Biological Activities of *Adenium obesum* (Forssk.) Roem. & Schult.: A Concise Review

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ABSTRACT

*Adenium obesum* (Forssk.) Roem. and Schult. is a succulent shrub commonly known as desert rose belongs to the family Apocynaceae. *Adenium obesum* is a native of Africa but nowadays is cultivated in several parts of the world including India as a popular ornamental plant. This plant represents one of the richest sources of phytochemicals such as glycosides and posses great potential for pharmaceutical and piscicultural applications. This review is therefore, an effort to give a detailed study of the literature on biological activities of *Adenium obesum*. It shows remarkable anticancer, antiviral, antibacterial, trypanocidal, acaricidal, molluscicidal, antioxidant and piscicidal activities. This review concludes that *Adenium obesum* has a great potential to treat various diseases, and could be used as a source for novel healthcare products in the near future, which requires further experimentation.

Keywords: *Adenium obesum*, Biological activities, Anticancer activity, Antibacterial activity

1. INTRODUCTION

Since time immemorial plants have been used as source of medicine. For thousands of years native peoples throughout the world have used traditional herbal medicine to treat many infectious human diseases [1]. Natural products and herbal medicines are a good source of new therapeutic agents and for the development of complementary and alternative medicines over traditional drug regimens [2]. In the last few years, there has been an exponential development in the field of herbal medicine, and these phytomedicines are gradually gaining popularity both in developed and developing countries due to their origin in nature, more potent intreatment of health problems and less side effects compared to marketed drugs [3-5]. Over half of the population of world depend on traditional medicine for healthcare, more than 80% of the less developed countries [6-8]. Medicinal plants are widely used by all sections of the human society either directly as medicines of folkloric value or indirectly as pharmaceutical formulation in modern medicine [9]. Between 10000 and 53000 species of plant are utilized in traditional medicine, and use of plants in medicine is an important and ubiquitous cultural trait [10,11]. The use of various parts of different medicinal plants to heal particular diseases has been in vogue from ancient times. Several diverse secondary metabolites are produced by plants that are not required for the immediate survival of the plant...
but are synthesized in response to stress as a measure of protection from microorganisms, diseases or from the environment [12]. A good number of secondary metabolites from plants possess significant biological activities with various applications [13]. These medicinal plants are usually known to exert their considerable diverse health benefits through the diverse phytochemicals they contain [14-19].

Adenium obesum (Forssk.) Roem. & Schult., a succulent plant commonly known as desert rose belongs to the dogbane family Apocynaceae is native from Africa such as Ethiopia, Kenya, Senegal, Somalia, Sudan and Tanzania, also found in Oman, Saudi Arabia and Yemen as wild plant [20-23]. It is one of the popular ornamental plants cultivated in many humid, tropical countries for decades such as India, Philippines and Thailand, with great relevance in the ornamental market due to its wide range of flower colour among cultivars, beautiful sculptural caudex and tolerance to drought stress [24-27]. The present review is a research update on Adenium obesum, an attractive shrub with significant medicinal attributes with an in-depth study of its biological activities.

2. PLANT DESCRIPTION

Adenium obesum is a beautiful deciduous pachycaul shrub with an attractive swollen trunk and fleshy, smooth, greyish-green to brown coloured, irregular-spaced branches that make it a unique and attractive for bonsai. Leaves are simple, spirally arranged at the ends of the branches and it produces lovely, variously coloured star-shaped flowers, but without fragrance. Terminal clusters of flowers are formed during the entire year. During summer the plant may be almost totally covered in blooms [25] (Fig. 1). Fruit is follicle and at maturity it splits along one side to release seeds with hairy pappus attached for dispersion by the wind [25].

Figure 1. Different parts of Adenium obesum. A. Flowers. B. Stem. C. Leaves

3. SYSTEMATIC POSITION

The systematic position of Adenium obesum is demonstrated as follows:

Kingdom: Plantae
Subkingdom: Tracheobionta
Superdivision: Spermatophyta
Division: Magnoliophyta
Class: Magnoliopsida
Subclass: Asteridae
Order: Gentianales
Family: Apocynaceae
Genus: Adenium Roem. & Schult.
Species: Adenium obesum (Forssk.) Roem. & Schult.

4. BIOLOGICAL ACTIVITIES

Adenium obesum is an important medicinal plant which shows a wide range of biological activities (Fig. 2). The plant exhibits anticancer, antiviral, antibacterial, trypanocidal, acaricidal, molluscicidal, antioxidant and piscicidal activities which are presented below.

4.1. Anticancer Activity

After several years of intensive research, various bioactive molecules from Adenium obesum were identified to prevent and treat the cancer disease. Ethanol extract of aerial part of A. obesum exhibited cytotoxic property against epidermoid carcinoma of the nasopharynx test system of human beings. The bioactive molecules in the extract were identified as the hongheloside A, honghelin, cardenolides somalin, and, 16-acetilstrospeside, and the flavonol 3,3′-bis(O-methyl)quercetin [28]. Yamauchi and Abe [29] isolated 30 cardiac glycosides and pregnanes from the roots and the stems of A. obesum. Oleandrigenin β-gentiobiosyl-β-thevetoside was the major glycoside and neridienone A and 16, 17-dihydrorneridienone A, common pregnanes in A. obesum, were isolated. Cepleanu et al [30] reported that the crude extracts of A. obesum exhibited very strong cytotoxicity against two human colon carcinoma cell lines. Two pregnanes possessing cytotoxic property against murine leukemia P388/S cells were isolated from the leaves of A. obesum [31]. Arai et al [32] isolated 17 cardiac glycosides from bioassay-guided fractionation of this plant extract. These compounds showed strong hedeghog Hh/GLI signalling inhibitory activities. The inhibition of GLI-
related protein expression was also observed in pancreatic cancer cells (PANC1) of human that express Hh/GLI components erroneously. The expressions of GLI-related proteins PTCH and BCL2 were inhibited. Further these active compounds also exhibited selective cytotoxicity against two cancer cell lines. Almehdar et al [33] reported that the methanolic extracts of A. obesum exhibited potential cytotoxic activity against three human cancer cell lines, such as, breast cancer (MCF7), cervix cancer (HELA) and hepatocellular carcinoma (HEPG2) cells.

4.2. Antiviral Activity

Methanolic extracts of Adenium obesum exhibited in vitro anti-influenza virus activity using influenza virus A/PR/8/34 (H1N1). The isolated active compound was identified as oleandrigenin-β-D-glucosyl (1→4)-β-D-digitalose [34].

4.3. Antibacterial Activity

The antibacterial activities of Adenium obesum have been proved against several bacterial strains (Table 1). Adamu et al [35] reported that the aqueous extract of stem bark of A. obesum have possess strong antibacterial potential against different hospital borne pathogenic bacterial strains, namely, Proteus mirabilis, Pseudomonas aeruginosa, Staphylococcus aureus and Escherichia coli. Methanolic and petroleum ether extracts of the stem-bark of A. obesum also exhibited potent antibacterial property against several pathogenic Gram negative bacteria strains, namely, Escherichia coli, Neisseria gonorrhoea and Salmonella typhi [36]. According to Tijjani et al [37] methanolic extract of A. obesum stem-bark in combination with oxytetracycline indicated strong antibacterial activity against the pathogenic bacterial isolates. Hossain et al [38] evaluated antimicrobial potency of different solvent extract of A. obesum stem against food-borne pathogenic bacterial strains in Oman. According to them the average range of inhibition potency crude extracts with different polarities was 0-24% by maceration method and inhibition potency 0-17% by soxhlet method. Hossain et al [39] reported that different crude extracts of the leaves of A. obesum have also possessed strong antibacterial activities against different pathogenic bacterial strains. Sharma et al [40] showed that methanolic extract of A. obesum leaves has potent antibacterial activity against Gram positive bacteria Staphylococcus aureus and Bacillus amyloliquefaciens and, ineffective against Gram negative bacteria Pseudomonas aeruginosa and Escherichia coli. Their study suggested that leaves of A. obesum plant can be exploited as an antibacterial agent which may be utilized as potent therapeutic agents for various infectious diseases.

4.4. Antioxidant Activity

Bungihan and Matias [41] reported considerable radical scavenging activities of ethanolic extract of Adenium obesum flower using DPPH assay from Nueva Vizcaya, Philippines. Ebrahim et al [42] also reported that Adenium obesum flower extracts are rich source of anthocyanins and possess a significant antioxidant activity. Alseini [43] reported high antioxidant activity of methanolic extract Adenium obesum flower in Saudi Arabia. In another work, antioxidant activity of methanolic extract of A. obesum stem was evaluating using DPPH assay and showed that different concentration and different crude extracts from the stems of A. obesum exhibited strong free radical scavenging activity. The strong free radical scavenging activity in different stems crude extracts might be due to high quantity of poly phenolic compounds [44]. According to AL-Ghudani and Hossain [45] different crude extracts of roots of Adenium obesum exhibited significant antioxidant activity by DPPH and maceration methods.

4.5. Trypanocidal Activity

Methanol extract of Adenium obesum stem bark exhibited significant trypanocidal activity against Trypanosoma brucei. Using a 1 h exposure time, methanol extracts of A. obesum stem bark stopped 50% of the motility of T. brucei in vitro at 4 mg/mL [46].

4.6. Larvicidal Activity

Dichloromethane extract of Adenium obesum tuber showed promising larvicidal activity against Aedes aegypti mosquito larvae, vector of yellow fever, dengue hemorrhagic fever diseases [30].

4.7. Acaricidal Activity

Aqueous stem bark extract of Adenium obesum showed effective acaricidal activity against the ticks Boophilus and Amblyomma [47].
Table 1. Antibacterial activity of different extracts of *Adenium obesum*

<table>
<thead>
<tr>
<th>Parts of <em>Adenium obesum</em> used</th>
<th>Solvent used for extraction</th>
<th>Bacteria tested</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stem bark</td>
<td>Aqueous</td>
<td><em>Escherichia coli, Proteus mirabilis, Pseudomonas aeruginosa, Staphylococcus aureus</em></td>
<td>[35]</td>
</tr>
<tr>
<td>Stem bark</td>
<td>Methanol, Petroleum ether</td>
<td><em>Escherichia coli, Klebsiella pneumoniae, Neisseria gonorrhoea, Pseudomonas aeruginosa, Salmonella typhi</em></td>
<td>[36]</td>
</tr>
<tr>
<td>Stem bark</td>
<td>Methanol</td>
<td><em>Bacillus subtilis, Corynebacterium ulcerans Escherichia coli, Klebsiella pneumoniae, Pseudomonas aeruginosa, Salmonella typhi, Staphylococcus aureus, Streptococcus pyogenes</em></td>
<td>[37]</td>
</tr>
<tr>
<td>Stem</td>
<td>Methanol</td>
<td><em>Escherichia coli, Proteus vulgaris Pseudomonas aeruginosa, Staphylococcus aureus</em></td>
<td>[38]</td>
</tr>
<tr>
<td>Leaves</td>
<td>Methanol</td>
<td><em>Escherichia coli, Proteus vulgaris Pseudomonas aeruginosa, Staphylococcus aureus</em></td>
<td>[39]</td>
</tr>
<tr>
<td>Leaves</td>
<td>Aqueous, Methanol</td>
<td><em>Bacillus amyloliquefaciens, Escherichia coli, Pseudomonas aeruginosa, Staphylococcus aureus</em></td>
<td>[40]</td>
</tr>
</tbody>
</table>
4.8. Molluscicidal Activity

Methanol extracts of *Adenium obesum* at sublethal concentration may be used to control the snail *Bulinus truncatus* as it inhibits biochemistry and physiology of the snail [48].

4.9. Piscidical Activity

*Adenium obesum* is a known piscidical plant [49]. The plant extract can be exploited for effective management of aquaculture pond against some undesirable weed predatory aquatic organisms in order to help safeguard native species and/or the stocked desired fish species [50]. The ethanol extract of *Adenium obesum* stem bark is very toxic which can be used as a tool for management of aquaculture pond before stocking of desired fish species was evaluated in *Clarias gariepinus* by Abalaka *et al* [51]. Abalaka *et al* [52] also reported that the plant extract treated fish exhibited signs of behavioural changes with respiratory distress, adaptive responses and nervous compromise as well as mortality in some of the extract treated fish.

5. CONCLUSION

In the present investigation, relevant literatures have been reviewed to congregate the information about biological activities of *Adenium obesum*. On the basis of the information given in the present review, it could be concluded that *Adenium obesum* is a very important and interesting medicinal plant with an enormous potential as anticancer, antibacterial, antiviral and other therapeutic agents and as a vast source of phytochemicals showing antioxidant activities. The biological activities showed by this plant suggest the development of therapeutic medicinal products for human uses. The therapeutic potential of the plant is yet to be exploited and more researches are required to upgrade the extraction and phytochemical analyses processes.

Conflict of Interest

The authors declare that they have no conflicts of interest.

References


