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Review Article

Saraca asoca: A scoping review on the phytoconstituents, bioactives and their therapeutic effects

Sahil Salvi[a], Ryan Varghese[a], Gargi Digholkar[a], Abha Deshpande[a], Chinmay Malvankar[a], Atmaram Pawar[a] and Dileep Kumar[a,b]*

[a]Poona College of Pharmacy, Bharati Vidyapeeth (Deemed to be) University, Pune Maharashtra, India.
[b]Department of Pharmaceutical Chemistry, Poona College of Pharmacy, Bharati Vidyapeeth (Deemed to be) University, Pune Maharashtra, India.

*Correspondence: dileep.0@gmail.com

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Abstract

Saraca asoca or *S. asoca*, belonging to the family *Caesalpinaceae*, is popularly known as Ashoka and is a valuable indigenous plant of traditional and pharmacological significance. With a growing number of people seeking treatments and health practices devoid of synthetic medicines' adverse effects, medicinal herbs are becoming more mainstream. Ashoka has traditionally been employed to treat dysentery, colic, piles, biliousness, dyspepsia, and ulcers and is also known to display CNS depressant activity and regulate irregular menstrual cycles. The qualitative phytoconstituents of Ashoka's leaves, flowers, fruits, and bark, such as glycosides, flavonoids, tannins, and saponins, carry vast potential in therapeutic and diagnostic techniques. Formulations containing these components can efficiently exert anti-microbial, anti-inflammatory, anti-menorrhagia, anti-diabetic, anthelmintic, and analgesic activity. This review focuses on research associated with the medicinal qualities, phytochemistry, and pharmacological profile of *Saraca asoca* (Roxb.), De. wild.

Keywords: *Saraca asoca;* plant extracts; herbal medicine; pharmacognostic features

Introduction

Saraca asoca [Roxb.] Willd., also known as Ashoka, is one of India's most ancient, highly revered, and sacred trees. The former also forms a significant part of the Ayurvedic physician's armamentarium. *S. asoca* is not only considered a sacred plant in India but also in Nepal and Sri Lanka. From a religious front, *S. asoca* is mentioned in the Ramayana and the Buddhist and Jain literature [1,2]. *S. asoca* is a small, evergreen tree found in the rainforests throughout the Indian sub-continent, especially in the Himalayan region, Kerala, and Bengal. Being a wild tree, and with the growing knowledge of its therapeutic utility, the density of *S. asoca* has plummeted drastically in its natural habitat. This has led to the inclusion of this species in the list of vulnerable species, reported by the International Union for Conservation of Nature (IUCN). The latter can also be attributed to its genetically slow growth rate, the destructive collection of the crude drug, and the absence of a suitable cultivation and collection strategy [3]. Typically, the bark of *S. asoca* is utilized for its medicinal properties. Additionally, its seeds are essential for treating urinary discharges. It has been claimed that the bark of *S. asoca* demonstrates a wide range of pharmacological activities, including astringent, alexiteric, anthelmintic, demulcent, and emollient properties. In addition, *S. asoca* phytoconstituents can treat dyspepsia, thirst, polydipsia, blood disorders, biliousness, weariness, tumours, colic, haemorrhoids, ulcers, bloody uterine discharges, and menorrhagia [4,5].

Habitat

The primary habitat of *S. asoca* has been traced back to the Deccan plateau, mainly in the central areas and the central region of the western ghats near the west coast of India. Its prevalence is predominant

in the fertile and semi-fertile areas of the Indian subcontinent, at the height of approximately 750 m above sea level [6]. In Kerala, it is found in the districts of Kannur, Kollam, Palakkad, and Thrissur. Additionally, it is found abundantly on the roadside in eastern Bengal, South India, and the Andaman Islands. The taxonomic position or scientific classification of *S. asoca* has been tabulated below [7].

Cultivation

The *S. asoca* tree grows well in tropical to sub-tropical climates. Generally, these trees demand a slightly acidic to fertile, neutral soil and moderate to deeply well-drained soil. It thrives well in partially shaded locations. During the rainy season, the seedlings are planted in manure-rich soil. Stem grafting is one of the most commonly used methods for crop propagation. The thinning and weeding of the crop are generally done to ensure better growth, usually after 15-20 days or as needed. The use of chemical fertilizers should be generally avoided. However, organic manures such as green and vermicompost should be employed per the specific requirements. Biopesticides derived from Azadirachta indica (Neem) or other alternative sources are often used to prevent these diseases. Although irrigation is not mandated, since the tree is rainfed, a weekly or fortnightly irrigation plan may be devised to optimize yield [6]

Kingdom	*Plantae*
Division	*Magnoliophyta*
Class	*Magnoliopsida*
Order	*Fabales*
Family	*Fabaceae*
Family	*Caesalpinioideae*
Genus	*Saraca*
Species	*asoca*

Morphological characteristics

S. asoca is a small evergreen tree up to 7-9 m high with numerous spreading and drooping glabrous branches. The leaves of *S. asoca* are pinnate, 15-30 cm long, constituting 2-3 pairs of lanceolate leaflets, cork-shaped at the base and with a short stipule, are intrapetiolar and completely united. The flowers of this plant are orange or orange-yellow in dense corymb and are very fragrant. Furthermore, the fruits of *S. asoca* are flat black pods, ellipsoidal, and apiculate [8]. The bark is dark brown to grey or black with a warty surface, channelled bark, smooth with circular lenticels, transversely rigid, and may even appear cracked. The width of the bark varies from 5 mm to 1 cm. Additionally, the entire cut surface turns reddish upon exposure to air. *S. asoca* bears around 4-8 ellipsoid-oblong and compressed seeds [9].

Microscopical features

Leaves

The transverse section of the leaf elucidates its dicotyledonous nature. The epidermis is single-layered. In addition, the mesophyll consists of a single-layered palisade and a multilayered spongy tissue with spaces. In the midrib, the vascular bundle is enclosed by a sclerenchymatous ring. The bundle sheath, xylem, and phloem are distinct and conspicuous under the microscope. The upper and lower epidermal cells are polygonal in shape and possess slightly wavy walls [10].

Roots

The roots form a circular outline when viewed in the transverse section. The outermost layer is the cork, composed of about 8-10 layers of tangentially elongated thick-walled cells. Moreover, the inner part of the cork region comprises two distinct zones within the secondary cortex. Among these cells, the outer layer is sclerenchymatous, while the remaining inner layers are made up of stone cells. Following this supporting region, a vast stretch of primary and secondary phloem is observed. The cells are parenchymatous, thin-walled, and polygonal. Additionally, 4-6 well-defined cambial layers are observed below the base zone. Within the secondary xylem regions, the xylem tracheids, vessels, and parenchymatous cells are present in alternating patches [9].

Bark

The transverse section of the stem bark reveals a periderm composed of a broad cork layer, a narrow radially flattened cambium and a wide secondary cortex with 1-2 continuous layers of stone cells. Furthermore, parenchymatous tissue is made up of prismatic crystals and yellow masses. The

secondary phloem consists of phloem parenchyma, sieve tubes with companion cells, and phloem fibers arranged in groups [11].

Stem

The *S. asoca* tree shows a circular stem when viewed as a transverse section. Small, ovoid projecting lenticels are observed on the surface. A monolayer epidermis is visible, accompanied by a thin cuticle. Beneath the epidermis, 5-6 layers of cork are observed, followed by approximately 12-16 layers of the cortex. The middle of the cortex region comprises 3-5 layers of well-arranged stone cells. Above the cortex is a well-defined phloem region containing tannin cells. The xylem region consists of tracheids and a few vessels. Furthermore, a central pith is observed, with thin-walled parenchyma and several pith cells associated with polygonal calcium oxalate crystals [9].

Pharmacognostic Characteristics

Powder characteristics

When seen using a microscope, the powder made from the bark of the *S. asoca* tree is noted to have a brown colour and flow freely. It is rich in fibers, stone cells, parenchymatous cells, parts of a sieve tube, and several components that have not been described [4]. It also has some tracheids.

Phytochemistry

S. asoca is abundant in phytoconstituents and plant bio-actives attributed to its pharmacological and therapeutic activity. These phytochemicals are tabulated in Table 1, while their chemical structures have been elucidated in Figure 1 [12,13].

Table 1. Phytoconstituents and plant bioactive analysed in *S. asoca.*

Plant Part	Phytoconstituent
Bark	Catechin [4]
	Epicatechin [2]
	Leucocyanidin [5]
	Procyanidin [1]
	11'deoxyprocyanidin B [3]
Dried Bark	Glycosides
	Isolariciresinol [9]
	Lyoniside [6]
	Nudiposide [7]
	Procyanidin B2 [11]
	Schizandriside [10]
	β-sitosterol glucoside
	5-methoxy-9-β-xylopyranosyl [8]
Flower	Apigenin-7-0-p-D-glucoside [13]
	Cyanidin-3,5- diglucoside [14]
	Gallic acid [15]
	Kaempferol [16]
	Linolenic acid [17]
	Linoleic acid [18]
	Oleic acid [12]
	Palmitic acid [19]
	Pelargonidin-3,5-diglucoside [20]
	Quercetin [21]
	Sitosterol [22]
	Stearic acid [23]
Seed and pod	Catechol [24]
	Leucocyanidin [5]
	Linoleic acid [18]
	Oleic acid [12]
	Palmitic acid [19]
	Stearic acid [23]

Traditional uses

The bark of *S. asoca* is a potentially therapeutic substance employed in treating dysentery, colic, piles, biliousness, dyspepsia, and ulcers. The leaves of the plant have been reported to demonstrate blood purifying properties. Juice obtained from *S. asoca* leaf extracts is often mixed with cumin seeds to offer relief from stomach aches. The flowers of *S. asoca* are often triturated in water and are used to treat hemorrhagic dysentery. However, the dried flowers are often administered as a management strategy to patients who have diabetes. *S. asoca* is utilized in developing medications for a broad spectrum of ailments associated with menstruation, such as leucorrhoea, dysfunctional uterine bleeding, and menorrhagia. Furthermore, the herb positively affects the endometrium and uterine muscles, and it may serve as a potent uterine tonic against irregular menstrual cycles [24]. The plant bioactive has also demonstrated potent therapeutic action against cardiac disorders and arrhythmias and has been studied to nourish the circulatory system. *S. asoca* has also been associated with improved urine flow and alleviation of painful urination [8]. A concoction prepared by boiling the barks of *S. asoca* in water along with certain other medicinal herbs has been a renowned traditional remedy for menorrhagia. This decoction has been administered in its liquid form every morning on an empty stomach [20]. As the plant is reported to remove toxins from the body, its efficacy as a treatment modality in relieving the burning sensation and improving the skin complexion has also been studied [5].

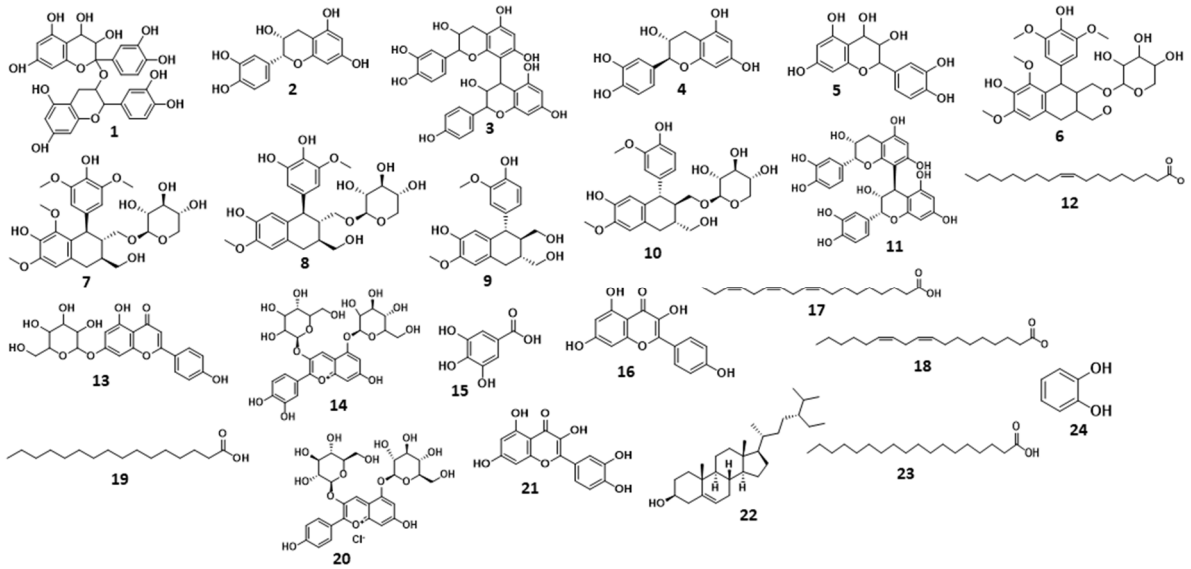

Figure 1. Phytochemicals and plant bioactive in the various parts *S. asoca.*

Adulterants

The scarcity of *S. asoca* is a significant cause for concern due to the naturally slow growth rate, the destructive extraction of crude medicines, and the absence of a coordinated cultivation and collection program. All of these factors have contributed to the current predicament. On the other hand, to fulfil the population's ever-increasing requirements and make the most of the available potential gains, it is frequently adulterated with the bark of *Polyalthia longifolia*. It is a tree that exhibits properties of the bark that are comparable to those of *S. asoca*. There are also instances in which the bark of *S. asoca* is combined with the bark of Rohitaka (*Aphanamixis polystachya*) and the peacock flower (*Caesalpinia pulcherrima*). The use of these adulterants brings about a significant decrease in the efficacy of the medications that are manufactured from these, which in turn brings about a compromise in the therapeutic efficacy. Although the barks have macroscopic features similar to those of *S. asoca*, a comparison of their biochemical and chromatographic properties indicated that they had considerable and substantial variances. Therefore, these techniques can be utilized to determine whether the crude drugs are authentic [21].

Pharmacological activity

Antimicrobial activity

The prevalence or absence of inhibitory zones and minimum inhibitory concentrations (MICs) values were used to evaluate the antibacterial activity of *S. asoca* and *S. indica* stem bark against medically relevant pathogens. Specifically, the methanolic and aqueous extracts of the stem bark of *S. indica* were validated using the disc diffusion method. These extracts effectively counteract most of the test bacteria, especially *Bacillus* species and *Pseudomonas aeruginosa* [25]. The extracts successfully demonstrated a strong antifungal property against *Cryptococcus albidus* and *Candida albicans*. The MICs of the methanolic and aqueous extracts were 0.5-2% and 1-3%, respectively. When tested against *Pseudomonas aeruginosa*, *Bacillus subtilis*, and *Bacillus cereus*, the methanolic extract displayed encouraging results with a MIC of 0.5%. Finally, both of the investigated extracts showed remarkable antibacterial activity against fungi, Gram-positive organisms, and Gram-negative organisms [17].

Anti-inflammatory activity

Ethanolic extracts of *S. asoca* have been shown to exhibit potent anti-inflammatory properties. A study conducted by Sharif et al. concluded that the ethanolic extract of *S. asoca* was successful in minimizing the effects of oedema in carrageenan-induced hind paw oedema in rats ($P<0.01$) [19]. The study employed a one-way analysis of variance (ANOVA) and Dunnett's test to examine the data collected. At a dose of 200 mg/kg, the plant extract demonstrated excellent anti-inflammatory activity. Although of short duration and intensity, compared to 10 mg/kg diclofenac, the increase in paw volume due to inflammation was reduced by 56.95%. However, maximum inhibition of oedema was observed at a dose of 300 mg/kg body weight, which reduced the inflammation by 64.14% at the fifth hour of the study [14].

Anti-menorrhagic activity

For centuries, the dried barks of *S. asoca* have been employed to treat menorrhagia [22]. In cases of uterine disorders, dried bark combined with flowers was given as a tonic to female patients, while it simultaneously acts as a uterine sedative. The stem bark of *S. asoca* has also been employed in treating a spectrum of ailments attributed to the menstrual cycle. An aqueous extract of the bark derived from hot water has been administered to females to make the uterus oestrus but to avoid producing tonic contractions. The aqueous extract of the bark has been reported to include active components that activate and relax the plain muscle of the ileum of guinea pig models.

Furthermore, the medication has been shown to stimulate the uterus, resulting in more frequent and prolonged contractions. In Pakistan, the bark of *S. indica* has also been employed in the alleviation of uterine discomfort and menorrhagia. However, in India, it has been used as an astringent that could aid in the cessation of menorrhagia-related uterine haemorrhage. In addition, it has also been used as a refrigerant and demulcent for uterine disorders and to provide an analgesic effect in regular abdominal pain resulting from menstruation [15].

Anthelmintic activity

Parasitic worms in the human body are attributed to malnutrition, weakness, and an increase in susceptibility to bacterial and viral diseases. Although the bark of the plant has anthelmintic activities, recent studies have revealed that even the leaves of *S. asoca* exhibit very potent anthelmintic activities [5]. Moreover, methanolic and ethanolic extracts, have both been reported to paralyze and be fatal to earthworms. Glycosides, alkaloids, tannins, flavonoids, and terpenoids appear to be the phytochemical elements that indicate the anthelmintic activities of ethanolic and methanolic extracts. These phytoconstituents decreased the life expectancy of earthworms, which might be attributed to the β-tubulin interference [16]. In a recent study conducted on Indian earthworms, the leaves of *S. asoca* were powdered, before being passed through a number 40 sieve and stored in a desiccator. These powdered leaves were then extracted by employing Soxhlet and maceration methods. Regarding the Soxhlet method, the methanolic extract showed more potency when it came to anthelmintic activity than the

ethanolic extract. However, the ethanolic extract which was obtained from the maceration method exhibited better anthelmintic activity than the methanolic extract. In both cases, the methanolic and ethanolic extracts were found to be more potent than the control, at least in terms of anthelmintic properties [26].

Uterine tonic activity

S. asoca is often used as an endometrial and ovarian tissue stimulant in Ayurvedic medicine. Research and evidence insinuate that U-3107 (Eve Care®), a herbal preparation consisting of several plant extracts, employing *Saraca indica* is one of its main constituents, demonstrated a significant decrease in uterine motility and a great reduction in contractions induced by acetylcholine in non-estrogenized, non-gravid Wistar rats. The estrogenic effect of U-3107 was considered in normal and ovariectomized rats. U-3107 was given as an aqueous suspension for 21 days. The uterine weight of the ovariectomized rats treated with U-3107 did not increase compared to the ovariectomized control rats. U-3107 has estrogenic activity, but only in the presence of a functioning ovary, and it does not have pregestational activity [27]. Although more human trials are required to assess the scope and applicability of this formulation, uterotonic-like qualities may be attributed to the plant and bark of *S. asoca*.

Analgesic activity

The leaf extracts of *S. asoca* in different solvents like methanol, ethanol, and water exhibit significant analgesic properties. Phytochemical screenings of such extracts indicate the presence of tannins, triterpenoids, saponin, flavonoids, and glycosides, which are also speculated to assist in relieving or modifying the pain responses. These properties were tested on albino mice, in which pain was induced by the formalin and tail immersion method. From both these methods, different extracts of *S. asoca* leaves were found to exhibit dose-dependent analgesic properties in both phases of pain. These analgesic properties have been attributed to the ability of the plant to inhibit sensory nerve stimulation, causing formalin-induced pain (early phase) to be numbed since formalin shows an effect by direct stimulation of sensory nerve fibers [28]. Moreover, in the late phase, the pain was caused by inflammatory mediators such as bradykinins or histamines, and since the extracts showed dose-dependent properties in both phases, it can be concluded that *S. asoca* acts on both the central as well as the peripheral nervous systems. The bark and root have also been shown to possess analgesic properties [29].

Central nervous system depressant activity

The leaves of *S. asoca* have revealed central nervous system (CNS) depressant actions when mixed with various solvents, such as petroleum ether, chloroform, methanol, and water, depending on the polarity of the solvents used [30]. In albino mice, the methanolic extract demonstrated the strongest CNS depressant effect. This was evaluated in a study by Verma et al. using an actophotometer that helped to examine formative locomotor activity and phenobarbital-induced sleeping time. Additionally, the methanolic extract was demonstrated to be the most effective as it extensively reduced the onset of action while concurrently prolonging the sleep duration induced by phenobarbital. A 400 mg/ml dose formulated in methanol was found to exert an effect comparable to the standard CNS depressant drug, chlorpromazine. These extracts also significantly reduced the locomotor activity in mice by about 67.33%. These studies validate the CNS depressant potential of *S. asoca* and its derived extracts [19].

Antidiabetic activity

The traditional Indian medicine for the treatment of diabetes included a decoction made from the addition of the bark powder from *S. asoca* in milk or its leaf decoction, taken twice a day. The flavonoid fraction of flowers and leaves has been demonstrated to inhibit α-glucosidase and α-amylase, which are generally overexpressed in diabetes. In a study conducted by Kumar et al., Swiss albino male mice were injected with streptozotocin (STZ) to induce diabetes. Diabetic rats demonstrated a significant decrease

in elevated blood glucose levels posts 21 days of treatment with *S. asoca* leaf extracts formulated in various organic solvents. The average weight of the STZ- induced diabetic mice was also observed to be lower, which was attributed to continuous glucose excretion and a decrease in peripheral glucose absorption and glycogen synthesis. The administration of glibenclamide and other plant-derived extracts facilitated a dose-dependent reduction in serum levels of total cholesterol, triglycerides (TG), low-density lipoproteins (LDL), and very-low-density lipoproteins (VLDL), and intermediate-density lipoproteins (IDL). It also positively affected serum concentrations of high-density lipoprotein (HDL) and total protein by adequately increasing their concentrations. These extracts were also associated with an improvement in pancreatic, renal, liver, and overall health of these diabetic mice [18].

Larvicidal activity

Since synthetic organic pesticides have the potential to harm the ecosystem and some vectors, causing them to develop resistances, plant-based larvicides are usually preferred. Plant phytochemicals have been known to regulate the growth of insects, insect repellants, and larvicides. To test the larvicidal activity of *S. asoca*, an aqueous extract, a methanol extract, a chloroform extract, a petroleum ether extract, and a hexane extract were prepared according to the polarity of the solvents used. The larvicidal activity was established in the chloroform extract of the bark and the petroleum ether extract of the leaves and was successfully tested against the vector of lymphatic filariasis, *C. quinquefasciatus*. After 24 h of exposure, larval mortality was recorded. The chloroform extract of the bark expressed values of LC_{50} and LC_{90} of 291.5 and 499.3 ppm, respectively. The extract of petroleum ether from the leaves demonstrated larvicidal activity with values of LC_{50} and LC_{90} of 228.9 and 458.3 ppm, respectively [31].

Anti-ulcer activity

Various components of *S. asoca* have been identified to demonstrate antiulcer effects. In albino rats with pyloric ligation and aspirin-induced stomach ulcers, an aqueous suspension consisting of bark, flowers, dried flower buds, and seeds was shown to exhibit significant antiulcer action, as evidenced by recent investigations. Upon treatment with aqueous extract, gastric juice volume and ulcer index were significantly lower in both tests than in control rats [32]. The phytoconstituents, viz. flavonoids, tannins, phenolic glycosides, saponins, sterols, and triterpenes, are speculated to be the cause of these antiulcerogenic effects. The antiulcerogenic properties of the extract are assignable to the antioxidant properties of the flavonoids found in the aqueous extract, which stimulate mucous secretions and inhibit basal gastric secretions, synthesize endogenous gastric mucosal prostaglandin, and synthesize endogenous gastric mucosal prostaglandin. A comparison of alcoholic and aqueous extracts revealed that the alcoholic extract showed slightly better antiulcer properties [33].

Anticancer activity

In the last two decades, the utilization of herbal products and phytomedicines has expanded globally. Herbal treatments and medications have long been utilized as complementary or alternative therapies to treat numerous forms of malignancies. Various medicinal plants have been used for the prevention and treatment of cancer around the world. Moreover, several *in vivo* and *in vitro* studies have been carried out explicitly on the anticancer activities of *S. asoca*. These studies have yielded several encouraging outcomes, indicating that not only does *S. asoca* possess anticancer properties, but also it has the potential to be used as a cancer treatment medicine [34]. Ethnobotanical studies of *S. asoca* have revealed that its flower flavonoid fraction has properties that can prevent two-stage skin cancer and preferably act toward Dalton's ascites and Sarcoma-180 tumour cells. In contrast, it was non-toxic to normal cells. Catechin has been found to prevent cancer, while epigallocatechin and polyphenol-E have also been demonstrated to suppress cancer cell proliferation [35]. Therefore, it can be concluded that *S. asoca* shows significant anticancer properties, which are speculated to be the result of the presence of various polyphenols and flavonoids in the plant. In an in vitro test, a lectin called "Saracin" extracted from the seed integument triggered apoptosis in human T-lymphocytes [36].

Antifungal activity

The leaves, flowers, and bark extracts of common medicinal plants have been reported to exhibit antifungal properties. A study conducted on *S. asoca*, the antifungal activity in fungal species *A. niger* and *A. fumigatus*, showed that the *S. asoca* extracts possess antifungal properties. These antifungal properties were then determined by evaluating the methanolic and acetonic extracts using the disc diffusion method and measuring the diameter of the inhibition zone. Autoclaved and distilled water were used as a control. Plates were incubated for a day at 28°C, after which the inhibition zones were measured in millimetres (mm). Owing to the analyses summarized in Table 2, it was concluded that the methanolic extract possessed slightly better antifungal effects than the acetonic extract [37].

Table 2. Comparison of the antifungal activity of *S. asoca* extracts against fungal species.

Fungal Species	Methanolic Extract (Zone of inhibition in mm)	Acetonic extract (Zone of Inhibition in mm)
A. niger	16	15
A. fumigatus	20	16

Anti-nephrolithiatic activity

Kidney stones are solid calcium deposits that stay together in concentrated urine. They often take the form of calcium oxalate and acid salts. The passage of these stones through the urinary tract can be extremely painful. It has been shown that the root of *S. asoca* possesses lithotripsic characteristics that help in the breakdown of oxalic acid crystals found in the kidneys [38]. As a result, it has been demonstrated that administering *S. asoca* root extract decreases pain in conditions when the renal passage is blocked [39].

Anti-arthritic and Cardioprotective activity

Arthritis is generally attributed to the inflammatory response mediated by pro-inflammatory cytokines. As previously stated, ethanolic extracts of *S. asoca* leaves, bark, and root have been known to demonstrate anti-inflammatory properties. These extracts have been shown to reduce rheumatoid arthritis in rats by lowering the levels of lysosomal and liver enzymes and serum collagen and restoring the normal structure of the joints [40]. The extracts prevent numerous transcription factors, such as AP-1, GATA-1, and others, from binding to their target DNA sequences, thus decreasing the levels of pro-inflammatory cytokines. According to studies, the ethanolic extract of *S. indica* has also been reported to protect cardiac tissues from inflammatory cell infiltration [41].

Toxicology

Ashoka extract is a therapeutically active organo-chemical compound from plant sources, exhibiting limited or no toxic effects upon administration [42]. Teli et al. studied the effects of Ashoka administration on blood under experimental conditions [43]. It was revealed that Ashoka showed no toxic effects upon regular administration. Further, another animal study examined the toxicity of Ashoka extract up to the dose of 1000 mg/kg [44]. No adverse toxic effects such as diarrhoea, irritation or convulsion were observed. Additionally, animals did not exhibit any observable behavioural changes [44].

Future perspective

In ancient Indian texts, *S. asoca* is regarded as a universal panacea. Ashoka is the drug of choice for female problems. Menorrhagia, leucorrhoea, dysfunctional uterine haemorrhage, haemorrhoids, and other feminine problems have been treated with Ashoka for centuries. It has various pharmacological activities, including anti-cancer, anti-menorrhagic, anti-microbial, larvicidal, antioxidant, anti-tumour, CNS depressant, anti-diabetic, anti-mutagenic, and genoprotective properties. *S. asoca's* ethnopharmacological and traditional applications are well-known. However, performing thorough and rigorous evidence-based modern experimental research with well-defined and robust

process parameters from sample collection to product finish is the key to bringing better, safer, more effective, and standardized pharmaceutical formulations from this plant. Systemic investigations using current technology such as spectroscopy and spectrometry are required to extract the maximum pharmacological potential of diverse Ashoka extracts. Studying the genetic markers of biosynthetic pathways linked to various recognized secondary metabolites from this plant would be significant, as this technique could lead to engineering Ashoka plants for certain metabolite profiles. It may inspire research linking specific metabolites to specific biological effects. Extensive research into isolating useful bioactive principles and synergistic interactions of phytochemicals, both of which are required for developing multi-active natural drugs for cancer chemoprevention, appears to be an area that is likely to yield a wealth of information.

Conclusion

In ancient Indian texts, the *S. asoca* tree is considered a sacred plant, renowned for being considered a cure-all. Since the birth of Ayurveda, the *S. asoca* tree has been employed in treating and managing gynecological disorders. Additionally, it possesses antibacterial, uterotonic, anticancer, anthelmintic, antioxidant, hypolipidemic, and antiulcer properties, among numerous other health benefits, and thus could be rightly regarded as a panacea. The plant of *S. asoca* comprises a broad spectrum of phytochemicals such as glycosides, oleic acid, linoleic acid, and palmitic acid, to name a few, and is also the source of various organic compounds. In current scenarios, various plants, their extracts, and phytoconstituents have been administered to manage various disorders. However, *S. asoca*, its extracts, and derived phytoconstituents could be administered to treat various ailments, owing to the multitude of pharmacological activities exerted by the same. In the modern medicinal era, where traditional plants with little or no toxicity are highly encouraged, *S. asoca* has enormous potential to be used in developing modern drugs, drug precursors, and plant-derived bioactive. However, the authors opine that extensive research, including *in-vitro*, *in-vivo,* and clinical studies, should be thoroughly conducted to validate its efficacy and potency in treating and managing various ailments

Authors contribution

All the authors have contributed equally.

Conflict of interest

The authors declare that there is no conflict of interest.

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