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"PHYTOCHEMICAL, PHARMACOLOGICAL, AND ETHNOBOTANICAL INSIGHTS INTO HELICTERES ISORA LINN. (AVARTANI): A VERSATILE MEDICINAL PLANT WITH THERAPEUTIC POTENTIAL"

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ABSTRACT

Commonly referred to as Avartani or the Indian Screw Tree, Helicteres isora Linn. is a medicinal plant that is widely utilised in Chinese, Siddha, Ayurvedic, and Unani medicine. The herb, which is indigenous to Southern Asia and portions of Africa, has long been used to cure infections, diabetes, gastrointestinal issues, and even snakebite. The taxonomy, colloquial names, geographic range, phytochemical makeup, pharmacological activity, and ethnobotanical use of H. isora are all thoroughly covered in this paper. Phytochemical analyses have identified a diverse range of bioactive constituents, including cucurbitacin, neolignans, flavonoids, alkaloids, and polyphenols. Extracts from various parts of the plant—roots, fruits, bark, leaves, and flowers—have shown significant pharmacological actions such as antidiabetic, antioxidant, antimicrobial, anticancer, hepatoprotective, antispasmodic, anti-inflammatory, anthelmintic, and wound healing activities. Experimental studies validate many traditional claims, supporting its use in managing diseases such as diabetes, diarrhoea, cancer, and microbial infections. Given its broad-spectrum bioactivity

and rich phytoconstituent profile, Helicteres isora holds considerable promise for development into modern therapeutic agents. Further clinical investigations and pharmacological standardizations are recommended to harness its full medicinal potential.

KEYWORDS: Helicteres isora, Phytochemicals, Ethnobotany, Pharmacological activities, Medicinal plants.

INTRODUCTION

Avartani (Helicteres isora) basic information: The medicinal plant avartani (Helicteres isora Linn.) is used to treat a variety of illnesses. Known by some as the Indian Screw tree, Helicteres isora is a small tree or big shrub that grows in Northern Oceania and Southern Asia. Although it is occasionally placed to the family sterculeaceae, it is typically referred to the family Malvaceae. Helicteres isora is known as Avartani and Avartaphala in Sanskrit. An Ayurvedic herb called East Indian Screw tree is used to cure intestinal parasites, diarrhoea, dysentery, and stomach colic. Its fruits, stem, roots, and bark are all utilized medicinally. Avartani is a traditional remedy for snake bites, newborn constipation, and diarrhoea. The famous Ayurvedic saying "Yatra A krutihi Tatra Gunaaha Vasanti" states that if a plant part resembles an organ, it can be used to heal that organ's problems. Avartani is a word for rotation. Traditional medicine makes use of Helicteres isora's fruits and roots of Asia, Iraq, and South Africa, where they are developed with the potential to treat a wide range of illnesses, such as diabetes, cancer, infections, and gastrointestinal disorders. Although the tree is presently harvested for its fruits and roots, which are used in Chinese medicine, the bark's fibres were used to manufacture rope and sacks in the 19th century. This is the first investigation of international trade in the fruits of Helicteres isora Linn, a plant that is widely utilized in traditional medicine. In India, Pakistan, and Bangladesh, it is utilized in local folk traditional medicine, Ayurveda, Siddha, and the Unani medical system. The fruits of this plant are used in Jammu products in Indonesia, Malaysia, and Thailand, while the roots are utilized in traditional Chinese medicine in China. Avartani's fruit is twisted. The fruits evoke a mental image of the intestine. They are therefore helpful in the treatment of intestinal parasites. When the fruit is twisted, it can help with stomach ache. Sunbirds, butterflies, and Hymenoptera are the primary pollinators of this plant's red flowers. Antioxidants, carbs, proteins, fibre, calcium, phosphorus, and iron are all abundant in Helicteres isora. Gallic acid, caffeic acid, vanillin, and p-coumaric acid are examples of active phytoconstituents. The Sterculiaceae family includes the enormous arborescent shrub Helicteres isora L. It is used as

a postpartum tonic and as an anti-gastrospasmodic, anthelmintic, antispasmodic, antipyretic, antidiarrheal, and antidysenteric. This plant's fruits are used as an anticonvulsant, abdominalgia, and colic remedy, while its stems are used as an anthelmintic, colic, and aphtha. The root juice has long been used to treat snake bites, diabetes, and emphysema. Iron, calcium, phosphate, proteins, fibre, carbs, and antioxidants are all abundant in Helicteres isora. Vanillin, p-coumaric acid, gallic acid, and caffeic acid are examples of active phytoconstituents. The roots have yielded isocucurbitacin b and cucurbitacin b. The big arborescent shrub Helicteres isora L. belongs to the Sterculiaceae family.

Table No 1: Taxonomy.

Kingdom	**Plantae**
Class	Angiosperms
Sub Class	Eudicots
Order	Malvales
Family	Malvaceae
Sub Family	Helicteroideae
Genes	Helicteres
Species	H. isora
Binomial Name	Heisters isora
General Name	Avartani, Marorphali

Fig No 1: Helicteres Isora.

Table no 2: Vernacular Names of Avartani in Different Languages.[1]

Languages	**Name Of Plant**
Sanskrit	Murva, Avartani, Avartaphala.
Hindi	Marorphali, Marodphali
English	Indian Screw Tree, East India Screw Tree
Tamil	Balampari
Telugu	Guvadarra
Gujarat	Maradashingh, Maradashinghi
Oriya	Murmuriya

Distribution: Avartani is found distributed in dry forests throughout Central and Western India, from Bihar as far West as Jammu and Western Peninsula.

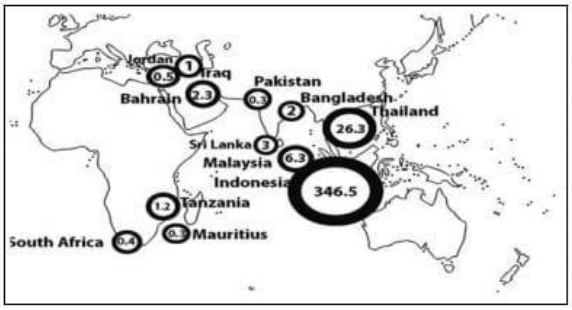

Fig No 2: Distribution.[2]

Phytochemical composition: Phytochemical composition: An essential first step in determining the bioactive substances found in medicinal plants is to conduct phytochemical analyses of the plant. These substances are used in a variety of ways in the pharmaceutical industry to create new medications. Carbohydrates, saponin tannin, proteins, steroids, anthraquinone glycosides, cardiac glycosides, phenolic chemicals, terpenoids, alkaloid salts, and free alkaloids are all detected by phytochemical screening of the plant's crude 03B extract and chloroform extract. Octadecnoic acid, hexadecanoic acid, and berberine are all present in the plant's subcritical extract, which was made at 10 bar of pressure, 160°C, a sample-to-solvent ratio of 1:30, and for 30 minutes.[3,4]

Table No 3: Phytoconstituents of Helicteres Isora Linn.

Sr. No	Plant Part	Phytoconstituents	Reference
01	Roots	Cucurbitacin B, Isocucurbitacin B, and Oleanolic acid	[5,6]
02	Fruits	Neolignans, Helisterculins A, Helisterculins B, Helisorin, 4'-O- β - D- glucopyranosyl rosmarinic acid,2R-O-(4-O-β-D-glucopyransoyl caffeoyl)-3-(4hydroxyphenyl) lactic acid, Sanguinarine, Berberine Chloride and Muscimol	[7,8]
03	Leaves	Tetratriacontanyl-tetra-tricontanote, flavones-5,8-dihydroxy-7,4 dimethoxyflavone Trifolin and Hibifolin	[9,10]
04	Fruit and Bark	Polyphenols, Tannins, Carotenoids, Flavonoid, Carbohydrates, Proteins, Fibres, and Minerals Such as Calcium, Phosphorus and Iron	[11]
05	Flowers	Alkaloids, Carboxylic acid, Coumarins, Tannins, Phenol, Xanthoproteins, and Carbohydrates	[12]

Table No 4: Reported Pharmacological actions of Helicteres isora Linn.

Sr. No.	Part used	Reported activity	Solvent used for extraction	Reference
01	Fruits	Antioxidant and	Hot water	[13]

		antidiabetic activity		
02	Fruits	Antimicrobial activity	Methanol	[14]
03	Fruits	Antibacterial and antispasmodic activity	Acetone	[15]
04	Fruits	Antibacterial activity	Aqueous, acetone, ethanol and methanol	[16]
05	Fruits	Antioxidant and anticancer activity	Acetone, hexane and iso-propyl alcohol	[17]
06	Fruits	Anthelmintic and antioxidant activity	Methanol and petroleum ether	[18]
07	Fruits	Antioxidant Antioxidant activity	Aqueous, aqueous methanol, methanol and acetone	[19]
08	Fruits	Antioxidant activity	Hot aqueous	[20]
09	Fruits	Antioxidant activity	Aqueous, ethanol and Methanol	[21]
10	Fruits	Antibiofilm activity	Methanol and petroleum ether	[22]
11	Fruits	Anticancer activity	Chloroform	[22]
12	Fruits	Antitumor activity	Methanol	[23]
13	Fruits	Anti-inflammatory activity	Hexane, dichloromethane	[24]
14	Fruits	Antispasmodic activity	Dichloromethane	[25]
15	Fruits	Cardiotonic activity	Distilled water	[26]
16	Fruits	Anti-protoscolice activity	Boiled water	[27]
17	Fruits	Snake bite	Ethanol	[28]
18	Barks and fruits	Antibacterial activity	Petroleum ether, benzene, chloroform, acetone	[29]
19	Bark	Hypolipidemic activity	Aqueous	[30]
20	Bark	Hypoglycaemic activity	Aqueous	[31]
21	Bark	Brain antioxidant and lipid peroxidation	Aqueous	[32]
22	Bark	Antifungal activity	Methanol and petroleum ether	[33]
23	Bark	Anti-inflammatory activity	Methanol and petroleum ether	[34]
24	Bark	Anthelmintic activity	Methanol	[35]
25	Bark, root and seeds	Anti-diarrheal activity		[36]
26	Roots	Antidiabetic and hypolipidemic activity	Ethanol	[36]
27	Roots	Antihyperglycemic and lipid lowering activity	Butanol and aqueous	[37]
28	Roots	Antipyretic activity	Alcohol and aqueous	[38]
29	Roots	Antinociceptive activity	Petroleum ether, chloroform and aqueous ethanol	[39]
30	Roots	Hepatoprotective activity	Ethanol	[40]
31	Leaves	Wound healing activity	Petroleum ether, chloroform, acetone, ethanol and hydroalcoholic	[41]
32	Arial parts	Hepatoprotective activity	Ethanol	[42]
33		Antioxidant activity	Hexane, chloroform and methanol	[43]

Table No 5: Ethnobotanical claims and their probable scientific explanations.

Plant Parts	Disease	Ethno-medicinal use	Possible scientific basis	Experimental evidences (ref)
1] Bark	Diarrhoea	Bark boiled in water and consumed three times a day	Antimicrobial and antispasmodic properties	(15–17,44)
2] Fruits	Diabetes	Each person consumes one fresh fruit orally.	Antioxidant activity and its consequences on hypolipidemia and hyperglycaemia	(20,40,45,46)
	Gastrointestinal problems	Three times a day, consume about 5 grammes of fruit powder with salt and water.	Effects of antioxidants and antimicrobials	(15,16,20,40,44–46)
	Weakness in new born baby	1] To treat severe weakness, a new newborn is massaged with a mixture of fruit paste, mustard oil, and turmeric paste. 2] To relieve pain in the newborn, fruits are fried in mustard oil.	Antioxidant and antispasmodic properties	(17,20,40,45,46)
	Post- delivery weakness	Following childbirth, ladies are given a blended sweet dish consisting of fruit powder, various herbs, and spices. They might receive it while pregnant.	Antioxidant and antispasmodic properties.	(17,20,40,45,46)
	Sores of ear	Fruits are used to make ear ache liniment.	Antioxidant and antimicrobial properties	(15,16,20,40,44–46)
2.1] Seeds	Dysentery	Take 5 grammes of boiled seed powder with water twice daily.	antimicrobial action for amoebiasis-related diarrhoea and dysentery.	(15–17,44)
3] Roots	Diabetes	Twice daily, fresh root juice is consumed.	Activity against hyperglycaemia	(19,47–49)
	Cut and wounds	Turmeric paste and fresh root paste are administered externally.	Antioxidant and antimicrobial properties	(15,16,20,40,44–46)
	Diarrhoea	Decoction of roots	Antioxidant and antimicrobial properties	(15,16,20,40,44–46)
4] Leaves	Scabies	Paste is administered topically to the scabies infected site twice daily until it heals.	Antimicrobial qualities	(15,16,44)
	Skin infection	Three times a day, fresh leaf paste is applied.	Antimicrobial qualities and antioxidant activity	(20,40,45,46)

	Snake bite	The affected area is covered with fresh leaf paste.	It is possible that inflammation is significantly influenced by free radical scavenging activity.	(20,40,45,46)

1. Antidiabetic and Hypolipidemic Activity

In Swiss albino mice, Chakrabarti et al. demonstrated the ethanolic extract of Heliceres isora L. roots' antidiabetic and hypolipidemic properties.

After being administered to insulin-resistant and diabetic mice for nine days, ethanololic extract of Helicteres isora L. root resulted in a significant reduction in plasma glucose, lipids, and insulin at a dose of 300 mg/kg. Helicteres isora L. root ethanolic extract exhibits hypolipidemic and insulin-sensitizing properties, and it may be used to treat Type II diabetes].[36] According to Kumar G and Murugesan AG, streptozotocin-induced diabetic rats showed hypolipidemic effects from Helicteres isora L. aqueous bark extract. Streptozotocin-induced diabetic rats showed a substantial reduction in serum and tissue cholesterol, phospholipids, fatty acids, and triglycerides after receiving Helicteres isora bark extract at doses of 100 and 200 mg/kg for 21 days. Low-density lipoproteins (LDL) and very low-density lipoproteins (VLDL) levels are decreased, whereas high-density lipoproteins (HDL) are significantly elevated. Helicteres isora L. bark extracts at 200 mg/kg had a greater lipid-lowering impact than those at 100 mg/kg.[30] Suther et al. assessed Helicteres isora Linn Fruits' antidiabetic properties. In vitro glucose uptake in the isolated rat hemidiaphragm model was used to investigate the antidiabetic impact.[13] The aqueous extract of Helicteres isora L. bark's hypoglycaemic action was documented by Kumar G et al. in rats with normal blood sugar, glucose, and streptozotocin-induced diabetes. The aqueous extract of Helicteres isora L. bark at doses of 100 mg/kg/p.o. decreased blood glucose levels in normal rats from 64.5 to 48.5 mg% and 67 to 47 mg% after two hours of oral extract administration. Additionally, streptozotocin-induced diabetic rats showed a significant decrease in blood glucose levels of 68 to 105 mg% and 66 to 85.5 mg% after 21 days of daily oral administration of the extract. According to the findings, Helicteres isora L. bark aqueous extract may have a hypoglycaemic effect on diabetic rats.[31] In rats with diabetes induced by alloxan, Venkatesh et al. demonstrated the antihyperglycemic and lipid-lowering properties of Helicteres isora L. root extracts. In alloxan-induced diabetic mice, they found that oral treatment of butanol and aqueous extracts of Helicteres isora L. at a dose of 250 mg/kg for 10 days significantly reduced blood glucose, total cholesterol, triglycerides, and urea.[37]

2. Antibacterial Activity

The antibacterial properties of a methanolic extract of the fruits and bark of Helicteres isora L. were assessed by Gayathri Devi et al. Bacillus subtilis, Pseudomonas aeruginosa, and Proteus vulgaris were all significantly inhibited by the fruits and bark extract, whereas Bacillus subtilis, Pseudomonas aeruginosa, Paratyphii A, and Staphylococcus aureus were moderately inhibited. Significant efficacy was demonstrated by the petroleum ether extract against Salmonella typhimurium, E. coli, and Paratyphii B. While chloroform and acetone extracts have been shown to be unsuccessful against the majority of the species tested, benzene extracts have been proven to be efficient against Paratyphii B and E. coli. As a result, methanolic extract exhibited more antibacterial activity than acetone, petroleum ether, benzene, and chloroform extracts.[29] Varghese et al. extracted the phytoconstituents from Helicteres isora Linn fruits and assessed their antibacterial qualities. The methanolic extract's minimum inhibitory concentration (MIC) value against Staphylococcus aureus and pseudomonas aeruginosa was determined to be 8µg/ml and 10µg/ml, respectively.[14] Helicteres isora L. fruits' antibacterial and antiplasmid properties were assessed by Shriram V. et al.[15]

Tambekar et al. discovered that Helicteres isora fruit extracts in aqueous, acetone, ethanol, and methanol had antibacterial qualities. Fruit aqueous extracts of H. isora strongly inhibited Salmonella typhimurium, E. Coli, Staphylococcus epidermidis, and Proteus vulgaris; they moderately inhibited Salmonella typhi, Enterobacter aerogenes, and Staphylococcus aureus, and they least inhibited Pseudomonas aeruginosa. Acetone extracts had the lowest bactericidal activity, ethanol and methanol extracts had moderate antibacterial activity, and the aqueous extract had the highest.[16]

3. Antibacterial activity

Helicteres isora Linn fruit extracts in acetone, hexane, and iso-propyl alcohol were tested for antioxidant activity by Kumar TM et al. When Helicteres isora fruit acetone extract was compared to hexane and iso-propyl alcohol, it demonstrated high antioxidant activity.[17] Manke MB et al. showed the in-vitro antioxidant activity of petroleum ether and methanolic extracts of Helicteres isora Linn. fruits. Antioxidant activity was assessed using 2, 2-diphenyl-1-picryl hydrazyl (DPPH) tests and hydrogen peroxide (H2O2) radical scavenging assays. Methanol extract exhibited the highest DPPH free radical scavenging activity (IC50 42.95 µg/ml), whereas petroleum ether extract had the lowest IC50 (89.81 µg/ml) in

compared to regular ascorbic acid (IC50 23.75 µg/ml). Ascorbic acid showed an IC50 value of 9.64µg/ml, while methanol and petroleum ether extracts had concentration-dependent hydrogen peroxide breakdown activity with IC50 values of 36.61 µg/ml and 74.40 µg/ml, respectively. Methanol extracts showed higher antioxidant activity than petroleum ether extracts.[18] According to Kumar V. et al., Helicteres isora fruits exhibit broad-spectrum antioxidant capacity against free radicals and dramatically improve a number of conditions linked to the generation of free radicals, such as DNA damage, protein oxidation, and lipid peroxidation. The plant extracts demonstrated lipid peroxidation inhibition and concentration-dependent free radical scavenging properties. In terms of reducing power (360 ± 5.9 gallic acid equivalent), total antioxidant activity (150 ± 5.6 gallic acid equivalent), scavenging of free radicals like DPPH (75.6%) and OH (100%) and maximal (97.4%) inhibition of lipid peroxidation at 1000 µg/ml, the aqueous-methanol extract showed the highest antioxidant potential among the four extracts.[19] It is commonly known that DNA strands can be broken and damaged by free radicals, which eventually results in cytotoxicity, mutagenesis, and cancer.[28] Kumar G. et al. evaluated the effects of Helicteres isora bark extracts on lipid peroxidation and brain antioxidant status in streptozotocin-diabetic rats. The activities of plasma insulin, superoxide dismutase, catalase, glutathione peroxidase, glutathione s-transferase, and reduced glutathione were significantly elevated in the brains of streptozotocin-diabetic rats given 100 mg/kg b.w. and 200 mg/kg b.w. of Helicteres isora bark extract and tolbutamide for five weeks. Both Helicteres isora bark extracts and the standard medication significantly decreased the production of hydroperoxides and thiobarbituric acid reactive substances in the brain, suggesting that Helicteres isora bark extracts may be involved in protecting against membrane damage caused by lipid peroxidation.[32] Basniwal et al. examined the hot aqueous extract of Helicteres isora L. fruits' in vitro antioxidant activities. When compared to several standards such as L-ascorbic acid, quercetin, and rutin, the hot aqueous extract of Helicteres isora L. fruits shown notable antioxidant activity by scavenging superoxide anion, nitric oxide, and hydrogen peroxide radicals.[20] The antioxidant activity of aqueous, ethanolic, and methanolic extracts of Helicteres isora fruits was assessed by Polani et al. Fruit extracts with methanolic, aqueous, and ethanolic extracts demonstrated the highest, moderate, and lowest levels of radical scavenging activity, respectively.[31] Vennila et al. showed the in vitro antioxidant activity of Helicteres isora L. It has been demonstrated that Helicteres isora extracts in methanol, hexane, and chloroform have antioxidant properties. When it came to antioxidant activity, the chloroform extract performed better than the methanol and hexane extracts.[32] Using the

microsomal lipid peroxidation assay, Suthar et al. evaluated the antioxidant activity of Helicteres isora hot water extract and discovered that it had low activity (IC50 value of 740.64 ± 4.76 µg/ml) and maximum activity (IC50 value of 25.12 ± 0.18 µg/ml) for the 1, 1-diphenyl, 2-picryl hydrazyl assay method. In the β-carotene-linoleate model, the extract demonstrated 45.63% antioxidant activity.[13]

4. Antifungal and Anti-biofilm Activity

The antifungal activities of Helicteres isora Linn. stem bark were investigated by Jain et al. Cryptococcus neoformans, Candida tropicalis, Trychophyton rubrum, Microsporum furfures, and Epidermophyton floccosum are the five different fungi in which the effects of methanol and petroleum extracts of Heliceres isora Linn's stem bark have been examined. Methanol extracts demonstrated high antifungal activity, but petroleum ether extracts shown only moderate antifungal activity.[33] The antifungal effects of petroleum ether and methanol extracts of Heliceres isora Linn fruits against the planktonic and biofilm formation of Candida albicans were evaluated by Manke MB et al. At a dosage of 2 mg/ml, Helicones isora Linn's methanol extract completely inhibited planktonic growth, whereas petroleum ether extract had no impact up to 4 mg/ml. When 1 mg/ml of methanol extract was present, biofilm formation decreased, and when 2 mg/ml of it was present, biofilm formation was dramatically inhibited ($p<0.05$). By contrast, petroleum ether extract had very little anti-biofilm activity against C. albicans, whereas the methanol extract of Helicteres isora Linn fruits demonstrated anti-biofilm activity.[34]

5. Anticancer and antitumor activity

Varghese et al. evaluated the chloroform extract of Helicteres isora L. fruits for its anticancer qualities. The drug has a potent anticancer effect on human breast cancer because it contains alkaloids and flavonoids.[22] Kumar TM et al. reported the anticancer activities of solvent extracts from the fruits of Helicteres isora Linn. On human lung cancer cells, Helicteres isora fruit acetone extract had superior anticancer activity, while crude protein and acetone extracts shown anticancer action against reactive oxygen species.[17] Using the Trypan blue exclusion assay for cell viability and the micronucleus assay for normal human blood cells, Pradhan et al. reported that Helicteres isora demonstrated anticancer activity against the B16F10 melanoma cell line. 50% methanol extract of Helicones isora showed antitumor activity at a concentration of 300 µl/ml, and lymphocyte cultures treated with it showed a very low

percentage of micronucleus, or 0.007%, in contrast to the standard drug doxorubicin, which showed 0.018% micronucleus.[23,23]

6. Anti-inflammatory activity

Badgujar et al. showed that stem bark extracts from Helicteres isora L. had potent anti-inflammatory effects in albino rats. Carrageenan-induced inflammation in albino rats has been used to assess the anti-inflammatory effects of petroleum ether and methanol extract from the stem bark of Helicteres isora L. Methanol extract (100 mg/kg) decreased rat paw oedema by 56.14%, while petroleum ether extract inhibited it by 36.84%. Methanol extract showed potent anti-inflammatory effects, in contrast to petroleum ether extract.[37,36] Rattanamaneerusmee et al. claim that Helicteres isora L. fruit extract has anti-inflammatory qualities. The anti-inflammatory characteristics of the extracts were investigated in relation to prostaglandin E2 (PGE-2), cyclooxygenas-2 (COX-2), nitric oxide (NO), and tumour necrosis factor alpha (TNF-α). The results indicated that hexane extract had the maximum efficacy on PGE-2 synthesis, decreasing PGE-2 production by 69.68 ± 0.017%, followed by 80% ethanol extracts with 57.17 ± 0.021%. Celecoxib, on the other hand, acted as a COX-2 inhibitor. Dichloromethane extracts were the most effective at inhibiting COX-2 synthesis as compared to celecoxib (106.58 ± 0.003%), followed by 80% ethanol extracts (56.58 ± 0.003%). At 100 µg/mL, the hexane extract from H. isora fruit inhibited TNF-α production by 51.61 ± 0.79%.[24]

7. Antipyretic activity

Tiwari et al. evaluated the antipyretic qualities of alcohol and aqueous extracts of Helicteres isora L. roots. The effectiveness of antipyretics was evaluated in Wistar rats of both sexes using a yeast-induced pyrexia model. Pyrexia was induced by injecting 20% w/v distilled water with brewer's yeast. At dose levels of 200 and 400 mg/kg b.w., both alcohol and aqueous extracts demonstrated potent antipyretic effects within 30 minutes of drug delivery.[39,38]

8. Antispasmodic activity

Pohocha N and Grampurohit ND discovered that the fruits of Helicteres isora Linn have antispasmodic qualities. Three spasmogens acetylcholine, histamine, and barium chloride were examined in vitro on the ileum of guinea pigs to determine their antispasmodic properties. The activity was compared with two popular antispasmodic drugs, atropine and diphenhydramine hydrochloride. The activity was further examined in vivo by using the

marker approach to watch the gastrointestinal motility in mice. The results demonstrated the potent antispasmodic effects of Helicteres isora Linn's fruits.[25]

9. Cardiotonic Activity

Dama et al. examined the cardiotonic effects of digoxin and Helicteres isora Linn fruits on a frog heart that was isolated. Because of its faster beginning of action, the first study confirmed that Helicteres isora had better cardiotonic activity than digoxin. Further studies have shown that Helicteres isora is less toxic than digoxin, which gives it an edge over digitalis.[26]

10. Antinociceptive Activity

The antinociceptive qualities of Helicteres isora were evaluated by Venkatesh et al. The acetic acid-induced writhing test has been used to examine the antinociceptive effects of Helicteres isora root extract in mice at a dosage of 250 mg/kg. Chloroform, petroleum ether, and aqueous ethanol extracts have all shown potent antinociceptive effects. According to phytochemical analysis, the primary components of the active extracts include sterol, triterpenoids (petroleum ether extract), and their glycosides (chloroform and aqueous ethanol extracts), which may be the reason for the observed antinociceptive action.[40,39]

11. Hepatoprotective Activity

Giang et al. evaluated the hepatoprotective potential of Helicteres isora ethanol extract against paracetamol-induced liver injury in mice. The ethanol extract of H. isora L. (250, 500, and 1000 mg/kg b.w. daily) significantly restored the alterations in the biochemical activity of liver tissue and blood caused by paracetamol. The hepatoprotective action of H. isora L. was further confirmed by the pathological examination of liver tissue. In histological investigation, mice with 1000 mg/kg b.w. per day dosages of the extract displayed completely intact liver sections that were almost equivalent to those of animals who received no treatment.[42] Helicteres isora Linn's hepatoprotective efficacy against CCl4-induced liver injury in rats has been assessed by Chitra MS and Prema S. The parameters have examined aspartate transaminase, alanine transaminase, total protein, and serum total bilirubin. activities of alkaline phosphatase, total protein, alanine transaminase, and aspartate transaminase. Significant protection against CCl4-induced hepatocellular damage was demonstrated by ethanolic root extract.[40]

12. Anti-protoscolice Activity

In vitro anti-protoscolice action was demonstrated by the boiled water extract of Helicteres isora L. fruits, according to Nabaa et al. Compared to the albendazole medication, which eliminated protoscolice viability at a rate of 0% after 120 hours, the boiled water extract of H. isora fruits at a concentration of 300 mg/ml was the most successful at doing so after 192 hours at a percentage of 23%. Cystic hydatide infection may be treated with boiled water extract of H. isora fruits instead of chemotherapy.[27]

13. Wound Healing Activity

Renuka M. and Prakash I. have demonstrated that extracts from the leaves of Helicteres isora Linn can heal wounds. the wound-healing capabilities of petroleum ether, chloroform, acetone, ethanol, and hydroalcoholic extracts of Helicteres isora Linn leaves were evaluated in rat models of incision and excision wounds. The hydroalcoholic extract showed significant ($P < 0.05$) wound-healing effectiveness.[44]

14. Anthelmintic Activity

Manke MB et al. discovered that methanolic and petroleum ether extracts of Helicteres isora Linn. fruits exhibited in-vitro anthelmintic activity. The in-vitro anthelmintic activity of methanol and petroleum ether extracts of Heliceres isora fruits was evaluated using the time for paralysis and death (min.) against Indian earthworms Pheretima posthuma. Extracts at several doses (10, 20, and 50 mg/ml) were tested using the bioassay. Albendazole was added at a concentration of 20 mg/ml as the standard reference, and normal saline solution (0.9%) NaCl served as the control. Methanol extracts had more anthelmintic effectiveness than petroleum ether extracts.[26] It has been reported that tannins, a polyphenolic substance, have an anthelmintic action because they can bind glycoprotein on the parasite's cuticle or free proteins in the host animal's gastrointestinal tract, killing the worms (15,26). The threshold for significant activity was 50 mg/mL, even though all of the extracts showed concentration-dependent effect. At a dosage of 50 mg/mL, the extract showed better efficacy than regular albendazole, with paralysis time (12.54 min) and death time (16.55 min). The study found that a methanolic extract of H. isora bark has a potent anthelmintic effect on adult Indian earthworms.[17] Manke MB et al. evaluated the anthelmintic potential of Helicteres isora bark extract in adult Indian earthworms by dividing the earthworms into groups and administering extract at concentrations of 10, 20, and 50 mg/mL, standard albendazole at a dose of 10 mg/mL, and normal saline as a control. The length of paralysis and death was considered an indication of anthelmintic activity against Indian adult earthworms.[17]

15. Anti-diarrheal activity

The fruit is demulcent, astringent, and antispasmodic qualities help children and newborns with bowel clutching and flatulence. Diarrhoea and dysentery are treated with the seeds, bark, and root.[47]

16. Treatment of Snakebites

The capacity of Helictites isora ethanol and aqueous extracts to inhibit enzymes in vitro has been examined. The Naja Naja venom neutralisation assay has been investigated using the minimum indirect haemolytic dose (MIHD) assay and the in vitro tissue damaging method. The enzyme-inhibition activity of Naja Naja venom is demonstrated by Helicteres isora ethanolic extract.[48]

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