TANG HUMANITAS MEDICINE

Review

A better understanding of traditional uses of *Careya arborea* Roxb.: Phytochemical and pharmacological review

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ABSTRACT

Careya arborea Roxb. (Lecythidaceae) is a significant medicinal plant known as kumbhi in Ayurveda. Though, most of the plant parts are used in traditional systems of medicine, bark and leaves constitute the important medicinal parts. The present review gives an account of the updated information on its phytochemical and pharmacological properties. The review reveals that numerous phytochemical constituents have been isolated from the plant possessing hepatoprotective, antioxidant, antimicrobial, anticoagulant, analgesic, antidiarrhoeal and various other important activities. Leaves are used in filaria, colic, loose motions and ulcers. Bark is used as an antipyretic, abortifacient, antipruritic and in smallpox, urinary discharges and rheumatic pain. Since last few decades, extensive exploration has been done to establish the biological activities and pharmacology of the extracts and plentiful chemical constituents including flavonoids, tannins, alkaloids, terpenoids and many other have been isolated.

Keywords *Careya arborea*, kumbhi, phytoconstituents, pharmacological activities

INTRODUCTION

Careya arborea Roxb., commonly known as wild guava, is a medium sized deciduous tree; exhibiting dark grey colour and exfoliating in thin strips. It is widely available in India, Ceylon, Malay and Peninsula.

The word Lecythidaceae means large tropical trees bearing large fruits with woody skins (wikipedia.org). Lecythidaceae is a family of tropical trees and consists of about 20 different genera and 450 different species. The family is generally concentrated in the wet regions of tropical South America, with some genera in Africa and Asia.

The stem bark is used in the treatment of tumours, bronchitis, epileptic fits and skin diseases (Kirtikar et al., 1975). It is also used as a remedy for diarrhoea (Sikarwar et al., 1994), dysentery with bloody stools and ear pain (Bhandary et al., 1995; Girach et al., 1994). It is a leech repellent, fish poison and antivenin activities have been also reported in the literature (John 1984; Selavanayahgam et al., 1994; Talapatra, 1981).

Geographical source

A deciduous tree found throughout India up to an altitude of 1,500m and in Andaman Islands. It is planted in gardens and roadsides for its large conspicuous leaves and showy flowers and fruits (Kumar et al., 2010; Sharma et al., 1996).

Morphology

A handsome tree up to 20 m in height with a spreading crown; leaves are alternate, 15 - 30cm long and 7.5 - 15 cm wide, broadly obovate or oblong-ovate, apex rounded, obtuse or shortly acuminate, margins are crenate- denticular, rather membranous, glabrous, 10 - 12 pairs of lateral leaves; petiole is 0-1.8 cm, long, stout and margined, crowded at the ends of the branches, penninerved, not dotted and are red when young. Flowers are large and handsome, in racemes or interrupted spikes, white-pink or yellowish white, 6.3 - 9 cm across, foetid, born in thick swollen hard terminal spikes each with a central elliptic bract and two linear lateral ones, showy, crowned with persistent calyx, ill smelling and sessile. Fruits are large, globose, fleshy, and indehiscent and are crowned with the calyx-limb and are 6.3 - 7.5 cm in diameter. Seeds have large embryo and obsolete cotyledons nesting in fleshy pulp (Parrotta et al., 2001).

Physical Evaluation

The physical evaluation of *Careya arborea* bark indicated: total ash (12%), sulphated ash (9.49%), water soluble ash (2%), acid insoluble ash (0.9%), water soluble extractive value (16%), alcohol soluble extractive value (7.2%) and loss on drying (14%) (Wadkar et al., 2009).

Traditional Uses

Careya arborea as a whole plant and different parts has a long history of being used for a variety of medicinal uses (Table 1).

Phytochemical Work

Extensive phytochemical work has been carried out on *Careya arborea, which indicated the presence of* different classes of phytoconstituents, justifying the traditional uses of plant (Table 2).

Pharmacological Work

The phytochemical investigations revealed the presence of a maximum number of phytoconstituents in methanolic and ethanolic extract of bark and whole plant. The literature survey reported a number of biological activities attributed to flavonoids present in these extracts (Table 3).

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Table 1. Traditional uses of *Careya arborea* Roxb.

Part used	Uses
Whole plant	Astringent, demulcent, antipyretic, antipruritic, in cough, cold and eruptive fevers Smallpox (Pal et al., 1999)
	Snake bite (Bhandary, 2000-2001; Chandra et al., 1989; Jain, 1970)
Fruits	Cold and cough (Kapoor and Kapoor, 1980)
	Digestion promoter (Ahmed, 1982; Iyengar, 1986; Shah, 1982)
Flowers	Aphrodisiac Acrid, cures 'Kapha', demulcent in cough and cold Tonic (Borthakur et al., 1996; Upadhye et al., 1994)
	Vaginal ruptures
	Fever (Rai et al., 1992)
	Colic and loose motions (Prakash and Mehrotra, 1991)
	Cold and Cough (Bedi, 1978; Shah, 1983)
Calyx	Filaria (Mohan and Singh, 1996)
Seeds	Colic and loose motions (Kumar and Pullaiah, 1999)
Leaves	Fever and swellings (Maheshwari, 1986)
	Ulcers and skin diseases (Sharma, 1985)
Twig	Leech repellent (John, 1984)
Gum exudates	Jaundice after delivery (Samvatsar, 2000)
	Tongue ulcers (Girach and Aminuddin, 1995)
Stem bark	Constipation (Singh, 1993)
	Diarrhoea (Rama Rao, 1999)
	Skin diseases (Joshi, 1980)
	Dysentry In asthma, dental diseases and snake bite (Kothari and Londhe, 1999)
Stem sap	Menorrhegic (Pandey, 1991)
Root	Astringent (Parinitha, 2004)
Bark	Washing and cleaning abscesses, boils, ulcers and diarrhoea
	Ear pain (Bhandary et al., 1995)
	Skin diseases (Malhotra and Moorthy, 1973)
	Antipyretic, antipruritic and eruptive fever (Singh and Aswal, 1992)
	Smallpox and stomach disorders (Sadhale, 1991)
	Wound healing and body pain (Mohapatra, 1991)
	Astringent and demulcent Cough and Cold Alexiteric, anthelminthic and in urinary discharges Rheumatic pain and diarrhoea (Jain, 1965)
	Eye complaints Abortifacient (Mohanty, 1999)
	Asthma, dental diseases and snake bite
	Tumors, dyspepsia, bronchitis and colic
	Coarse fibre for cordage ropes, cloth sacking and saddle making (Mukherjee and Ray, 1980; Row and Sastry, 1964)

Hepatoprotective and In vivo antioxidant effects

The methanolic extract of *Careya arborea* (MECA) stem bark was evaluated for its hepatoprotective and antioxidant effects in wistar albino rats. The hepatotoxicity was induced by carbon tetrachloride (30 CCl_4, 1 ml/kg b.w in liquid paraffin 3 doses (i.p) at 72 h interval).The MECA at the doses of 50, 100 and 200 mg/kg and silymarin 25 mg/kg was administered to the CCl_4 treated rats. Analytical parameters like serum transaminase (GOT, GPT), Alkaline Phosphatases (ALP), bilirubin, uric acid and total protein were measured in the rats induced hepatotoxicity by CCl_4. The effects of the extract on lipid peroxidation (LPO), enzymatic antioxidant (Superoxide dismutase (SOD) and catalase (CAT), and nonenzymatic antioxidant (Glutathione (GSH), Vitamin C and Vitamin E were estimated. The MECA and silymarin produced significant ($p < 0.05$) hepatoprotective effect by decreasing the activity of serum enzymes, bilirubin, uric acid, and lipid peroxidation and significantly ($p < 0.05$) increased the levels of SOD, CAT, GSH, vitamin C, vitamin E and protein in a dose dependent manner. From these results, it was suggested that MECA possess potent hepatoprotective and antioxidant activities (Kumar et al., 2005).

Antimicrobial and antioxidant activities

Antimicrobial activities of MECA were carried out using disc diffusion methods with Gram positive and Gram negative bacteria and some fungal species. MECA showed broad-spectrum antimicrobial activity against all tested microorganisms. antimicrobial activity against all tested microorganisms. Antioxidant and free radical scavenging activities of MECA was assessed by using 1,1-diphenyl-2-

Table 2. Phytochemical investigation of *Careya arborea* Roxb.

Plant part	Type of extract	Chemical constituents
Whole plant (excluding root)	50% methanolic extract	Tannins (Atal, 1978)
Flowers	Petroleum ether, benzene and chloroform extracts	Steroids and triterpenoids
	Chloroform and ethanolic extracts	Phenols
	Ethanolic extract	Tannins (Shantha, 1987)
Seeds	Petroleum ether extract	α- spinasterol, α- spinasterone
		α–spinasterol, Δ^{22}- stigmastenol (Mahato and Dutta, 1972)
	α- spinasterol, α- spinasterone	Triterpenoids: Barringtogenol C, Barringtogenol D, 16 desoxy barringtogenol (Mahato and Dutta, 1973)
		Starch (Soni, 1991)
Leaves	Petroleum ether extract	Taraxerol (Mahato, 1967)
		Careyagenolide, maslinic acid, 2α hydroxy ursolic acid (Das and Mahato, 1982)
		n-hexacosanol, α –spinasterol, taraxerol, taraxeryl acetate, β-sitosterol, ellagic acid and quercitin (Gupta, 1975)
		Triterpene ester- careaborin (Talapatra, 1981)
	Ethanolic extract	Tannins (Gupta, 1981)
		Absence of saponins, alkaloids and flavonoids (Kapoor, 1969)
Leaves (Forming feed of livestock in North-eastern hill region)		Crude protein, ether extract, crude fibre, ash, nitrogen free extract, organic matter (Varma, 1982)
		Nitrogen (George, 1957)
		Energy as fodder 902.4Kcal/Kg, metabolizable energy 1543.4 Kcal/Kg and digestible energy 1789.6 Kcal/Kg (Joshi, 1976)
Bark		Sterols and terpenes (Bhattacharjee, 1969)
		Absence of alkaloids, saponins and flavonoids (Kapoor, 1972)
		Saponins and tannins (Joshi and Sabnis, 1989)
		Pyroligenous acid and other components (Kedare and Tendolkar, 1953)
		Presence of steroids, terpenoids, alkaloids, flavonoids and saponins

picryl-hydrazyl radical (DPPH), superoxide anion radical, nitric oxide radical and hydroxide radical scavenging assays. The antioxidant activity of MECA increased in a concentration-dependent manner. The results indicated that the MECA can be a potential source of natural antimicrobial and antioxidant agents (Kumar et al., 2006).

CNS activity

The methanol extract of barks of *Careya arborea* was used to investigate central nervous system (CNS) activity in Swiss albino mice and Wistar albino rats. General behaviour, exploratory behaviour, muscle relaxant activity and phenobarbitone sodium-induced sleeping time were studied. Methanol extract of barks at 100 and 200 mg/kg caused a significant reduction in the spontaneous activity (general behavioural behaviour), remarkable decrease in exploratory behavioural pattern, a reduction in muscle relaxant activity, and also significantly potentiated phenobarbitone sodium- induced sleeping time. The results suggest that methanol extract of *Careya arborea* exhibit CNS depressant activity in tested animal models (Kumar et al., 2008).

Antitumor and antioxidant activity

The methanol extract of bark was evaluated for the anticancer potentials against Dalton's lymphoma ascites (DLA)-induced ascitic and solid tumors. The methanol extract of its bark given orally to mice at the dose of 250 or 500 mg/kg body weight for 10 days caused significant reduction in percent increase in body weight, packed cell volume and viable tumor cell count when compared to the mice of DLA control group. Restoration of haematological and biochemical parameters towards normal was also observed. Histological observations of liver and kidney also indicated repair of tissue damage caused by tumor inoculation. The extract at the dose of 5 or 25 mg/kg body weight given i.p daily for 14 days significantly reduced the solid tumor volume induced by DLA cells (Natesan et al., 2007).

Antidiarrhoeal activity

The methanol extract of the *Careya arborea* Roxb. bark significantly reduced castor oil-induced diarrhoea in mice. This effect supports the local traditional use of the plant against

Table 3. Pharmacological actions of *Careya arborea* Roxb.

Plant part	Type of extract	Pharmacology
Trunk bark	90 and 10% methanolic extract	No sedation and analgesia in mice No effect on B.P and respiration in cats No direct action/ antagonism on the isolated intestine of rabbit and guinea pig, isolated uterus of guinea pig, frog rectus abdominis muscle and isolated frog heart (Bhatnagar et al., 1961)
Whole plant (excluding root)	50% ethanolic extract	No activity when screened for antibacterial/ antifungal/ antiprotozoal/ antiviral/ hypoglycaemic/ anticancer and diuretic activities Phenols Tannins (Shantha, 1987) Effect on respiration, nictating membrane, CVS and CNS of experimental animals; isolated guinea pig ileum and rat uterus (Bhakuni et al., 1969)
Stem bark	Petroleum ether extract α- spinasterol, α- spinasterone	α- spinasterol, α- spinasterone α–spinasterol, Δ^{22}- stigmastenol (Mahato and Dutta, 1972) Triterpenoids: Barringtogenol C, Barringtogenol D, 16 desoxy barringtogenol (Mahato and Dutta, 1973) Starch (Soni, 1991)
Leaves	Petroleum ether extract Ethanolic extract	Taraxerol (Mahato, 1967) Careyagenolide, maslinic acid, 2α hydroxy ursolic acid (Das and Mahato, 1982) n-hexacosanol, α –spinasterol, taraxerol, taraxeryl acetate, β-sitosterol, ellagic acid and quercitin (Gupta, 1975) Triterpene ester- careaborin (Talapatra, 1981) Tannins (Gupta, 1981) Absence of saponins, alkaloids and flavonoids (Kapoor, 1969)
Leaves (Forming feed of livestock in North-eastern hill region)		Crude protein, ether extract, crude fibre, ash, nitrogen free extract, organic matter (Varma, 1982) Nitrogen (George, 1957) Energy as fodder 902.4Kcal/Kg, metabolizable energy 1543.4 Kcal/Kg and digestible energy 1789.6 Kcal/Kg (Joshi, 1976)
Bark		Sterols and terpenes (Bhattacharjee, 1969) Absence of alkaloids, saponins and flavonoids (Kapoor, 1972) Saponins and tannins (Joshi and Sabnis, 1989) Pyroligenous acid and other components (Kedare and Tendolkar, 1953) Presence of steroids, terpenoids, alkaloids, flavonoids and saponins

diarrhoea (Saha et al., 2003).

Analgesic activity

Isolation of the bark of *Careya arborea* Roxb. bark afforded piperine- an alkaloid chemically known as 1-5-(1,3-benzodioxol-5-yl)-1-oxo-2,4-pentadienylpiperidine. At oral doses of 10, 20 and 30 mg/kg body weight, piperine exhibited inhibition of acetic acid induced writhing in mice repectively. At doses of 20 and 30 mg/kg body weight, the compound also showed prolongation of tail flicking time of mice 30 min after the treatments determined by the radiant heat method. Thus, the isolated alkaloid was found to possess significant central and peripheral analgesic activity (Ahmed, 2002).

Cytotoxic and antioxidant activity

The successive chloroform and ethyl acetate extracts and crude 50% methanol bark extract were evaluated for cytotoxic and antioxidant activity. The extracts exhibited potent cytotoxicity against cancerous RD, Hep-2 and HeLa cell lines. They were found to be safe against the normal Vero cell line. The methanol and aqueous extracts possessed strong antioxidant activity against many oxidants in the in-vitro antioxidant screening. The results show strong cytotoxic and antioxidant properties, which are due to high total phenol content present in the plant.

Anticoagulant activity

Methanolic extract of *Careya arborea* bark was evaluated for anticoagulant activity by the assay of activated partial thromboplastin time (aPTT), Prothrombin time (PT), and thrombin time (TT). Bark extract caused significant ($p < 0.05$) increase in aPTT, PT and TT at all doses were almost equivalent to the response of warfarin. Prolongation in PT may be due to decrease in coagulation factors such as VIII, IX, XI, XII and prekallikrein involved in intrinsic pathway (SubhadraDevi et al., 2011).

CONCLUSION

Use of herbal medicinal plants has been distinctive in our lives right from the primitive period till today and provided us with the data on the use of plants or plant products as therapeutic agents in treating various ailments by virtue of their phytoconstituents (Chahlia et al., 2009; Saikia et al., 2006; Srivastav et al., 2011).

Careya arborea Roxb. is an important medicinal plant. Extensive literature survey revealed its phytochemical constituents and pharmacological potential as an important traditional drug. The drug is enriched with flavonoids, tannins, terpenoids and sterols. The plant exhibits many pharmacological activities like antimicrobial, antioxidant, antitumor, analgesic, hepatoprotective, antidiarrhoeal, anticoagulant and diuretic properties. However, a systematic phytochemical investigation is required to standardize the drug with reference to the presence of flavonoids with suitable marker compounds. A systematic phytochemical work is under progress in Authors' laboratory.

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CONFLICT OF INTEREST

The authors have no conflicting financial interests.

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