyl acetate extract.

Table 6: Total antioxidant capacity (mg AAE/g) among different solvent extracts of *A. lebbek* seeds

Total antioxidant capacity (mg AAE/g)		
Methanol	Aqueous	Ethyl acetate
7.75 ± 0.84	19.11 ± 0.82	1.42 ± 0.02

4. Discussion

Seeds from *A. lebbeck* are valuable bioresource for both conventional and cutting-edge therapies. They can be used to create a variety of chemical entities and pharmaceutical intermediates for the discovery and development of novel drugs (Venkatesh and Mohana, 2019). Reported high ash, crude fiber, and carbohydrate contents, seeds should work well as an additive in animal feed. These findings show that all necessary elements are present in adequate amounts. The outcomes of the antioxidant tests demonstrated that the extracts under study had strong antioxidant activity, demonstrating their capacity to function in varied degrees as radical scavengers. This investigation showed that seed extract had higher IC₅₀ value as compared to standard ascorbic acid. Therefore, ascorbic acid had high antioxidant potential when compared to seed extract.

5. Conclusion

The results of the current study are very significant for the pharmaceutical and dietary supplement industries. As compared to methanol and ethyl acetate extract, the research findings showed that *A. lebbeck* seed aqueous extract had highest total phenolics and total flavonoids. Therefore, aqueous seed extract had lower IC₅₀ value and act as good antioxidant. To identify the various compounds that make up the antioxidant system and develop applications for the food and pharmaceutical industries, more research will be required in the future.

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Conflict of interest

The authors declare no conflicts of interest relevant to this article.

References

- Adubiaro, H. O.; Olaofe, O. and Akintayo, E. T. (2011). Chemical composition, calcium, zinc and phytate interrelationships in *Albizia lebbeck* and *Daniellia oliveri* seeds. *Oriental Journal of Chemistry*, **27**(1):33.
- Aggarwal, P.; Singh, S.; Sangwan, S.; Moond, M. and Devi P. (2022). Effect of extraction solvents on antioxidant potential of *Prosopis cineraria* (L.) leaves. *Ann. Phytomed.*, **11**:426-431.
- AOAC (1990). Official methods of analysis. Association of Official Analytical Chemists: Washington, DC. *Chemistry*, **146**:299-307.
- AOAC (1995). Official Methods of Analysis. 16th Ed. A.O.A.C. Virginia, DC, U.S.A.
- Bansal, A. and Priyadarsini, C. (2021). Medicinal properties of pPhytochemicals and their production, *10.5772/intechopen.98888*.
- Basra, S. M. A.; Farooq, M.; Tabassam, R. and Ahmad, N. (2005). Physiological and biochemical aspects of pre-sowing seed treatments in fine rice (*Oryza sativa* L.). *Seed Science and Technology*, **33**(3):623-628.
- Burns, R. E. (1971). Method for estimation of tannin in grain sorghum. *Agronomy Journal*, **63**:511-512.
- Devi, P.; Singh, S.; Sangwan, S.; Dalal, P. and Moond, M. (2020). Effect of pH on antioxidant and phytochemical activities of mulhatti roots (*Glycyrrhiza glabra* L.). *Journal of Agricultural Science and Technology*, **11**:276-282.
- Devi, P.; Singh, S.; Suman, Sharan, P. and Moond, M. (2022). Effect of various solvent fractions on antioxidant activity of satawar (*Asparagus racemosus* Willd.) tubers. *Advances in Health Sciences Education*, **27**:914-923.
- Dubois, M.; Gilles, K.A.; Hamilton, J. K.; Rubers, P.A. and Smith, F. (1956). Colorimetric method for determination of sugar and related substances. *Analytical Chemistry*, **28**(3):350-356.
- Elshiekh, Y. H.; Alagbash, R. E.; Ali, R. A.; Saad, F. O. and Musharaf, M. (2020). Phytochemical constituents, antibacterial screening and antioxidant activity of *Albizia lebbeck* (L.) Benth (Seed). *World Journal of Advanced Research and Reviews*, **7**(1):035-040.
- Harborne, J.B. (1973). *Phytochemical methods*. Chapman and Hall, London.
- Hassan, L. G.; Umar, K. J. and Atiku, I. (2007). Nutritional evaluation of *Albizia lebbeck* (L.) pods. *American Journal of Food Technology*, **2**(5):435-439.
- Hatano, T.; Kagawa, H.; Yasuhara, T. and Okuda, T. (1988). Two new flavonoids and other constituents in licorice root, their relative astringency and radical scavenging effects. *Chemical and Pharmaceutical Bulletin*, **36**:2090-2097.
- Hossain, S.; Islam, J.; Ahmed, F.; Hossain, M.A.; Kaium Siddiki, M.A. and Hossen, S. M. (2015). Free radical scavenging activity of six medicinal plants of Bangladesh: A potential source of natural antioxidant. *Journal of Applied Pharmacy*, **7**:96-104.
- Jackson, M.L.C. (1973). *Soil chemical analysis* orientice-Hall of India, Private Limited, New Delhi.
- Marinova, D.; Ribarova, F. and Atanassova, M. (2005). Total Phenolics and total flavonoids in Bulgarian fruits and vegetables. *Journal of the university of Chemical Technology and Metallurgy*, **40**:255-260.
- Maynard, A.J. (1970). *Methods in Food Analysis*. Academic Press, New York, 176.
- Mishra, S. S.; Gothecha, V. K. and Sharma, A. (2010). *Albizia lebbeck*: A short review. *Journal of Herbal Medicine and Toxicology*, **4**(2):9-15.
- Muhammad, N. O.; Jimoh, F. O.; Nafiu, M. O.; Oloyede, O. B. and Salawu, M. O. (2010). Nutrients and antinutrients analysis of *Albizia lebbeck* seed.
- Goel, N.; Kumari, S.; Singh, S.; Moond, M.; Panghal, M.; Rani, I.; Sangwan, V. and Bhardwaj, K.K. (2022). Mineral content, bioactive ingredient identification and antioxidant activity of *Argemone mexicana* L. flowers extracts. *Ann. Phytomed.*, **11**(2):478-483.
- Goel, N.; Kumari, S.; Singh, S.; Sangwan, V.; Bhardwaj, K.K.; Moond, M.; Panghal, M. and Rani, I. (2022). Evaluation and comparison of the leaves and stem of *Argemone mexicana* L. in various solvents for total phenolics, total flavonoids and antioxidant activity. *Ann. Phytomed.*, **11**(2):494-499.
- Nehra, S.; Singh, S. and Rani, S. (2022). Stabilisation of soybean oil with pod coat extracts of cowpea (*Vigna unguiculata*). *Legume Research*, pp:1-7. [10.18805/ag.D-5551](https://doi.org/10.18805/ag.D-5551)
- Nelson, N. (1944). A photometric adaptation of the Somogyi method for determination of glucose. *Journal of Biological Chemistry*, **153**: 375-380.
- Orwa, C.; Mutua, A.; Kindt, R.; Jamnadass, R. and Simons, A. (2009). *Agroforestedatabase: A tree reference and selection guide*, version 4.0. <http://www.worldagroforestry.org/sites/treedbs/treedatabases.asp>.
- Pandey, A. and Chaudhary, A. K. (2018). Pharmacognostical and phytochemical analysis of stem bark of *Albizia lebbeck* Benth. *Journal of Pharmacognosy and Phytochemistry*, **7**(5):1020-1023.

- Pathak, N.; Gohil, P.; Patel, N. B.; Kasture, S.; Jivani, N. and Bhalodia, Y. (2009).** Curative effect of *Albizia lebbbeck* methanolic extract against adjuvant arthritis-with special reference to bone erosion. *Int. J. Pharm. Sci. Drug Res.*, **1**(3):183-187.
- Petrovska, B. B. (2012).** Historical review of medicinal plants' usage. *Pharmacognosy Reviews*, **6**(11):1.
- Prieto, P.; Pineda, M. and Aguilar, M. (1999).** Spectrophotometric quantitation of antioxidant capacity through the formation of a phosphor molybdenum complex: Specific application to the determination of vitamin E. *Analytical Biochemistry*, **269**:337-341.
- Ruig, W.GD. (1986).** Atomic absorption spectrophotometric determination of calcium, copper, iron, magnesium, manganese, potassium, sodium and zinc in animal feeding stuffs, interlaboratory collaborative studies. *Journal of Association of Official Analytical Chemists*, **69**: 1009.
- Kumari, S.; Sindhu, M.; Singh, S.; Goel, N.; Rani, I. and Panghal, M. (2022).** Determination of total phenolic, free radical scavenging activity and antimicrobial activity of root extracts of *Argemone mexicana L.* in methanol solvent. *Ann. Phytomed.*, **11**(1):450-454.
- Saleem, U.; Raza, Z.; Anwar, F.; Ahmad, B.; Hira, S. and Ali, T. (2019).** Experimental and computational studies to characterize and evaluate the therapeutic effect of *Albizia lebbbeck (L.)* seeds in Alzheimer's disease. *Medicina*, **55**(5):184.
- Singleton, V.L. and Rossi, J.A. (1965).** Colorimetry of total phenolics with phosphomolybdenic phosphotungstic acid reagents. *American Journal of Enology and Viticulture*, **16**:144-158.
- Somogyi, M. (1952).** Notes on sugar determination. *Journal of Biological Chemistry*, **195**:19-23.
- Suman;Devi,P.; Sheetal and Singh, S. (2022).** Phytochemical screening and determination of total phenols, flavonoids and micronutrients of floral and leafy parts of *Prosopis cineraria (L.)* Druce (Angiosperms: Fabaceae). *Ann. Phytomed.*, **11**(1):523-529.
- Venkatesh, H. N. and Mohana D. C. (2019).** Antimicrobial activities of successive solvent extracts of *Albizia lebbbeck* and *Solanum seaforthianum* against some human pathogenic microorganisms. *Asian J. Pharm. Clin Res.*, **12**(6):294-296.
- Wadood, A.; Ghufuran, M.; Jamal, S. B.; Naeem, M.; Khan, A. and Ghaffar, R. (2013).** Phytochemical analysis of medicinal plants occurring in local area of Mardan. *Biochem anal Biochem.*, **2**(4)L1-4.
- Yadav, M.; Chatterji, S.; Gupta, S. K. and Watal, G. (2014).** Preliminary phytochemical screening of six medicinal plants used in traditional medicine. *Int. J. Pharm. Pharm. Sci.*, **6**(5):539-542.
- Yadav, V. K.; Deoli, J.; Rawat, L. and Adhikari, B. S. (2014).** Traditional uses of medicinal tree species in Renuka forest division, Western Himalaya. *Asian Pac J. Health Sci.*, **1**(2):72-77.
- Zia-Ul-Haq, M.; Ahmad, S.; Qayum, M. and Ercisli, S. (2013).** Compositional studies and antioxidant potential of *Albizia lebbbeck (L.)* Benth. pods and seeds. *Turkish Journal of Biology*, **37**(1):25-32.

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