Saponins from Genus *Albizia*: Phytochemical and Biological Review

Singab AN*, Bahgat D, Al-Sayed E and Eldahshan O

Department of Pharmacognosy, Faculty of Pharmacy, Ain-Shams University, Cairo, 11566, Egypt

Abstract

*Albizia* is a large genus that belongs to family Fabaceae; most of *Albizia* species are rich in triterpenoidal saponins. These species were used in folk medicine for the treatment of rheumatism, stomach aches, cough, diarrhea, wounds, and as an anthelmintic. Many pharmacological activities were reported for the fractions or extracts containing saponins. Also, various pharmacological activities were reported for the pure isolated saponins. This review focuses on the distribution of saponins among the different species of genus *Albizia* and their pharmacological activities.

Keywords: *Albizia*; Cytotoxicity; Echinocystic acid; Oleanolic acid


Introduction

*Albizia* is a large genus belonging to the family Fabaceae, which comprises about 150 species that are widely distributed in Africa and Central South America. Most of these plants are fast-growing subtropical and tropical trees and shrubs. Phytochemical investigation of different *Albizia* species revealed the presence of different classes of secondary metabolites, such as saponins, terpenes, alkaloids and flavonoids, but most of the phytochemical studies done on different *Albizia* species lead to the isolation of saponins. Saponins are secondary metabolites of a glycosidic nature that are widely distributed among plant kingdom. The aglycon part maybe a steroidal or triterpenoidal chain or a branched form, most often composed of D-glucose, L-rhamnose, D-galactose, D-glucuronic acid, L-arabinose, D-xylose or D-fucose. Saponins have been used extensively in drug-related metabolites of a glycosidic nature that are widely distributed among different species of *Albizia* species lead to the isolation of saponins. Saponins are secondary metabolites of a glycosidic nature that are widely distributed among plant kingdom.

Pharmacological activities of extracts containing saponins from different *Albizia* species

Anti-inflammatory activity: The aqueous ethanolic extract of *A. amara* roots showed analgesic effect at dose of 200 mg/kg administrated to rats compared to the standard dose of aspirin (100 mg/kg). The analgesic effect was evaluated using hot plate method test [2]. The aqueous and ethanolic extracts of *A. lebbeck* leaves revealed analgesic effect at doses of 50, 100, and 200 mg/kg administrated to rats. The analgesic effect was evaluated using the hot plate test and tail flick method [4].

Nootropic and anxiolytic activity: The n-butanol fraction of the methanolic extract of *A. lebbeck* leaves showed nootropic and anxiolytic activity at dose of 25 mg/kg administrated to albino mice. This effect was evaluated using the elevated plus maze test [5].

Anti-histaminic activity: The ethanolic extract of *A. lebbeck* stem bark inhibited histamine signaling in sensitized rats at a dose of 200 mg/rat through suppression of H1 receptors and histidine decarboxylase genes (HDC) transcriptions [6].

Anti-microbial activity: The 70% aqueous ethanolic extract of *A. ferruginea* stem bark and leaves showed antimicrobial activity against *Staphylococcus aureus*, *Bacillus subtilis*, *Escherichia coli*, *Pseudomonas aeruginosa*, *Candida albicans*, *Aspergillus niger*, and *Penicillium notatum*. The anti-microbial activity was evaluated by calculating zone of inhibition where the leaves extract was more active and *P. aeruginosa* was resistant to both extracts [7].

Anti-spermatogenic activity: Oral administration of 50 mg/kg of a saponin-rich fraction obtained from the *A. lebbeck* stem bark for 60 days to male rats led to decrease in the weights of testes, epididymides, spermatid was reduced by 73.04% [8]. Pharmacological activity wasn’t only evaluated on extracts containing saponins, but it was also evaluated on pure isolated saponins. Table 1 and Figures 1-7 shows

*Corresponding author:* Singab AN, Department of Pharmacognosy, Faculty of Pharmacy, Ain Shams University, 11566, Cairo, Egypt, Tel: +2 02 2405 1120; Fax: +2022405 1107; E-mail: deang@pharma.asu.edu.eg, abdelnasser.sengab@pharma.asu.edu.eg

Received June 12, 2015; Accepted June 24, 2015; Published June 29, 2015


Copyright: © 2015 Singab AN, et al. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.
<table>
<thead>
<tr>
<th>Species</th>
<th>Investigated Part(s)</th>
<th>Isolated saponins</th>
<th>Pharmacological activity</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. adiantifolia</td>
<td>Root</td>
<td>Adiantifoliosides A [1 in Figure 1] Adiantifoliosides B [2 in Figure 1] Adiantifoliosides D [3 in Figure 1]</td>
<td>Compound [1 in Figure 1] and compound [3 in Figure 1] induced apoptosis in Jurkat cells at concentration of 5 µM and 1 µM, respectively.</td>
<td>Haddad et al. [15]</td>
</tr>
<tr>
<td>A. chinensis</td>
<td>Stem bark</td>
<td>Albizide D [4 in Figure 1] Albizide E [5 in Figure 1] Julibroside J8 [6 in Figure 1]</td>
<td>Compounds [4 in Figure 1] and [5 in Figure 1] showed cytotoxic activity on HCT-8, Bel-7402, BGC-823, As49, and A2780 cell lines. The IC₅₀ values for compound [4 in Figure 1] were: 7.7, 0.7, 0.08, 0.30 and 0.9 µM, on the five mentioned cell lines respectively. The IC₅₀ values for compound [5 in Figure 1] were: &gt;10, 0.6, 0.03, 1.2, and 0.3 µM, respectively.</td>
<td>Liu et al. [20]</td>
</tr>
<tr>
<td>A. coriaria</td>
<td>Root</td>
<td>Coriarioside A [7 in Figure 2] Coriarioside B [8 in Figure 2] Gummiferaside C [9 in Figure 2]</td>
<td>Compound [7 in Figure 2] and [9 in Figure 2] showed cytotoxic activity on HCT 116 and HT-29 cell lines The IC₅₀ values for compound [7 in Figure 2] were 4.2 µM and 6.7 µM, respectively. The IC₅₀ values for compound [9 in Figure 2] were: 2.7 µM and 7.9 µM, respectively.</td>
<td>Noté et al. [19]</td>
</tr>
<tr>
<td>A. gummifera</td>
<td>Stem bark</td>
<td>3-O-[(β-D-glucopyranosyl(1→2)]-L-arabinopyranosyl(1→6)]-β-D-glucopyranosyl]</td>
<td>No reports were traced for the pharmacological activity.</td>
<td>Debella et al. [14]</td>
</tr>
<tr>
<td>A. grandibracteata</td>
<td>Leaves</td>
<td>Grandibracteoside A [14 in Figure 4] Grandibracteoside B [15 in Figure 4] Grandibracteoside C [16 in Figure 4]</td>
<td>Compounds [14-16 in Figure 4] showed cytotoxic activity on KB and MCF-7 tumor cell lines. The IC₅₀ values for compound [14 in Figure 4] were: 1.3 µM and 0.4 µM, respectively. The IC₅₀ values for compound [15,16 in Figure 4] were: 2.3 µM and 1.7 µM, respectively.</td>
<td>Krief et al. [21]</td>
</tr>
<tr>
<td>A. inundata</td>
<td>Aerial parts</td>
<td>3-O-[α-L-arabinopyranosyl (1→6)]-2-acetamido-2-deoxy-β-D-glucopyranosyl acetic acid lactone [17 in Figure 5]</td>
<td>Saponins [17,19,22 and 23] showed cytotoxic activity on JMAR, MDA1986 and B16-F10, SK-MEL-28 cell lines. The IC₅₀ values for compound [17 in Figure 5] were: 4.7 µM, 8.7 µM, 7.3 µM, and 12.4 µM, respectively. The IC₅₀ values for compound [19 in Figure 6] were: 5.1 µM, 2.8 µM, 1.6 µM, and 9.2 µM, respectively. The IC₅₀ values for compound [22 in Figure 5] were: 6.9 µM, 10.1 µM, 9.0 µM, and 8.6 µM, respectively. The IC₅₀ values for compound [23 in Figure 5] were: 6.3 µM, 11.5 µM, 8.2 µM, and 8.1 µM, respectively.</td>
<td>Zhang et al. [16]</td>
</tr>
<tr>
<td>A. julibrissin</td>
<td>Stem bark</td>
<td>Julibroside J5 [26 in Figure 1] Julibroside J8 [6 in Figure 1] Julibroside J12 [27 in Figure 1] Julibroside J13 [28]</td>
<td>The Inhibition (%) against Bel-7402 cell line for the compounds [6, 26-28 in Figure 1] at a concentration of 100 µg/mL was 58.29, 86.66, 63.98, and 93.33, respectively.</td>
<td>[ Kun Zou et al. 2005]</td>
</tr>
<tr>
<td>A. mollis</td>
<td>Bark</td>
<td>Molliside A [29 in Figure 7] Molliside B [30 in Figure 7] Concinicoside A [31 in Figure 7] Albiziaasinapin A [32 in Figure 7]</td>
<td>No reports were traced for the pharmacological activities.</td>
<td>Cheng et al. [22]</td>
</tr>
</tbody>
</table>
the distribution of saponins among different *Albizia* species and their pharmacological activities.

**Results and Discussion**

Plants of the genus *Albizia* have been used in the traditional medicine worldwide for the treatment of rheumatism, stomach ache, and cough, diarrhea, for wound-healing and as an anthelmintic. In traditional Indian and Chinese medicine, *Albizia* plants have been used to treat insomnia, irritability, wounds, tuberculosis, as anti-dysenteric and as antiseptic.

Literature revealed that *Albizia* is rich in triterpenoidal saponins in which the aglycon part may be oleanolic acid, echinocystic acid, acacic acid lactone [20 in Figure 7]. Compounds [33 in Figure 6] and [20 in Figure 7] showed cytotoxic activity on HepG2 cell line. The IC$_{50}$ value for compound [33 in Figure 6] was: 9.13 µg/mL. The IC$_{50}$ value for compound [20 in Figure 7] was: 10 µg/mL.

Melek et al. [18]

A. subdimidiata Whole plant Albizia trioside A [35 in Figure 6] Albizia trioside B [36 in Figure 5]

Compounds [35 in Figure 5] and [36 in Figure 5] showed cytotoxic activity on A2780 cell line with IC$_{50}$ values of 0.9 µg/mL, and 0.8 µg/mL, respectively.

Abdel-Kader et al. [13]

**Table 1:** Distribution of saponins among *Albizia* species and their pharmacological activities.

<table>
<thead>
<tr>
<th>Species</th>
<th>Plant Parts</th>
<th>Saponins Isolated</th>
<th>Pharmacological Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. procera</td>
<td>Bark</td>
<td>Compounds [33 in Figure 6] and [20 in Figure 7]</td>
<td>Cytotoxic activity on HepG2 cell line.</td>
</tr>
<tr>
<td>A. subdimidiata</td>
<td>Whole plant</td>
<td>Compounds [35 in Figure 5] and [36 in Figure 5]</td>
<td>Cytotoxic activity on A2780 cell line with IC$_{50}$ values of 0.9 µg/mL, and 0.8 µg/mL, respectively.</td>
</tr>
</tbody>
</table>

**Figure 1:** Structures of the saponins isolated from genus *Albizia*.
R1    R2    R3
(7)  Ara  Glu  MT-Qui
(8)  Xyl  H    MT
(9)  Xyl  H    MT-Qui

Figure 2: Structures of the saponins isolated from genus *Albizia*.

R1=H

Figure 3: Structures of the saponins isolated from genus *Albizia*.
Figure 4: Structures of the saponins isolated from genus Albizia.

Figure 5: Structures of the saponins isolated from genus Albizia.
Figure 6: Structures of the saponins isolated from genus Albizia.

Figure 7: Structures of the saponins isolated from genus Albizia.
acid lactone or machaeronic acid γ-lactone while the sugar residue may be arabinose, xylose, rhamnose, fucose, glucose or 2-acetamido-2-deoxy glucose.

Most of these saponins have been reported to have cytotoxic activity on different cell lines, which highlights the importance of performing more in-depth studies in order to know the mechanism of the cytotoxic activity of these saponins and the structure activity relationship. Also, many extracts of different species of genus Albizia have been reported to have many pharmacological activities, such as antimicrobial activity of A. ferrugenia [9] and A. lebbeck [10], Anti-diabetic activity of A. odoratissima [11], and anti-depressant activity of A. julibrissin [12]. Therefore, further studies are required to determine whether these pharmacological activities are attributed to saponins or not [13-22].

References