



A COMPREHENSIVE REVIEW OF THE PHARMACOGNOSTICAL, PHYTOCHEMICAL AND PHARMACOLOGICAL PROPERTIES OF *ASTERACANTHA LONGIFOLIA* (L.) NEES

Dr. Rinto Babin B.S.

Associate Professor

Department of Dravyaguna Vigyana

IIMT Ayurvedic Medical College and Hospital, Meerut

ABSTRACT:

Asteracantha longifolia Nees, commonly associated with the Ayurvedic drugs Kokilaksha or Ikshuraka, is a medicinal plant of the family Acanthaceae. It has attracted research interest because of its traditional applications in Vata-Rakta, reproductive health, urinary disorders and other conditions. Its reported phytochemical constituents include triterpenoids, phytosterols, flavonoids, alkaloids and fatty acids. Pharmacognostic investigations have examined macroscopic and microscopic characters, physicochemical parameters, powder characteristics and chromatographic fingerprints.

Various research activities have been already conducted to check its efficiency in various clinical conditions. Important challenges remain in establishing botanical identity, distinguishing plant parts, standardizing chemical composition and translating traditional indications into evidence-based therapeutic claims. The identity of Kokilaksha or Ikshuraka requires particular scrutiny because classical commentators and later Materia medica sources do not always treat these names identically. This review critically examines botanical authentication, organ-specific pharmacognosy, phytochemical standardization and pharmacological evidence, with special emphasis on the classical indications of Vatarakta and Vajikarana. It proposes an integrated quality-control framework to improve the reproducibility and scientific evaluation of this medicinal resource.

Keywords: Kokilaksha, *Asteracantha longifolia*, Pharmacognosy, Phytochemistry, Pharmacology, etc

INTRODUCTION:

Medicinal plants are important sources of traditional therapeutics and potential pharmacologically active compounds. However, their scientific evaluation depends on reliable botanical identification, consistent raw-material quality, reproducible chemical composition and appropriately designed biological studies.

Asteracantha longifolia (Kokilaksha) is a medicinal herb associated with traditional Ayurvedic and Unani practice. The plant has been investigated for its chemical constituents and reported antioxidant, anti-inflammatory, diuretic, hypoglycaemic, hepatoprotective and reproductive effects.

These therapeutic associations make right identification especially important. The species, plant part and preparation investigated in a pharmacological experiment must correspond to the material whose traditional use is being evaluated.

The present review therefore treats pharmacognosy not merely as a description of plant morphology, but as the foundation for evaluating traditional identity, chemical consistency, therapeutic plausibility and research reproducibility.

Botanical Identity and Nomenclature of *Asteracantha longifolia*:

Asteracantha longifolia belonging to family Acanthaceae; is also known as *Hygrophila auriculata* and commonly known as “Neermulli, Talmakhana, Kokilaksha & Iksura” is a common plant growing in marshy and water-logged areas. The plant is an important medicinal herb, widely distributed in India and is used for different medicinal purposes. *Asteracantha longifolia* (L.) Nees, Acanthaceae, is a source of the Ayurvedic drug, 'Kokilaksha' and the Unani drug, Talmakhana.

Systematic position:

Division: Spermatophyta

Sub-division: Angiospermae.

Class: Dicotyledonae.

Sub-class: Gamopetalae.

Series: Bicarpellary.

Order: Personales

Family: Acanthaceae.

Identity of *Asteracantha longifolia*^{1,2}

Asteracantha longifolia is a common plant found throughout in India. It belongs to the Acanthaceae family and its common name is kokilaksha, which means, the beeja of kokilaksha look like the eyes of Kokila or the Indian Cuckoo. Kokilaksha is an annual herb that grows up to the height of 60 cms. The plant stem is square and hairy and thickened at the nodes. The bark is dark brown in colour while the leaves are elliptic-lanceolate and hispid. The flowers of this herb are violet and somewhat purple-blue. The fruit is oblong, linear, glabrous and about 1cm long containing seeds which are spherical hairy and brown in colour. It is a wonderful herbal plant which helps in enhancing carnal activity and libido in humans.

Synonym: *Hygrophila auriculata* (Ref: Medicinal Plants Indian Herbal Heritage)

Hygrophila spinosa (Ref: Pharmacopoeia Indica)

Vernacular names:

English: *Hygrophila*, Marsh Barbel

Hindi: Talmakhana

Sanskrit: Kokilaksha, Gokanta

Gujarati: Ekhro

Marathi: Talmakhana, Vikhra, Kolsunda

Bengali: Shulamardan

Kannada: Kalavanka bija

Tamil: Nirumuli

Malayalam: Vayalchulli

Telugu: Kokilakshi

Table: 1 Scientific classification of *Asteracantha longifolia* Nees.³

Kingdom	Plantae – plantes, Planta, Vegetal, plants
Sub-kingdom	Viridiplantae
Infra-kingdom	Streptophyta – land plants
Super division	Embryophyta

Division	Tracheophyta – vascular plants, tracheophytes
Subdivision	Spermatophytina – spermatophytes, seed plants, phanerogames
Class	Magnoliopsida
Superorder	Asteranae
Order	Lamiales
Family	Acanthaceae – acanthacees
Genus	Asteracantha
Species	Longifolia

Kokilaksha (*Asteracantha longifolia* Nees.)

A stout herb growing in wet places.

Stem: Numerous, fasciculate spinous at the nodes.

Leaves: Narrow, lanceolate in whorls of 6, the 2 outer 2 leaves of the whorl are larger.

Flowers: Sessile axillary verticals surrounded by the rigid spines.

Calyx: 4 partite to the base or nearly so the upper sepal the broader.

Corolla: Deeply bilabiate the upper lip- 2 lobed, the lower 3 lobed & with 2 callosities on the palate.

Stamens: 4 didynamous.

Style: Pubescent

Stigma: Simple acuminate

Capsule: 2 celled compressed 4-8 seeded at the base.

Seeds: Hygroscopically white hairy supported on hard retinacula.

Macroscopic Pharmacognostic Characters:⁴

Root - Mostly adventitious, whitish to brown; no characteristic odour and taste.

Stem - Usually unbranched, fasciculate, sub-quadrangular, swollen at nodes, covered with long hairs which are numerous at the nodes, externally greyish-brown, creamish-brown in cut surfaces; no characteristic odour and taste.

Leaf - Greenish-brown, 1-7 cm long, 0.5-1 cm wide, subsessile, lanceolate, acute, entire and hairy.

Flower - Yellowish-brown, usually occurring in apparent whorls of eight (in 4 pairs) at each node; bracts about 2.5 cm long, with long white hairs; calyx 4-partite, upper sepal 1.6-2 cm long, broader than the other three, which are 1.3 cm long, all linear-lanceolate, coarsely hairy on the back and with hyaline ciliate margins; corolla 3.2 cm long, widely 2 lipped, tube 1.6 cm long, abruptly swollen at top; stamens 4, didynamous, second pair larger; filament quite glabrous; anthers two celled, subequal, glabrous; ovary two celled with 4 ovules in each cell; style filiform, pubescent; stigma simple, involute with a fissure on upper side.

Fruit - Two celled, linear-oblong, compressed, capsule about 0.8 cm long, pointed, 4-seeded.

Seed - Ovate, flat or compressed, truncate at the base, 0.2-0.25 cm long and 0.1 - 0.15 cm wide, hairy but appearing smooth; when soaked in water immediately get coated with mucilage, light brown; taste slightly bitter and odour not distinct.

Microscopic Pharmacognostic Characters:⁴

Root - Root shows a single layered epidermis of thin-walled, rectangular to cubical, parenchymatous cells having unicellular hairs; secondary cortex composed of round to oval or oblong, thin-walled cells having large intercellular spaces; most of these cells divided longitudinally and transversely with walls forming 4-6 or

more chambers; size of these cells and intercellular spaces gradually reduce towards the inner region, where these cells are mostly radially elongated, arranged in radial rows, a few thick-walled cells found scattered singly throughout secondary cortex; secondary phloem narrow consisting of small, thin-walled, polygonal cells; phloem fibres thick-walled, occur in groups of 2-6 or singles, scattered throughout the phloem region; secondary xylem forms continuous ring; vessels angular, broader towards centre, arranged radially having spiral thickenings, surrounded by thick-walled parenchyma and xylem fibres; fibre walls uniformly thickened; multi and uniseriate medullary rays occur from primary xylem region upto secondary cortex; ray cells thin walled, radially elongated in xylem region, circular to transversely elongated in phloem region.

Stem - Shows somewhat sub-quadrangular outline; cork consists of 5-10 rows of rectangular, radially arranged, moderately thick-walled, brownish cells; collenchyma 4-8 layered consisting of isodiametric cells; a few thick-walled, isolated cells found scattered in this zone; cortical cells thin-walled, round, oblong, variable in size, with a number of large air cavities; a special feature of these cells is the formation of tangential and radial walls within the cell dividing it into 4-5 or more parts; most of cells contain numerous acicular crystals of calcium oxalate; endodermis single layered, composed of transversely elongate, thin-walled cells; phloem narrow, consisting of round to polygonal cells, peripheral ones larger, inner cells smaller; fibres thick-walled, single or in groups of 2-3, some cells contain calcium oxalate crystals similar to those found in cortical cells; xylem present in a ring; vessels with spiral thickenings, arranged radially; fibres elongated with wide lumen and pointed tips, medullary rays uni to multi serrate extend up to secondary cortex; ray cells thin-walled, radially elongated in secondary xylem, transversely elongated in secondary phloem; pith large, composed of polygonal, thin-walled parenchymatous cells, having small intercellular spaces; a few cells contain calcium oxalate crystals similar to those found in secondary cortex.

Leaf - Midrib shows concavo-convex outline; epidermis on either surface covered with thick cuticle; collenchyma 2-5 layered; stele composed of small strands of xylem and phloem having some groups of fibre; rest of tissues composed of thin-walled, parenchymatous cells, a few of them containing acicular crystals of calcium oxalate ; cystolith present beneath upper and above the lower epidermal cells.

Lamina - Shows epidermis single layered on either surface, composed of thin-walled, parenchymatous, tangentially elongated cells, covered with thick cuticle; stomata diacytic, 1-5 celled hairs present on both surfaces; palisade 1-2 layered; spongy parenchyma composed of 3-5 layered, loosely arranged cells traversed by a number of veins; palisade ratio 6.25-15.75; stomatal index 17.24-30.78; vein islet number 17-42.

Fruit - Shows single layered epidermis covered with striated cuticle followed by 5-10.



image-1: morphology of *Asteracantha longifolia* Nees.

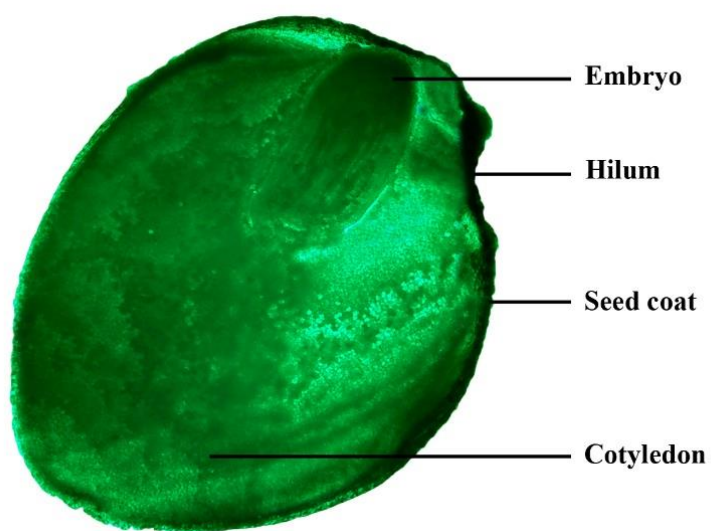


image-2: Outline of LS-*Asteracantha longifolia*

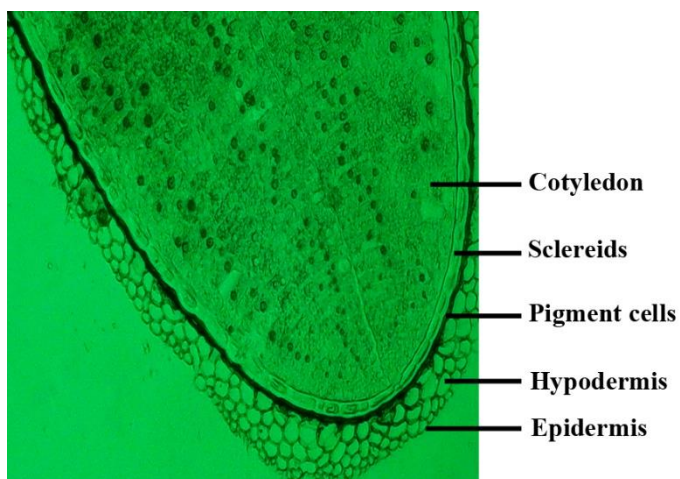


image-3: Outline of TS-Asteracantha longifolia

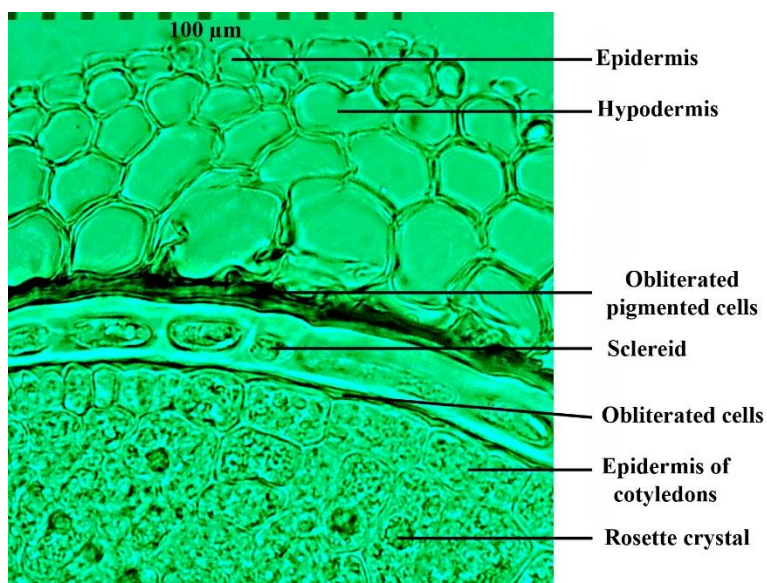


image-4: TS of Asteracantha longifolia

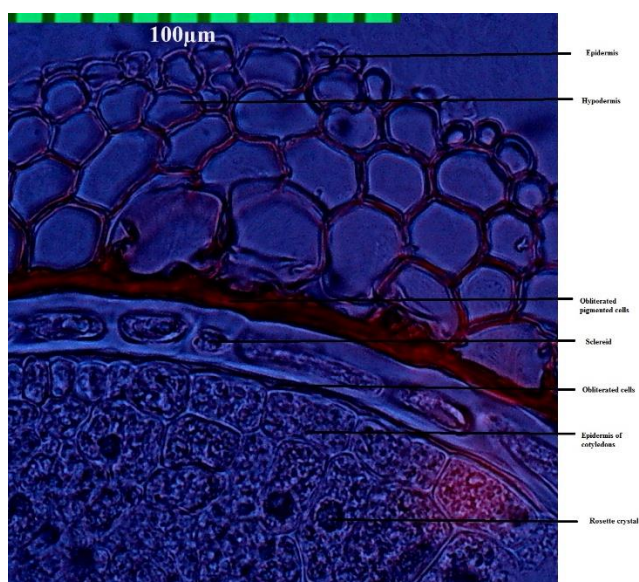
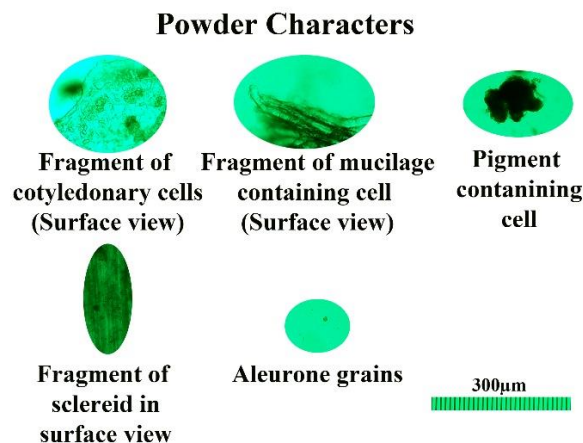


image-5: TS of Asteracantha longifolia (under UV)

image-6: Powder Characters of *Asteracantha longifolia* seeds

PHYTOCHEMISTRY:⁵

Composition of *Asteracantha longifolia*

The leaves of *Asteracantha longifolia* contain: The aliphatic esters 25-oxo-hentriacontanyl acetate and methyl 8-n-hexyltetracosanoate, Butelin, Lupeol at 0.051%, Stigmasterol and β -sitosterol (0.069%)

The stems contain: Lupeol (0.121%), β -sitosterol (0.029%).

The aerial parts of contain: A seed oil containing linoleic acid (11%), palmitic acid (8%) and stearic acid (0.6%), Asterol I-IV, Asteracanthine and asteracanthinine (alkaloids) [1][8], Lupeol at 0.044% [6], β -sitosterol (0.031%).

The roots contain: Lupeol (0.25% dry weight), β -sitosterol (0.06%).

In a preliminary qualitative analysis of the compounds in *Asteracantha longifolia* leaves the classes of steroids, saponins ($0.68 \pm 0.12\%$), tannins ($4.92 \pm 0.18\%$), phenolics ($0.16 \pm 0.10\%$), and cardiac glycosides were found while terpenoids, alkaloids, and flavonoids were absent.[2] Despite this, in the quantitative analysis there was a detectable alkaloid ($1.14 \pm 0.14\%$) and flavonoid ($0.24 \pm 0.19\%$) content.

Phytochemical screening of *Asteracantha longifolia* ⁶

Fresh plant materials were washed under running tap water, air dried and then homogenized to fine powder and stored in airtight bottles. 25 g of air-dried powder was taken in 100 ml of water in a conical flask, plugged with cotton wool and they were shaken at room temperature for 2 days. After 2 days hours the supernatant was collected and the solvent was evaporated to make the final volume one fourth of the original volume and stored at 4°C in airtight bottles. 25 g of air-dried powder was taken in 100 ml of methanol in a conical flask, plugged with cotton wool and they were shaken at room temperature for 2 days. After 2 days the supernatant was collected and the solvent was evaporated to make the final volume one fourth of the original volume and stored at 4°C in airtight bottles.

Table:2 Showing Phytochemical screening of *Asteracantha longifolia*

Sl.No.	Phyto constituents	Methanol	Aqueous
1.	Alkaloids	+	-
2.	Saponins	-	+
3.	Steroids	+	-
4.	Phenolic compounds	+	-
5.	Tannins	+	+
6.	Flavonoids	+	+
7.	Terpenoids	-	-
8.	Carbohydrate & Glycosides	+	+
9.	Protein & Amino acids	+	+
10.	Anthraquinones	-	-

Review over Pharmacological activities

1. Aphrodisiac activity: The ethanolic extract of aerial parts shows androgenic as well as improvement of sexual behaviour of rat in dose dependent manner, it also improves the histo-architecture of testis and increase the concentration of sperm count in epididymis and also increase testosterone level. The effect of aerial parts of *Asteracantha longifolia* on the sexual behaviour of male albino rats. The ethanolic extract of aerial parts of *Asteracantha longifolia* was administered to groups of rats in 100, 150 and 200 mg kg⁻¹ doses for a period of 28 days, and the action compared with control rats. The changes in body and organ weight, sexual behaviour, histo-architecture and fructose levels of seminal vesicles were observed. The sexual behaviour was assessed by determining parameters such as mount frequency (MF), intromission latency, mount latency (ML) and post-ejaculatory latency. The ethanolic extract exhibited pronounced anabolic effects in treated animals, as evidenced by gains in the body and reproductive organ weights. Increased spermatogenesis due to treatment with extracts was also witnessed in transverse section. The treatment further markedly affected sexual behaviour of the animals, as reflected by the reduction of ML, increase in MF and enhanced attract ability towards females. A significant increase in the sperm count as well as fructose levels of seminal vesicles was noted.⁷

2. Liver protecting activity: The aqueous extract of whole plant and root of *Asteracantha longifolia* possesses hepato-protective and antioxidative properties against CCl₄- and paracetamol-induced hepato-toxicities (Hewawasam et al., 2003, Usha et al., 2007). Petroleum ether extract of *Asteracantha longifolia* affects liver and kidney functions and metabolism and haematological parameters in high doses (40 and 80 mg/kg) whereas low weekly dose (20 mg/kg) and low and moderate daily/therapeutic dose (2 and 4 mg/kg) does not exhibit any appreciable toxic action (Mazumdar et al., 1996). Methanolic extracts of the aerial parts of show hepatoprotective activity against paracetamol and Thio acetamide intoxication in rats (Singh & Handa, 1999). Ahmed et al. (2001) studied the against of aerial parts of against chemically induced hepato-carcinogenesis in Wistar rats. Methanol extract of seed showing antitumor promoting potential inhibit hepatocarcinogenesis in Wistar rats, increase GPx and CAT, ODC. Shivashangari et al. (2004) studied the protective efficacy of *Asteracantha longifolia* on acetaminophen-induced liver damage in rats. Shanmugasundaram & Venkataraman (2006) studied the aqueous extract of the roots for hepatoprotective in CCl₄-induced liver toxicity in rats and in vitro antioxidant activity using ferric thiocyanate (FTC) and Thio barbituric acid (TBA) methods. Shailajan et al. (2005) showed the whole plant study of *Asteracantha longifolia* was hepatoprotective activity against CCl₄ induced liver dysfunction in rats. Later they also reported that the slurry, aqueous extract and ethanolic extract of whole plant powder showed hepatoprotective effect against galactosamine induced hepatotoxicity.^{8,9,10,11,12}

3. Hypoglycaemic activity: Ethanolic extract (Al Eth) of aerial parts of *Asteracantha longifolia* (100 and 250 mg/kg body weight) when administered to rats for three weeks showed significant reduction in blood glucose level. There is also decrease in Thio-barbituric acid reactive substances (TBARS) and hydroperoxide in both liver and kidney. The treatment with Al Eth significantly increased the glutathione (GSH), glutathione peroxidase (GPx), glutathione S-transferase (GST) and catalase (CAT) in the drug-treated group, which is comparable to the control group. Al Eth treated rats also showed decreased lipid peroxidation that is associated with increased activity of superoxide dismutase (SOD) and catalase (Vijayakumar et al., 2006). Fernando et al. (1991) investigated the effects of hot water extracts of *Asteracantha longifolia* whole plant material on the glucose tolerance of normal human subjects and maturity onset diabetic patients. Administration of aqueous extract of *Asteracantha longifolia* to rats prior to glucose loading showed hypoglycaemic action as it was significant increase in the glycogen content of liver and muscle and a significant increase in triacylglycerol content of adipose tissue in comparison with control rats. However, the plant extract had no effect on the gluconeogenic capacity of the kidney or intestinal glucose absorption (Fernando et al., 1998 Fernando et al. 1989).^{13,14}

4. Haematopoietic activity: Petroleum ether extract of root from *Asteracantha longifolia* increases WBC count significantly (Mazumdar et al., 1996). Ethanolic extract (100 and 200 mg/kg, p.m.) of the aerial parts of *H. spinosa* significantly increased the haemoglobin, haematocrit, RBC and total WBC, as compared with vehicle treated control rat. In anaemic male albino rats, the extract significantly increased haemoglobin, haematocrit and RBC count (Gomes et al., 2001). Petroleum ether and chloroform extract of leaves show haematopoietic activity as it significantly increases erythrocyte count, leukocyte count, and haemoglobin count (Pawar et al., 2006a; 2006b).¹⁵

5. Antioxidant activity: The methanolic extract of leaves contain phenolic and flavonoid shows promising antioxidant activity (Sawadogo et al., 2006). Aqueous extract of leaves of *A. longifolia* shows potent antioxidant activity in various invitro model (Dasgupta& De, 2007).¹⁶

6. Neurology¹⁶

A. Neuroprotection: The terpenoid fraction of *Asteracantha longifolia* (100-200mg/kg) orally for seven days in rats then subject to transient global cerebral ischemia, supplementation was associated with improvements in cognitive testing and reductions in brain lipid peroxidation with a potency comparable to 500mg/kg Vitamin E.

B. Aphrodisia: An ethanolic extract of the seeds (100-200mg/kg) to rats over 28 days caused dose-dependent increase in mounting frequency (380-472% of control) and similar reductions in mounting, intromission, and post-ejaculatory latencies; all doses were non significantly more libido enhancing than the active control of 0.5mg/kg testosterone injections.

7. Cardiovascular Health: The chloroform extract of the leaves of *Asteracantha longifolia* (250-500mg/kg intraperitoneal injections in mice) given for 22 days after cyclophosphamide-induced anaemia was able to restore levels of blood cells (normalization after 15 days) indicative of haematopoietic potential. The suppression in bone marrow cell count was also normalized by treatment with *Asteracantha longifolia* and elsewhere in haloperidol-induced anaemic rats an ethanolic extract of the aerial parts (100-200mg/kg) given via intraperitoneal injections was able to almost normalize blood cell parameters (haematocrit, RBC count, haemoglobin) after 19 days. In rats that are not anaemic and given 200mg/kg of the ethanolic extract (injections), administration of the supplement does not appear to stimulate erythropoiesis and is met with a small (possibly clinically irrelevant) decline relative to untreated control.¹⁷

8. Interactions with Glucose Metabolism

A. Absorption: Large oral doses of the water extract of the aerial parts of the plant (leaf and stem, dosed at 5g/kg bodyweight in rats) has failed to modify the absorption of glucose.

B. Glycogen: Oral ingestion of the water extract has failed to modify gluconeogenesis in the rat liver following an oral glucose tolerance test. In rats, administration of a water extract (at 5g/kg bodyweight) prior to glucose loading has resulted in increased glycogen storage in both the liver (108.5±9.5%) and skeletal muscle (57.8±4.2%) although an increase in triglyceride storage of adipose tissue (10.2±1.8%) was also noted.

C. Diabetes: 100-250mg/kg of the ethanolic leaf extract for three weeks in diabetic rats is able to reduce fasting blood glucose associated with a normalization of antioxidant enzymes (glutathione peroxidase, catalase, and glutathione-S-transferase) and lipid peroxidation. Oral ingestion of 10mL/kg of a hot water leaf extract (where each mL is equivalent to 1g of plant material) in normal humans is able to reduce exposure to glucose following an oral glucose tolerance test by 25%; the drink was slightly more effective in diabetics since it reduced exposure by 36%.^{13,14}

9. Interactions with Cancer Metabolism:

A. Hepatocarcinoma: A methanolic extract of the seeds (200-400mg/kg) every other day for eight weeks in rats given hepatic tumours appears to be able to reduce subsequent foci development by up to 51% (relative to control) associated with an attenuation of the toxin-induced decline in glutathione peroxidase and catalase.^{12,18,19}

CONCLUSION:

Kokilaksha, botanically known as *Asteracantha longifolia* (L.) Nees, currently treated taxonomically as a synonym of *Hygrophila auriculata*, is a pharmacognostically significant medicinal plant with documented macroscopic characters, various organ-level investigations, preliminary physicochemical standards and a diverse reported phytochemical profile.

Its principal research strength is the availability of an established body of traditional, phytochemical and preclinical literature. Its principal weakness is the lack of sufficiently harmonized, validated evidence linking botanical identity and chemical consistency to clinical outcomes.

Asteracantha longifolia (L.) Nees is a potent drug, that is capable to do aphrodisiac activity, hepatoprotective activity, Hypoglycaemic activity, Haematopoietic activity, Antioxidant activity, Cardiovascular as well as anti-cancerous activities too.

REFERENCES:

1. Mukharjee. Quality control of herbal drugs. 1st edition, New Delhi. Business Horizon Pharma publisher (2002).
2. Anonymous. Quality standards of Indian Medicinal Plants, ICMR, 2003
3. http://www.it.is.gov/servlet/singleRpt/singleRpt?search_topic_TSN&search_value-182343
4. Ayurvedic Pharmacopoeia of India, Part-1, Vol-2: Page no:88-94
5. Anonymous. Quality standards of Indian Medicinal Plants. Indian council of Medical Research. 2003; 212-218. P.V. Sharma, Database on Medicinal Plants Used in Ayurveda. New Delhi: Central Council for Research in Ayurveda and Siddha; (2002)
6. Doss A, Preliminary phytochemical screening of some Indian Medicinal Plants, Vol:29, Ancient Science of Life. (2009)
7. Nagendra Singh Chauhan, Vinod Dixit, *Asteracantha longifolia* (L.) Nees, Acanthaceae: chemistry, traditional, medicinal uses and its pharmacological activities - a review, The Revista Brasileira de Farmacognosia (2010)
8. Ahmed S, et al. Anti-tumour promoting activity of *Asteracantha longifolia* against experimental hepatocarcinogenesis in rats. Food Chem Toxicology. (2001).
9. Shanmugasundaram P, Venkataraman S. Hepatoprotective and antioxidant effects of *Hygrophila auriculata* (K. Schum) Heine Acanthaceae root extract. J Ethnopharmacology. (2006).
10. Raj VP, et al. In vitro and in vivo hepatoprotective effects of the total alkaloid fraction of *Hygrophila auriculata* leaves. Indian J Pharmacol. (2010).
11. Singh A, Handa SS. Hepatoprotective activity of *Apium graveolens* and *Hygrophila auriculata* against paracetamol and thioacetamide intoxication in rats. J Ethnopharmacology. (1995).
12. Shivashangari KS, Ravikumar V, Devaki T. Evaluation of the protective efficacy of *Asteracantha longifolia* on acetaminophen-induced liver damage in rats. J Med Food. (2004).
13. Vijayakumar M, et al. Action of *Hygrophila auriculata* against streptozotocin-induced oxidative stress. J Ethnopharmacology. (2006).
14. Effect of *Artocarpus heterophyllus* and *Asteracantha longifolia* on glucose tolerance in normal human subjects and in maturity-onset diabetic patients.
15. Haematopoietic activity of *Asteracantha longifolia* on cyclophosphamide-induced bone marrow suppression.
16. Kanhere R, et al, Neuroprotective and antioxidant potential of terpenoid fraction from *Hygrophila auriculata* against transient global cerebral ischemia in rats. Pharm Biol. (2013).
17. Pawar RS, et al. Erythropoietic activity of *Asteracantha longifolia* (Nees.) in rats. J Ethnopharmacology. (2010).
18. Hewawasam RP, et al. Protective effect of *Asteracantha longifolia* extract in mouse liver injury induced by carbon tetrachloride and paracetamol. J Pharm Pharmacol. (2003)
19. Shailajan S, et al. Effect of *Asteracantha longifolia* Nees. against CCl₄ induced liver dysfunction in rat. Indian J Exp Biol. (2005)