



A mini-review on the phytochemistry and biological activities of selected Apocynaceae plants

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ARTICLE INFO

Article Type:
Mini Review

Article History:
Received: 12 April 2019
Accepted: 21 June 2019

Keywords:
Phytochemistry, Biological activities,
Medicinal plants

ABSTRACT

This review aims at studying the phytochemistry and biological activities of some selected Apocynaceae plants. Eleven members of this family were reviewed for their phytochemistry and biological activities. Interestingly, the commonly isolated compounds reported from *Mondia whitei* (Hook.f.) Skeels, *Secondatia floribunda* A. DC, *Carissa carandas*, *Tabernaemontana divaricate*, *Nerium oleander*, *Wrightia tinctoria*, *Tabernaemontana divaricate*, *Alstonia scholaris*, *Carrisa spinarum* Linn, *Thevetia peruviana* and *Caralluma lasiantha* were triterpenoids, flavonoids, phytosterols, cardiac glycosides and lignans. All of them exhibited remarkable biological activities, mostly similar to each other. This review provides a detailed insight into the pharmacological activities of these selected members of this family.

Implication for health policy/practice/research/medical education:

This review provides a detailed insight into the pharmacological activities of Apocynaceae plants and showed that selected members of this family can be used as a reliable source for preparation of new drugs.

Please cite this paper as: Ekalu A, Ayo RG, Habila JD, Hamisu I. A mini-review on the phytochemistry and biological activities of selected Apocynaceae plants. J Herbmed Pharmacol. 2019;8(4):269-273. doi: 10.15171/jhp.2019.39.

Introduction

The plants used for medicinal purposes are known to be potential sources of therapeutics and play important role in our daily life (1,2). In developing nations, medicinal plants are used as alternative source of treatments (3) whereby the extracts and phytochemicals isolated from them have shown *in vitro* and *in vivo* biological activities (4).

Mankind has used herbal products to treat pains and to even cure different forms of ailments (4) for the past 60 000 years (5). Presently, over 50 % of natural drugs that are being used for medication, are derived from plants (5,6).

The World Health Organization (WHO) has reviewed that about 80% of the population all over the world use herbs to treat various ailments (7) as well as for their other healthcare needs (2).

Herbals are natural products that have been found to be safe because of the limited side-effects. Apart from the medicinal uses of these herbals, they are also used as dietary supplements assisting the human body as defensive mechanism against these diseases. These days, herbal products are being sold in powder form, tablets, capsules and tea extracts (4). Traditionally, herbal products are

seen to be harmless to people; they do not hesitate to take them without any prescription and in any dosage. However, some of these plants may be toxic and can cause grave health problems. However, some that are taken may not be effective and some may even interact with other drugs used. Assessing the quality and standard of these herbal products is very important so as to determine the bioactive ingredients that confers on them these huge medicinal potentials (8). This review provides a detailed insight into the pharmacological activities of these selected members of this family.

The Apocynaceae family

Apocynaceae family (also called the dogbane family) includes flowering plants which are made up of herbs, shrubs, trees, stem succulents and vines (5). The origin of members of this family were traced to the Europe, Asia, Africa, Australia, and American tropics or subtropics, with some temperate members (9). The former family called Asclepiadaceae (and now Asclepiadoideae) is considered to be a subfamily of the Apocynaceae which contains 348 genera (10). Many of these species are mainly the tall trees found in tropical forests. However, some members grow

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in tropical dry areas while some members are perennial herbs found in temperate zones (5). Many of these plants are known to have milky latex while some species of the family are known to be poisonous if ingested. For instance, *Adenium* a genera of the Apocynaceae family have been reported to have a milky latex while *Pachypodium* have only clear sap without latex (3).

Major characteristic features of this family are that almost all species are known to produce milky sap (10). Ethnomedicinally, the Apocynaceae family is being used to treat malaria, gastrointestinal ailments, fever, pain and diabetes as well as skin infections (10). Some of the Apocynaceae plants have been reported for the anticancer and antimalarial properties (1). This family is known as one of the largest and useful families in angiosperm

(6). Because of the huge medicinal values of this family, many of them have been used in the treatment of various ailments (11). They are also consumed by many tribes as food and used as poisons (1). The Apocynaceae plants are reported to be rich in triterpenoids, flavonoids, alkaloids, steroids, glycosides, phenols and lactones, (4,11). Phytochemicals like sugars, sterols and lignans as well as lactones have been reported in this family (4). Antimicrobial, anti-inflammatory, antioxidant and cytotoxic activities of crude extracts and the compounds isolated from various members of the Apocynaceae family have been reported (6,11). The summary of phytochemical and pharmacological activities of selected Apocynaceae plants is given in Table 1.

Table 1. Summary of the most important phytochemicals and pharmaceutical activities of selected Apocynaceae plants

Plant source	Phytochemicals	Biological activity	Ref.
<i>Mondia whitei</i> (Hook.f.) Skeels	Propacin, coumarinolignan, 5-cloropropacin, (-)-loliolide, 2-hydroxy-4-methoxybenzaldehyde and isovanilin, 2-hydroxy-4-methoxybenzaldehyde and 3-hydroxy-4-methoxybenzatdehyde (isovanillin)	Anti-inflammatory, aphrodisiac, antimicrobial, anti-tyrosinase and antioxidant activity.	(8,11-13)
<i>Secondatia floribunda</i> A. DC	Gallic acid, caffeic acid, cianidin, apigenin, catechin and quercetin.	Antibacterial activity clinically significant against strains of <i>Staphylococcus aureus</i> and <i>Escherichia coli</i> .	(7)
<i>Carissa carandas</i>	Rutin, epicatechin, quercetin, and kaempferol, Sitosterol glucoside, Triterpenoids, lupeol, betulinic acid, oleanolic acid, α -amyrin and β -amyrin, Oleanolic acid, carinol, carissanol, and (-)-nortrachelogenin.	Flavonoids exhibited anti-inflammatory activity against croton oil-induced edema in an albino mouse model with IC ₅₀ of 500 μ g/ml. Stigmasterol exhibited marked anti-inflammatory activity. The compounds exhibited anti-inflammatory activity against proinflammatory mediators such as nitric oxide (NO), tumor necrosis factor- α , and interleukin-1b. Exhibited anti-tumor activity, anti-plasmodial activity against the chloroquin-sensitive (D6) strains of plasmodium falciparum parasite with IC50 value of 1.95 Dg/ml.	(4,9,11,14-18)
<i>Tabernaemontana divaricata</i>	Calycosin and formononetin.	These flavonoids exhibited anti-inflammatory activity against croton oil-induced edema in an albino mouse model with IC ₅₀ of 500 μ g/ml.	(4,11)
<i>Nerium oleander</i>	oleandric acid and kaneroside.	Exhibited anti-inflammatory and anticancer activity.	(11)
<i>Wrightia tinctoria</i>	wrightial and lupeol, stigmasterol, β -sitosterol, campesterol, phytosterol and lanosterol.	These triterpenoids exhibited antimicrobial, anti-inflammatory, and antitumor activity. Exhibited hepatoprotective, anti-inflammatory, and antihyperlipidemic activities	(4,11,15)
<i>Tabernaemontana divaricata</i>	Taraxasterol acetate.	Exhibited antimicrobial, anti-inflammatory, and antitumor activity.	(4,11)
<i>Alstonia scholaris</i> .	Alstonic acids and oleanolic acid, stigmasterol, β -sitosterol, and campesterol.	These triterpenoids exhibited antimicrobial, anti-inflammatory, and antitumor activity. Exhibited hepatoprotective, anti-inflammatory, and antihyperlipidemic activities	(4,11)
Spinarum Linn	odoroside and evomoside.	Exhibited antimicrobial, anti-inflammatory, and antitumor activity.	(4,17,19)
<i>Thevetia peruviana</i>	Thevefolin.	Thevefolin was reported to be effective for TRAIL resistance in human gastric adenocarcinoma cells.	(4,20)
<i>Caralluma lasiantha</i>	luteoline-4-O-neohesperidoside and 3 β ,14 β -dihydroxy-14 β -pregn-5-en-20-one.	Exhibited antibacterial activity against both Gram (-) bacteria and Gram (+) bacteria	(2,17,21)

Phytochemistry and biological activities of Apocyanaceae family

Biological assays have been done on *Mondia whitei* (Hook.f.) Skeels including anti-inflammatory, anti-tyrosinase, antimicrobial, anti-aphrodisiac and antioxidant activities (8). The qualitative phytochemical analysis of ethanol extract of *M. whitei* led to the isolation of propacin, coumarinolignan, 5-chloropropacin,

(-)-loliolide, 2-hydroxy-4-methoxybenzaldehyde and isovanillin (12).

A methylene chloride extract of *Mondia whitei* (Hook.f.) Skeels yielded various compounds including 2-hydroxy-4-methoxybenzaldehyde and 3-hydroxy-4-methoxybenzaldehyde (isovanillin) (11,13). The chemical structure of some compounds isolated from selected Apocynaceae plants are given in Figure 1.

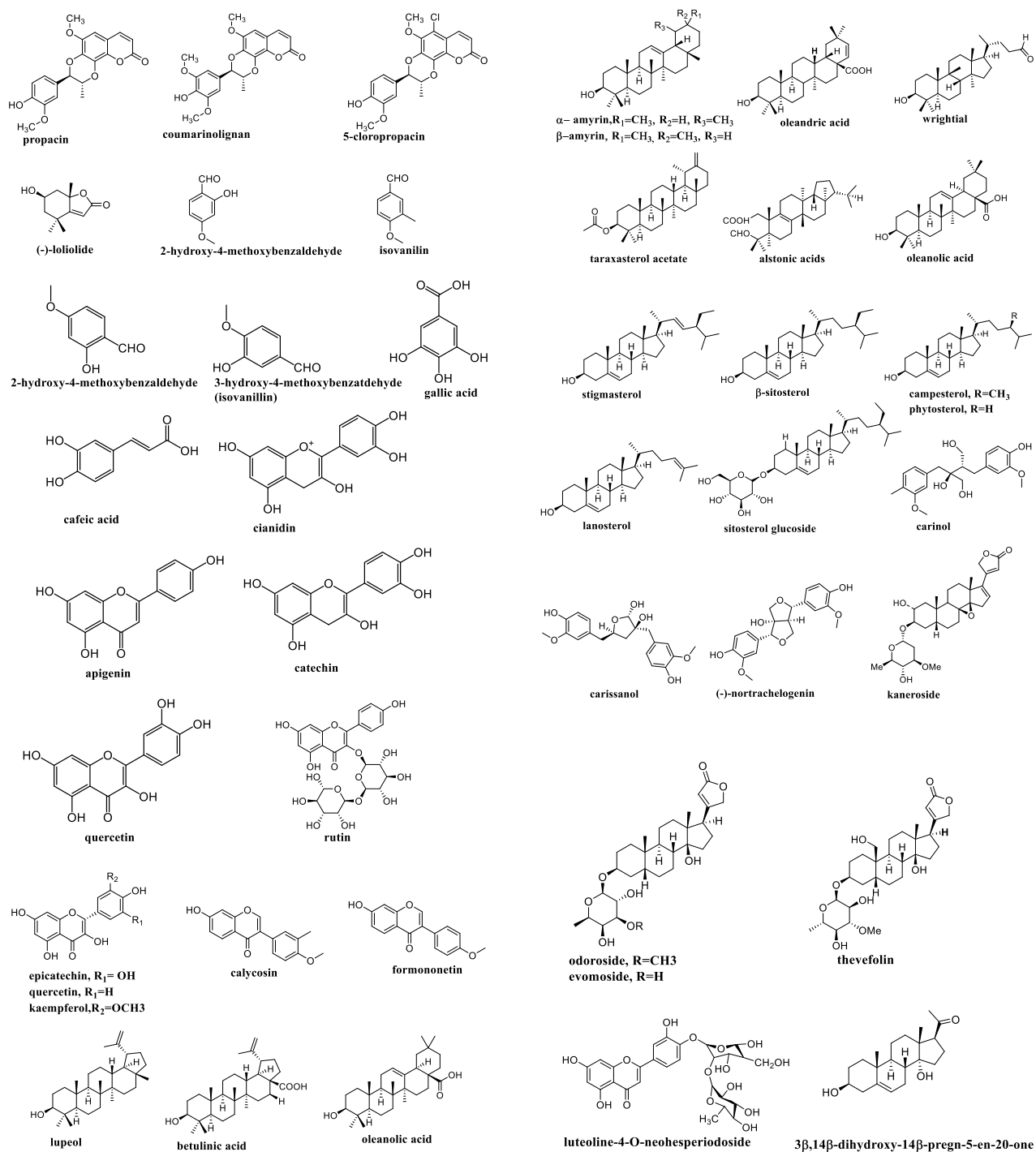


Figure 1. Chemical structure of some compounds isolated from selected Apocynaceae plants.

The phytochemical investigation of the ethanol extract of the stem bark of *Secondatia floribunda* A. DC (Apocynaceae) showed antibacterial activity clinically significant against strains of *Staphylococcus aureus* and *Escherichia coli* (13). The compounds isolated from this extract were gallic acid, caffeic acid, cianidin, apigenin, catechin and quercetin (7,13).

Also, rutin, epicatechin, quercetin and kaempferol were isolated from *Carissa carandas* fruits as principal flavonoids with the total flavonoid content of 4.8 mg/100 g (1). The root and stem extracts of *Tabernaemontana divaricata* were also reported to contain novel flavonoids, calycosin and formononetin (1). All of these flavonoids exhibited anti-inflammatory potential against croton oil-induced edema in an albino mouse model with IC_{50} of 500 μ g/mL (1,11).

Triterpenoids, lupeol, betulinic acid, oleanolic acid, α -amyrin and β -amyrin were largely distributed in the leaves, roots, and fruits of the *Carissa* genus (15). A novel oleandric acid isolated from *Nerium oleander* exhibited anti-inflammatory and anticancer potential (4,11). Phytochemical investigation of *Wrightia tinctoria* led to the isolation of a new triterpenoid, wrightial, and known lupeol (4). Taraxasterol acetate was isolated from the roots and stem of *T. divaricata* (4,11). Alstonic acids and oleanolic acid were reported from the leaves of *Alstonia scholaris*. These triterpenoids exhibited antitumor, antimicrobial and anti-inflammatory activities (15). Oleanolic acid exhibited anti-inflammatory activity against proinflammatory mediators such as nitric oxide (NO), tumor necrosis factor- α (TNF- α), and interleukin-1b (4,16).

Bioactivities exhibited by phytosterol include anti-inflammatory, hepatoprotective and antihyperlipidemic activities (11). *Wrightia tinctoria* and *Alstonia scholaris* contain various kinds of phytosterols such as stigmasterol, β -sitosterol, and campesterol. Also, uncommon sterols, phytosterol and lanosterol were reported from *Wrightia tinctoria* seeds. Sitosterol glucoside was isolated from *Carissa carandas* roots. Stigmasterol from *Carissa carandas* has shown marked anti-inflammatory activity (4,14).

Carinol, carissanol and (-)-nortrachelogenin were isolated from the root extract of *Carissa carandas* (15).

A cardiac glycoside, kaneroside was isolated from the leaves of *Nerium oleander* (21). Cardiac glycosides were also isolated from the roots of *Carissa carandas* (4) and identified as odoroside and evomoside (19). Thevefolin was reported as a cardenolide of *Thevetia peruviana*. Thevefolin was reported to be effective for TRAIL resistance in human gastric adenocarcinoma cells (20).

Caralluma lasiantha has been studied for its phytochemical potential and the crude extract led to the isolation of luteoline-4-O-neohesperidoside and 3 β ,14 β -dihydroxy-14 β -pregn-5-en-20-one which exhibited antibacterial activity against both Gram (-) bacteria and Gram (+) bacteria (21).

Conclusion

The Apocynaceae plants have been reported for their vast medicinal potentials. In this study, eleven members of the Apocynaceae plants were reviewed for phytochemical constituent and biological properties. The most important phytochemicals commonly isolated from these plants were triterpenoids, flavonoids, phytosterols, cardiac glycosides and lignans. These phytochemicals were reported to exhibit similar biological activities. We also noted that all of them possess a wide range of biological properties. The ethnomedicinal uses of the Apocynaceae plants in treatment of various kinds of ailments might probably be due to these bioactive constituents.

Authors' contributions

AE prepared the manuscript while authors RGA, JDH and HI supervised the research. All authors contributed equally in planning and carrying out this study. All authors read the manuscript and confirmed the publication for final version.

Conflict of interests

No conflicts of interest among the authors.

Ethical considerations

Ethical issues have been observed by the authors.

Funding/Support

This study receives no funding or grant.

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