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ETHNO-MEDICINAL CLAIMS, PHYTOCHEMISTRY AND PHARMACOLOGY OF *SPONDIAS PINNATA*: A REVIEW

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ABSTRACT: *Spondias pinnata* is a well-known plant indigenous to South East Asian countries. The plant has been used intensively in many traditional herbal medicines across the globe. This plant has been known to possess antimicrobial, anti-diabetic, ulcer-protective, anti-cancerous, anti-diarrhoeal, anthelmintic, cytotoxic and hepatoprotective activity. It has also been reported that different parts of the plant is used as anti-thirst, anti-emetic and as an anti-tubercular agent. It owes its different pharmacological activities to the wide range of phytoconstituents that are present in the plant. The plant is found to contain sterols, flavonoids, polysaccharides and gums. β-amyrin, oleanolic acid and amino acids—glycine, cystine, serine, alanine and leucine, daucosterol, cycloartanone 24-methylene and lignoceric acid, ellagitannins, galloylgeranin, lignoseric acid and β –carotein are the other constituents that are found to be present in the plant. An attempt has been made to compile these phytoconstituents studies and the different ethnomedicinal and pharmacological properties of *Spondias pinnata* and provide a full-fledged review in a single document. This review emphasizes the need for more extensive research and isolation and characterisation of individual constituents from this plant.

INTRODUCTION: *Spondias pinnata* also known as *Spondias mangifera* (Linn. F.) Kurz. (Family – Anacardiaceae) is an evergreen to deciduous tree which is distributed throughout India, Sri Lanka and South-East Asian countries. The tree has a strong, stout trunk having a smooth ash-coloured bark; growing up to 27 meters in height. The branches are terete and glabrous. Leaves are observed to be compound, imparipinnate and alternate and clustered at twig ends and are about 30-45 cm long; leaflets 3-5 pairs and a terminal one 7.5-18 c.m by 3.5-7.8 cm oblong or elliptical oblong, acuminate, quite entire, more or less oblique.

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The main nerves of the leaves are numerous, horizontal, straight, joined by straight intra-marginal ones. The petioles are 5-6mm long. The genus Spondias Linn. is comprised of 17 species, out of which 7 are native to the neotropics and about 10 to the tropical Asia [1]. The surface of the bark is smooth bearing irregular cracks having a grey to pale reddish brown colour. The bark when injured exudes a clear and sticky sap with turpentine like smell.

Flowers are bisexual and fruits are yellow in colour; fleshy with a pulp which is finely flavoured and edible. The seeds bear ridges and are having a hard and fibrous surface. *S. pinnata* is a species which grows well in light abundant areas [2]. The plant *Spondias pinnata*; also called as Indian hog-plum (English), amara (hindi), amra (Bengali), amora (Assamese), amrataka (Sanskrit), ambalam (Tamil), avimamadi (Telegu), ambula (Oriya) is a medicinally, nutritionally and economically important plant [3].

The fruit is also called as Jangli Aam in folkloric medicine. In Ayurveda it has various names such as Madhuparni, Kundalini, Kapitana, Markataamra [4]. This plant is found in parts of India, Sri Lanka, Burma, China (South, Hainan), Malaysia, Thailand, Laos, etc. The fruits when unripe are often used for making pickles. Almost all parts of the plant like young leaves, flowers and fruits are edible. Its roots, bark, leaves and fruits are useful and are used in traditional medicine (Badoni and Bisht, 2009; Gardner *et al*., 2000) [5].

In India it is found and cultivated in Andhra Pradesh, Maharashtra, Kerala, West Bengal, Andaman and Nicobar Islands, sub-Himalayan Tracts and forests of Western Peninsula [6]. The fruit has been widely consumed by humans since time immemorial. Various communities in different parts of India have been using the fruits of these plants as vegetables or as traditional medicines. In Assam, various ethnic communities eat the fruit as such, or sometimes it is made into pickles. It is also used in curries to give it a sourly astringent taste. The tribes of Mayurbhanj District of Orissa have been using this fruit traditionally as a medicinal agent on treating various ailments [3].

FIG. 1: *SPONDIAS PINNTA* TREE

FIG. 2: THE FRUIT OF *SPONDIAS PINNATA*

In Ayurveda, it has been used as a potent medicine in case of haemorrhagic diseases with a recommended dosage of Stem bark of 5–10 g powder for decoction (*Ayurvedic Pharmacopoeia of India*, Vol. II); 1–3 g powder (*Ayurvedic Pharmacopoeia of India*, Vol. III) [4]. The Bicolano people of the Philippines used the young leaves of *S. pinnata* in meat stew and as fillings for fish sinanglay, a Bicolano delicacy [2]. Observations have shown that the resin exudate of this plant is also consumed by wild animals like monkeys and birds. This may be due to its remedial properties and protective pharmacological actions [5].

FIG. 3: ARRANGEMENT OF LEAVES IN *SPONDIAS PINNATA*

Ethno-Medicinal Claims: The young shoot is eaten as vegetable. The fruit is a valuable source of vitamin C. The fruit and root serves as an anti-thirst remedy. The bark has been used for its diuretic properties in Thailand [7].

The trunk barks are traditionally used as refrigerant, tonic, antiseptic, astringent by different ethnic communities of India. The bark also has anti-dysenteric, anti-diarrhoeal and anti-emetic effects. A paste or lotion of the bark extract when rubbed on to the skin provides relief from sprain and strain is also useful in case of both articular and muscular rheumatism [8].

Fruits, leaves, bark of *S. pinnata* are strong anti-scorbutic agents. Roots of the plants are traditionally used for regulating menstruation. All parts of this plant have been used in folkloric medicine as an anti-tubercular agent, while the unripe fruits were used as an aphrodisiac [3].

The Ayurvedic Pharmacopoeia of India recommends stem bark in haemorrhagic diseases [4].

The leaves of *S. pinnata* are aromatic, acidic and astringent in nature and are used for flavouring. Ethnomedicinally, its juice is applied to relieve ear ache. The root bark powders have been recommended for regulation of menstruation. Reported antibacterial, antitumor, antipyretic, antispasmodic and antihistamine activities are few other mentionable uses of the plant [9].

The fruits are used in bilious dyspepsia. In ethno-medicine, equal quantities of bark juice of *S. Pinnata* and *Sygizium cuminii* (Linn) Skeels are prescribed as remedy for dysentery. The fruit juice is useful antiscorbutic. The fruit pulp cures rheumatism and is used in bilious dyspepsia [1].

10 g of tender fruit juice mixed with 50 g of sugar candy and 0.6-0.8 g of black pepper powder is used as a home-made remedy for biliousness [10].

The Sonowal Kachari Tribe of Dibrugarh District of Assam eat the fruit for curing dyspepsia and dysentery. The fresh seed paste is applied externally on skin diseases such as ring worms, abscess [11].

The tribes of Ganjam district of Orissa drink the root paste duly suspended in water in reducing blood sugar in the patients with diabetes mellitus [9].

Other Commercial Uses: Wood is used extensively in temporary constructions, mouldings, interior finishing, drawers, turnery, articles, carvings and core stock of plywood. The wood is also suitable in the manufacture of matchsticks, matchboxes, boxes and crates; owing to their lightness and softness. Leaves and fruits of the plants are also used as fodder for pigs in farms. The trees when cultivated, serves as living fences and also provides adequate shade [2].

The wood is also used as raw materials for making tea-chests, boats, canoes and floats. It is also used as fuel [12].

Taxonomy of the plant:

Kingdom: Plantae

Subkingdom: Viridaeplantae

Infrakingdom: Streptophyta

Division: Tracheophyta

Subdivision: Spermatophytina

Infradivision: Angiospermae

Class: Magnoliopsida

Superorder: Rosanae

Order: Sapindales

Family: Anacardiaceae

Genus: Spondias

Species: *Spondias pinnata*

Synonym: *Spondias mangifera*

Organoleptic characteristics of the Fruit: The fruit is simple, succulent, fibrous and drupe type of fruit. When ripe the epicarp becomes thin and greenish yellow. The soft mesocarp is acidic, juicy when ripe, aromatic and 6-8 celled. The endocarp is tough, fibrous and woody.

- Shape & size: Ovoid or oblong, and up to 4-5 cm in diameter.
- Colour: Fresh fruit is yellowish green and dried fruit is externally dark brown and internally yellowish brown.
- Taste: Astringent.
- Odour: Aromatic pleasant
- Texture: Hard, stone semi-woody, fibrous with many cavities outside. Epicarp and mesocarp is very brittle, easily fragmented from fibrous endocarp after drying.
- Microscopy: The detailed TS of mature fruit passing through the centre are circular in outline with Epicarp, mesocarp and fibrous endocarp [10].

Nutritional Value: *S. pinnata* has been identified as a high priority bioresource recently. It has been presumed to have outstanding economic and ecological value. The analysis of the edible portion of the fruit gave the following values: moisture, 90.3; protein, 0.7; fat, 3.0; fibre, 1.0; carbohydrates, 4.5; and mineral matter , 0.5%; calcium, 36.0; phosphorous, 11.0; iron, 3.9; thiamine, 0.02; riboflavin, 0.02; nicotinic acid, 0.3 and Vitamin C, 21.0 mg./100g; Vitamin A value, 450 I.U./100g [12].

A sample fruit contained sucrose (2.9%), glucose (1.7%), and fructose (1.8%). The fruit contains Iodine (0.45-0.61 mg./kg., dry wt.) [12].

According to a study conducted in 2010; *S. pinnata* has been found to contain the following values:- food energy 189–203 kcal/g, crude fat 12.23–12.54%, crude fiber 3.13–4.03%, total carbohydrate 23.54–16.30%, sodium 1.38–0.96%, calcium 0.93-0.15%, iron 1.5–1.3%, and copper 0.9–1.23 0% [13].

A sample fruit from Assam, on analysis has been found to possess the following values: - moisture, 76.62%; crude protein, 3.336; crude fibre 23.07; starch 5.09; reducing sugar 69.56, phosphorous 0.483, iron 0.043, calcium 5.967 and potassium 83.60 mg./10g. (Kandali and Konwar 2006) [14].

Phytochemistry: *S. pinnata* is found to contain many chemical constituents of important pharmacological activities.

Total phenolic content of S. pinnata has been found to be 42.60 mg Gallic Acid Equivalents/g db of plant. The total flavonoid content of *S.pinnata* has been found to be 14.80 mg Gallic Acid Equivalents/g db of plant [15].

Thorough studies of the plant have revealed the phytochemistry and thus it is found to contain sterols, flavonoids and gums. The gum exudates of the plant are found to contain acidic polysaccharides [1].

The fruit is found to contain contains beta-amyrin, oleanolic acid and amino acids- glycine, cystine, serine, alanine and leucine; polysaccharides are also present. Aerial parts gave lignoceric acid, 24-methylenecycloartanone, stigmast- 4-en-3-one, beta-sitosterol and its glucoside [4]. β-amyrin, oleanic acid amino acids like alanine and leucine are few of the isolated compounds from *S. pinnata* [1].

The aerial parts of S. pinnata were also found to contain daucosterol, cycloartanone 24-methylene and lignoceric acid [9]. Ellagitannins, galloylgeranin, lignoseric acid and β -carotein have been isolated from the plant [8].

Established Pharmacological Activities:

Hypoglycemic activity: The hypoglycaemic activity of *S. mangifera* was tested for their hypoglycaemic activity using normoglycemic study and oral glucose tolerance test in adult Wistar rats of either sex weighing 150-200 g. In normoglycemic studies; the methanolic extracts of the roots of *Spondias mangifera* at a dose of 400mg/kg body weight showed reduction in blood glucose levels from 4 hours of the treatment as compared to the standard; glibenclamide which showed reduction in glucose 1 hour from the treatment. But the aqueous extracts at the dose of 400kg/mg body weight showed significant decrease in glucose levels from 4 hours of the treatment. Whereas the chloroform extract did not show any promising effect.

In oral glucose tolerance test; the methanolic and aqueous extracts significantly reduced the blood glucose levels at the tested dose at 200 and 400 mg/kg body weight from 60 minutes of glucose loading whereas the chloroform extract did not show any effect.

In anti-hyperglycemic studies, the rise in the blood glucose that was achived after alloxanisation was reduced by glibenclamide to an extent of 63.22% after 8 hours whereas the methanolic extact reduced blood glucose upto 53.88%. Thus, this study justified the folkloric use of the roots of *S. mangifera* for reducing blood glucose levels [9].

Anthelmintic activity: The ethanolic and acetone extracts of the bark of the plant *Spondias pinnata* contain different glycosides which exhibited potent anthelmintic properties (Panda B.K. *et al*) [16]. Different extracts of the bark of *S.pinnata* is reported to contain anthelmintic activity against Indian earthworms *Pheritima posthuma* in a dose dependent manner. The activities of the different extracts were compared with the standard piperazine citrate. Among the different extracts, the chloroform extract was found to be the most promising [17].

A comparative study of acetone and ethanolic extracts of the bark of S. pinnata was reported. The results were compared with the standard drugs like piperazine citrate and albendazole. The anthelmintic activity was evaluated against earthworms *Pheritima posthuma.* The time taken for the worms to cause death or paralysis was noted. The acetone extracts of concentrations of 50mg/mL and 100 mg/mL were reported to cause mortality in 82 and 54 minutes respectively. The ethanolic extracts showed anthelmintic activity in a dose dependent manner within a concentration range of 10mg/mL to 100 mg/mL. The ethanolic extract was found to have more potency as an anthelmintic than the acetone extract [2].

Anti-cancer activity: In a recent study; the bark of *S. pinnata* is also reported to have an anti-cancer activity. 70% methanolic extract of the bark of S. pinnata was tested for its anti-cancer activity. It was found to promote apoptosis in human lung adenocarcinoma cell line (A549) and human breast adenocarcinoma cell line (MCF-7). The methanolic extract of the bark of *Spondias pinnata* showed significant cytotoxicity to both A549 and MCF-7 cells with an IC_{50} value of 147.84 ± 3.74 and 149.34 ± 13.30 µg/mL, respectively.

No cytotoxicity was found in normal human lung fibroblast cell line (WI-38): IC_{50} 932.38 ± 84.44 µg/mL. Flow cytometric analysis and confocal microscopic studies confirmed that the methanolic extract of the bark of *S. pinnata* was successful in inducing apoptosis in both malignant cell lines. Furthermore, immunoblot result proposed that the pathway of apoptosis induction may be due to increase in Bax/Bcl-2 ratio in both cell types, which resulted in the activation of the caspase-cascade and ultimately lead to the cleavage of Poly adeno ribose polymerase. For the first time this study proved the anticancer potential of *S. pinnata* against human lung and breast cancer by inducing apoptosis through the modulation of Bcl-2 family proteins.

This study has promoted the need of further investigation of *S. pinnata* to develop it as a therapeutic anti-cancer agent [18].

Ulcer-protective activity: The effect of the extracts on indomethacin-induced ulceration in adult Wistar rats was also evaluated using cimetidine as positive control.

The 90% methanolic extract inhibited the ulcerogenic effect of indomethacin. The ulcer was induced using different concentrations of indomethacin (30, 60 and 100 mg/kg). It was observed that the animals which received 100-200 mg/kg of bark extract showed lesser developments of gastric lesions. The orally given extract produced a dose dependent inhibition of the ulcerogenic effect of indomethacin, reducing the ulcer index from 17.7 (control) to 8.7 and 6.7 for the 100 mg/kg and 200 mg/kg, respectively, resulting in preventive ratio of 50.4 and 62.0, respectively [8].

Anti-microbial activity: *In-vitro* antibacterial activity of the methanolic and aqueous extract of *S. pinnata* was evaluated by cup plate diffusion method at the concentration of 50 mg, 100 mg and 150 mg; against *Escherichia coli, Salmonella typhimurium* and *Vibrio cholerae*. Penicillin and streptomycin used as standard drug during the test. The methanolic extract exhibited good antibacterial activity while the aqueous extract showed only mild antibacterial activity against *Escherichia coli, Salmonella typhimurium* and *Vibrio cholerae* [8].

Methanolic extract of the bark of *S. pinnata* obtained by cold maceration process has also showed potent anti-bacterial effects against both Gram positive and Gram negative bacteria. The strains used in this test were *Bacillus subtilis* (*B. subtilis*) ATCC10876, NCIM-2156, *Bacillus cereus* (*B. Cereus*) ATCC10876, NCIM-2156 and *Staphylococcus aureus* (*S.aureus*) ATCC BAA1026, NCIM-2079 were used as Gram-positive bacteria and bacterial cultures of *Escherichia coli* (*E. coli*) ATCC10536NCIM-2056, *Proteus mirabilis* (*P. Mirabilis*) ATCC12453, NCIM-2241 and *Pseudomonas aerugenosa* (*Ps. Aeruginosa*) ATCC10662,NCIM-2036 were used as Gram negative bacteria.

It was found that at a concentration of 128 µg/mL the methanolic extract of the stem bark of *S. pinnata* has antibacterial activity against *B. subtilis, S. aureus, E. coli and P. Mirabilis*. On the other hand, the extract at a concentration of 64 µg/mL had antibacterial activity against *S. aureus* and *E. coli*. However the extract did not have antibacterial activity against any of ther straisn used in the experiment at concentrations of 16 µg/mL and 32 µg/mL.

64 µg/mL was found to be the minimum inhibitory concentration (MIC) of the extracts against *S. aureus* and *E. coli* bacteria and that against *B. Subtilis* and *P. mirabilis* bacteria was found to be 128 µg/mL [19].

The anti-microbial potential of the resin of the plant *S. pinnata* was also evaluates against *Saccharomyces cerevisiae, Bacillus subtilis, Escherichia coli, Enterobacter sakazakii* and *Acinetobacter baumannii.* However it was found that *B. subtilis* was the most susceptible organism to the resin. The resin was ineffective against Gram (-) bacteria and *S. cerevisiae,* a fungus. Thermal stability test showed that the antimicrobial activity of the resin was heat stable [5].

S. pinnata is also found to have anti-microbial activity against fish pathogens like *P. fluorescens* isolates, *Aeromonas* sp. isolates, *Edwardsiella* sp. isolates [20].

In another experiment, the 80% methanolic extract of the fruit of *S. pinnata* was found to be effective against both Gram positive and Gram negative bacteria. Among the strains that were used in this experiment are Gram negative *Shigella boydii* (ATCC 9361), *S. flexneri* (ATCC 12022), *S. sonnei* (ATCC 25931), *Salmonella typhi* (ATCC 14612), *Pseudomonas aeruginosa*, (ATCC 25619), *Vibrio cholerae* (ATCC 14035); and; Gram positive *Staphylococcus epidermidis* (ATCC 12228), *S. pyogenes* (ATCC 19615), *S. saprophyticus* (ATCC 15305) and *S. aureus* (ATCC 6538) [1].

Anti-diarrhoeal activity: *S. mangifera* has also been found to possess great anti-diarrhoeal properties against castor oil induced diarrhoea in adult Wister rats. The activity was measured against the standard diphenoxylate hydrochloride (5mg/kg). The animals were treated with 100, 200 mg/kg methanolic extracts of *S. mangifera.* After 1 hour of the treatment the animals were challenged with 1 mL of castor oil orally and observed for the consistency of the faecal matter.

A significant decrease in the number of wetness and frequency of defecation was observed in castor-oil induced diarrhea by *S. mangifera* bark extract (100-200 mg/kg, p.o). This effect was comparable with that of diphenoxylate hydrocholide (5mg/kg, p.o), an anti-cholinergic drug [8].

Anti-oxidant activity: In a study conducted on fifteen edible fruits found in Nepal; it was found that *S. pinnata* showed a more potent free radical scavenging activity than Vitamin C. The extracts of *S. pinnata* showed a 16% radical scavenging activity at 5µg/mL whereas Vitamin C only showed 5% radical scavenging activity at 5µg/mL.

The correlation coefficients (R^2) of 0.7189 and 0.7246 for the methanol and water extracts, respectively, showed the antioxidant activity in correlation with TPC [21].

Antioxidant activity of the methanolic extract of the fruit of *S. pinnata* has also been determined by analysing its scavenging effect on $ABTS^{\bullet+}$ free radical. The extract sample was prepared within a concentration range of 0 – 10 µg/µL. A portion of each dilution (50 µL) was mixed with 3 mL of $ABTS^{\bullet+}$ solution and allowed to stand for 6 minutes and then its absorbance was measured at 734 nm using a spectrophotometer. Trolox was used as a standard. The antioxidant activity is reported as %inhibition along with IC_{50} and also as Trolox equivalent antioxidant capacity (TEAC). While Trolox is found to shown an IC_{50} of 10.14 and TEAC of 1; the extract of the fruit of *S. pinnata* is found to have an IC_{50} value of 3769.18 and TEAC of 0.004 [7].

In another study; 70% methanolic extract of the stem bark of *S. pinnata* has been found to be a potent source of antioxidants. The extract showed a TEAC value of 0.78 ± 0.02. The extract was also found to be a potent iron-chelator with IC_{50} value of 66.54 ± 0.84 µg/mL. 100 mg of the plant extract yielded 91.47 ± 0.004 mg/mL gallic acid-equivalent phenolic content and 350.5 ± 0.004 mg/mL quercetin-equivalent flavonoid content. The IC_{50} values for scavenging of free radicals of hydroxyl radicals, superoxide anions, nitric oxide, hydrogen peroxide, peroxynitrite, singlet oxygen and hypochlorous acid were reported to be 112.18 ± 3.27 µg/mL, 13.46 ± 0.66 µg/mL, 24.48 ± 2.31 µg/mL, 44.74 ± 25.61 mg/mL, 716.32 ± 32.25 µg/mL, 58.07 ± 5.36 µg/mL and 127.99 ± 6.26 µg/mL, respectively [22].

Cytotoxic activity: Preliminary cytotoxic activity of the extract of the fruit of *S. pinnata* has been reported. It was determined by using Brine shrimp lethality test.

DMSO solutions of the ethanolic crude extract were applied against *Artemia salina* in a one day in-vivo test. Vincristine sulphate was used as a standard and the experiments carried out in triplicate and the mean values were taken. The lethality of the extract to brine shrimp was determined after 24 hours of exposure. Cytotoxicity exhibited by the ethanol crude extract was found to be significant; because the LC50 values were found to be 2.12±0.09 for the ethanol crude extract, and 0.32±0.05 µg/mL for vincristine sulphate [1].

Hepatoprotective activity: The hepatoprotective effect of the ethyl acetate and methanolic extracts of stem heart wood *S. pinnata* were carried out against carbon tetrachloride induced rats. The levels of hepatic damage were tested in both treated and untreated groups using various biochemical markers like SGPT, SGOT, ALP and bilirubin. It was observed that the oral administration of the ethyl acetate extract of *S. pinnata* stem heart wood in doses of 100, 200, 400 mg/kg significantly decreased the altered SGPT, SGOT, SALKP and total bilirubin levels to near normal levels in CCl_4 induced hepatotoxicity in rats.

The hepatoprotective effect was further established by histopathological examination of the liver sections of the CCl_4 intoxicated rats. The normal cellular shape of the liver was retained in the rats treated with the ethyl acetate and methanolic extracts if the stem heart wood of *S. pinnata*. This activity was comparable with the standard drug Silymarin. This may be due to the presence of bioflavanoids which have hepatoprotective properties [23].

Thrombolytic activity: In a study; the exocarp of the fruit of *S. pinnata* produced significant thrombolytic activity. The thrombolytic activity was evaluated using a method developed by Daginawala using streptokinase as the standard substance. The test showed that the exocarp of S. pinnata fruit has statistically significant thrombolytic activity ($P<0.05$ for ethyl acetate and aqueous fraction, $P<0.001$ for others) [24].

CONCLUSION AND FUTURE SCOPE: *Spondias pinnata* is a relatively unutilised natural resource which has been investigated for its miraculous potential only recently. This review throws a light on the different ethno-medicinal and scientifically established pharmacological activities of the plant. The plant has been used ethno medicinally as refrigerant, tonic, antiseptic, astringent, anti-dysenteric, anti-diarrhoeal , anti-emetic, in case of both articular and muscular rheumatism, anti-scorbutic, regulating menstruation, as an aphrodisiac, in haemorrhagic diseases, to relieve ear ache, in bilious dyspepsia and in diabetes mellitus.

Few of these uses; like Anti-diarrhoeal activity, Anti-microbial activity, Ulcer-protective activity, Anti-cancer activity, Anthelmintic activity, Hypoglycemic activity has also been scientifically proven. However other activities which are reported in various ethnomedicinal uses are yet to be scientifically explored and approved. The plant also contains a number of therapeutically important and effective phytoconstituents like phytosterols, flavonoids, phenols, acidic polysaccharides and gums.

The approved anti-cancer activity of this plant explains that it is a plant which is having a high biological and medicinal value. It is of prime importance that these potential plants should be utilised for the greater good of the human race. It implies that more extensive researches and analyses should be carried out in order to screen various pharmacological properties; isolate the bioactive compounds and to validate the ethnomedicinal uses of this plant that have been passed on from generation to generation within a particular community or ethnic group.

The details of the pharmacological activities and phytochemistry that has been included in this review can open up new avenues regarding this plant and will promote isolation of pure, specific compounds and formulation of herbal drugs for human consumption which will be as safe and effective as it promises to be.

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