Albizia amara - A Potential Medicinal Plant: A Review

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Abstract: Albizia amara is an important medicinal plant found throughout India. The entire plant possesses pharmaceutical constituents of great significance. The present article gives an update on bioactive compounds and medicinal importance of Albizia amara. This plant has been used as an important folk medicine for the treatment of several diseases like diarrhea, gonorrhea, skin diseases, poisonous bites and leprosy. Further, phytochemical investigation revealed the presence of wide variety of bioactive compounds such as macrocyclic spermine alkaloids, triterpene saponins, phenols, flavonol glycosides, tannins, sterols in the plant extract of A. amara. In addition, the plant extract possess the pharmacological properties like anticancer, antihyperlipidimic, antiinflammatory, antimicrobial, analgesic and antioxidant activities. Because of the presence of several phytoconstituents, pharmacological activities and wide distribution, this will be an ideal plant resource for the treatment of several endemic diseases.

Keywords: Albizia amara, Medicinal Plant, Bioactive compounds, Pharmacological Properties

1. Introduction

The genus Albizia is represented by more than 100 species and are mainly confined to tropical and sub-tropical regions of Asia, Africa and Australia. About 16 species of Albizia are indigenous to the Indian subcontinent and have been cultivated as avenue trees, shade trees in tea and coffee plantation. Albizia species are socially significant as high quality timber yielding and as a valuable resource for gum. Most importantly, Albizia julibrissin, Albizia lebbeck, Albizia procera and Albizia amara are some of the most considered species in Ayurvedic medicine.

Albizia amara (Nallaregoo, Chigaraku in language telugu) belongs to the family leguminaceae, is a valuable medicinal and multipurpose drought tolerant tree commonly found in dry forests of India. The wood of Albizia amara is purplish brown with lighter bands, very hard and strong and used for making cabinets in building and agriculture purpose (Gamble 1935). The plant extracts of A. amara are used extensively in traditional medicine (Reddy et al., 1967).

Geographical Distribution

A. amara is a strong light-demandeer, intolerant of shade, very hardy and shows marked resistance to drought. It is widely distributed in Africa, occurring from Sudan and Ethiopia southwards to Zimbabwe, Botswana and the Transvaal. It mainly grows in sandy woodlands. In India, it is present in the dry regions of Tamil Nadu, Andhra Pradesh and Karnataka (Chakrabarthy T et al., 1996).

Morphology

Albizia amara is a large deciduous tree, up to 10 meters tall, branches are densely yellowish or gray pubescent. Leaves 12cms long, petiole 1.3cm long, gland near middle and above petiole, rachis to 12cm long, pinnas 6 – 10pairs, leaflets 15 – 25 pairs, narrow – elliptic, overlapping, 8 x 2.5 mm, appressend, pubescent or glabrescent, base – sub acute, margin sparsely ciliate, apex obtuse. Flowers are creamy white to pale yellow, solitary or 2 – 3 fascicled in upper axis. Pods flat, compressed, greyish brown, 8 – 20cm faintly veined, straight or wavy along indehiscent contains 6 - 8 seeds (Orwa et al., 2009).

Taxonomic Classification

Kingdom : Plantae
((Unranked) : Angiosperms
((Unranked) : Eudicots
(Unranked) : Rosids
Order : Fabales
Family : Fabaceae
Subfamily : Mimosaceae
Tribe : Ingae
Genus : Albizia
Species : amara
### Table 1: Medicinal Significance of Albizia species

| SNo | Species                  | Phytoconstituents                                                                 | Medicinal Importance                        | References                  |
|-----|--------------------------|----------------------------------------------------------------------------------|---------------------------------------------|----------------------------|
| 1   | *A. adenophora*          | Budmunchiarnes L4 & L5.                                                          | Antimarial                                  | Ovenden SP et al., 2002.   |
| 2   | *A. adianthifolia*       | Aurantiamide acetate                                                            | Antioxidant activity                        | Steinrut L et al., 2011b  |
| 3   | *A. amara*               | Budmunchiarnes A-C                                                               | Hepato protective                           | Umbrae et al., 2009;      |
|     |                          |                                                                                 |                                             | Mar W et al., 1991.       |
| 4   | *A. anethelmintica*      | Ethanolic extract                                                               | Analgesic, antioxidant activity             | Steinrut L et al., 2011b  |
| 5   | *A. chevalieri*          | Leaf extract                                                                     | Antioxidant activity                        | Aliya et al., 2008        |
| 6   | *A. chinensis*           | Albizosides A-C                                                                 | Cytotoxic activity                          | Rui L et al., 2009.       |
|     |                          | Kaempferol-3-O-α-L-rhamnopyranoside, Quercetin-3-O-α-L-rhamnopyranoside,         |                                             |                            |
|     |                          | Luteolin, Kaempferol, Quercetin                                                   |                                             |                            |
| 7   | *A. coriaria*            | Oleane type saponin coriariosides                                                | Anticancer                                  | Not OP et al., 2009.      |
| 8   | *A. grandibracteata*     | Grandibracteosides A–C                                                         | Anticancer                                  | Sabrina K, 2007.          |
| 9   | *A. gummifera*           | Vitalboides-A, vitalboides-A, 2'-methylglucuronate                              |                                             |                            |
|     |                          | 3-O-[(β-D-glucopyranosyl(142)]-[α-L-arabinopyranosyl(146)]-β-D-glucopyranosyl]-oleic acid | Anti trypanosomal, anti cancer               | Steinrut L et al., 2011 a.|
| 10  | *A. inopinata*           | Felipealbizina A, felipealbizine B                                              | Neurologic activity                         | De Assis TS et al., 1999. |
| 11  | *A. inundata*            | 3-O-[α-1-arabinopyranosyl]-[1→6]-2 acetamido-2-deoxy-β-D-glucopyranosyl          | Cytotoxic activity                          | Zhang et al., 2011.       |
|     |                          | echinocystic acid                                                                |                                             |                            |
| 12  | *A. julibrissin*         | Julibrosides J1 & J9, J29, J30 and J31.                                          | Cytotoxic activity, anticancer              | Zheng L et al., 2006;Zou K et al., 2006. |
|     |                          | quercetin and isoquercetin                                                        |                                             |                            |
|     |                          | Alibibrissinoside B                                                              | Antioxidant, antidiabetic                   | Lau CS 2007 ; kang TH et al., 2000. |
|     |                          | 3, 5, 4’-trihydroxy, 7, 3- dimethoxy-3-O-β-D-glucopyranosyl-α-L-xylolpyranoside. |                                             | Jung MJ et al., 2004.     |
| 13  | *A. lebbeck*             | Albiziasaponins A, B and C                                                       | Antimicrobial                               | Varshney et al., 1976.    |
|     |                          | Quercetin, kaempferol, 3-O-α-rhamnopyranosyl (1→6)-β-glucopyranosyl (1→6)-β-    | Cytotoxic activity, Anticancer.             | Ganguly NB et al., 1993.  |
|     |                          | galactopyranosides.                                                              |                                             |                            |
|     |                          | Budmunchiarnes L1-L3.                                                            | Anti inflammatory                           | Babu NP et al., 2009.     |
| 14  | *A. mollis*              | Molliside A-B, Concinnoside A, Albiziasaponin A                                 | Sedative                                    | Zou K et al., 2000.       |
| 15  | *A. myriophylla*         | Albizzine A                                                                       | Antioxidant                                 | Steinrut L et al., 2011b  |
|     |                          | Albiziasaponins A-E                                                              |                                             |                            |
| 16  | *A. odoratissima*        | 7, 8-Dimeth-C20oxy-39, 49 methylenedioxylavone, 7, 29, 49-Trimethoxylavone       | Leprosy, Ulcers, Cough                      | Zou K et al., 2000.       |
| 17  | *A. procera*             | 3-O-[β-Dxylopyranosyl-(1→2)-α-L-arabinopyranosyl-(1→6)-2 acetamido-2-deoxy-β-D- | Antioxidant, Anticancer.                    | Khatoon, 2013.             |
|     |                          | glucopyranosyl]-echinocystic acid, 5, 2’, 4’-trihydroxy-3, 7, 5’-trimethoxyflavonol-2’-O-β-D-galactopyranosyl-(1→4)-O-β-D-glucopyranoside |                                             | Melek FR, 2007.           |
| 18  | *A. subdimidiata*        | Albiziatrioside A and B                                                          | Cytotoxic activity, anticancer              | Abdel-Kader M et al., 2001; |
|     |                          |                                                                                |                                             | Lau CS et al., 2007.      |

2. **Phytochemical Significance of Albizia Amara**

**Phytochemical Constituents:**

Sastry et al (1966) reported that the petroleum ether extract of Heart wood has only fatty acid methyl ester where as ethanolic extract contained only triterpene saponin ((Reddy et al., 1967).

The petroleum ether extract of leaves contained fatty acid methyl ester where the ethanolic extract had triterpene saponins, a phenolic glycoside and a flavonol glycoside
called 4’-O-methyl rutin (Deshpande et al., 1977). Further hydrolysis of triterpene saponin gave oleanolic acid, echinocystic acid, glucose, arabinose and rhamnose. He also isolated β-sitosterol from the benzene extract ((Deshpande et al., 1977). Further from the ethyl acetate and acetone extracts different compounds like melanoxetin, 3’-O-methyl – melanoxetin, melacacidin, 3’-O-methyl –melacacidin tetra methyl ether, 4’-O-methyl –melacacidin tri methyl ether were isolated and characterized as potential phenolics. Extracts prepared from seeds were found to contain spermine macrocyclic alkaloids, Budmunchiamines D-I based on their interaction with DNA (Pezzuto et al., 1991, 1992). The seed oil contain high content of linoleic acid and palmitic acid and low content of caprylic, lauric acid and lignoceric acid (Munir et al., 1995). The chromatographic finger print analysis of methanolic leaf extract by HPTLC technique confirmed the presence of macrocyclic alkaloids Budmunchiamines L4 and L5 (Rajkumar et al., 2010).

### Anticancer Activity

The methanolic extract of seeds was found to contain macrocyclic pithecolbine alkaloids (Mar et al., 1991). Of these Budmunchiamines A-C was found to have high cytotoxic potential towards cultured mammalian cell lines like Human Breast Cancer (UCISO-BCA-1), Colon Cancer (UCISO-COL-2), Lung Cancer (UCISO-LUC-1) and melanoma (UCISO-MEL-2) cell lines (Mar et al., 1991). In addition, the isolates inhibited the activity of the enzymes HIV-Reverse transcriptase and Cyclooxygenase. Further Budmunchiamines A-C were evaluated for its potential to inhibit human lymphocyte transformation, platelet aggregation and phorbal ester induced chemiluminiscence with human granulocytes (Mar et al., 1991). The extracts showing anticancerous activity of bark of Albizia amara. The methanolic extract was assessed by Thippeswamy et al., (2013). Aspergilus flavus and its aflatoxin B1 production was completely inhibited in vitro by BUA at 1 mg/ml concentration (Thippeswamy et al., 2013). In addition Thippeswamy et al., (2014) reported the inhibitory effect of BUA on growth and fumonosin B1 production of Fusarium verticillioides, a phytopathogenic fungi. So, it was emphasized that BUA can be used as an antifungal agent against post harvest fungal infestation of food commodities and mycotoxin contamination (Thippeswamy et al., 2014).

### Antioxidant Activity

Suresh Kumar et al., (2008) and RajKumar et al., (2012) reported that the methanolic leaf of A. amara possess strong anti oxidant and free radical scavenging properties. The preliminary screening of the extract showed the presence of saponins, tannins, alkaloids, flavonoids and phenolic compounds. Mulapalli et al., (2012) reported the antioxidant activity of bark of Albizia amara. The ethanolic extract of bark increases the activity of super oxide dismutase and catalase which indicate it as good antioxidant which may be due to the presence of saponins, tannins and glycosides Mulapalli et al., (2012). The free radical scavenging potential and antioxidant properties of methanolic leaf extract was studied by Raj Kumar et al., (2012). The antioxidant activity of the extract were investigated by three different methods-2, 2, Diphenyl -1-Picryl hydrazil(DPPH) radical assay, free radical scavenging assay and reducing power assay. Further, total phenol content of the methanolic extract in terms of Gallic acid equivalent was found to be 243.47 µg. Thus a positive relationship between total phenols and antioxidant activity was found in A. amara Raj Kumar et al., (2012). Kandhasamy et al., (2012) reported that the acetone extract and sub-fractions of A. amara stem bark for their free radical scavenging potential and antioxidant properties. Of these, the ethyl acetate fraction exhibited higher 2, 2, Diphenyl -1-Picryl hydrazil(DPPH) and ABTS radical scavenging activities than the standard quercitin due to the presence of chemical constituents like Melanoxetin, melacacidin, 3’-O-methyl melanoxetin, 3’-O-methyl melacacidin trimethyl ether.

### Larvicidal activity

Murugan et al., (2006) reported the larval toxicity and smoke repellent potential of methanolic leaf extract at different concentrations against the different instar larvae and pupae of Dengue vector i.e Aedes aegypti. Further, the smoke repellent potential of the coils made from the leaves was very high and considerably affected the mosquito survival.Murugan et al., (2006) reported that phytochemical analysis of the methanolic extract may contain macrocyclic spermine alkaloids, echinocystic acid.
Anti-inflammatory activity

Khan et al., (2010) evaluated the ethanolic extracts (200mg/Kg) of *A. amara* was able to show significant anti-inflammatory and analgesic activity as compared with standard drug Aspirin 100 mg/kg. The percentage reduction in paw volume observed against Carrageenan induced paw oedema for *Albizia* was 15 %. In hot plate method, the percentage inhibition was 61.91% (Khan et al., 2010). The ethanolic leaf extract showed the presence of oleanolic acids, echinocystic acid, 4'-0-methylrutin.

Antihyperlipedemic activity

Mulapalli et al., (2012) reported the anti hyperlipedemic and antioxidant activity of bark of *A. amara*. The ethanolic bark extract had significant effect against high cholesterol diet induced hyper lipidemia and also decreased the level of serum cholesterol, triglycerides, LDL, VLDL, SGOT, SGPT, alkaline phosphatases and a significant increase in the level of serum HDL. The extract also increases the activity of super oxide dismutase and catalase which indicate it as good antioxidant (Mulapalli et al., 2012). In addition Rohith et al., (2014) also studied the anti hyperlipidemic activity of ethanolic bark extract on Triton X-100 induced model of hyperlipidemia in rats and found significant decrease of LDL and increase of HDL in the serum. Phytochemical screening of the ethanolic bark extract reported the presence of glycosides, saponins and tannins.

Hepatoprotective Property

Sastry et al., (1966) reported that the petroleum ether extract from BARK gave a fatty acid methyl ester and β-sitosterol where as ethanolic extract gave triterpene saponins, tannins and glycosides. In particular, saponins is known to elicit serum cholesterol lowering activity by causing resin like action, thereby reducing the entero hepatic circulation of bile acids. In the process, the conversion of cholesterol to bile acids is increased in liver resulting in concomitant hypocholesterolemia (Umbare et al., 2009).

Skin Diseases

The seed oil contain high content of linoleic acid and palamitic acid and low content of caprie, lauric acid and lignoceric acid (Munir et al., 1995) and is used for the treatment of leprosy and leucoderma. Paste of leaf and root bark of Albizia amara is used to cure both skin diseases and poisonous bites (Ayyanar et al., 2005). The flowers of Albizia amara have been applied to boils, eruptions, swellings and also regarded as an emetic. It is used as a remedy for dandruff (Mar et al., 1991).

Other Phytochemical properties

Seeds of *Albizia amara* are regarded as astringent and used in the treatment of piles, diarrhea and gonorrhea. The flowers are used as a remedy for cough, ulcers, dandruff and malaria (Mar et al., 1991). The bark of the tree yield gum which is used for ulcers (Kashyapa & Ramesh 1992) and molluscidal infection (Ayoub & Yankov , 1986).The bark extract may contain chemical constituents like saponins, glycosides, tannins. Aqueous leaf extract of *Albizia amara* was used by traditional healers of Tanzania for treatment of diarrhea, epilepsy, severe backache, loin pain and other abdominal problems (Mbuya et al., 1994). Olapade et al., (1995) published that some of the phytocomponents in the bark elicit a wide range of biological activities like hypoglycemia, hypoaetometia etc. The bark of Albizia amara is used as an astringent in diarrhea and dysentery and internally to check uterine bleeding and the discharge in gonorrhea as well as topically in Ophthalmia and as a wound dressing (Muchuweti et al., 2006). The alkaloid extracts of Albizia amara was also found to exhibit antiarthritic activity (Akilandeswari et al., 2009)

Table 2: Pharmacological Significance of the plant Albiziaamara

| SN o | Disease | Type of Extract/Chemical constituent | Type of Chemical constituent | References |
|------|---------|-------------------------------------|-----------------------------|------------|
| 1    | Anticancer | Methanolic seed extract | Macrocyclicspermine alkaloids | Mar et al ., 1991(11) |
|      |          | Methanolic seed extract | Macrocyclicspermine alkaloids | Pezzuto et al ., 1991,1992(7,8) |
|      |          | Ethyl acetate leaf extract | Macrocyclicspermine alkaloids | Gopinath et al ., 2013(12) |
| 2    | Antimicrobial | Methanolic seed extract | Macrocyclicsperminealkaloids,echinocystic acids | Mar et al ., 1991(11) |
|      |          | Methanolic leaf extract | Saponins,tannins,alkaloids,terpenoids,glycosides,flavonoids, phenols,cardiac glycosides ,quinones | Baltazyet et al ., 2010(13) |
|      |          | Chloroform leaf extract | Alkaloids & steroids | Praveen et al ., 2011(15) |
|      |          | Methanolic leaf extract | Macrocyclicspermine alkaloids | Thippeswamyet et al ., 2013,2014 (16,17) |
| 3    | Antioxidant | Methanolic leaf extract | Saponins,tannins,alkaloids,terpenoids,glycosides,flavonoids, phenols,cardiac glycosides ,quinones | Suresh Kumar et al ., 2012(18) |
|      |          | Ethanolic bark extract | Oleancic acids, Echinocystic acid | Mullaappal et al ., 2012(20) |
|      |          | Methanolic leaf | Saponins,tannins,alkaloids,terpenoids,glycosides,flavonoids | Raj Kumar et al ., 2013(20) |
| Extract Type | Active Compounds | Reference |
|--------------|------------------|-----------|
| Ethyl acetate bark extract | Oleanolic acids, Echinocystic acid | Kandhasamy et al., 2012 (21) |
| Methanolic leaf extract | Saponins, tannins, alkaloids, terpenoids, glycosides, flavonoids, ds, phenols, cardiac glycosides, quinones. | Murugan et al., 2006(22) |
| Ethanolic leaf extract | Saponins, alkaloids, terpenoids, glycosides, flavonoids, cardiac glycosides, quinones. | Khan et al., 2010(23) |
| Ethanolic bark extract | Oleanolic acids, Echinocystic acid. | Mullapalliset al., 2012(20) |
| Petroleum ether bark extract | Fatty acid methyl esters, β-sitosterol. | Sastry et al., 1996(3) |
| Ethanolic bark extract | Oleanolic acids, Echinocystic acid. | Umbare et al., 2009(25) |
| Seed extract | Linoleic acid & Palmitic acid. | Muntret et al., 1995(9) |
| Leaf & Root bark paste | Glycosides, tannins, Triterpenesaponins. | Ayyanates et al., 2005(26) |
| Bark extract | Triterpenesaponins, phenols. | Muchuwetset al., 2006(31) |
| Aqueous leaf extract | Saponins | Mbuyate et al., 1994(29) |
| Gum extract of bark | Saponins, glycosides, tannins. | Ayyabe et al., 1986(28) |
| Flower & Leaf extract | Triterpenesaponins. | Mar et al., 1991(11) |

3. Future Prospective

Globally the research on traditional medicine is gaining momentum. Herbal drugs are rapidly becoming popular in recent years as an alternative and safe therapy. In some cases the crude extract of the medicinal plant may be used while in other the bioactive compounds isolated are used in curing various diseases. The pharmaceutical compounds of seeds and leaves of *Albizia amara* has potential broad spectrum of anticancer activity which can be confirmed with *in vivo* animal models. Another bioactive compound Budmunchiamine A can be used as an alternative to chemical preservatives for the management of pre and post harvest fungal infestations and mycotoxin contamination in food grains. The future perspective demands on the isolation and identification of the active principle and elucidation of the mechanism of action of a drug. Hence research in both mixture of traditional medicine and single active compounds are very important. It may be concluded that *Albizia amara* shall be considered as a promising plant with various therapeutic properties and can be further explored in curing various diseases. This review would explore the immense utility of *Albizia amara* and encourages further research of its potential bioactive compounds for the evolution of preventive health care without any harmful side effects.

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References

[1] *Albizia* species. http://en.wikipedia.org/wiki/Albizia. [Accessed: ]

[2] Gamble JS, The Flora of the Presidency of Madras, (Adlard & Son, Ltd, London), 1935.

[3] Chakrabatry, T & Gangopadhyay, M (1996) J. Econ. Taxon. Bot. 20: 581-597. The genus Albizia in India.

[4] Orwa et al, *Albizia amara* botanical information. Agroforestry Database 4.0, 2009; p 1-5

[5] Ganguli NB, Bhatt RM. Mode of Action of active principles from stem bark of *Albizia lebbeck*. Indian J Experiment Biol 1993; 31: 125-129.

[6] Abdel-Kader M, Hoch J, John M, Evans R, James S, Stephen W, Dalton, James M, Kingston G. Two biologically active saponins from *Albizia subminidata* from the Suriname rainforest. J Nat Prod 2001; 64: 536-539.

[7] De Assis TS, de Almeida RN, Da-Cunha EVL, De Medeiros IA, de Lima AM, de de Souza FVM, da Silva MS, Braz-Filho R, Barbosa-Filho JM. Two New Macrocyclic Alkaloids from *Albizia inopinata*. Lat Am J Pharm 1999; 18: 271-275.

[8] Ovenden SP, Cao S, leong C, Flotow H, Gupta MP, Butler MS. Spermine alkaloids from *Albizia adinocephala* with activity against Plasmodium falciparum plasmspin II. Phytochem 2002; 60: 175–177.

[9] Jangwan JS, Maneesha Dobhal, Naveen Kumar. New cytotoxic saponin of *Albizia lebbeck*. Indian J Chemists 2010; 49: 123-126.

[10] Zhang H, Samaki AK, Rao KV, Cohen MS, Temmermann BN. Cytotoxic oleane-type saponins from *Albizia imundata*. J Nat Prod 2011; 74(3): 477-82.
and Albizia saman on growth and fumonisin B1 production by Fusarium verticillioides, International Food Research Journal 21(3): 947-952 (2014).

[47] Suresh Kumar P, Sucheta S, Sudarshana Deepa V, Selvamani P, Latha S (2008) Antioxidant activity in some selected Indian medicinal plants. African Journal of Biotechnology 7: 1826-1828.

[48] Sartaj Banu Mulapalli, Helen Sheeba D.A., Navithaa, Ramesh C., Evaluation of antihyperlipidemic and antioxidant activity of Albizia amara (Roxb.) Boiv., International Journal of Biological & Pharmaceutical Research. 2012; 3(7): 875-882

[49] Rajkumar T, Satheesh Kumar E, Sinha BN (2012) Evaluation of antioxidant properties of Albizia amara leaves.International Journal of Advance Pharmaceutical and Biological Sciences 2: 99-106.

[50] Kandhasamy Sowndhararajan, Sun-Chul Kang, In vitro free radical scavenging potential of acetone extract and sub-fractions of Albizia amara (Roxb.) Boiv. stem bark, Current Research on Agriculture and Life Sciences (2012) 30(2): 110-114

[51] K. Murugan, P. Murugan, A. Noortheen, Larvicidal and repellent potential of Albizia amara Boivin and Ocimum basilicum Linn against dengue vector, Aedes aegypti, Bioresource Technology 98 (2007) 198–201

[52] Khan A, Shah RD, Pallewar S (2010) Evaluation of anti-inflammatory and analgesic activity of ethanolic extracts of Inularacemosa and Albizia amara. Int J Pharmacog Phytochem Res 3:22–27

[53] Rohith Gundamaraju, KimKahHwi, Rajeev K Singla, Ravi Chandra vemuri, Sartaj Banu Mullanpalli, Antihyperlipidemic potential of Albizia amara(Roxb) Boiv.bark against Triton X-100 induced condition in rats, Phcog Res 2014;6 :267-273

[54] Reddy Sastry CV, Rukmini C and Ramachandra Rao L, Chemistry of Saponins : part III – Isolation of new flavonol Glycoside, 4'-0- Methylquercetin-3-rutinoside, from Albizia amara Benth.Indian J.Chem., Vol 5, Dec-1967

[55] Umbare RP, Mate GS, Jawalkar DV, Patil SM, Dongare SS. Quality evaluation of Phyllanthus amarus (Schumach) leaves extract for its hypolipidemic activity. Biology and Medicine. 2009; 1(4): 28-33.

[56] Munir A, Shadab Q, Ahamed M and Qamar S, 1995, Studies on the fixed oil of Albizia amara.Pakistan. J. Sci.38 : 277-288.

[57] Muchuweti M , Nyamukonda L , Chagonda LS, Ndhlala AR, Mupure C , Benhura M (2006) Total phenolic content and antioxidant activity in selected medicinal plants of Zimbabwe. International Journal of Food Science and Technology 41(Supplement 1): 33-38.

[64] Akialadeswari S, Senthamarai R, Valarmathi R, Savarinsha JA, Selvan A (2009) Evaluation of anti-inflammatory and anti-arthritic activity of Albizia lebbeck and Albizia amara extracts. Biomed 4: 295-302.

[65] Weisner K, Mac Donald DM, Valenta Z, Armstrong R (1952) Can J Chem 30:761

[66] Weisner K, Mac Donald DM, Bankiewicz C, Orr DE (1968) Can J Chem 46:1881

[67] Weisner K, Valenta Z, Orr DE, Leide V, Kohan G (1968) Can J Chem 46:3617