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To investigate the Phytochemical and Pharmacological evaluation of *Saraca asoca*

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Abstract: The present study seeks to investigate the phytochemical constituents and pharmacological properties of *Saraca asoca*, a medicinal plant esteemed in traditional Ayurvedic medicine. *Saraca asoca*, commonly referred to as the Ashoka tree, is renowned for its therapeutic applications, particularly in the treatment of gynecological disorders. The research entails a comprehensive analysis of the plant's bioactive compounds, including flavonoids, glycosides, tannins, and saponins, which are hypothesized to contribute to its medicinal properties.

Phytochemical screening of *Saraca asoca* extracts has revealed a rich presence of secondary metabolites with significant potential health benefits. These compounds have been subjected to various in vitro and in vivo pharmacological evaluations to ascertain their efficacy. The pharmacological investigations primarily focus on the plant's anti-inflammatory, antioxidant, antimicrobial, and analgesic properties, with particular emphasis on its role in managing menstrual disorders and promoting uterine health.
Preliminary results indicate that *Saraca asoca* exhibits significant pharmacological activities that corroborate its traditional medicinal uses. Notably, its anti-inflammatory and antioxidant effects suggest potential therapeutic applications in the management of oxidative stress-related conditions. Furthermore, the antimicrobial activity of the plant extracts underscores its potential in combating microbial infections.
The study concludes that *Saraca asoca* possesses a diverse array of bioactive compounds that may offer therapeutic benefits across various medical conditions. However, further research is warranted to isolate specific active constituents and to elucidate their mechanisms of action. This investigation highlights the significance of *Saraca asoca* in traditional medicine and its potential for integration into modern pharmacological practices.

IndexTerms **–** menstrual disorders, therapeutic benefits, bioactive compounds

1. INTRODUCTION

"Arthritis" is a combinatorial word originated by the mixing of Latin and Greek. In Greek, "Arthron" signifies joint and in Latin "Itis" specifies inflammation. Thus, arthritis is normally viewed as a disease caused as a result of inflamed joints. Inherently, it is not just a single disease rather a collection of medical problems collectively termed as "Arthritis". Nearly 47 million adults and 300,000 children suffer in the US alone [1]. The disease can incapacitate permanently if proper treatments are not provided in time. Globally, it imposes a huge financial burden through wage loss along with the cost of medications [2,3]. Several treatment pathways are now available just to control the disease but no imminent cure is found yet. For proper understanding about the disease, it is worthy to know the mechanics of a bone joint.
Usually, when a bone moves or twists on similar piece(s) to maintain the functional flexibility, it is then characterized as a joint. During movement the ligaments act as elastic bands to help keep the bones in the same place. Under all situations whether in resting or moving, ligaments always hold them at the same place. Cartilage tissue covers the bone surfaces to prevent from direct rubbing thus smoothens the limb movement without causing pain or bone erosion due to friction. The cavity inside the joint is filled with synovial fluid produced by the cells from synovial membrane which is aligned with the ligaments within joint cavity (Figure1) [4]. In case of arthritis, primarily the suffering starts due to faulty joints.
The reasons that trigger the disease are many; A) possible cartilage damage, B) shortage of the synovial fluid, C) autoimmune attack, D) infections [5]. By nature, arthritis is versatile. Here are the few common ones: 1. Osteo-arthritis (OA), 2. Rheumatoid Arthritis (RA), 3. Gout, 4. Ankylosing Spondylitis (AS), 5. Lupus arthritis, (LA), 6. Infectious arthritis (IA), 7. Juvenile arthritis (JA), 8. Psoritic arthritis (PA), 9. Fibromyalgia. The most outbreaks are seen for OA, RA and gout or to a certain extent AS, whereas the remaining others are less frequent [6].

1.2 Epidemiology of Arthritis:

Numerous studies are conducted concerning the incidence of various forms of arthritis in western and eastern hemisphere. So far, no precise reason whether genetic predisposition or environmental stimulus plays any role has been identified so far. Studies performed by Helmick et al identifies that in the US alone > 21 % adults or ~ 46.4 million are diagnosed to be currently suffering from the arthritis. Further as reported in 2008, approximately 1.3 million of the US population have the RA which is somewhat less than that estimated (2.1 million) in 1995. The study also indicates that AS sufferer ranges from 0.6 to 2.4 million whereas the

LA affects 161,000 to 322,000. In case of JA, the value is ~ 294,000. The study also shows that ~ 27 million of the US population possesses clinical OA which is up from 21 million compared to the year 1995. Regarding other kinds, about 5.0 million have Fibromyalgia and ~ 3.0 million carries the gout (up from 1995 which was 2.1 million) [7,8]. A Canadian study in recent decade shows that in general, ~ 15% of the overall population suffers from any kind of arthritis. Among the victims, 48.8% are male and 51.2% are the female. The difference is claimed significant which is supported by other studies pointing the problem more toward females. The study further indicates that within the Canadian nationals, white Europeans / Caucasians bear a higher percentage (19.7%) than the Asians (5.5%) or other ethnic categories (8.8%, including Africans & other non-Caucasians). Several relating studies convince also that the Asian race have lower incidences of any arthritis irrespective of their age, sex or education level [7-10]. In US, concerning the ethnicity, no exact consensus has been reached concretely but a few studies reflect that there is a distinguishable role regarding some forms of arthritis. For example, as an average estimate, the incidence of RA is seen somewhat higher within the Hispanics community [7]. As stated by Symmons et al that globally, in previous decades, arthritis is estimated to be the 40th leading cause of non-fatal burden. In the last decade just before changing of the century, it has been accounted that about 0.7% of the total years people lived with disability (YLD). In next decade following the World Health Report, just RA alone is considered to be the 31st leading cause of YLD globally and that percentage (0.7%) increases to greater than >1% [11]. As published by Inoue et al, that in the hip joints OA are more prevalent within Caucasians than in Asians, particularly comparing to the Japanese [12]. Studies performed in nineties covering up the last three decades indicate that among developing Asian nations the prevalence of RA is just about the same as for Western nations (0.75%) whereas according to Modi et al, in the case of India or Pakistan it is somewhat less, about 0.55% [11]. The value is even remarkably low (0.4%) for China and Indonesia including both urban and rural population [11]. Interestingly, in rural African nations RA is considerably low whereas it is extremely high in Jamaica (2%) and Latin American nations (1.5%) [13]. The ecological factors or genetic variations are suspected to be largely responsible behind these differences. A number of studies show that the frequency of RA or its severity is somewhat less within Asians and West Africans [14]. Studies conducted in the US with worldwide focus on RA alone showed that the prevalence is much higher in Europe and North America than in any developing nations [15]. The major data collection by ILAR (International League against Rheumatism), for the developing nations was carried out mostly from China, Philippines, Malaysia, Indonesia and South Africa (not India or Pakistan) [10,16,17]. The data from India or Pakistan remains questionable. According to some studies, no real difference exists when compared with the West-European nations [10,18]. The genetic profile associated with RA is uniform for both India and Pakistan but definitely not for the Chinese or other South Asians. The differences in HLA motif is considered to be the underlying reason [14].

The degeneration of cartilage within bone joints sets the attack of OA which starts at the median age of 40. Studies showed that among the OA sufferers, the disease affects nearly 13.9% adults from the age over 25 or older and 33.6% around the age of 65 or higher which estimates about 12.4 million people in that age group. Concerning the incidence of OA correlating with age and sex, women show the higher rates than men mostly after the age of 50. In that way, men possess 45% lower risk of knee and 36% reduction in case of hip OA [7,8]. The prevalence of knee OA is severe for the women than men. The widely famed Framingham study also validates the fact by judging the pictures of radiography of the knees. The higher incidence of OA for women with increasing ages in comparison to the men are distinctively noticeable which is supported by the other studies also [19]. A follow up of Framingham study showed that the risk of knee OA turns 60% lower within the women who are using hormone replacement therapy than those abstaining from it. This very finding led to speculate that estrogen could have a chondro-protective role, which may disappear with the menopause. Several studies also favor the preventive role of estrogen [20]. Since OA is linked to the aging so its incidence rate is higher among the women in Asian countries because they age and reach the menopausal stage earlier. Studies within Asian women show that the incidence depends further on their professions and living conditions. Thus the hip and knee OA within working Asian women are exceedingly common and associated with their occupational activity which often involves serious physical labor. For that they frequently show a higher incidence rate than men. The victims belong mostly to the poor and rural community [11].

The Gout is also counted as an inflammatory arthritic disease, very common among the men. In the US, its incidence is higher within black than the white males, about 3.1 vs 1.8 of 1000 persons counted in each year for last 34 years. The Rochester Epidemiology Project shows that there is an increase of incidence from 45.0 out of 100,000 persons in 1977-78 to 63.3 in the year 1995 -96. The ratio of male to female is 3.3 toM1.0 as seen in both cases whereas below the age of 65 the rate is 4 to 1 [21]. The prevalence of ankylosing spondylitis (AS) is normally less compared to either RA or OA but certainly not ignorable. The epidemiological surveys were conducted in various populations and subpopulations and the value ranges from 0.036 % to 0.10%. The incidence is lower in Greece and Japan because of the low occurrence of HLA-B27 antigen [22-23]. The involvement of antigen HLAB27 expression is believed to be the common cause but that is not always the exact reason. Following the New York criteria, the prevalence of AS in Dutch population was seen 0.24% whereas the value for HLA-B27 is noted to be 0.1%. Surprisingly only a limited number among the AS sufferers corresponds to HLA-B27 positive. In previous Norwegian study within Lappish population the prevalence of AS was reported 1.1 - 1.4% and the male to female ratio was 4:1. In that particular study the prevalence of HLA-B27 antigen is noticed to be a common factor because it corresponds well, ~ 91%, signifying that this antigen could be the major cause of AS within them. In Asian region the average prevalence of OA is 0.11% which is almost equal to that of Chinese, Thai and average Caucasians but not for the Japanese who bears a significantly lower rate due to low prevalence of HLA-B27 antigen. The middle-east Arab population shows a higher rate of AS compared to the south Asians. Further the diversity of HLA-B27 antigen regarding the subtypes is identified when Indonesian Chinese (HLA – B2704) are compared with the natives (HLA –B2705). In India, the study conducted by ILAR or Community Oriented Program for the Control of Rheumatic Diseases (COPCORD) by Chopra et al showed that the prevalence of AS in rural Indian population is 0.09%. The study was conducted with 4092 adults of whom 18.5% expressed pre- rheumatologic complain [24,25].

1.3 NATURE and CAUSES:

As already mentioned, that arthritis belongs to two main categories. OA which is the most prevalent one often starts due to wear and tear or rather say by the rupture of cartilage tissue. Whereas in case of RA, it is the body's immune system that creates the trouble by attacking cartilage. Considering that fact, the present-day treatments are constructed which brings much success in controlling the disease. But in all cases the joints experience inflexibility along with the pain, swelling and bone erosion. For OA,

the disease is viewed as a common ailment whose incidence goes up with the ages. The disease is identified by observing progressive degradation of the articular cartilage causing severe discomfort accompanied with pain and loss of mobility.

2. PLANTS USED IN TREATMENT OF ARTHRITIS

2.1 Curcuma longa (Zingiberaceae)

The plant commonly known as turmeric is an herbaceous flowering plant which is native to Indian subcontinent.It is a potential antiarthritc agent.The main active constituent of the plant is curcumin which is a bright yellow coloured chemical compound [26].Chemically it is a diarylheptanoid which are natural phenols responsible for turmeric's yellow colour [27].It has several pharmacological activities such as anti-diabetic, hypolipidemic, anti-inflammatory, anti-diarrhoeal, hepatoprotective etc.Several research studies are reported on the antiarthritic effect of curcumin.Zheng et al reported that a nanoemulsion of curcumin shows significant effect similar to the IV administration of curcumin [28].Thus they accomplish the conversion from IV to oral administration of curcumin for the management of arthritis.R Arora et al reported that curcumin solid lipid nanoparticles not only improve the biological performance of curcumin but also establish the method as a potential pain inhibitor in arthritis.[29]A study is reported by Nonose N et al stated that oral administration of curcumin significantly reduces the inflammation in zymogen induced arthritis [30]. Gang Huang et al reported that curcumin gives protection against collagen induced arthritis [31].

2.2 Boswellia serrata (Burseraceae)

Boswellia is a very important plant and is used for thousands of years for the treatment of inflammation and swelling in Ayurvedic medicine. In various Unani and Ayurvedic preparations the oleo-gum resin of this plant was used for the treatment of many diseases. The first terpenoid which is isolated from the oleo-gum resin is Boswellic acid. There are several derivatives of boswellic acids are established [32]. Among them 3-O-acetyl-11-keto-β-boswellic acid (AKBA) show the highest activity against arthritis [33]. In 2003, medical researchers selected 30 patients who are suffereing from osteoarthritis of the knee and a randomized blind placebo-controlled trial was conducted. The result showed the range of motion was increased and swelling was reduced from arthritis in the patients. Mishra et al reported that a combined formulation of both Glycyrrhiza glabra and Boswellia serrata showed significant anti-arthritic activity [34]. Sadiq Umar et al reported that the prepared Boswellia serrata gum resin extract give protective effect on arthritis and this effect is shown might be due to the modulation of the immune system [35].

2.3 Cuscuta reflexa (Cuscutaceae)

Cuscuta reflexa is a parasitic medicinal plant which is also known as dodder plant, devil's hair used for the treatment of many diseases. It contains several phytoconstituents such as dulcitol, mannitol, sitosterol, lycopene, apigenin-7-β-rutinoside, 6-7 dimethoxy coumarin, quercetin, hyperoside, propenamide, reflexin, lutein, cuscutin, cuscutalin, kaempferol, kaempferol-3-O-glucoside [36].It is used as anti-diabetic, anti-oxidant, anti-inflammatory, anti-pyretic and anti-microbial agent [37]. It is a potent anti-inflammatory agent. Several researches prove that this plant shows significant effect in arthritis. Damerakonda Kumaraswamy et al reported that ethanolic extract of Cuscuta reflexa shows significant anti-arthritic effect [38]. Vennila et al reported that this plant posseses marked anti-arthritic activity [39].

2.4 Piper longum (Piperaceae)

Piper longum also known as Indian long pepper (pipli) is a flowering vine belonging to the family Piperaceae which is commonly used as a spice. The main chemical constituents of the plant are piperine, piperlongumine, piperlonguminine, and methyl 3, 4, 5-trimehoxycinnamate.

It is used as an anti-inflammatory, anti-amoebic, hepatoprotective and immune-modulatory activities. A study reported by Yende et al stated that the two doses (200 and 400 mg/kg) of the aqueous extracts of the seeds shows 46.32% inhibition in paw swelling in Freund's complete adjuvant induced arthritis in rats by the inhibition of the adherence of neutrophils to endothelial monolayer by the suppression of the TNF-α induced expression of intercellular adhesion molecule-1, vascular cell adhesion molecule-1, E-selectin and it shows inhibition of NF-B. Overall, it showed significant anri-arthritic activity of the plant extract on male wistar rats [40].

2.5 Coriandrum sativum (Apiaceae)

It is an herbaceous volatile oil containing plant which is grown throughout the India and the parts of the plant used medicinally are seeds, fruits and leaves. The chemical constituents of the plant are linalool, geraniol, citronellol, borneol etc. [41] which are essential oils. Cineole which is an essential oil component present in this plant has anti-arthritic and anti-rheumatic property. The plant is useful as stomachic, tonic, carminative, diuretic and stimulant. It has anti-bacterial, anti-oxidant and anti-carcinogenic activities. A study which is reported by Nair V et al stated that at a dose level of 8, 16 and 32 mg/kg of the hydroalcoholic extracts of the seeds shows reduction in paw swelling in male wistar rats which is induced by formaldehyde and CFA methods by the inhibition of the pro-inflammatory cytokines and TNF-□. So, the study proved about the anti-arthritic activity of the plant [42].

2.6 Cinnammomum zeylicanium (Lauraceae)

Cinnamomum zeylanicum is small topical evergreen tree which is mainly cultivated in Sri Lanka, Myanmar, and southern coastal areas of India. Cinnamaldehyde and eugenol are the main active constituents of the plant. It also contains some other constituents such as pinene, cymene, caryophyllene etc14. It is used as an analgesic, anti-pyretic, anti-inflammatory, anti-microbial, anti-diabetic and anti-oxidant. Vetal S et al reported that the polyphenolic extract of the bark of the tree at a dose level of 8 mg/kg showed significant anti-arthritic potential in male wistar rats in CFA model by the improvement of the body weight and the level of serum C-reactive proteins when compared with control group. Here the by inhibiting leukocyte immigration and prostaglandin synthesis the anti-arthritic activity was mediated [43].

2.7 Caesalpinia pulcherrima (Caesalpiniaceae)

It is a species of flowering plant which is native to the tropics and subtropics of the America, but its exact origin remained unknown. It is useful medicinal agent. This plant contains a glycoside which is made up of ß-amyrin, glucose and the free amino acids such as alanine, aspartic acid, glycine, proline, valin, leucine, threonine. There are several free sugars are also present such as lactose, galactose etc [44]. It is used as an anti-oxidant, anti-cancer, anti-diabetic, anti-microbial, anti-inflammatory activity etc. A study is reported by Rajaram et al clearly stated that the ethanolic extract of the plant shows significant decrease in paw volume and it helps to normalize the haematological abnormalities in adjuvant induced arthritic rats and thus it posseses significant anti-arthritic activity [45].

2.8 Asparagus racemosus (Asparagaceae)

It is an effective medicinal plant which is used in Ayurvedic medicine. It is grown commonly throughout Nepal, Sri Lanka and India. The main active chemical constituent of the plant is shatavarin which is a steroidal saponin. There are 6 shatavarins such as I-VI [46]. It has several pharmacological effects. It has anti-secretory, anti-ulcer, anti-bacterial, anti-protozoal effect, also used as an anti-tussive agent. Mittal and Dixit reported that the hydroalcoholic extract of the plant showed significant anti-arthritic and anti-inflammatory effect at oral dose level of 200 mg/kg and 400 mg/kg [47].

2.9 Abutilon hirtum (Malvaceae)

It is a small shrub which is native to tropical and subtropical regions and in India it is found in Tamil Nadu. The plant contains important phytoconstituents such as β-Sitosterol and tocopherol and the plant essential contains α-pinene, caryophyllene, caryophyllene oxide, endesmol, farnesol, borenol, geraniol, geranyl acetate, elemene and α-cineole etc [48]. A study reported by Nitin Bhaji pale showed that the methanolic extract of the plant shows significant reduction in arthritis [49].

2.10 Terminalia pallida (Combretaceae)

It is a species of the genus Terminalia and is a flowering plant and native in India mainly found in Andhra Pradesh and Tamil Nadu. The main active constituents of the plant are gallic acid and ellagic acid [50]. Hamed Ali Shaik et al reported that the ethanolic extract of the plant showed excellent anti-arthritic activity by checking it in the Bovine Serum Albumin [51].

2.11 Withania somnifera (Solanaceae)

It is commonly known as Ashwagandha, Indian ginseng is a very important herb which is used for over 3000 years in Ayurvedic medicine. The main therapeutically active chemical constituents of the plant are withanolides. The withanolides have C28 steroidal nucleus with C9 side chain, having a six membered lactone ring. Besides withanolide, it also contains withanosides, sitoindisides, alkaloids, Saponins, phenolic compounds and flavonoids etc14. It is used as a nerve tonic, aphrodisiac, adaptogen, antirheumatic agent, memory enhancer, antidiabetic, immunomodulatory etc. Different studies are done to determine the anti-arthritic activity of this plant. A study reported by Gupta and Singh clearly revealed that at a dose level of 600 and 800 mg/kg significantly decreased the severity of arthritis by the suppression of inflammatory mediators and also helps to improve the functional recovery of motor activity in experimental animals [52]. Khedgikar et al reported that in menopausal osteoporosis and bone injury the active compound withaferin-A showed to stimulate the differentiation and growth of osteoblasts by increased expression of osteoblast-specific transcription factor and mineralizing genes [53]. A study reported by Kiran R Giri states that ethanolic extract of the plant showed significant dose dependent acute and chronic anti-inflammatory activity in carrageenan with comparison to hydrocortisone [54].

2.12 Allium sativum (Amaryllidaceae)

It is a species of the genus onion and native to Central Asia and Northeastern Iran and used for several thousands of years for human consumption. It mainly contains volatile oil with sulpher containing active compounds among them allicin, alliin and ajoene are notable14. The study reported by Tillán Capó et al stated that syrup which containing this plant extract showed significant anti-arthritic activity [55]. It is also used as an anti-viral, anti-bacterial agent.

2.13 Trigonella foenum-graecum (Fabaceae)

It is an herbaceous plant which is also known as fenugreek widely ued in traditional medicine. The fenugreek seeds contain high amount of mucilage, choline and trigonelline14. Its extracts showed good activity as an anti-hyperglycaemic, anti-oxidant, anti-cancer and anti-inflammatory. A study reported by Sindhu G et al says that the mucilage obtained from the fenugreek seeds at a dose level of 75 mg/kg showed significant anti-arthritic effect [56].

2.14 Terminalia chebula (Combrataceae)

The plant also known as haritaki is an important, well known and widely used herb in the Indian traditional medicinal system. It contains several active phytoconstituents such as tannins, flavonoids, resins, fixed oil and sterols. The active constituents of the tannins include chebulic acid, ellagic acid, chebulagic acid, chebulinic acid etc14. It possesses several pharmacological activities such as anti-bacterial, anti-viral, anti-amoebic, anti-fungal, anthelmintic, anti-diabetic, anti-ulcerogenic etc. Nair V et al reported in a study that the hydroalcoholic extract of the plant showed good antiarthritic activity in complete Freund's adjuvant induced arthritic models. The extract showed the anti-arthritic potential by reducing the levels of several factors related to arthritis such as TNF, IL-6 and IL-1 [57].

2.15 Lawsonia inermis (Verbenaceae)

It is also knowned as henna tree and is native to Northern Africa, Southern Asia, Northern Australia and tropical areas. The main active constituent of the plant is lawsone which is a natural dye14. It also contains other compounds such as flavonoids (luteolins, apigenin), coumarins such as esculetin and scopletin etc. Kore K. J et al reported that potential anti-arthritic activity is given by

the hydroalcoholic extract of the plant against two different models, they are adjuvant induced arthritis and formaldehyde induced arthritis model [58].

2.16 Punica granatum (Lythraceae)

The plant is also known as pomegranate is widely available in several countries such as India, Southern Asia, Tropical Africa etc. There is a specific tonic was used for the treatment of rheumatism in Iranian traditional medicinal system which consists of seeds and juice of the plant. The major chemical constituents of the plant are gallic acid, anthocyanins, ellagic acid, tannins, flavones, flavonoids, antocyanidins, sterols, quercitin, triterpenoids etc [59]. The plant has numerous pharmacological activities such as anti-inflammatory, anti-carcinogenic, anti-oxidant, hypotensive, hypolipidaemic and anti-diabetic etc. Shukla et al reported in a study that the anti-arthritic activity was shown by the fruits of the plant at a dose level of 13.6-34 mg/kg by the inhibition of the spectrum of signal transduction pathway in male wistar rats [60].

2.17 Ruta graveolens (Rutaceae)

This is an herbaceous plant which is native to the Balkan Peninsula. The major chemical constituents which are isolated from this plant are acridone alkaloids, coumarins, terpenoids, flavonoids, rutin, quercitin, epoxide, graveoline, 2-heptanol acetate, geyrene etc [61]. It is reported to have several pharmacological properties such as anti-inflammatory, analgesic, antiandrogenic, antihyperglycaemic and anticancer etc. A study reported by Ratheesh M et al clearly stated that the polyphenolic fraction of aerial parts of the plant showed antiarthritic activity in male wistar rats induced by CFA model at a dose level of 10 mg/kg. The activity was shown by the inhibition of the prostaglandin's synthesis, decreased ceruloplasmin, lipid peroxidation and release of other inflammatory mediators [62].

2.18 Sida rhombifolia (Malvaceae)

It is a perennial or sometimes annual plant commonly found in India. It is used in Ayurvedic medicine named as kurumthotti. The major active constituents which have been isolated from the plant are steroids, glycosides, fatty acids, anthraquinone glycoside, alkaloids, flavonoids, Saponins etc [63]. It is used as an anti-microbial, anti-bacterial, anti-inflammatory, anti-pyretic and anti-arthritic. Gupta SR et al reported in a study that at the dose level of 30 and 100 mg/kg the aqueous and methanol extracts of the aerial parts of the plant shows reduction of the paw edema induced by CFA method. Thus, it showed significant anti-arthritic activity [64].

2.19 Xanthium strumarium (Asteraceae)

It is commonly known as cocklebur or broad bur, clotbur or burdock datura is an indigenous plant of India. The active constituents that are isolated from the aerial parts of the plant are mainly alkaloids; sesquiterpene lactones such as xanthinin, xanthumin, xanthatin; sulphated glycoside such as xanthostrumarin, atractyloside, carboxyatractyloside; phytosterols, xanthanol, isoxanthanol, xanthinosin, 4-oxo-bedfordia acid, hydroquinone, xanthanolides, α and γ-tocopherol, linoleic acid etc [65]. Therapeutically it is used as anti-bacterial, anti-tumor, anti-tussive, anti-fungal, anti-cancer, anti-malarial, hypoglycaemic agent. Patil MV et al reported that the ethanolic extract of this plant showed significant antiarthritic activity by the inhibition of the release of inflammatory mediators [66].

2.20 Vitex negundo (Lamiaceae)

Commonly known as Chinese chaste tree or horseshoe vitex this plant is widely used as folk medicine specifically in Southeast Asia. It is native to Southern India and Burma [67]. The main chemical constituents of the plant are alkaloids such as nishindine, flavonoids like flavones, luteolin-7-glucoside, iridoid glycosides, vitamin C, β-sitosterol, phthalic acid, benzoic acid, fatty acid, vanillic acid, hydroxybenzoic acid [68]. It is used as an anti-inflammatory, analgesic, anticonvulsant, antioxidant and antirheumatic agent. Pandey A et al reported in a study that the ethanolic extract of the leaves of the plant showed significant antiarthritic activity at the dose level of 1.56 mg/10 ml, 3.12 mg/10 ml, 6.25 mg/10 ml and 1.25 mg/10 ml by decreasing the levels of ESR, leukotriene B4, PGE2, cytokines, IL-17, TNF-α etc [69].

2.21 Lantana camara (Verbenaceae)

This plant is also known as wild sage, red sage etc is native to India. For the treatment against rheumatism the decoction of leaves of the plant was used traditionally. It contains several phytochemical constituents such as flavones, isoflavones, antocyanins, coumarins, lignins, alkaloids, phenolics, tannins, saponins, triterpinoids, phytosterols etc [70]. It has several pharmacological activitie such as anti-oxidant, anti-inflammatory, anti-diabetic, anti-fungal, anti-bacterial, anti-fertility and wound healing activities. Gundamaraju et al reported in a study that the ethanolic extracts of the leaves of the plant has been proved to show good antiarthritic activity at dose level of 5, 10 and 20 mg/kg by the inhibition of lipoxygenase and cyclooxygenase [71].

2.22 Citrullus colocynthis (Cucurbitaceae)

This plant is also known as bitter apple is a desert viny plant native to the Mediterranean Basin and Asia especially Turky. It contains several important phytoconstituents such as alkaloids, glycosides, flavonoids, tannins, sterols etc. It is used as laxative, purgative, anti-bacterial, analgesic etc. Kachhawah et al reported that the hydroalcoholic extract of the fruits of the plant showed significant antiarthritic activity [71].

3. Saraca asoca as anti-arthritic agent

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 [72,73]. 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 [74]. 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 [75,76].

3.1 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 [77]. 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 seed [78].

3.2 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 [80]. 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 andalleviation of painful urination [77] A concoction prepared by boiling the barks of S. asoca in water alongwith 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 [79]. 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 [76].

3.3 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 [81]. The extracts prevent numerous transcription factors, such as AP1, GATA-1, and others, from binding to their target DNA sequences, thus decreasing the levels of proinflammatory cytokines. According to studies, the ethanolic extract of S. indica has also been reported to protect cardiac tissues from inflammatory cell infiltration [82].

4. 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.

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