Indigofera Aspalathoides: Plant of Researcher's Interest-A Review

Panchacharam G[*1] , Dr. Deepa N[2]

Saveetha College of Pharmacy, Saveetha Institute Of Medical and Technical Sciences, Thandalam, Chennai, Tamil Nadu, India.

Corresponding Author: Dr. Deepa. N, Email: deepanatarajan@yahoo.com

ABSTRACT

Herbal medications have been utilised in traditional systems of treatment for thousands of years, including Siddha, Ayurveda, and Unani, among others. Medicinal plants were used extensively by the allopathic system of medicine in order to develop novel molecules for the treatment of difficult disorders. It is commonly recognised that the plant Indigofera aspalathoides, often known as 'Sivanar vembu,' is effective in treating skin problems. Researchers in the fields of phytochemistry and pharmacology have examined it for its anti-cancerous and antioxidant properties. All of the most recent information on its authenticity, phytochemistry, and pharmacology is covered in detail in this review. An analysis of the plant's phytochemical composition revealed the presence of phenolic compounds, tannin, alkaloids, triterpenes, flavonoids, saponins, and steroids. This medication has undergone extensive testing for its anti-cancerous and anti-oxidant properties. Anti-microbial, hypoglycemic, hepatoprotective, anti-inflammatory, and antiviral activities have all been observed in conjunction with this compound. This plant produces a thailam (oil extracted using a traditional extraction process) that is commonly utilised by Siddha practitioners to treat a variety of diseases. This review focuses on a variety of therapeutic characteristics of the plant that have been scientifically validated, and it provides solid support for the traditional usage of the plant.

INTRODUCTION:

Natural compounds with medical significance for medication development are discovered mostly via the study of plants. Plants are used to make a large number of the medications available today, with simple synthetic changes being used to create fresh compounds. Medicinal plants are abundant in India, because to the country's diverse vegetation. In both herbal and conventional medicine, they are used to treat various conditions. They not only aid in the treatment of ailments, but they also aid in the restoration of good health, which is something that pharmaceutical treatments are unable to provide. Because of this, in recent years medicinal plants have garnered increased interest from scientists, as seen by an increase in the number of publications on their chemistry, pharmacology, and clinical studies.

Its biochemical properties, which are common in traditional remedies, provide Indigofera aspalathoides significant therapeutic potential. Aiming to address these issues, the current review focuses on the phytochemical and pharmacological properties of Sivanar vembu (Indigofera aspalathoides). Known as Sivanar vembu or sivan vembu in Tamil, the plant Indigofera aspalathoides, which belongs to the Fabaceae (Papilonaceae) family, is a low understory shrub with copiously terete spreading branches that grows in a terete pattern.

Traditionally, it has been used to treat a variety of skin problems and tumours in South India and Sri Lanka [1].

TAXONOMICAL CLASSIFICATION:

Kingdom: Plantae

Order: Fabales

Family: Fabaceae

Sub family: Faboideae

Tribe: Indigofereae

Genus: Indigofera. L

Species: Indigofera aspalathoides Vahl

Vernacular names:

The plant is called by various names like in Ratakohomba in Sanskrit, Sivamballi in kannada and Manali in Malayalam.

BOTANICAL DESCRIPTION:

It is a herb that grows upright. Some are little trees that grow up to 5-6m (16-20 ft) in height. When young, the stem is dark brown, then greyish white, and branched to a width of 0.7cm to 1.5cm. Roots are dark in colour and woody, with lateral roots ranging in breadth from 0.5 to 3.0 cm. The leaf is trifoliate, pale green, obanceolate, digitate, sessile, and crowded on the young branches; the stipules are minute. The flower is small and white.

Leaflets are folded adaxially, with one leaflet having the lamina vertical and the other having the lamina laterally deflexed. It is the presence of large, circular canals in the midrib and leaf edges that distinguishes adaxially folded leaflets from other leaflets. It is also possible to have a varying distribution of canals. The canals have a diameter of 50 millimetres. The lamina is clearly bifacial in appearance. It is composed of square or rectangular epidermal cells with broad, thin walls that are 15-20 mm in width. Adaxial zone of palisade cells, median level of circular cells, and adaxial zone of spongy parenchyma cells are all found in the mesophyll, which is further subdivided into three zones. The palisade cells are placed in two rows and are thin and cylindrical in shape, as well as being tightly packed together. It is made up of three layers of spongy parenchyma cells that are lobed and loosely packed together. The thickness of the lamina is 250 mm.

The midrib is characterised by the presence of a tiny circular collateral circulatory bundle that is located in the middle of the rib. There is no canal present in the midrib. The vascular bundle is made up of three or four shoots, parallel lines of xylem components, and a small group of phloem elements, all of which are connected by capillaries. The abaxial epidermis is distinguished by the presence of prominent papillae cells. Vein islets are broad and irregularly formed, and vein terminations are well defined and either simple or forked terminally in the lamina. The vein terminations are characterised by a spherical cluster of tracheids. They are short and cylindrical in shape, with pitted thickenings on the walls of their chambers. The tracheids measure 30 millimetres in length and 10 millimetres in width.

Thickness of the stem is around 900 mm, and it is composed of intact epidermis, a broad heterogeneous cortex, secondary phloem and xylem, and a large pith. The epidermis is made up of tiny spindle-shaped cells with thick walls. There are one or two layers of chlorenchyma cells followed by a few layers of parenchyma cells, and then a discontinuous cylinder of gelatinous fibres that is three or four cells wide. The inner epidermis is composed of one or two layers of chlorenchyma cells, followed by a few layers of parenchyma cells.

The roots are 800 mm thick. It is composed of periderm that is rather broad and superficial, as well as wide shallow cracks. There are parenchymatous & dense continuous sclerenchyma cells in the area after the periderm. The secondary phloem is broad and continuous in its distribution. Secondary xylem is dense and compact, compressing a large, circular, thick-walled diffuse mass of vessels and sclerenchymous ground tissue into a small space. Secondary xylem is composed mostly of xylem. The root is 2-5 mm thick at its thickest point. It features a periderm that is larger and deeply fissured, as well as discontinuous, radial segments of fibres that connect to the cortical area. This 1.5-mm-thick cylinder is composed of around nine fan-shaped radial bands of arteries and fibres and broad dilated rays, all of which are connected by a central vein. Within each xylem band, there is a large circular thick walled radial chain of vessels that runs down the length of the vessel [2]. The radial level xylems are further divided into smaller units by dilated rays.

PHYTOCHEMISTRY:

According to the phytochemical study, the plant contains steroids, triterpenes, alkaloids, phenolic groups, flavones, tannin, sugars, amino acids, and reducing sugar [3]. Spectrophotometric techniques were used to determine the total amount of phenols and tannins in Indigofera aspalathoides leaves and stems. The plant has more phenols than tannins [4], which is a good thing. Indigofera aspalathoides chloroform extracts were used to isolate the compounds indigocarpan and mucronulatol, both of which were previously unknown compounds. [5] Single x-ray analysis, were utilised to determine the structure of the molecules and the GC-MS analysis of the methanolic extract of Indigofera aspalathoides revealed ten main peaks, each of which corresponded to a phytoconstituent found within the plant. [6] Dodecanoic acid, tetradecanoic acid, and n-Hexadecanoic acid are three of the compounds that exhibit antioxidant and antibacterial properties.

TRADITIONAL USES:

The cooling and demulcent properties of the leaves, blossoms, and delicate shoots are well known. The leaves are used to treat leprosy, malignant diseases, abscesses, dandruff, and edematous tumours, among other conditions [7]. Thailam, a Siddha medicine that is used to treat persistent eczema, has this plant as one of its primary constituents. The roots are soaked in coconut oil and used to treat chronic eczema, acute tumours, and psoriasis, among other herbs [8]. To relieve toothache and aphthae, chewing the root is recommended.

PHARMACOLOGICAL STUDIES:

Anti-arthritic activity

The anti-arthritic efficacy of an ethanol extract of the stems of Indigofera aspalathoides Vahl (EIA) was tested in rats with complete Freund's adjuvant-induced arthritis (CFA-induced arthritis). The extract was supplied orally at dosages of 250 and 500 mg/kg daily for 30 days at the highest and lowest concentrations. The volumes of the paws were measured on days 7, 14, 21, and 30 of the study. Biochemical parameters in EIA-treated arthritic rats were

significantly altered, as was the level of SOD, GPx, LPO, and catalase. These findings demonstrate that EIA has an exceptional antiarthritic effect in rats with CFA-induced arthritis [9], and that EIA has an exceptional antiarthritic effect in humans [9].

Anti-bacterial activity

The antifungal activity of several Indigofera aspalathoides extracts was examined using the disc diffusion method, which was used to test the results. Methanol extract exhibited the greatest inhibitory activity against (Candida albicans; Candida parapsilosis; Candida tropicalis) with zones of inhibition of 13 mm, 14 mm, and 16 mm, respectively, followed by ethyl acetate (zones of inhibition of 13 mm, 15 mm, and 16mm, respectively), hexane (zones of inhibition of 13 mm, 15 mm, and 16 mm, respectively), and acetone (zone of inhibition of 15 mm, 16mm and 18mm respectively). The methanol extract has been shown to be effective against all of the pathogens tested [10].

Through the use of the disc agar method, several extracts of Indigofera aspalathoides' leaves and roots were tested against 13 microbial species, including 8 bacteria and 5 moulds, to determine their antimicrobial activity. While the petroleum ether, chloroform, and acetone leaf and root extracts of this plant were found to have antibacterial activity against B. cereus, E. aerogens, S. typhi, P. vulgaris, and S. aureus, while the methanol extract of Indigofera aspalathoides was found to have both antibacterial and antifungal activity against S. aureus and B. cereus The methanol root extract, on the other hand, exhibited the greatest inhibitory zone against P. vulgaris (22mm). The antibacterial and antifungal activity of root extracts was shown to be better [11]. With the use of the agar gel diffusion technique, the antibacterial properties of naturally obtained kuzhi thailam from Indigofera aspalathoides were compared to those of a commercially available product of Indigofera aspalathoides kuzhithailam [12].

Anticancer activity

It was determined that the ethanol extract of Indigofera aspalathoides (EIA) has anticancer effect when tested against the Ehrlich ascites carcinoma (EAC) tumour model. It enhanced the survival duration as well as the normal peritoneal cell count in the intestine. The restoration of haematological indices and protein levels that had been changed by tumour inoculation [13,14]. An investigation of the anticancer and antioxidant effects of an aqueous extract of Indigofera aspalathoides on fibrosarcoma in male albino rats was carried out in this study. A study has been conducted to determine the activity of antioxidant enzymes such as catalase (CAT), glutathione peroxidase (GPx), and superoxide dismutase (SOD) in serum, liver, and kidney of control and experimental animals, respectively. By administering an aqueous extract of Indigofera aspalathoides to fibrosarcoma-bearing rats, the levels of antioxidant enzymes CAT, SOD, and GPx were restored to near-normalcy. Because of its antioxidant properties, the use of Indigofera in the treatment of fibrosarcoma in male albino rats resulted in improved recovery from 20-MCA-induced fibrosarcoma [15].

The chemopreventive properties of Indigofera aspalathoides were investigated in rats that had been subjected to chemically induced carcinogenesis. The activity levels of nucleic acids such as total DNA and RNA, as well as hexose, hexosamine, and sialic acid in the liver and kidney of treated rats, were utilised to monitor the chemopreventive effect of the plant extract in the liver and kidney of treated rats. As a result of treatment with aqueous extracts of the fibrosarcoma-bearing plant Indigofera aspalathoides, the observed increase in the levels of DNA, RNA, hexose, hexosamine, and sialic acid in the liver and kidney tissues of the fibrosarcoma-bearing animals returned to a more or less normal state [16,17]. In the study of the therapeutic effectiveness of an aqueous extract of Indigofera aspalathoides against the

growth of transplanted experimental fibro sarcomas in wistar male albino rats, it was discovered that the drug-treated group of animals had smaller tumours than the control group. UDPGT and GST, which are both Phase II enzymes in the liver, were shown to be dramatically decreased [18].

The intraperitoneal injection of 400mg/kg of ethanolic extract of Indigofera aspalathoides (EEIA) has been shown to have a protective effect in Dalton's ascitic lymphoma [19]. On a DMBA-induced hamster buccal pouch cancer model, the impact of ethanolic extract of Indigofera aspalathoides (EIA) on hepatic xenobiotic enzymes and its chemopreventive activity were investigated. EIA treatment resulted in a much lower level of hepatic phase I enzymes and a significantly higher level of Phase II enzymes in hamsters, which might explain its chemopreventive action [20].

In male wistar rats, an ethanol extract of Indigofera aspalathoides (250 mg/kg) was given orally to see if it had a chemopreventive effect. When compared to liver tumor-bearing rats, it significantly reduced DEN-induced liver tumours, as evidenced by lower levels of enzymatic antioxidants (superoxide dismutase and catalase) [21].

Anti-diabetic activity

In streptozotocin (STZ) – nicotinamide induced non-insulin dependent diabetes mellitus rats, a preliminary examination was carried out to assess the alcoholic extract's antidiabetic impact, normoglycaemic, and antihyperglycaemic activity. Normal and experimental diabetic rats were given a graded dosage of the alcoholic extract suspended in gum acacia (250 and 500 mg/kg). In comparison to glibenclimide, the effect on glucose tolerance and hyperglycemia investigations revealed only a minor reduction in blood glucose levels at both dosage levels. In normal rats, a normoglycaemic research demonstrated a considerable percentage drop in blood glucose level from the beginning value of 21.20 percent and 25.20 percent (250 and 500mg/kg, respectively), compared to 1.85 percent in the control group. The alcoholic extract of Indigofera aspalathoides was shown to be a source of anti-diabetic chemicals [22].

Anti-inflammatory activity

The antioxidant capabilities of indigocarpen and mucronulatol were tested for cyclooxygenase-1 (COX-1) and cyclooxygenase-2 (COX-2) inhibitory activity. Indigocarpen inhibited COX-1 significantly, and its anti-inflammatory efficacy in vivo was found to be equivalent to that of the conventional medication ibuprofen. The binding orientations of indigocarpan in the active areas of COX-1 and COX-2 were discovered using molecular docking experiments. Amala Bhaskar et al. showed anti-inflammatory activity of Indigofera aspalathoides alcoholic extract in rats, while Rajkapoor et al. reported anti-inflammatory activity of Indigofera aspalathoides dried stem in rats [23,24].

Anti-oxidant activity

Two fractions of Indigofera aspalathoides leaves were studied for their free radical scavenging activity. Four in vitro models were utilised to assess activity: DPPH radical, ABTS radical, Nitric oxide radical, and hydroxyl radical scavenging tests. When compared to normal antioxidants, both fractions demonstrated high antioxidant activity. Despite the fact that the chloroform fraction contains less polyphenolic compounds, it has higher radical scavenging activity than the ethanol fraction, indicating that structural characteristics of polyphenolic compounds play a role in their antioxidant potential [25].

Anti-viral activity

In juvenile chinchillas and BALB/c mice, the antiviral activity (Respiratory viral infection RSV) of a poly herbal formulation including Indigofera aspalathoides was examined. In chinchillas infected with escalating dosages of RSV, a dose-effect was clearly visible. At the lower doses tested, no symptoms of sickness were seen at any point throughout the post-challenge period. Animals that were given larger doses of the virus without receiving the poly herbal formulation therapy, on the other hand, showed indications of acute respiratory illness. This clearly shows that pretreatment with the poly herbal mixture prevents viral replication within four days after challenge [26].

Hepatoprotective activity

The antihepatotoxic effect of an alcoholic extract of Indigofera aspalathoides stem against CCl4-induced liver damage in rats was tested. Biochemical and histopathological indicators were used to assess the action. The histological alterations in a liver sample were compared to a control group. The extract was found to have a significant hepatoprotective effect [27]. Hepatoprotective effects of ethanol extracts of Indigofera aspalathoides and Bauhinia variegata against the hepatotoxicant paracetamol were investigated. The hepatoprotective action of these extracts is demonstrated by the near-normal levels of biochemical markers impacted by paracetamol-induced hepatotoxicity, such as SGOT, SGPT, ALP, and GGPT. When compared to control group mice, alcohol extracts of Indigofera aspalathoides and Bauhinia variegata were revealed to have antioxidant effects against free radicals, LPO, SOD, catalase, and GPx produced during paracetamol-induced hepatotoxicity. After treatment with alcohol extracts of Indigofera aspalathoides and Bauhinia variegata, histopathological investigations of liver sections revealed regenerative alterations in hepatocytes. The alcohol extracts of Indigofera aspalathoides and Bauhinia variegata have a dose-dependent hepatoprotective effect [28].

Nephroprotective activity

In wistar male albino rats, the methanol extract of Indigofera aspalathoides was tested against gentamicin-induced nephrotoxicity. The researchers looked at blood urea, serum creatinine, serum uric acid, serum electrolytes, and antioxidant indices such Renal SOD, catalase, LPO, and GPx. The results revealed a considerable decrease in high serum marker levels as well as a significant increase in kidney SOD, catalyse levels. A histopathological research found that the dosage level of 500mg/kg had a protective effect, but the dose level of 250mg/kg had only limited protection [29].

Wound healing activity

A chloroform extract of Indigofera asphalathoides vahl. was tested for wound healing properties using an excision wound model. Two different dosage levels of the chloroform extract were tested. When compared to the control rats, the wound treated with plant drug showed a higher rate of wound contraction, increased levels of Hydroxyproline, Hexosamine, SOD, and Ascorbic acid, and decreased levels of Lipid peroxides. Histopathological studies also revealed progressive collagenation and a lower number of macrophages [30].

CONCLUSION:

This plant's therapeutic significance is demonstrated by the extensive research and resources accessible on it, which demonstrate that Indigofera aspalathoides possesses significant anti-

neoplastic and antioxidant properties. As a result, the traditional medical system offers physiologically active compounds and facilitates the discovery of novel drugs.

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