

Review Article

PHARMACOLOGICALLY ACTIVE SAPONINS FROM THE GENUS *ALBIZIA* (FABACEAE)

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ABSTRACT

*Albizia* species (Family – Fabaceae) are endemic in tropical America, Africa and Southeast Asia. *Albizia lebeck*, *Albizia julibrissin*, *Albizia gummifera*, *Albizia chinensis*, *Albizia adiatifolia* and *Albizia procera* are some importantly considered species in the traditional medicine. These species are used in folk medicine for the treatment of rheumatism, stomach ache, cough, diarrhea, wounds, anthelmintic and others. Saponins are the main compound present in species of this genus and showed many pharmacological properties as antioxidant, antidiabetic, anthelmintic, antibacterial, hepato protective, anti-inflammatory and cytotoxic. The present investigation reviews the main saponins pharmacologically active of species of the genus *Albizia*.

**Keywords:** *Albizia*, Saponins, Pharmacology properties.

INTRODUCTION

*Albizia* is a genus that has small to large trees (up to 30m), simpodal growth, usually with a short trunk and a broad crown. *Albizia* has a discontinuous distribution, the most highly diverse in tropical America, then Africa (including Madagascar), Southeast Asia and Malaysia. Based on observations of herbarium collections 33 species are recognized from the southern United States to Argentina [1].

*Albizia* is a tropical genus that includes at least 470 names. Lewis and Rico Arce, 2005 reported 120-140 species. The first classification of *Albizia* was performed by Benth (1875), although many current *Albizia* species were originally included in the genus *Acacia* and *Pithecellobium*. Benth (1875) included nine genus in the tribe Ingeae: *Affonsea* St. Hill, *Albizia* Durazz, *Archidendron* F. Muell, *Calliandra* Benth, *Enterolobium* Mart, *Inga* Willd, *Lysiloma* Benth, *Serianthes* Benth and *Pithecellobium* Mart. Barneby & Grimes (1996, 1997) and Barneby (1998) reclassified the tribe Ingeae focusing in the New World species and genera placed in five informal alliances. New vegetative considerations such as branching pattern and developmental stages of vegetative and floral buds were used to allow greater phylogenetic analysis.

Saponins are secondary metabolites of glycosidic nature widely distributed in higher plants but also found in some animal sources as marine invertebrates. Saponins possess a wide range of pharmacological properties including expectorant, antiinflammatory, vaso protective, hypocholesterolemic, immunomodulatory, hypoglycemic, molluscicidal, antifungal, antiparasitic and many others. Another important application of saponins is their use as adjuvants in the production of vaccines and some steroidal saponins served as economically important raw materials for the pharmaceutical industry in the production of steroidal hormones. The main saponins isolated from *Albizia* genus are triterpenoid saponins. There are no reports on the literature about the isolation of steroidal saponins of species of this genus [2].

Important biological activities have been reported as to crude extracts and as to purified substances of species of this genus. Alcoholic extracts and/or hydroalcoholic of *Albizia* species showed anticonvulsant, sedative, anti-inflammatory, antitumor, antifungal, antibacterial and antiparasitic activity [3].

***Albizia lebeck* benth**

*Albizia lebeck* Benth. is a large upright tree with falling leaves and widely distributed in India and Bangladesh where it receives the name of "Sirisa" and can also be found in South Africa and Australia [4]. Virtually all parts of the tree are used in the composition of folk

remedies for abdominal tumors, boils, cough, eye diseases, flu and lung diseases. The seed oil is used for leprosy and the swelling powder. Indians use the flowers for spermatorrhea. It has astringent, rejuvenating and tonic action. Ethanol extracts of *A. lebeck* showed anticonvulsant activity since saponins isolated from the leaves showed neurotropic and anxiolytic activity in albino mice, and inhibits mast cell degranulation [5]. Its bark has been used as an ingredient in "Ayurvedic Kadha" used to treat asthma for over 2000 years. A decoction of the bark also protects against broncho constriction induced by acetylcholine and histamine. Its antitussive action and the ability to prevent bronchospasm induced by allergens are also reported. Furthermore, it is known to be useful in the treatment of allergic conjunctivitis and atopic allergy [6].

*Albizialebeck* extracts showed considerable metabolic wealth as catechins, kaempferol, quercetin, lupeol,  $\alpha$ -myrincin, saponins (Albiziasaponins A, B, and C) (Fig. 1), triterpenoids, and an unusual glycoside Albizinin [7].

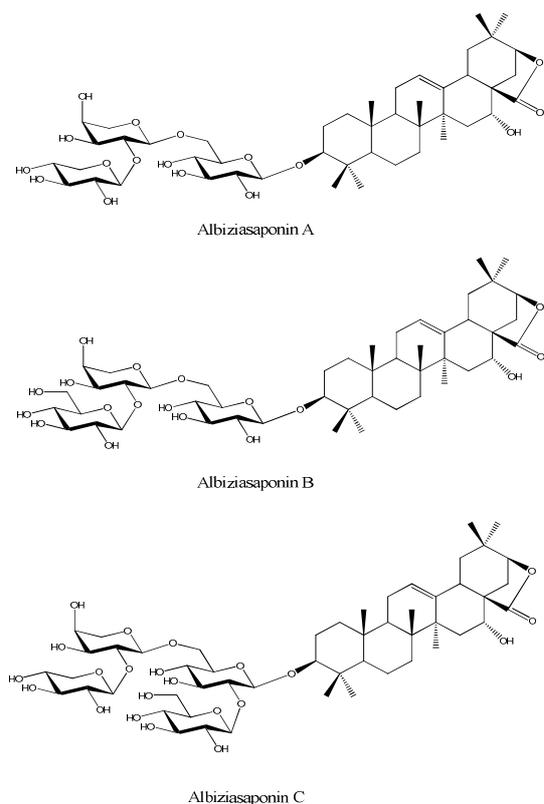
***Albizia julibrissin* durazz**

*Albizia julibrissin* species, commonly called Mimosa or Silk Tree, are widely distributed in Asia, Africa, Australia and America tropical and subtropical [8]. It is native to Asia from Iran to Japan. *A. julibrissin* is a tree-shaped umbrella reached 6 meters high. The bark is greenish gray color with vertical stripes when older. The leaves are bipinnate, 20-45 cm in length and 25 cm in width 12 divided into 4-12 pairs of pinnae, each with 10-30 pairs of leaflets and the leaflets are oblong, length 6-12 mm and 1-4 mm ample.

From June to July, inflorescence of attractive pink flowers are produced on top of the branch with intense perfume, featuring a source of nectar for bees. The fruit consists of *A. julibrissin* flat pods with bulging seeds, each pod measuring 8-18 cm long and 1.5-2.5 cm wide and can be seen from June to February. Since the seeds are typically oval-shaped, approximately 1.25 cm long, are produced by the pod [9].

*Albizia julibrissin* Durazz. is used in folk medicine as a sedative and anti-inflammatory agent and in traditional Chinese medicine, has been used together with *Polygonum multiflori* caulis and *Ganoderma* for the treatment of insomnia. In modern pharmacology exhibits antitumor activity, immunomodulatory and anti-platelet effects. The extract of the rind is a sedative and anti-inflammatory for the treatment of pain and swelling of the lungs, skin ulcers, wounds, bruises, abscesses, boils, hemorrhoids and fractures drug, and has shown cytotoxic activity [10]. Flowers have been commonly used to treat depression, anxiety and insomnia. The seeds are a source of oil, and are used as feed for animals. Similarly, the seeds of which

exhibit proteolytic enzymes readily coagulate milk without developing any bitterness in cheese after 3 months of ripening [11].

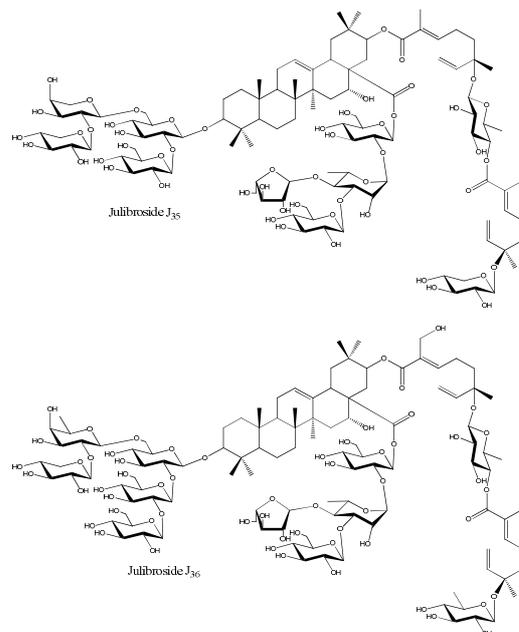
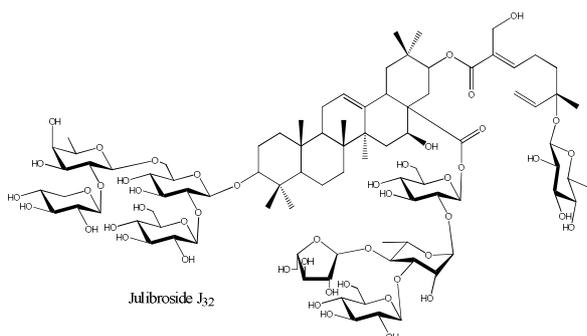


**Fig. 1: Structure of three saponins isolated from *Albizia lebeck*, *Albizia saponina* A, B and C**

Chemical constituents of several classes of secondary metabolites have been isolated from *A. julibrissin*. Flavonoids, lignans and tannins are the main groups obtained, however saponins are the main chemical markers of *Albizia* species in question. Over sixty triterpenoids compounds were isolated from this genus, some with significant cytotoxic and antitumor effect.

Most aglycone is the type of oleanolic acid substitution oligosaccharides in positions C-3, C-21 and C-28 to form triterpenoid saponins. In the sugar chain at C-28, all saponins are replaced with Glc-(1 → 3) - [Ara-(1 → 4)]-Rha-(1 → 2)-Glc. The sugar chain at C-3, on the other hand, has six options Xyl-Ara/Fuc-GlcXyl-Ara/Fuc-Glc (2-NHAc) and Xyl-Ara/Fuc- (Glc) Glc, as for the sugar chain at C-21, there are only two types of sugars (Qui or Xyl) [12].

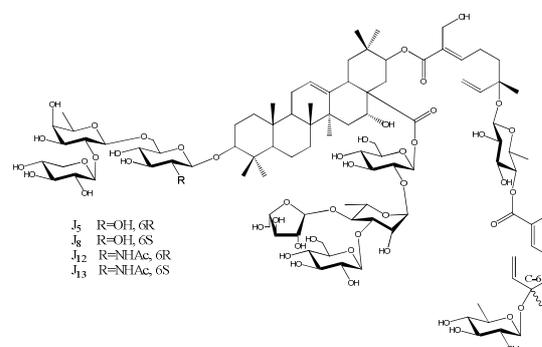
Extracts of the bark and stems from *A. julibrissin* showed some triterpenoid saponins that is acylated with acid groups linked and aglycon of monoterpenes. Some of these saponins exhibited remarkable inhibitory activity against cancer cell lines in vitro (Fig. 2) [13].



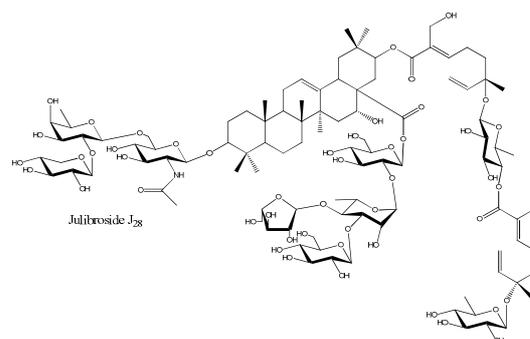
**Fig. 2: Structure of three complex triterpenoid saponins of *Albizia julibrissin*, Julibroside J32, Julibroside J35 and Julibroside J36**

Four saponins were isolated from *A. julibrissin*, J5, J8, J12 and J13 (Fig. 3). The J8 and J13 saponins showed significant cytotoxic activity against cancer cell lines [14].

A potent antitumor activity was attributed to saponin isolated from *A. julibrissin*, J28 (Fig. 4). Have Zhang *et al.*, 2006, isolated and elucidated three complex triterpenoid saponins *A. julibrissin*, J29, J30 and J31 (Fig. 5). All saponins exhibited antitumor activity against human tumor cells line [15].



**Fig. 3: Structure of four saponins of *A. Julibrissin*, J5, J6, J12 and J13.**



**Fig. 4: Structure of the Julibroside J28.**

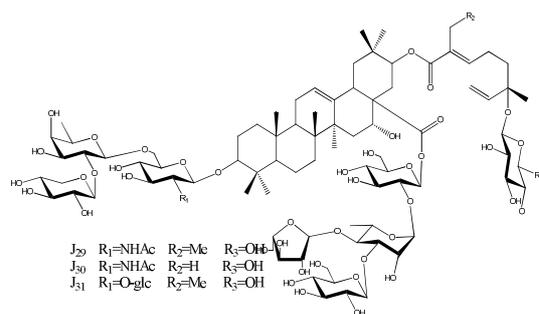


Fig. 5: Structure of three saponins isolated from *A. julibrissin*, J29, J30 and J31

#### *Albizia gummifera* smith

*Albizia gummifera* Smith. is a tree-shaped canopy umbrella, 50 m high and widely distributed in the highlands of southwestern Ethiopia. It is used by the natives for the treatment of various diseases. Six triterpenoid glycosides were isolated from this species, a monodesmosidicsaponin, a bidesmosidicsaponin, a estigamasterol, two new sapogenin glycosides containing macarinic acid and a  $\gamma$ -lactone, and a sapogenin lactone (Fig. 6) [16].

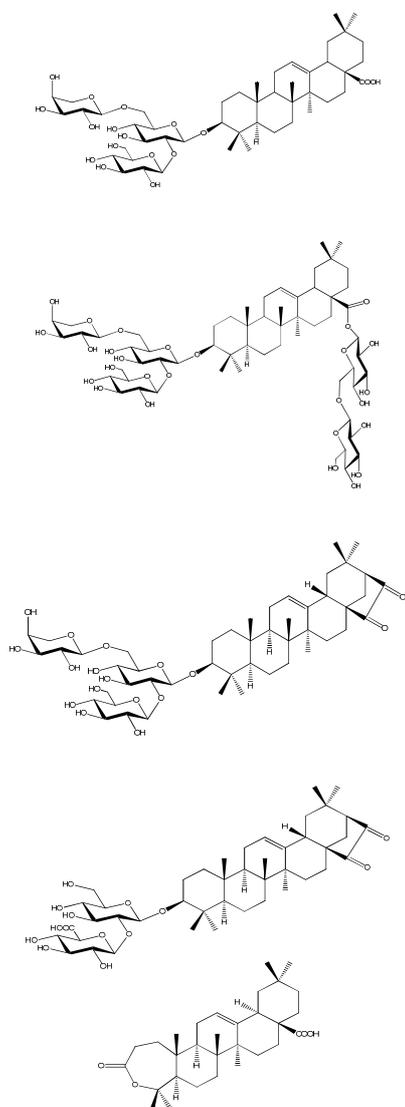


Fig. 6: Structure of four triterpenoid saponins and sapogenin from *Albiziagummifera*

#### *Albizia chinensis* merr

*Albizia chinensis* is an unarmed, deciduous or evergreen tree with a flat, spreading crown, up to 30(-43) m tall and trunk up to 70(-140) cm in diameter; bark dark gray, rather smooth, densely hooped, lenticellate, thin; live bark 5 mm thick, pinkish-red. Branchlets slightly angular in the distal parts, terete, puberulous to tomentose, glabrescent.

Two complex triterpenoid saponins of *Albizia chinensis* Mer. Were isolated from the butanolic extract between peels. The saponins, called Albizosides D and E (Fig. 7) showed cytotoxic activity against human tumor cells line [17].

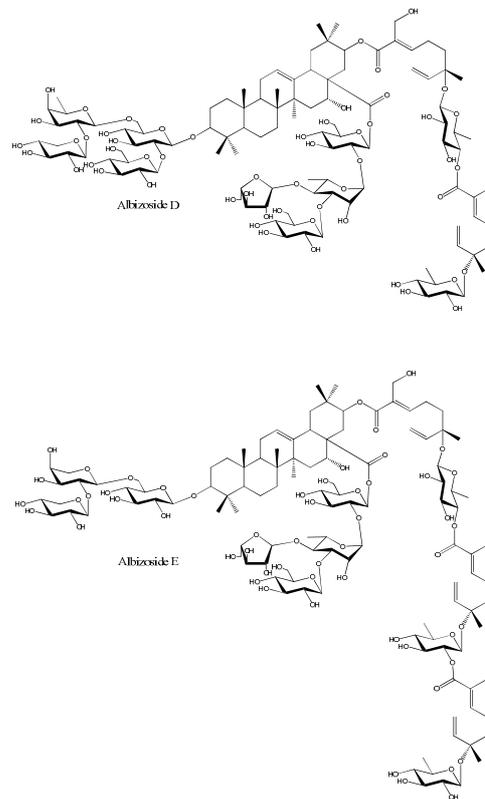


Fig. 7: Structure of Albizosides D and E isolated from *Albizia chinensis* Merr

#### *Albizia adianthifolia*

*Albizia adianthifolia* is widespread, occurring from Senegal east to Kenya, and south to Angola, eastern South Africa and Swaziland; also in eastern Madagascar. The wood of *Albizia adianthifolia* is used for light construction (e. g. posts, rafters) and carving (e. g. images, spoons, masks, clubs). It is also suitable for light flooring, joinery, interior trim, furniture, cabinet work, boat building, vehicle bodies, toys and novelties, tool handles, baseball bats, boxes, crates, hardboard and particle board. The wood is used as firewood, although it burns quickly; it is also made into charcoal.

Various parts of this plant are used in traditional medicine. Bark sap is applied to the eye to treat river blindness and conjunctivitis, and internally against respiratory complaints, as an anodyne and to treat allergic reactions; it is also applied to sores and to allay toothache. A bark infusion or decoction is administered to treat scabies and other skin complaints, and to treat fever. Pounded bark is applied externally to boils and itching skin, and internally as a vermifuge. A twig-bark decoction is administered as a purgative and anodyne. In traditional South African medicine the bark of *Albizia adianthifolia* is used to improve memory and to treat Alzheimer's disease. A root infusion is applied to treat eye complaints, and powdered roots are administered to women in labour or with irregular menstruation. The leaves are used internally against diarrhea and gonorrhoea, and

externally to treat wounds and sore feet. A fruit extract is drunk to relieve stomach-ache. In southern Cameroon the gum from the bark is used in hunting poison. In the Central African Republic bark and leaves serve as fish poison.

Three triterpenoid saponins Adianthifoliosides A, B and D (Fig. 8), and two prosapogenins, Pro 1 and Pro 2 (Fig. 9) were isolated from *Albizia adianthifolia*. Both saponins as prosapogenins showed important biological activities in human leukemic T cells and splenocytes. All the isolated saponins also showed synergistic activity with lympho proliferative concanavalin A (ConA) of splenocytes [18].

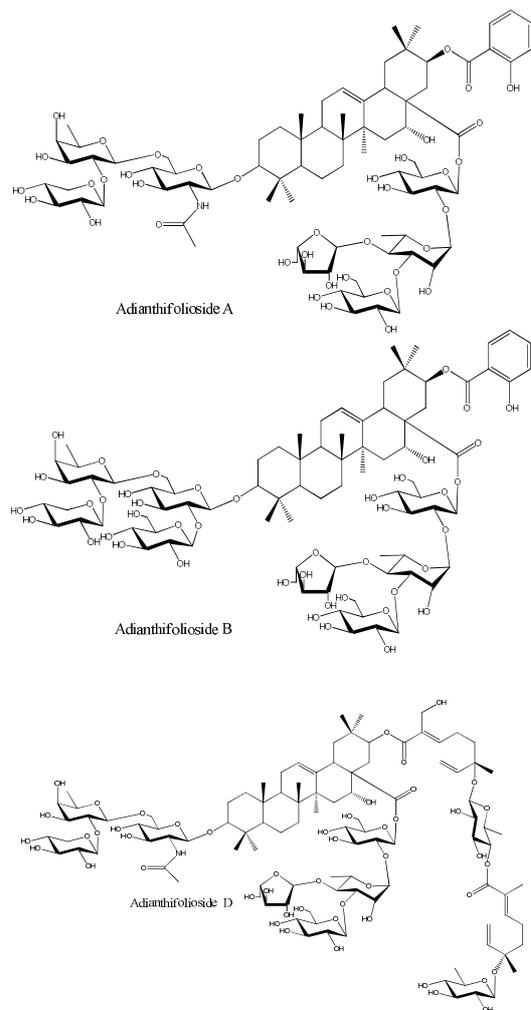


Fig. 8: Structure of Adianthifoliosides A, B and D isolated from *Albizia adianthifolia*

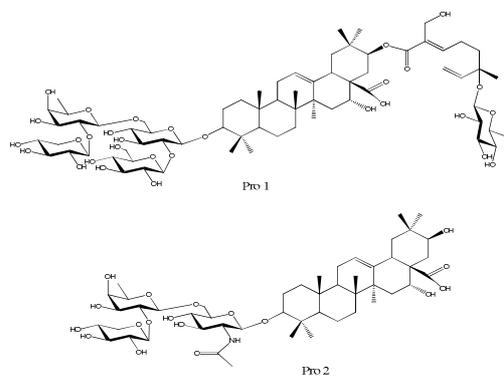
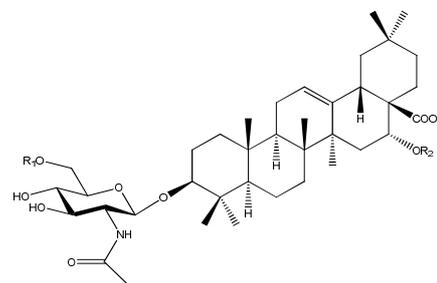


Fig. 9: Structure of two prosapogenins, Pro 1 and Pro 2, isolated from *Albizia adianthifolia*.

### *Albizia procera*

*Albizia procera* is a tree grown in the streets and public gardens in Egypt. In folk medicine, the bark is considered useful in pregnancy and stomach pain. There are reports in the literature of seven isolates triterpenoid glycosides from the bark of *Albizia procera* (Fig. 10) [19].



|          | R <sub>1</sub>       | R <sub>2</sub> |
|----------|----------------------|----------------|
| 1        | β-D-Xyl(1→2)-β-D-Gal | β-D-Glc        |
| 2        | β-D-Xyl(1→2)-α-L-Ara | β-D-Glc        |
| 3        | α-L-Ara(1→2)-α-L-Ara | β-D-Glc        |
| 4        | β-D-Xyl(1→2)-α-L-Ara | H              |
| 5        | α-L-Ara(1→2)-α-L-Ara | H              |
| <b>R</b> |                      |                |
| 6        | β-D-Xyl              |                |
| 7        | α-L-Ara              |                |

Fig. 10: Structure of seven triterpenoid saponins isolated from *Albizia procera*

### CONCLUSION

Saponins of species of the genus *Albizia* showed many pharmacological properties as anticonvulsant, sedative, anti-inflammatory, antitumor, antifungal, antibacterial and antiparasitic. It may be concluded that *Albizia* species shall be considered as a promising plant with various therapeutic properties and can be further explored pharmacologically against various ailments. This review showed a brief study on the immense utility of the genus *Albizia* saponins and encourages phytochemicals to drive to isolate and purify new pharmacologically active saponins from other species of this genus.

### CONFLICT OF INTERESTS

Declared None.

### ACKNOWLEDGEMENT

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