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PHYTOCHEMICAL ANALYSIS AND BIOLOGICAL ACTIVITIES OF SOYMIDA FEBRIFUGA (ROXB.) JUSS (MELIACEAE): AN OVERVIEW

Dr. A. P. Rajput^{1*} & Bhagvan .C. Kachhava²

¹ K.K.Wagh Arts, Commerce, Science & Comp.Science College Nashik.422003.

²Asst. Prof. , K.E.S.A.C.S College Kalwan (Manur) Pin-423501 Tal- Kalwan Dist-Nashik (Maharashtra)

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ABSTRACT: From old historical era plants are considered as a biosynthetic innovative, which can able to produce primary and secondary metabolites. Many primary metabolites such as, proteins carbohydrates, lipids and secondary metabolites like glycosides, alkaloids, flavonoids, tannins, volatile oils etc., which are therapeutically useful in human beings and animals are obtained from these solar energy biosynthetic laboratories. In *Soymida febrifuga* roxb Adr. Juss various complex chemical substances of different compositions are found as secondary metabolites in one or more parts of these plants such as root, bark, stem bark, heart wood, leaves, flower, fruit and seed etc. These secondary metabolites have ability to alter biological processes, which can reduce the risk of chronic diseases in human beings such as diabetes. A large number of modern drugs have been isolated from natural sources which were used in traditional medicines such as tribal medicine in the form of crude drugs. Hence, it is essential to isolate and identify active constituents from the extracts and to verify their therapeutic activity and specify dose-response relationship. Along with the developments in synthetic chemistry, higher plants are still a source of the medicinal constituents. For exploring traditional medicines and to investigate their scientific applications an endemic medicinal plant *Soymida febrifuga* Adr. Juss which has been used as a traditional folklore medicine. The present review is therefore gives an idea about the detailed survey of literature on its Pharmacognosy, phytochemistry as well as traditional and pharmacological uses.

Key Words: *Soymida febrifuga*, root bark, stem bark, heart wood, leaves, flower, fruit and seed traditional folklore medicine, Pharmacognosy, Phytochemistry, Pharmacological.

Introduction

Medicinal plants are used to treat illness and diseases for thousands of years. They have gained economical importance because of their application in pharmaceutical, cosmetic, perfumery and food industries. The interest in herbal systems of medicine is growing day-by-day because nature can cure many diseases.¹

Medicinal plants of commercial significance include poppy, Isabgol, Senna, Cinchona, Ipecac, Belladonna, Ergot, Amla, Chirata, Kalmegh, Safed musli, Ashoka, Ashwagandha, Bael, Shatavari, Tulsi, Brahmi, Chandan, Pippali etc. If endemic plants are not protected, they may become extinct. The Govt of India has recognized some plant species which need to be conserved, they include: *Azadirachta indica*, *Aegle marmelos*, *Andrographis paniculata*, *Asparagus racemosus*, *Bauhinia vahlii*, *Emblia officinalis*, *Holorrhena antidysenterica*, *Gymnema sylvestre*, *Litsea glutinosa*, *Mallotus philippensis*, *Pterocarpus marsupium*, *Soymida febrifuga*, *Strychnos potatorum*, *Sapindus emarginatus*, *Strychnos nux-vomica*, *Terminalia bellerica*, *Terminalia chebula*.²

The Government of India has mounted a programme of Vanaspathi Van Project to promote Indian System of Medicine and for development of medicinal plants in degraded forests¹².

Diabetes is one of the major culprits responsible in degrading the health of a person in this stressful life. During world war-II when insulin was not available in many countries, search was made for a substitute for insulin from plant sources. Moreover drugs used in Type-2 have a number of limitations as they produce severe adverse effects and high rate of secondary failure³.

Many plant species in folk medicine were used for their hypoglycemic properties and therefore used to treat diabetes⁴. Some of the plants with anti- diabetic activity include *Allium cepa*, *Coccinia indica*, *Ficus glomerata*, *Gymnema sylvestre*, *Momordica charantia*, *Pterocarpus marsupium*, *Rauwolfia serpentina*, *Syzygium cumini*⁵.

Plants with proven hypoglycemic effects were found to contain compounds like terpenoids⁶, glycosides^{7,8}, Alkaloids⁹ and saponins¹⁰ etc.

Liver is major functional organ in the body and its diseases causes serious health problems which are encountered very commonly in present era. The cause for these problems may be harmful drugs, chemicals, alcohol, environmental pollution etc. Conventional medical therapy for many common liver disorders,

including non alcoholic fatty liver disease and viral hepatitis has limited efficacy and potentially life threatening side effects¹².

Various medicinal plants are used in traditional medicine for their hepato protective effects. The most commonly used medicinal plants for management of liver diseases include *Phyllanthus spp (Euphorbiaceae)* *Silybum marianum*, *Glycerrhiza glabra* etc⁵. Plants are considered to be biosynthetic innovatives, which produce primary and secondary metabolites.

Many primary metabolites like carbohydrates, proteins and lipids and secondary metabolites like glycosides, alkaloids, tannins, volatile oils etc., which have therapeutic effects in human beings and animals are obtained from these solar powered biosynthetic laboratories. Secondary metabolites have been shown to alter biological processes which may reduce the risk of chronic diseases in humans. An impressive number of modern drugs have been isolated from natural sources. Many of these isolations were based on the uses of the agents in traditional medicines¹¹. Modern research has made it possible to isolate and identify active constituents from the extracts and to verify their therapeutic activity and specify dose-response relationship. In spite of developments in synthetic chemistry, higher plants are still a source of the medicinal compounds. With a view to explore traditional medicines and to investigate their scientific applications, an endemic medicinal plant *Soymida febrifuga* Adr. Juss, which has been used as a traditional folklore medicine¹².

Habitat:

It grows well in dry forests of W. Peninsula. Extending northwards to Merwara, the Mirzapur hills and Chota Nagpur, Ceylon, dry deciduous forests of India, A.P. It is found in N. Circars from Ganjam to Godavari, on laterite hills and in the forests of Deccan from Kurnool to Mysore and hills of Chingleput. It is found in Rajamundry, Tirupathi, Pakhal regions of A.P. Grows well on lime soils, black cotton soils, and dry stony hills. It is also found in dry forests of Kerala, Gujarat, U.P. Bihar, Ceylon, Karnataka, Madhyapradesh, Maharashtra, Orissa, Rajasthan, Tamilnadu, Srilanka¹³. It is also found in Manu Devi, region of satpuda ranges of northern Maharashtra.

Classification¹² (Zipcodezoo.com)

Domain : Eukaryota

Kingdom : Plantae

Sub-Kingdom : Viridiaeplantae

Phylum : Tracheophyta

Sub-phylum : Euphylllophytina

Infraphylum : Radiatopses

Class : Magnoliopsida

Sub-class : Rosidae

Super order : Rutanae

Order : Rurales

Sub order : Melineae

Family : Meliaceae

Subfamily : Solanoideae

Tribe : Solaneae

Vernacular names¹³

Bengal : Rohan, Rohira,

Bombay : Rohing

Central Provinces : Rohini, Rohun,

Deccan : Rohunna, Rouen, Ruhina

English : Bastard cedar, Indian red wood, Rohan tree.

Gond : Somi

Gujarati : Rohani, Rohina

Hindi : Rakat rohan, Rohunna.

Khond : Soniangi

Lambadi : Ronero

Marathi : Potar

Merwara : Rohan

Sanskrit : Agniruha, Atiruh, Chandravallabha, Kashamansi
 Lomakarani, Mahamansi, Mansarohini,
 Prahavaralli, Patranga, Suloma, Vasa, Vikasha,
 Viravali, Vritta,
 Tamil : Sem, Somadanam, Sombu, Sumi, Surakkali,
 Telugu : Sevamanu, Somi, Somida, Somili
 Urdu : Rohan
 Uriya : Karwi, Sohan, Sonhan, Suam.

Ayurvedic Properties:

GUNA(Quality) : Laghu (light to digest), Ruksh(dryness)
 RASA (Taste) : Kashay- astringent, madhura-sweet, Katu(pungent)
 VIPAK (Metabolism) : Katu-undergoes pungent test conversion after digestion
 VIRYA (potency) : Sheet
 PRABHAV (Impact) : Angmard-prashman,aphrodisiac improves vigor.

Morphology of *Soymida febrifuga*: It is a tall tree. Leaves 23-45 cm long, crowded towards the ends of branches. Leaflets 3-6 pairs, opposite, elliptic (or) oblong, obtuse, glabrous, penni nerved, nerves are numerous and conspicuous beneath. Base is rounded in equilateral i.e. the lower side generally extending further down the petiole than the upper. Petioles are red in colour. Flowers in large terminal (or) axillary divaricately branched panicles often equaling the leaves, they are greenish white and appear in February-May. Sepals 5, rotund, margins membranous, slightly lacerate, petals 5, obovate, 6mm long, clawed, often notched at the apex. Staminal tube is about half as long as the petals, slightly urceolate, anthers, attached by the middle of the back. Ovary is glabrous, stigma large, discoid. Ovary is supplied only by carpellary ventrals. Ovules show attachment to parietal placentae. Fruit ripens in May-June. The capsules are 2.5-6.3 cm long, 5-celled and 5 valves separating from dessipinents which remain attached to thick spongy axis. Numerous seeds in each cell, flat, winged at both ends, with a soft felly covering. Bark slightly red, scale like¹⁴.

Pharmacognostic review of *Soymida febrifuga* Leaves¹⁵: Literature Survey revealed the Pharmacognostic study of leaves of *Soymida febrifuga*. Transverse section of leaves showed the presence of:

Upper Epidermis: Single layered, covered with thick cuticle. The cells are thin walled, polygonal in shape and large in size.

Palisade tissue: It is arranged in two layers, first layer is large in length. This layer is followed by spongy parenchyma and intracellular space. Colouring matter is seen in palisade cells & spongy parenchyma. Crystals of calcium oxalate are also present in spongy tissue. Vascular strands are present.

Lower Epidermis: It is single layered. The cells are similar in shape to upper epidermal cells but small in size. Mid rib is very prominent on both surfaces. It has ridges which are composed of collenchymatous cells. Vascular bundles occupy the middle region. This is surrounded by sclerenchymatous cells (3-5 layers). Ground space of mid rib is filled up by spongy parenchyma. The xylem vessels and sclerenchymatous fibres are lignified. Starch is absent^{12, 15}.

Powder Characteristic of leaves¹⁵:

The powder is dull greenish in colour. Odour and taste is characteristic aromatic. Powder shows fragments of epidermal cells, palisade cells, spongy Scleride cells are fibre like with tapering ends. parenchyma along with calcium oxalate crystals, spiral vessels and few epidermal cells with cicatrix.

Higher value of acid soluble ash indicates larger numbers of calcium oxalate crystals while lower value of acid insoluble ash indicates cleanliness of drug. Methanolic extract value is higher which indicate higher amount of polyphenolic, carbohydrate and glycoside type compounds.

Preliminary chemical test confirms that petroleum ether extract contains sterol and triterpene type compounds. While methanolic extract confirms sugars, flavonols, glycosides and tannin type compounds. TLC of petroleum ether extract shows blue and white fluorescence spots indicate sterols and triterpene type compounds. TLC of methanolic extract, after spraying with FeCl₃ shows spots with reddish brown colour may be of tannins and gray green colour may be of flavonols compounds¹⁵.

The walls are thick having wide lumens and pits are canal like and simple. They are lignified. Here also druses and prismatic type crystals are found. Druses (A group of crystal like calcium oxalates, silicates or carbonates) are scattered in powder, prismatic crystals occur is strands^{12, 15}.

Powder characteristic of root bark¹⁶:

Organoleptic Characters: Organoleptic Characters of root bark powder shows colour brownish red, odour astringent, taste astringent ends sweet and touch is smooth.

Powder microscopy: Diagnostic character of root bark powder shows stone cells, Oil globules, Starch grains Simple and compound, Prismatic crystals of calcium oxalate, Lignified fibers, Crystal fibers and Pitted stone cells.

Traditional uses:-

Soymida febrifuga bark extracts are used in treatment of rheumatoid arthritis¹⁷, asthma and good for ulcers¹³. The decoction of the bark has bitter resin used in vaginal infections, rheumatic pains and stomach pains. Bark is used as anti-cancer remedy, used in wounds, dental diseases, uterine bleeding and haemorrhage¹⁷. It is used as an acrid, refrigerant, anthelmintic agent, aphrodisiac, laxative, good for sore throat, removes vata and cures tridosha fevers, cough, asthma¹⁸. Removes blood impurities, good for ulcers, leprosy, dysentery and it has anti inflammatory activity. The bark is used in intermittent fevers and general debility, in advanced stages of dysentery and diarrhea. It is a good anti malarial like cinchona. It has antimicrobial activity. The bark is astringent to bowels and used in fevers in Yunani medicine, decoction is a good substitute for Oak-bark used for gargles, vaginal infections & enemas. The bark is a bitter tonic. A decoction of bark 1 in 20 was given in one ounce doses three times a day in cases of malarial fever¹³. Decoction of bark is used in tongue sores, fixing loose teeth, gum infection. The bark is crushed and used with water and administered in cough¹⁹.

Leaves:

Leaf extracts were found to be potent antioxidant, antimicrobial, anthelmintic and anti-ulcerogenic potential^{20, 21, 51}. Recently it has been reported against periodontal disease causing microorganisms²⁹. Leaf juice is used to control over bleeding in menstruation²².

Stem and root Bark

Bark contains a resinous bitter principle and is acrid, refrigerant, anthelmintic, aphrodisiac, laxative; good for sore throat; removes vata; cures tridosha fevers, cough, asthma¹³. Bark crushed with water and administered for cough and dysentery^{23,24}. Bark is used in Ayurveda to remove blood impurities; good for ulcers, leprosy, dysentery and anti-inflammatory in action²⁵. Decoction of stem bark (½ cup) is given orally in snake bite²⁶. Fresh or dried bark is boiled in water to make paste, it is tied on swelling for 3 days. The bark is credited with antiperiodic properties, astringent to the bowels and useful in fevers (Unani), bitter tonic, febrifuge, particularly prescribed in malaria. The decoction of the bark is well adapted for gargles, vaginal infections, enemata, rheumatic swellings and stomach pain. The bark is said to be used for blood coagulation, wounds, dental diseases, uterine bleeding and haemorrhage¹⁸.

The powdered bark is applied as a poultice and is used for leucorrhoea and leucoderma (Maurya and Dongarwar, 2012). Remarkably *S. febrifuga* is well known to treat fever/malaria among 80 plants analyzed for antiplasmodial activity^{27,28}. Decoction of inner bark possesses *in vivo* antitumour activity against transplantable rat carcinosarcoma and rat yoshida sarcoma²⁹. Extract of *Soymida febrifuga* were cytotoxic and was found to kill human pancreatic cancer cells^{30,31}. Antioxidant, 5-lipoxygenase inhibitory and anticancer activities of the bark extracts were recently reported³². Further recent reports also demonstrate that bark extracts were found to be hypoglycemic and antihyperglycemic suggesting its mode of action as hepatoprotective and antidiabetic nature. Strikingly, decoction of stem bark is used to increase sexual vitality in women and mixture along with sugar cane juice is used to regularize menstruation (Jain A, Katewa et al., 2004).

Root callus:

Methyl angolensate, which is a natural tetranortriterpenoid isolated from *Soymida febrifuga* root calluses was responsible for anti cancer activity. It was active against T-cell leukemia, and chronic myelogenous leukemia³³.

Phyto-constituents:**Bark:**

Previous investigations of the various parts of the *Soymida febrifuga* led to the isolation of lupeol, sitosterol, methyl angolensate, deoxyandrobin & two tetranortriterpenoids with a modified furan ring from the bark.^{17, 34, 35, 36}

Root and Stem heartwood:

Obtusifoliol and the flavonoids syringetin and dihydrosyringetin have been isolated from the root heartwood³⁷.1972 the tetranortriterpenoids febrifugin³⁸ and febrinins A and B together with the flavonoids naringenin, quercetin, myricetin and dihydromyricetin are reported to be isolated from the heartwood³⁹.

Root callus:

Methyl angolensate and Luteolin -7 Oglucoside were isolated from callus cultures of root⁴⁰.

Leaves:

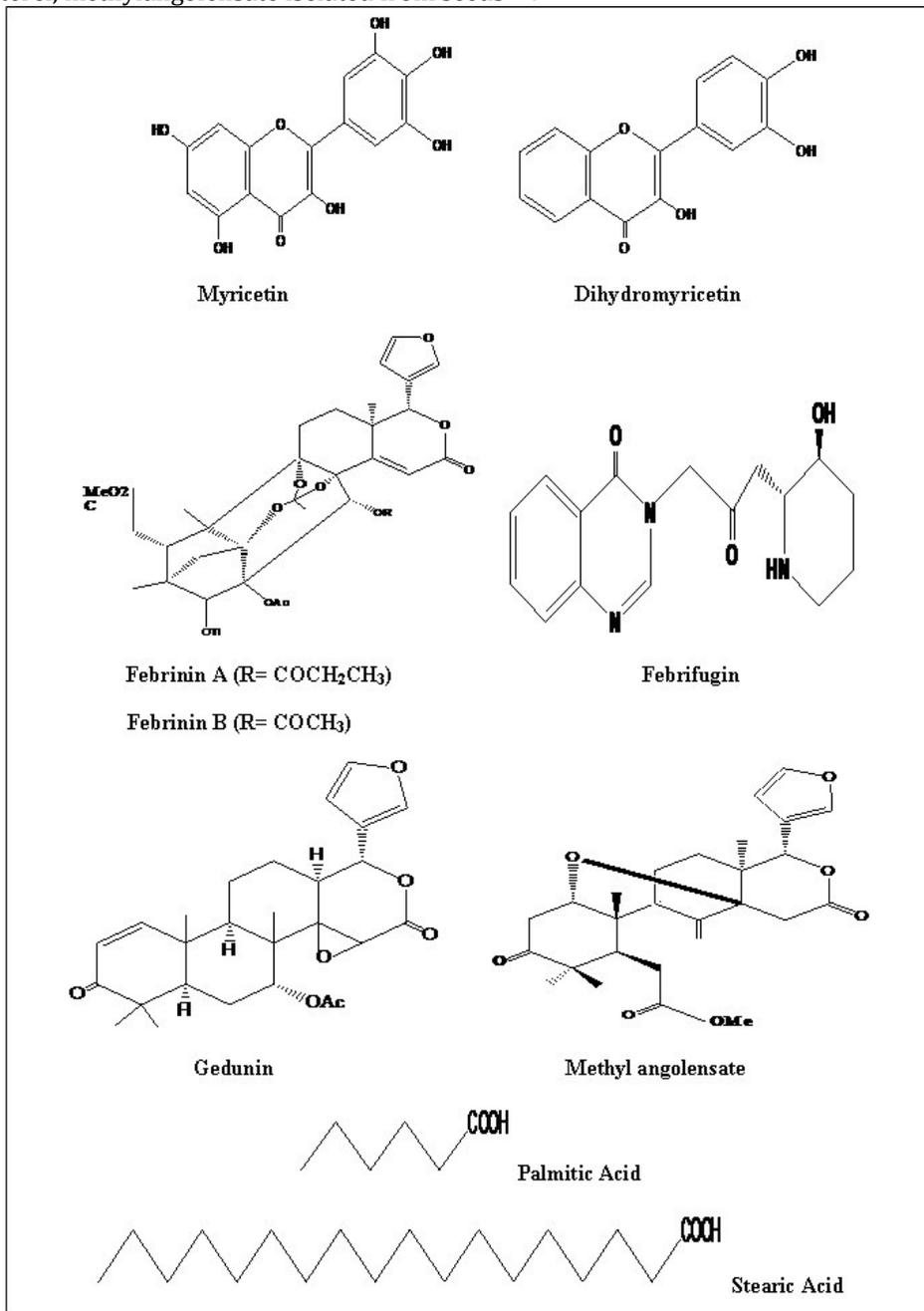
Quercetin 3-0-rhamnoside and quercetin 3-0- rutinoside have been isolated from the leaves⁴².

Fruit:

Three new tetranortriterpenoids, epoxyfebrinin-B,14,15dihydroepoxyfebrinin B and febrinolide together with deoxyandirobin, 17b-hydroxy-6a- acetoxyzadiradione (Connolly et al., 1979) methyl angolensate and sitosterol were reported to be found in the fruits (Mallavarapu et al.,1984).

Seed:

Lupeol, sitosterol, methylangolensate isolated from seeds ⁴².



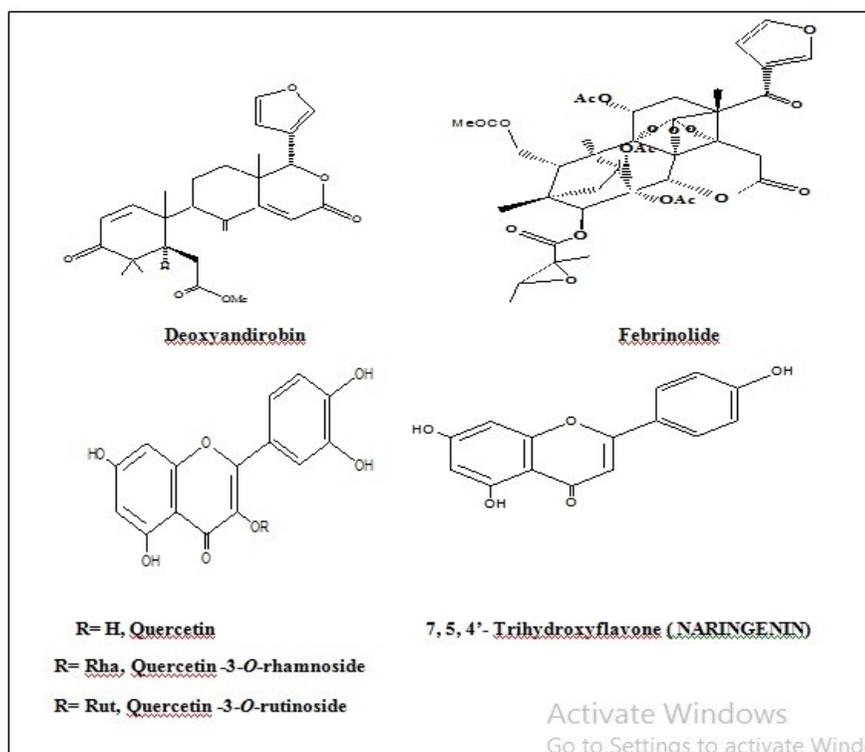
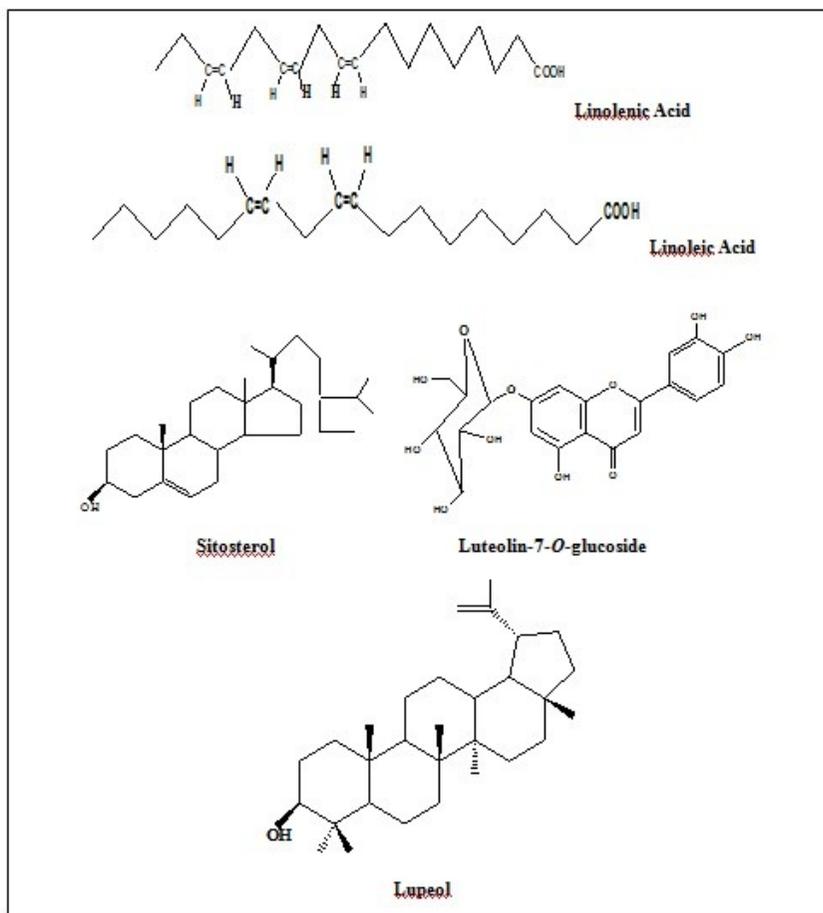


fig: - chemical structures of phytochemical active constituents of *soymida febrifuga* leaves.

BIOLOGICAL ACTIVITY:-

These chemical constituents were reported to be cytotoxic and strikingly are antimalarial, anti-inflammatory, antioxidant, antidiabetic, antiallergic, antifungal, antiulcer, spasmolytic, insect antifeedant, antihelminthic, antibacterial and anticancer in action¹².

Antioxidant, 5-Lipoxygenase inhibitory and anticancer activities:

Varicola Karunasree, Ciddi Veeresham, et.al have investigated the antioxidant, 5-lipoxygenase (LOX) inhibitory and anticancer activities of the bark extracts of this plant. Their results revealed that the polar methanol and aqueous extracts are potent in their antioxidant and 5-LOX inhibitory activities showing comparable or better effects than the reference compounds used. Conversely, despite showing a weak radical scavenging action, the relatively nonpolar chloroform extract exhibited better anticancer effect than the polar extracts against MCF-7, A-431 and HT- 1080 cell lines⁴³. G. Veda Priya et.al. evaluated the hydro alcoholic bark extract of *S. febrifuga* produced a dose dependent inhibition of free radical generation of superoxide anion, hydroxyl radical and DPPH radical *In vitro* antioxidant activity⁴⁴.

Hepatoprotective activity:

Ravi Teja M et.al. studied that the ethanolic extract of leaves has hepatoprotective activity against paracetamol and rifampicin induced hepatic damage model, and it showed very good hepatoprotective activity⁴⁵.

Antihistaminic activity

Ananta Krushna Palei et.al. investigated that the samples which partially antagonist is an agent which serve to inhibit the release or action of histamine. The drug can be described as a histamine antagonist⁴⁶.

Antidiabetic activity:

Varicola Karunasree et.al. studied that the various column fractions obtained from the bark extract of *S. febrifuga* showed significant hypoglycaemic and antihyperglycaemic activities in normal healthy and alloxan-induced diabetic rats, respectively. At a dose of 200 mg/kg, the 20% chloroform in acetone eluate showed the maximum activity that was comparable to that of glibenclamide³².

Antibacterial activity:

Sandhya Bhojar and Sharad Biradar have concluded that the antibacterial activity of acetone and methanol leaves extract shows maximum inhibition against pathogenic bacteria like *Klebsiella pneumoniae* (38mm) and *Pseudomonas aureginosa* (37mm) at its higher concentration. The distilled water extract also showed more activity against *Pseudomonas aureginosa* (35mm) at 10mg/disc⁴⁷. K.Riazunnisa et.al. evaluated that antibacterial activity of the extracts selected for major human pathogenic bacterial strains like *Bacillus subtilis*, *Escherichia coli*, *Klebsiella pneumoniae*, *Proteus vulgaris*, and *Staphylococcus aureus* by agar well diffusion method. The results of antibacterial activity revealed that the extracts showed excellent inhibitory activity against all the tested pathogens and the *Soymida* extract showed comparatively better activity than the other *H. indicus* extract⁴⁸.

Antiperiodontal activity:

Ninad Moon et.al. concluded that MeOH extracts of and *S. febrifuga* have excellent antibacterial activity against multi drug resistant strains of *Porphyromonas gingivitis* and *Prevotella intermedia*⁴⁹.

Antifungal activity:

Shubhangi Sharad Bhide et.al. investigated antifungal activity on *Candida albicans*, *Aspergillus Niger* and *Aspergillus flavones*. They have reported that methanol, water and total aqueous extracts showed prominent antimicrobial activity against all microorganisms⁵⁰.

Anthelmintic activity:

S.A.Gangurde et.al. evaluated anthelmintic activity of bark extracts on earthworm with albendazole as standard. According to their study methanol extract of bark showed comparable anthelmintic activity²¹.

Conclusion:

This review might be of great interest for researchers for further studies in principle biologically active compounds which have not been investigated specially from leaves for the invention of their potential pharmacological benefits. The present study review gives an idea about phytoconstituents and their uses for different diseases. Proper investigations of the phytochemicals will make this plant species a special wonder in the world of medicines.

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