IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

"A REVIEW ON THE PHYTOCHEMISTRY AND THERAPEUTIC POTENTIAL OF *SARACA ASOCA* (ROXB.) DE WILDE"

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Abstract: *Saraca asoca* deeply embedded in Ayurveda and other traditional medicine systems. Historically, plants like Ashoka have been the foundation for both ancient remedies and modern medicinal drug development. It is most renowned for its role in treating female reproductive disorders and promoting overall reproductive health. Beyond this primary use, it possesses a spectrum of valuable pharmacological properties, including anti-microbial, anti-inflammatory, anti-ulcer, and analgesic activities. The rich content of secondary metabolites in the plant makes it have a wide therapeutic potential. The bark, the leaves and the flowers are the most therapeutically active parts of the plant. General constituents found in the bark and leaves include flavonoids, tannins, steroids, volatile oil, glycosides, and polyphenols. Specifically, the bark contains lignin glycosides (e.g., lyoniside) and flavonoids (e.g., catechin and procyanidin B2). Antioxidant gallic acid and ellagic acid are key polyphenols across the bark, leaves, and flowers. Extracts from Ashoka have Anti-microbial activity against various bacteria and fungi. Anti-hyperglycemic effects, lowering blood sugar in diabetic models. Potent antioxidant properties. Cardioprotective and anti-ulcer effects. Analgesic, anti-pyretic, and anti-helminthic properties. Restoration of hormonal levels, confirming its positive effect on the menstrual cycle. Anti-arthritic and anti-epileptic activities. This vast array of beneficial compounds solidifies Saraca asoca's position as a critical resource in herbal medicine.

Index Terms - Saraca asoca, Phytochemicals, ayurvedic medicine, micropropagation.

I. INTRODUCTION

Since the beginning of life, plants have served as the source of food, shelter, and various remedial approaches, with their use for treating diseases being an ancient and common practice across almost all cultures. India has often been referred to as the medicinal garden of the world. Medicinal plants are also the primary source for the development of most modern medicines. *Saraca asoca* (Roxb.) de Wilde, commonly known as Ashoka, is a medicinal plant of the Caesalpiniaceae family (legume family). Its name, Ashoka, holds a deep meaning, representing "freedom from grief" or happiness. Ashoka holds a significant position in Ayurveda and other traditional systems of medicine and is a main ingredient in numerous Ayurvedic herbal formulations. It is especially sacred to the Hindu god of Love, Kamadeva, for whom it is worshipped every year on December 27, it is mentioned in Hindu mythology that the Indian philosopher and founder of Buddhism, Gautama Siddhartha (c.563-483 B.C.) was said to have been born under this

tree (P. Pradhan *et al.*,2009). The word Ashoka means "without sorrow", a reference to this bark's reputation for keeping a woman healthy and youthful (Nayak *et al.*, 2009; Pradhan *et al.*,2009). Ashoka is known as the "friend of women," its bark, leaves, and flowers are extensively used to address uterine and hormonal disorders (D. Priya *et al.*,2025). It is particularly popular for the treatment of female reproductive disorders, helping to maintain reproductive health, but it also possesses other valuable biological properties such as anti-microbial, anti-inflammatory, anti-ulcer, and analgesic activities. This species is currently listed as a 'globally vulnerable' species by the IUCN 2013.

Ashoka is an evergreen tree which is up to 9 m in height. The flowers are orange yellow in colour and arranged in dense corymbs. It occurs throughout India up to an altitude of 750m in central and eastern Himalayas. Leaves are paripinnate 15-20 cm long and the leaflets 6-12, oblong and rigidly sub-coriaceous. Leaves are narrowly lanceolate, cork like at the base and with a shot petiolar stipules are intra-petiolar and completely united. The bark is dark brown or grey or almost black with a warty surface. Stem bark is rough and uneven due to the presence of rounded or projecting lenticles. Bark channelled, smooth with circular lenticels and transversely ridged, sometimes cracked. Fracture splinting exposing a striated surface, a thin whitish and continuous layer is seen beneath the cork leaver. Flowers are fragrant. Flowers are Polygamous apetalous, yellowish orange turning to scarlet, in short laterally placed corymbose, auxiliary panicles, bract small, deciduous and calyx petaloid. Seeds are 4-8, ellipsoid-oblong and compressed (Ali *et al.*,2008 and Jain *et al.*, 1968).

Saraca asoca is found in the Western Peninsula, Sri Lanka, Malaysia, East Bengal, Burma, and the Central and East Himalayas. It is found on the northern plains, the west coast of the subcontinent, and the foothills of the central and eastern Himalayas in India (Preeti *et al.*,2012). *Saraca asoca* is primarily found in the central regions of the Deccan plateau and the western ghats close to India's west coast. It is most common in the Indian subcontinent's fertile and semi-fertile regions, which are about 750 meters above sea level (Warrier P K*et al.*,2001). 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 Island (Kulkarni RV-2018).

II. PHYTOCHEMICAL STUDY

Bark, flower, leaves, roots and seeds of *Saraca asoca* are used as medicine. The plant contains a broad spectrum of phytochemicals such as glycosides, oleic acid, linoleic acid, and palmitic acid. The qualitative phytoconstituents of Ashoka's leaves, flowers, fruits, and bark include glycosides, flavonoids, tannins, and saponins. Flavonoids exhibit strong anti-inflammatory and antioxidant properties, protecting uterine tissues from oxidative stress (Goleij *et al.*,2024).

Bark of *Saraca asoca* is the most important for its medicinal value. The bark contains tannin, catechol, flavonoids, sterol, glucosides, alkaloids, other organic calcium compounds (Kirtikar *et al.*,1981) and many compounds of potassium, sodium, calcium, aluminium, strontium, calcium, iron, magnesium and phosphate (A. mishra, *et al.*,2013). Tannins Act as natural astringents, reducing excessive bleeding and promoting tissue repair. Saponins improve uterine tone and enhance its contractility, aiding in the treatment of uterine disorders. Phenolic Compounds reduce oxidative damage and inflammation in uterine tissues. Glycosides help to regulate hormonal imbalances and improve reproductive health. (D. Priya *et al.*,2025). Bark also contains Catechin, Epicatechin, Leucocyanidin, Procyanidin, Glycosides, Isolariciresinol, Lyoniside, Nudiposide, Procyanidin B2, Schizandrisid. Flower contains Apigenin-7-0-beta-D-glucoside, Cyanidin-3,5-diglucoside, Gallic acid, Kaempferol. (Mohan, C.*et al.*,2016).

Leaves of *Saraca asoca* have been reported to contain alkaloids, steroids, flavonoids, tannins, saponins, terpenoids, polyphenolics, glycosides and many carbohydrates. Flavonoids such as quercetin, sitosterol, ceryl alcohol, and glucosides such as quercetin-3-O-rhamnoside and kaemferol-3-O-L-rhamnoside have been reported from *Saraca asoca* leaves (M. Gupta, *et al.*,2014). The antioxidant activity of the leaf extracts has been described to be due to the presence of polyphenolics such as gallic acid and ellagic acid (J. Saha *et al.*,2013)

The flowers of *Saraca asoca* have been shown to contain tannins, flavonoids, saracasin, saracadin, waxy substances, carbohydrates, proteins and steroids (Jayita Saha *et al.*,2012). They are especially known for the presence of many fatty acids such as oleic, palmitic, stearic, linolenic and linoleic acids; glucosides such as quercetin-3-O-P-D-glucoside, apigenin-7-O-p-D-glucoside, pelargonidin-3,5-diglucoside and cyanidine-3,5-diglucoside; steroids such as p- and y-sitosterol, flavonoids such as quercetin, leucocyanidin, and polyphenolics such as gallic acid and ellagic acid (A. Mishra et.al.,2013)

The seeds and fruits of this plant contain sterols like catechol and epicatechol, a lectin named saracin, leucocyanidin, salicylates. Ashoka seeds and fruits have fatty acids: oleic, linoleic, palmitic, and stearic acids. (Kumari *et al.*,2021). Phenols, flavonoids, tannins, saponins, carbohydrates, glycosides and salicylates have been demonstrated in the acetone extracts of *Saraca asoca* seeds (M. Gupta, *et al.*,2014).

III. PHYTOCHEMISTRY

Table 1 Plant Parts containing bioactive compounds and its activities.

Plant Part	Compound(s)	Activity of Compound	References
All Parts (Bark, Leaf, Flower)	Flavonoids, Catechin, β-sitosterol, Lignin glycosides	• Antioxidants. • Antipyretic • Anticancer	(Sadhu *et al.*,2007) (Ghatak *et al.*, 2015) (Varaprasad N. *et al.*, 2011). (Ahmad *et al.*,2022).
	General Compounds e.g., essential oil, tannin, gallic acid, (-)-epicatechin)	• Antimicrobial • Anti-arthritic medication.	(Shirolkar *et al.*, 2013) (Saravanan *et al.*, 2011)
Bark	β-sitosterol, quercetin and kaempferol	• Anticancer	(Pareeth C.M *et al.*,2024)
	Catechin (A major flavonoid)	• Chemo preventive potential	(Mukhopadhyay M. *et al.*, 2017)
	(+)-Pinitol	• Anti-inflammatory • Hypoglycemic activities	(Ahmad F. *et al.*, 2016)
	Other Key Compounds (e.g., Tannins, Catechol, Sterol, Glycosides, Leucocyanidin, ß-sitosterol glucoside)	• Menstrual disorders • Uterine infections, • Antibiotic and Antioxidant	(Fathima F. *et al.*, 2023) (Sadhu, S. *et al.*, 2007)
Flower	Flavonoids (General)	• Chemopreventive • Antioxidant.	(Mukhopadhyay, M. K. *et al.*,2017) (Pal *et al.*, 2014)
	Phytoestrogens (e.g., ß-sitosterol, Luteolin, Quercetin, Kaempferol)	• Estrogenic potency	(Swar, G. *et al.*, 2017)

Plant Part	Compound(s)	Activity of Compound	References
	Flower Extract Cyanidin-3,5-diglucoside	• Antibacterial • Anti-ulcers. • Antidiabetic	(Athiralakshmy *et al.*,2016). (Maruthappan V. *et al.*,2010) (Somani G. *et al.*,2015).
Pod and Seed	Fatty Acids (Oleic, Stearic, Linoleic, Palmitic acids), Catechol, Leucocyanidin, Leucocyanidin	• Analgesic, Antipyretic • Anti-inflammatory, cardioprotective	(Gupta M. *et al.*,2013). (Kalakotla S. *et al.*,2014).

IV. PHARMACOLOGICAL ACTIVITY

Since the birth of Ayurveda, the *Saraca asoca* tree has been employed in treating and managing gynecological disorders. Additionally, it possesses antibacterial, anti-inflammatory, anthelmintic, antimicrobial, antioxidant, analgesic, uterotonic, anticancer, hypolipidemic, and antiulcer properties, among numerous other health benefits, and thus could be rightly regarded as a panacea.

The ethanolic extract of *Saraca asoca* reported to have an anti-inflammatory activity and also shown to protect the cardiac tissue from infiltration of inflammatory cells. *Saraca asoca* extract has been proved for its blood purification activity (P. Pradhan *et al.*,2009). Ahmad et.al. isolated significant amount of (þ)-pinitol, a PDA inactive compound *Saraca asoca* bark. (þ)-pinitol is well known for its anti-inflammatory and hypoglycemic activities. (þ)-pinitol poses anti TNF-a and anti-inflammatory capacity to diminish carragenan induced edema. It was confirmed that the *Saraca asoca* bark methanol extract has no toxic effects as well (Ahmad F *et al.*,2015).

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 *Saraca asoca* exhibit very potent anthelmintic activities. 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 (Deepti B. *et al.,* 2012).

The extracts successfully demonstrated a strong antimicrobial 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 antimicrobial activity against fungi, Gram-positive organisms, and Gram-negative organisms (Sainath RS *et al.*,2009). The prevalence or absence of inhibitory zones and minimum inhibitory concentrations (MICs) values were used to evaluate the antibacterial activity of *Saraca 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 (Dabur R, *et al.*,2007). Methanolic and aqueous extracts of the stem bark effectively counteract most test bacteria, especially Bacillus species and Pseudomonas aeruginosa. (Mohan, *et al.*, 2016)

A number of studies have been reported to described the presence of various antioxidant compounds such as Catechin, flavonoids, - sitosterol and its glucoside form, ascorbic acid, lignin glycosides, polyphenols like gallic acid in petroleum ether, chloroform, and methanol extract of Ashoka leaves, bark and flowers (S. Panchawat *et al.,* 2010). The radical scavenging capacity of *Saraca asoca* with the chloroform extract

was evaluated using the DPPH assay based on the described method. The reduction in the absorbance of the DPPH solution following the introduction of the antioxidant was recorded at a wavelength of 490 nm. The radical scavenging antioxidants activity occurs via the donation of protons to DPPH. As a result of this reduction, the color shifts from purple to yellow, indicating an increase in radical scavenging activity due to free radical inhibition. The observed decrease in color intensity reflects the effectiveness of the antioxidant (Lakshya Dharamdasani1*et al.,* 2017).

The leaf extracts of *Saraca 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 *Saraca 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 (Verma A, *et al.,*2010).

Ashoka flower and bark are widely known in the field of Ayurveda for protecting nature against any gynecological problems and keep women safe and healthy. Many tribal Women of Chhattisgarh, consumes Ashoka bark after boiling into cow milk to prevent gynecological disturbances. To prevent uterine and menstrual cycle disorders dried Ashoka bark and flower are used in the form of a tonic and bark have a triggering effect on ovarian and endometrial tissue in women. In the case of local pain Ashoka bark paste is useful. (Ahmad *et al.,*2022). In Ayurvedic medicine *Saraca asoca* is a drug of choice for its stimulant activity on the endometrium and ovarian tissue. The estrogenic effect of U- 3107 (1mg/kg) was considered in healthy and Ovariectomized rats. U-3107 was administered as an aqueous suspension for a period of 21 days. The management of Ovariectomized rats did not any expand on uterine weight. Only in the presence of functional ovary U-3107 perform the estrogenic activity and is devoid of any pregestational activity. U-3107 is herbal preparation which is formulated by using various plant extract and is useful in variety of menstrual disorders like puberty, menorrhea, Dysmenorrhea, premenstrual syndrome, abnormal bleeding and threatened abortion (S. K. Mitra *et al.,* 1999).

The flower extracts of *Saraca asoca* were cytotoxic and induced apoptosis to the skin cancer cells at a concentration of 30µg/ml at the 24th-time point (Cibin *et al.,* 2012). In vitro study on *Saraca asoca* flowers supported the fact that *Saraca asoca* flowers have anticancer property. Study found that *Saraca asoca* flowers exhibited 50% cytotoxicity against Sarcoma-180 tumor cells and Dal-ton's lymphoma ascites at the concentration 54 mug and 38 mug respectively. *Saraca asoca* flowers had no activity on normal lymphocytes but had preferential activity against lymphocytes of leukemia patients (P. Pradhan *et al.,*2009). The potential of plant extract-based synthesis of MnO2 nanoparticles with anti-cancer properties as an alternative to traditional cancer therapies (Majani, S. *et al.,* 2023).

Maruthappan V *et al.,* (2010), conducted a study on albino rat models to check the anti-ulcer activity of *Saraca asoca*. Pyloric ligation and aspirin-induced gastric ulcer were the two models used of albino rats. It was observed that the aqueous suspension of flowers is associated with anti-ulcer activity.

Dermato-protective activity in classical text references is available about *Saraca asoca* which helps to improve skin complexion. Lot of research has been performed on Ashoka plant extracts and reported that the root, bark and seed extract of *Saraca asoca* useful in the treatment of skin complications such as eczema, psoriasis, acne, dermatitis, herpes- kushta/ visarpa, scabies, pruritis, tinea pedis and skin cancer. The flower extract of *Saraca asoca* contain flavonoids, has been shown to reduce the skin tumors induced by 7,12- dimethyl benzanthracene (T. R. Cibin *et al.,* 2012).

The petroleum ether, chloroform, methanol and aqueous extracts of leaves of *Saraca asoca* shows CNS depressant activity depending upon their polarity out of which the methanol extract shows maximum CNS depressant activity in albino mice. The activity was examined by using phenobarbitone induced sleeping time with the help of actophotometer. The extract of *Saraca asoca* significantly reduced the locomotor

activity in mice by 67.33%. The mechanism of the depressant activity can be associated with activation of gama- aminobutyric acid (GABA) receptors in the CNS by glycosides, flavonoids, saponins and tannins present in the plant extract which culminates in anxiolysis, muscle relaxation and sedation (A. Verma *et al.*,2010)

V. FUTURE ASPECTS

In ancient Indian texts, *Saraca asoca* is regarded as a universal panacea. Ashoka is the drug of choice for female problems. Menorrhagia, leucorrhea, dysfunctional uterine hemorrhage, hemorrhoids, and other feminine problems have been treated with Ashoka for centuries. It has various pharmacological activities, including anti-cancer, anti-menorrhagia, anti-microbial, larvicidal, antioxidant, anti-tumor, CNS depressant, anti-diabetic, anti-mutagenic, and Geno protective properties. *Saraca asoca* ethnopharmacological and traditional applications are well-known (Salvia, S. *et al.*, 2022). As this plant contain medicinally important phytochemical constituents, this led to its reduction through over exploitation for bark and its other parts. The plant is categorized as 'vulnerable' by International Union for Conservation of Nature (IUCN). It has been reported that the domestic demand of 'Ashoka' bark is greater than 15,000 metric tons in India (Sumangala *et al.*, 2017). Therefore, protection of this species becomes a necessity to prevent its extinction (Hegde *et al.*, 2017).

Ashoka cell culture system have not been established yet, which can help for investigating the different aspect of the bioactive metabolite production by this plant with the help of already established tools and methodologies, As the plant take many years to reach at maturity, the tissue culture techniques such as callus and suspension culture could be explored to assess the production of useful secondary metabolites by them (Satpal Singh *et al.*, 2015). For propagation of Saraca asoca, nursery raising from seeds and stem grafting are generally used. However, the plant is difficult to grow and the success rate is less than 20%. Therefore, there is a need for the development of alternate methods of propagation like micropropagation through in vitro culture (Puspangadan, P. *et al.*, 2004). A large number of true to type plants can be propagated within a short time and space and throughout the year through tissue culture of nodal explants (micropropagation) (Bhojwani, S., *et al.*, 1996).

The in vitro callus extract demonstrated significant microbial and scavenging activity when compared to the wild plant. After screening, it was discovered that the methanolic extract of this species contained more primary and secondary metabolites with potent antioxidant and antimicrobial qualities. The micro propagated plant can be used as a potent source of phytocompounds for commercialization without depleting wild plant resources (Arumugam Vignesh *et al.*, 2022).

VI. CONCLUSION

Saraca asoca is highly regarded as a universal panacea in the ayurvedic medicine. It is one of the universal plants having medicinal activities. It is widely used for curing various ailments due to its therapeutic potentials. This versatile plant is the source of various types of compounds, and the bark, leaves, flowers and seeds of the plant are of medicinal value. Ashoka is ancient and reliable source of medicine and used in many pharmacological activities like antibacterial, anti-inflammatory, uterotonic, anticancer, anthelmintic, antioxidant, hypolipidemic, antiulcer properties and have extend uses in Ayurveda, Unani and Homeopathy. The scientific studies have proved most of the claims of traditional medicines. *Saraca asoca* should be emphasized for the control of various diseases. However, further detailed clinical research appears worthwhile to explore the full therapeutic potential of this plant in order to establish it as a standard drug.

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