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Screening of select ornamental flowers of the family Apocynaceae for phytochemical constituents

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ABSTRACT

Objective: To examine the phyto-constituents present in some ornamental flowers of the family Apocynaceae. **Methods:** Aqueous, acetone, petroleum ether, chloroform and ethanol extracts of the flowers were prepared by adding 50 g of fresh fallen flowers of the family Apocynaceae (*Allamanda cathartica* Linn., *Allamanda violacea* Gardn. & Fielding, *Wrightia tinctoria* (Roxb) R.Br. and *Nerium oleander* Linn.) to 200 ml of these solvents; the constituents were shaken at room temperature for 24 h. After incubation, the extracts were filtered by using Whatman No.1 filter paper, collected and stored at 4°C. The extracts were concentrated by using vacuum evaporator and dried at 60°C. Preliminary phytochemical screening was performed by the Harborne method. **Results:** Different phyto-constituents such as alkaloids, phenolic compounds, flavonoids, saponins, glycosides, terpenoids, steroids, coumarins, quinones, phytosterols, proteins and carbohydrates were identified in the extracts. The presence or absence of the phyto-constituents depended upon the solvent medium used for extraction and the physiological property of the flowers. **Conclusions:** The findings of this study reveal that even ornamental flowers have potential antimicrobial compounds that may be of great use for developing plant-based drugs.

1. Introduction

Human beings have been utilizing plants for basic preventive and curative health care since time immemorial. Bioactive compounds derived from plant extracts have been reported scientifically for biological activities. Plants produce phytochemicals to protect themselves; but recent studies indicate that many phytochemicals can also protect humans against infectious diseases [1–5]. These biologically active ingredients are alkaloids, flavonoids, steroids, glycosides, terpenes and tannins [6–10]. There are innumerable potentially useful medicinal plants and herbs waiting to be evaluated and exploited for their effective therapeutic application [11].

Plants of the family Apocynaceae, commonly known as oleander or dogbane family, with about 200 genera and 2,000 species, are most commonly found in tropical and subtropical regions and have ornamental value. These plants are also well known for the alkaloids they contain,

many of which are poisonous, a number of which have since found their way into modern medicine.

Allamanda cathartica Linn. is a perennial shrub used in traditional medicine for treating malaria and jaundice. This plant is noted for its medicinal properties; all parts of the plant contain allamandin, a toxic iridoid lactone. The leaf extract of

A. cathartica was found to promote wound healing in Sprague Dawley rats [12]. The leaves are also the source of many bioactive compounds with anti-inflammatory activity [13]. The flower is also used as a laxative [14].

Phytochemical examination of *A. violacea* Gardn. & Fielding (common name: purple allamanda), an ornamental plant, indicated the presence of plumericin, isoplumericin and 5,6-dimethoxycoumarin [15]. The ethanolic extracts of the roots, leaves and stems of this plant have been reported to possess cytostatic, cytotoxic and anti-diabetic activities [16,17].

Nerium oleander Linn. is an evergreen shrub, commonly known as 'Arali' in Tamil, widely planted for its showy and fragrant flowers having religious and ornamental importance. The extracts of the leaves and flowers of *N. oleander* have cardio-tonic, diaphoretic, diuretic, emetic, expectorant and sternutatory properties. The decoction

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of the leaves is applied externally to treat scabies and to reduce swellings. This is a very poisonous plant, containing a powerful cardiac toxin. Because of its poisonous nature it is only used topically. The oil prepared from the root bark is used in the treatment of leprosy and diseases of scaly nature. The plant is also used as a rat poison, parasiticide and insecticide [18].

Wrightia tinctoria (Roxb) R.Br. is commonly known as 'Paalai' in Tamil. The bark of the plant is light grey, scaly and smooth [19], and its extract is used for treating dropsy and bilious problems [20,21]. It is considered to be effective against jaundice in the Indian indigenous system of medicine and possesses anti-inflammatory activity [22]. So far there are only a few studies pertaining to phytochemical constituents and pharmacological evaluation of the flowers of *W. tinctoria*.

Nowadays, most of the studies deal with plant parts other than flowers [23–25]. Hence this study was carried out to explore the phytochemical constituents of the floral extracts of select members of the family Apocynaceae such as *Allamanda cathartica*, *Allamanda violacea*, *Nerium oleander* and *Wrightia tinctoria*.

2. Materials and Methods

The flowers of *Allamanda cathartica*, *Allamanda violacea*, *Wrightia tinctoria* and *Nerium oleander* were collected from Scott Christian College (Autonomous), Tamil Nadu, India and identified by using the Flora of Scott Christian College Campus [26]. The flowers were examined carefully and old, infected and fungus-damaged flowers were removed. Extracts were prepared from fresh fallen flowers. Aqueous, petroleum ether, chloroform, ethanol and acetone extracts were prepared by adding 200 ml each of these solvents to 50 g of fresh flowers of each species in a conical flask and

shaking at room temperature for 24 h. After incubation, the extracts were filtered through Whatman No.1 filter paper and the filtrate used for phytochemical analysis as per the methods of Harborne [27].

3. Results

Preliminary phytochemical screening was done in various floral extracts of *A. cathartica*, *A. violacea*, *N. oleander* and *W. tinctoria*. The phytochemical constituents present are listed in Table 1. Aqueous extracts revealed the presence of phenols, flavonoids and carbohydrate in all the flowers, saponins in *A. cathartica*, *A. violacea* and *W. tinctoria*, glycosides in *A. violacea* and *W. tinctoria*, terpenoids in *A. violacea*, *W. tinctoria* and *N. oleander*, steroids in *A. cathartica*, *A. violacea* and *N. oleander*, coumarins in *A. cathartica* and *A. violacea*, quinones in *A. cathartica*, *W. tinctoria* and *N. oleander*, and phytosterols in *A. violacea* and *N. oleander*.

Petroleum ether extracts showed the presence of alkaloids in *W. tinctoria* alone, phenols in *A. violacea*, flavonoids in *N. oleander*, saponins in *A. violacea*, *W. tinctoria* and *N. oleander*, glycosides in *A. cathartica*, *A. violacea* and *W. tinctoria*, terpenoids and steroids in *A. cathartica*, coumarins in *A. violacea*, quinones in *A. violacea*, *W. tinctoria* and *N. oleander*, phytosterols in *A. violacea* and *N. oleander*, carbohydrate in *A. violacea* and *N. oleander*. Proteins were not detected in the petroleum ether flower extracts.

Chloroform extracts showed the presence of flavonoids and proteins in *W. tinctoria* and *N. oleander*, glycosides in *A. cathartica*, *A. violacea* and *W. tinctoria*, coumarins in *A. cathartica* and *N. oleander*, phytosterols in *A. cathartica*, *W. tinctoria* and *N. oleander* and carbohydrates in all the four flowers. Alkaloids, phenols, saponins, terpenoids,

Table 1

Preliminary phytochemical studies of floral extracts of *Allamanda cathartica* (A), *Allamanda violacea* (B), *Wrightia tinctoria* (C) and *Nerium oleander* (D).

Phytoconstituents	Solvents																			
	Aqueous				Petroleum ether				Chloroform				Ethanol				Acetone			
	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
Alkaloids	-	-	-	-	-	-	++	-	-	-	-	-	-	-	-	-	-	-	-	-
Phenolic compounds	++	++	++	+	-	++	-	-	-	-	-	-	-	+	++	-	+	-	+	++
Flavonoids	+++	+++	++	++	-	-	-	+	-	-	++	++	+++	+	++	+++	+++	+	++	+++
Saponins	+	+	++	-	-	++	++	++	-	-	-	-	+++	-	-	-	-	+	++	-
Glycosides	-	+	+	-	++	+	+++	-	+	++	+	-	+	-	-	-	-	-	-	-
Terpenoids	-	+++	++	++	++	-	-	-	-	-	-	-	-	+++	+	+++	+++	+++	+++	+++
Steroids	+	++	-	++	++	-	-	-	-	-	-	-	+++	+++	++	+++	+++	+++	+	+++
Coumarins	+	++	-	-	-	++	-	-	+	-	-	++	+++	++	+++	+++	+++	+++	+++	-
Quinones	++	-	++	++	-	++	++	++	-	-	-	-	+	++	-	-	-	+	-	++
Phytosterols	-	+	-	-	-	++	-	+	++	-	+++	+	-	++	+++	-	-	-	++	-
Protein	-	++	-	+++	-	-	-	-	-	-	+	++	++	++	+	-	+++	++	+++	+++
Carbohydrates	+	+	+	++	-	+	-	+	+++	+++	+++	+++	+	+++	-	+	+	+	-	++

Abbreviations: (-) absent; (+) low; (++) average; (+++) high.

steroids and quinones were not detected in the chloroform extracts.

Ethanol extracts showed the availability of phenols in *W. tinctoria* and *A. violacea*, flavonoids, steroids and coumarins in all the flowers, saponins and glycosides in *A. cathartica*, terpenoids in *A. violacea*, *W. tinctoria* and *N. oleander*, quinones in *A. cathartica* and *A. violacea*, phytosterols in *A. violacea* and *W. tinctoria*, proteins in *A. cathartica*, *A. violacea* and *W. tinctoria*, and carbohydrates in all the flowers except *W. tinctoria*.

Acetone extracts of these ornamental flowers showed the presence of phenols in *A. cathartica*, *W. tinctoria*, and *N. oleander*, flavonoids, terpenoids, steroids and proteins in all the four flowers, saponins in *A. violacea* and *W. tinctoria*, coumarins in *A. cathartica*, *A. violacea* and *W. tinctoria*, quinones in *A. violacea* and *N. oleander*, phytosterols in *W. tinctoria*, and carbohydrates in *A. cathartica*, *A. violacea* and *N. oleander*.

4. Discussion

The various phytochemical compounds detected from the flowers are known to have beneficial importance in medicinal sciences [28–32]. Recently, a number of studies have been carried out on the phytochemistry of plants across the world [33–37]. Ornamental flowers of the family Apocynaceae were selected for phytochemical screening in this study. The family is rich in alkaloids and some species are toxic to cattle and human beings. Various species of this family have a range of traditional uses. Several species are also widely grown for ornamental purposes [38].

Alkaloids were detected only in the petroleum ether extract of *W. tinctoria* and found to be absent in the other extracts. Alkaloids are generally used to treat diseases like malaria, reduce pain and manage heart diseases [39]. Suffredini *et al.* [40], who studied the efficacy of 38 aqueous and organic extracts obtained from 11 Amazonian Apocynaceae against *Staphylococcus aureus*, *Pseudomonas aeruginosa* and *Candida albicans*, found that the observed antimicrobial activity may be due to the presence of alkaloids.

The members of the family Apocynaceae are also known to contain cardioactive glycosides, as in *Allamanda* [41], *Nerium* [42,43] and *Wrightia* [44]. Glycoside compounds are containing a carbohydrate and non-carbohydrates residue (moiety) in the same molecule. In these compounds, the carbohydrate moiety is attached by an acetyl linkage carbon-I to the non-carbohydrate residue (aglycone). They all contain steroid as aglycone component in combination with sugar molecules. They are important in medicine because of their action on heart and are used in cardiac insufficiency [45]. Thus, cardiac glycosides are drugs and can be used in the treatment of congestive heart failure and cardiac arrhythmia. Generally, glycosides are non-volatile and serve as defense mechanisms of plants against predation by many microorganisms and herbivores [46].

Flavonoids found in flowers have been referred to as 'nature's biological response modifiers', because of their inherent ability to modify the body's reaction to allergies and

viruses; they also possess anti-allergic, anti-inflammatory, anti-microbial and anti-cancer properties [47]. Flavonoids obtained from the flowers of *N. oleander* were found to have high activity against *Staphylococcus aureus*, *Staphylococcus albus*, *Klebsiella* sp., *Candida albicans* and *Aspergillus niger* and moderate activity against *Pseudomonas* and *Proteus* sp. [18].

Steroidal compounds are of importance and interest in pharmacy. Synthetic steroids, which are widely used in modern medicine, have a range of side effects. But plant steroids are non-toxic and are known for their cardiogenic, insecticidal and antimicrobial properties. They are also used in nutrition, herbal medicine and cosmetics [48]. Phenols are a class of low-molecular-weight secondary metabolites found in most terrestrial plants. Phenolic compounds are the largest group of phytochemicals and account for most of the antioxidant activity in plants [49].

At lower concentrations tannins inhibit the growth of microorganisms and act as anti-fungal agents; at higher concentrations they act by coagulating the protoplasm of the microorganism [50]. Saponins are used as mild detergents and in intracellular histochemical staining. In medicine, they are used for treating hypercholesterolemia, hyperglycemia and weight loss, and have antioxidant, anticancer, anti-inflammatory and antifungal properties [51].

Recent studies indicate that some of the phytochemical constituents possess broad spectrum of bioactivity. The bioactive principle of the methanolic extract of *A. cathartica* showed high level of anti-inflammatory activity against carageenan-induced paw edema model in rats [52]. The chloroform soluble-fraction of *A. cathartica* showed high activity against *Shigella dysenteriae* [53]. Floral extracts of *A. violacea*, in particular, the ether and chloroform fractions, have good potentials for antioxidant use and lipid management [17]. Masduzzaman *et al.* [54] found that the total aqueous extract of *Allamanda* leaves exhibited higher inhibitory action against five pathogens than separated compounds. This indicates that some of the components essential for the inhibitory action might have been removed during the preparation of extracts in other solvents. Aqueous extract of *Allamanda* and separated compounds had antifungal properties and were potential agents for biological control of plant pathogens.

Phytochemical studies of the aqueous floral extract of *N. oleander* showed the presence of diverse bioactive compounds having higher anthelmintic activity when compared to the synthetic anthelmintic drug Albendazole [55]. Qualitative phytochemical analysis of the leaf extract of the plant also confirmed the presence of bioactive compounds with antioxidant activity [56]. The ethanolic extract of the latex of this species has potent piscicidal activity and its mode of action is the inhibition of the respiratory pathway of fish; as regards the anaerobic segments and adversely affects their oxidative metabolism and inhibits energy production by suppressing ATP synthesis [57].

The bark extracts of *Wrightia tinctoria* showed inhibitory activity against rat paw oedema [22]. The hydroalcoholic leaf extract of *W. tinctoria* showed very good antioxidant activity in DPPH, H₂O₂ and nitric oxide scavenging assays, with IC₅₀

values of $14.12 \pm 0.71 \mu\text{g/ml}$, $34.48 \pm 5.84 \mu\text{g/ml}$ and $71.47 \pm 5.95 \mu\text{g/ml}$ respectively. The high antioxidant potential of the extract may increase its antipsoriatic potential also. The antioxidant potential of a sample is important in any disease and is same with psoriasis, which is a chronic inflammatory skin disorder [58]. On the basis of the many studies referred to above, it is evident that the extracts of various species of Apocynaceae, including the presently studied species, have a wide range of bioactivity.

5. Conclusion

The ornamental flowers of *Allamanda cathartica*, *Allamanda violacea*, *Nerium oleander* and *Wrightia tinctoria* studied here can be potential sources of useful drugs with antimicrobial, antidiabetic and anti-inflammatory activities. Since these plants are commonly grown in Kanyakumari district, and produce a large number of flowers, these flowers can be a cheap source of efficacious drugs. Hence more advanced studies are needed in order to identify the bioactive principles to treat various human ailments.

Conflict of interest statement

We declare that we have no conflict of interest.

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