



A review of medicinal plants of the genus *Cordia*: Their chemistry and pharmacological uses

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Abstract

The plants of genus *Cordia* comprise of trees and shrubs which are widely distributed in warmer regions. The plants of this species have long been used in traditional and folk medicine for treating various illnesses. Some plants in this species were exhaustively explored and some others are yet to be. Substantial progresses on their chemical and pharmacological properties of some species have been made. In India, the fruits of this species are consumed as vegetable. The pharmacological studies carried out with extracts and purified compounds indicates that the plants of *Cordia* species possess analgesic, anti-inflammatory, antimicrobial, antiviral and antifertility activities. Various compounds like flavonoids, triterpenes, tannins, alkaloids and fatty acids possessing wide range of bioactivities were isolated from different plant parts of *Cordia* species. Based on these reports it is clearly indicated that the plants of *Cordia* genus possess potential therapeutic actions.

Key words: *Cordia*, glycosides, alkaloids, cytotoxic, anti-inflammatory, antimicrobial activities

1. Introduction

Natural products have served as a major source of drugs for centuries, and about half of the pharmaceuticals in use today are derived from natural products. The use of natural substances, particularly plants, to control diseases is a centuries old practice that has led to the discovery of more than half of all modern pharmaceuticals [1]. A growing world wide interest in the use of phytopharmaceutical as complimentary or alternative medicine either to prevent or ameliorate many diseases has been noted in recent years.

Cordia is a genus of trees or shrubs, sometimes subscendent in the borage family Boraginaceae. About 300 species have been identified worldwide, mostly in warmer regions. The plant parts like fruits, leaves, stem bark, seeds and roots of most species of plants of the genus *Cordia*, especially *Cordia dichotoma*, *C. myxa*, *C. oblique*, *C. verbenacea*, *C. martinicensis*, *C. salicifolia*, *C. spinescens*, *C. latifolia*, *C. ulmifolia*, among others, has long been used in traditional medicine for cicatrizant, astringent, anti-inflammatory, anthelmintic, antimalarial,

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diuretic, febrifuge, appetite suppressant, cough suppressant and to treat urinary infections, lung diseases and leprosy [2-4].

The aim of this review is to provide an overview on the recent status of chemical and pharmacological relevance of the extracts and active constituents isolated and identified in some of the plants belonging to the genus *Cordia*.

2. Biological investigations

The use of plants of *Cordia* species were highlighted in traditional literatures of Ayurveda and Materia Medicas. These plants were screened for many pharmacological activities and are listed in table 1.

The plants of the genus *Cordia* serve as a rich source of phytoconstituents. A wide range of compounds like Phenolics (Fig: 1), Flavonoids, Pyrrolizidine alkaloids, Cardiaquinones (Fig: 2), Tannins, Phenyl propanoid derivatives (Fig: 3) and triterpenes (Fig: 5) are observed. Some of these isolated compounds were reported to be

bioactive. A new meroterpenoid benzoquinone isolated from roots of *Cordia globosa* was compared for cytotoxic action with doxorubicin and the results were found statistically significant.

Triterpenoid benzoquinones were very commonly reported from *Cordia* species whereas rarely some cerebrosides (Fig: 4) were reported from *Cordia platythyrsa* [75]. Rosmarinic acid (Fig: 3) is an ester of caffeic acid and 3, 4-dihydroxyphenylactic acid [2-O-caffeoyl-3-(3, 4-di-hydroxy-phenyl)-L-lactic acid] was isolated from *Cordia verbenacea* by using semi preparative HPLC technique [47]. A polysaccharide isolated from *Cordia abyssinica* [48] was studied for emulsifying properties and exhibited best results between pH 7 and 11. Apart from these, various essential oils and fatty acids were also isolated from various *Cordia* species. A detailed data of compounds isolated from various plants of *Cordia* species are given in table 2.

Table 1. Biological Investigations

Species	Part Used	Reported Activity	Ref
<i>Cordia alliodora</i> (Ruiz & Pav.) Oken.	Root bark	Antifungal, larvicidal	5
<i>Cordia corymbosa</i> Willd. ex Roem. & Schult.	Fruits	Antimicrobial, Cytotoxic, Tumour inhibition	6
<i>Cordia curassavica</i> (Jacq.) Roem. & Schult.	Roots	Antifungal, Larvicidal Antibacterial	7 8
<i>Cordia cylindrostachya</i> Roem.& schult		Antibacterial, Anti-inflammatory	9
<i>Cordia dichotoma</i> G. Forst.	Fruits	Anthelmintic	10
	Fruits	Wound healing	11
	Leaves	Antifertility	12
		Juvenomimetic	13
		Biliary obstruction	14
		Nutritional food	15
<i>Cordia fragrantissima</i> Kurz.	Wood	Leishmanicidal	16

<i>Cordia francisci</i> Ten.	Leaves	Analgesic, Anti-inflammatory	17
<i>Cordia globosa</i> (Jacq.) Kunth.	Root	Cytotoxic	18
	Leaves	Vasodilator, Spasmolytic	19
<i>Cordia goetzei</i> Gürke.	Stem bark	Antifungal	20
<i>Cordia latifolia</i> Roxb.	Ripen fruits	Anti-Ulcer	21
		Antihistaminic	22
<i>Cordia linnaei</i> Stearn.	Roots	Antifungal, larvicidal	23
<i>Cordia martinicensis</i> (Jacq.) Roem. & Schult.	Leaves	Cytotoxic, Hepatotoxic	24, 25
		Anti-inflammatory, Analgesic	17
<i>Cordia monosperma</i> (Jacq.) Roem. & Schult.	Aerial parts	Antimicrobial	26
<i>Cordia multispicata</i> Cham.	Leaves	Antiandrogenic activity	27
<i>Cordia myxa</i> L.	Leaves	Anti-inflammatory	28, 17
		Analgesic, Anti-arthritic	29
	Fruits	Astringent, Anthelmintic	
		Diuretic, demulcent	30
	Leaves	Cytotoxic	25
	Fruits, leaves	Antimicrobial	31
		Alcoholic liver cirrhosis	32
	Bark	Antifertility	33
Antihistaminic		34	
Antitumour		35	
<i>Cordia oblique</i> Willd.	Seeds	Anti-inflammatory	36
<i>Cordia perrottettii</i> DC.	Fruits	Antioxidant	37
<i>Cordia plauhiensis</i> Fresen.		Larvicidal	38
<i>Cordia salicifolia</i> Cham.	Whole plant	Antiviral	39
		Excitatory & negative Iontropic effect	40
<i>Cordia serratifolia</i> Kunth.	Leaves	Analgesic, Anti-inflammatory	17
<i>Cordia sinensis</i> Lam.	Leaves	Antitumour	35
<i>Cordia spinescens</i> L.	Leaves	Antiviral	41
	Leaves	Anti-HIV	42
<i>Cordia ulmifolia</i> Juss. ex Dum. Cours.	Leaves	Cytotoxic, Hepatotoxic	24, 25
	Leaves	Anti-inflammatory, Analgesic	17
<i>Cordia verbenacea</i> DC.	Leaves	Anti-inflammatory, Analgesic, Fetus toxicity	43, 44, 45
	Aerial parts	Antimicrobial	46
	Leaves	Antiserum action, Potentiation	47

Table 2. Chemical Investigations

Species	Phytoconstituents	Part Used	Ref.
<i>Cordia abyssinica</i> R.Br.	Polysacharides, gums	Fruits	48, 49
<i>Cordia alliodora</i> (Ruiz & Pav.) Oken	Alliodorin	Root bark	5
	Tetracyclic di-o-methyl hydroquinone	Heart wood	50
<i>Cordia corymbosa</i> Willd. ex Roem. & Schult.	Meroterpenoid quinones-Cardiaquinone A & B	Roots	51
	Cardiaquinone C & D	Roots	52
<i>Cordia Cylandrostachya</i> Roem.& schult.	α -pinene, amphen, tricylene		9
<i>Cordia decandra</i> Hook. & Arn.	Menisdaurin, dhurrin, p-hydroxybenzaldehyde	Leaves	53
<i>Cordia dentata</i> Poir.	Rosmarinic acid, Quercetin, 3-o-rutinoside	Flowers	54
<i>Cordia dichotoma</i> G. Forst.	Arabinoglucan	Fruits	55
	D-Glucose, L-Arabinose	Fruits	56, 57
	γ -linolenic acid	Seed	58
	Quercetin, quercitrin	Leaves	59
<i>Cordia globosa</i> (Jacq.) Kunth.	7- methoxy flavone, 5-7, 3', 4'-tetrahydroxy methoflavone	Aerial parts	60
	Meroterpenoid benzoquinone, Napthoquinone	Roots	18
<i>Cordia goetzei</i> Gürke	Cordigone, cordigole, benzofurons.	Stem bark	20
<i>Cordia linnaei</i> Stearn	Isomeric meroterpenoid		
	Napthoquinone		61
	Napthoxirene	Roots	23
<i>Cordia macleodii</i> Hook. f. & Thomson	p-hydroxyphenylactic acid, Quercetin	Leaves, Flowers	62
<i>Cordia multispicata</i> Cham.	Cordinol A, Cordialin A	Leaves	63
<i>Cordia myxa</i> L.	Quercitrin or rutin	Leaves	64, 65
	Fixed oils	Seeds	66
	α -linolenic acid, linoleic acid, oleic acid, β -sitosterol	Leaves	67
	Carotenoids	Leaves	31
	Pyrrolizidine alkaloids	Leaves	68
	Saponins	Bark	69
	Minor minerals-Chromium		70

<i>Cordia obliqua</i> Willd.	Hesperetin-7-rhamnoside	Root	71
	Lupa-20, 29-ene-3-o- β -		
	D-maltoside	Root	72
	Toxifolin-3, 5-dirhamnoside	Seeds	73
	Natural gums, mucilages	Fruits	74
<i>Cordia platythyrsa</i> Baker	Cerebrosides	Stem bark	75
	Cordiachromes A-F	Heart wood	76
<i>Cordia plauhiensis</i> Fresen.	Saponins	Stem	77
<i>Cordia rothii</i> Roem. & Schult and <i>Cordia sebestina</i> L.	Linoleic and oleic acids,		
	β -Sitosterol	Leaves	78
<i>Cordia spinescens</i> L.	Magnesium lithospermate,		
	Magnesium rosmarinate,		
	Calcium rosmarinate	Leaves	79
<i>Cordia trichotoma</i> (Vell.) Arráb. ex Steud.	α -cadinol, α -muurolol	Heart wood,	
	Epi- α -muurolol	Sapwood	80
<i>Cordia verbenacea</i> DC.	α -pinene, trans-Cariophyllene,		
	Aloaromadendrene	Aerial parts	81
	Cordialin A, Cordialin B	Leaves	82
	Rosmarinic acid	Leaves	83
	Flavanols-artemetin, Brickelin	Aerial parts	84

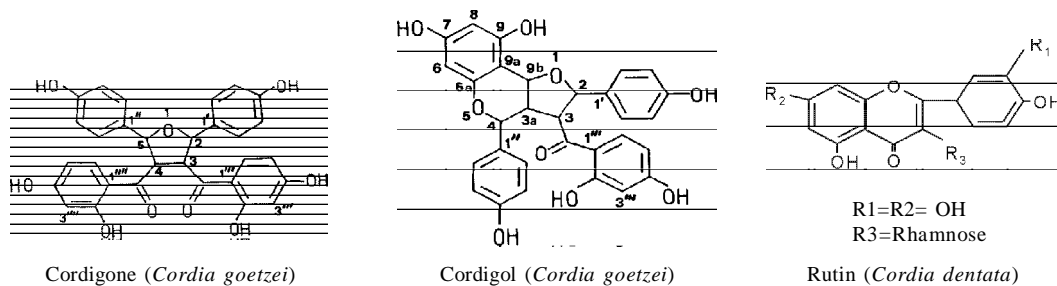


Fig. 1: Phenolic compounds isolated from various species

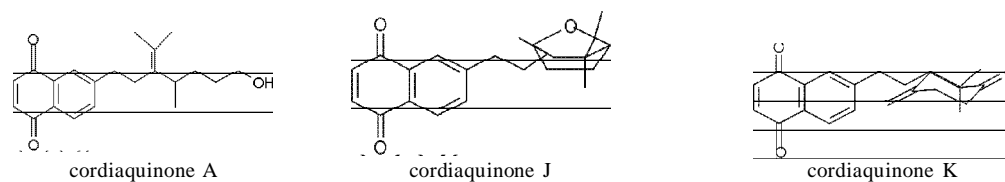


Fig. 2: Cordiaquinones isolated from *Cordia curassavica*

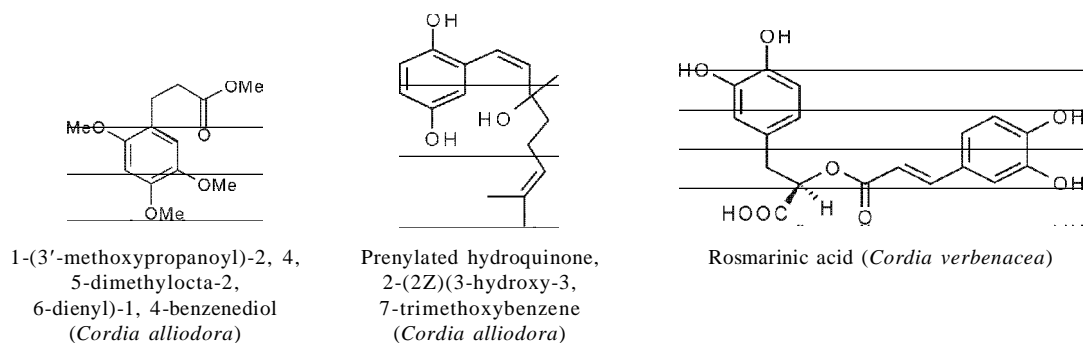
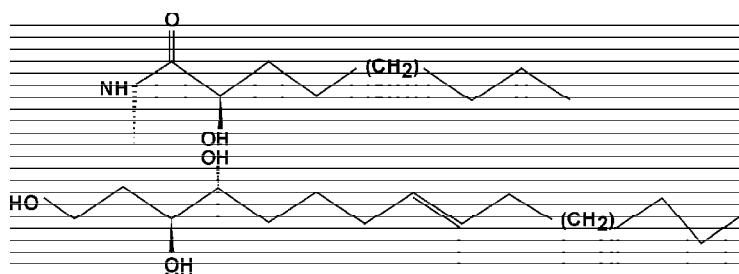
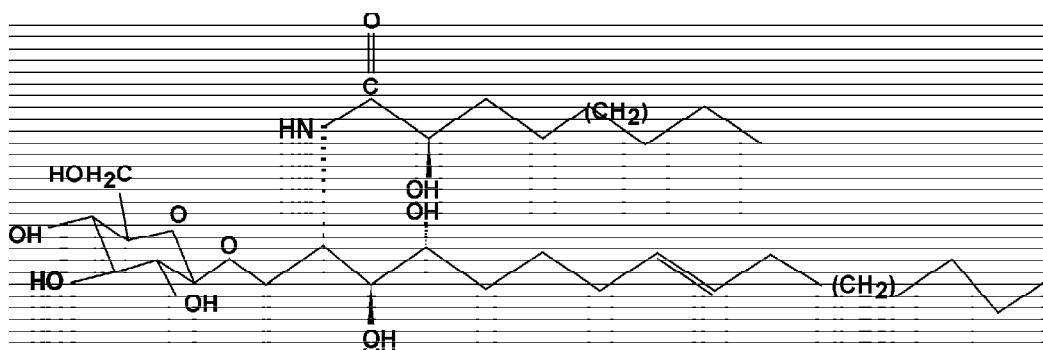


Fig 3: Phenyl propanoid derivatives from various *Cordia species*



(2S, 3S, 4R, 8E)-2N-[(2R)-2-hydroxy-tetracosanoyl]-8(E)-octadecene-1, 3, 4-triol



1-O-(b-D-glucopyranosyl)-(2S, 3S, 4R, 8E)-2N-[(2R)-2-hydroxy-tetracosanoyl]-8(E)-octadecene-1, 3, 4-triol

Fig. 4: Cerebrosides isolated from *Cordia platythyrsa*

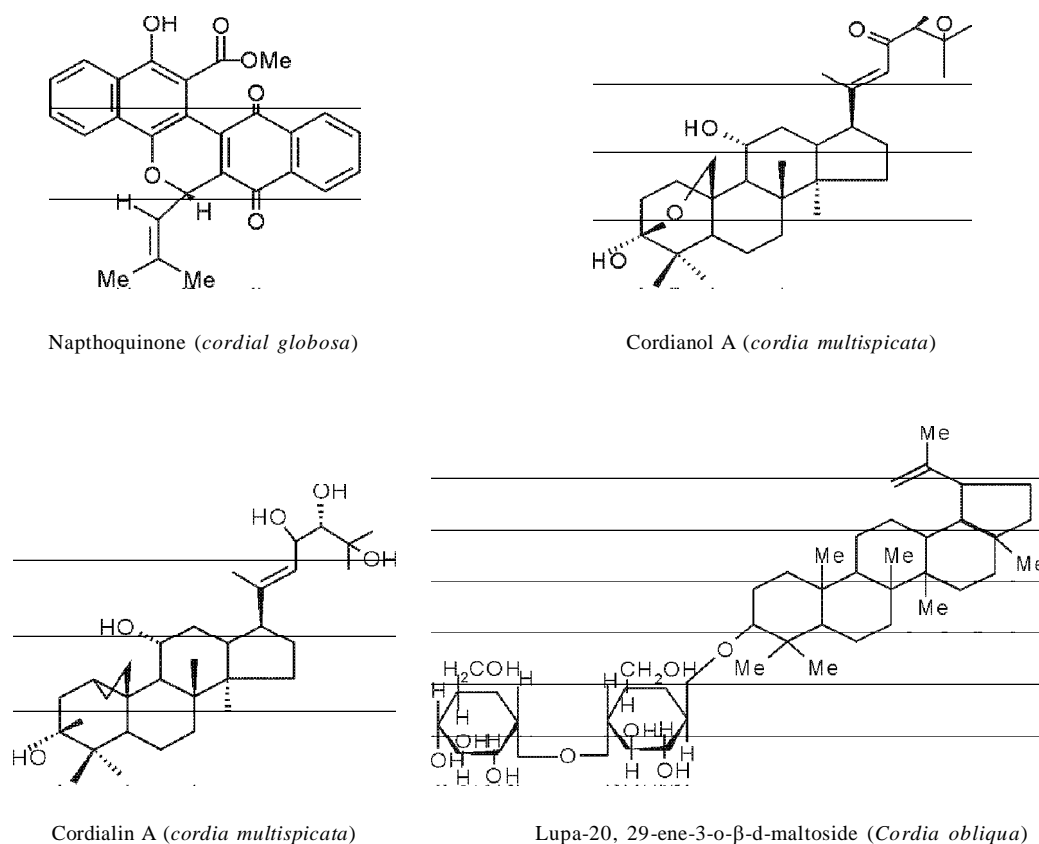


Fig. 5: Terpenoids isolated from various *Cordia* species

3. Discussion

The scientific evidence on the plants of *Cordia* species indicates the traditional usage of this species for treating different ailments was highly justified. Extensive phytochemical studies carried out on these plants and wide classes of compounds including flavanol glycosides, pyrrolizidine alkaloids, triterpenes, cardiaquinone, sphingolipids, cerebroside were isolated. *Cordia verbenacea* is one of the ingredients in the formulation “Acheflan” manufactured by Brazilian Ache laboratories [85]. Most of the activities of *Cordia* species were proved in animals. The lack of clinical studies on the *Cordia* species is well indicated

in this review. Similarly few reports are there on standardization of the bioactive compound present in the plants of this species. The polysaccharides isolated from *Cordia abyssinica* open the doors for development of new natural hydrocolloids [72] and emulsifiers [71].

4. Conclusion and perspectives

The present need for development of new therapeutic agents from natural sources had made the researchers to refresh and uncoil the literatures. This review gives a comprehensive data of compounds isolated and biological studies reported in this species. It is clear that *Cordia* species contains various compounds like

flavanol glycosides, pyrrolizidine alkaloids, triterpenes, cardiaquinones, sphingolipids, cerebrosides. Most of the traditional uses were scientifically proved in animal models. Some of the activities reported were anti-inflammatory, cytotoxic, antiviral, antimicrobial, anti-Ulcer, antifungal, larvicidal antiandrogenic activity. No potential side effects were reported from any of these plants where as hepatoxic effect was

reported from *C. ulmifolia*. Still the clinical effectiveness and other safety specifications about the doses are not clear. Development of suitable methods for effective isolation of bioactive compounds and reliable analytical techniques are future research perspectives. More over some plants of this species indicated the scope not only for development of new phytotherapeutic agents but also new pharmaceutical excipients.

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