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Hedychium Spicatum: A holistic review of its ethnobotany, phytochemistry and pharmacology

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Abstract
Hedychium spicatum Buch.-Ham. ex D.Don (*Zingiberaceae*), commonly known as spiked ginger lily or Kapur-kachari, is a perennial rhizomatous herb widely distributed in the Himalayan region and valued for its medicinal, aromatic and ethnobotanical significance. Morphologically, the plant is characterized by aromatic rhizomes, erect leafy stems, lanceolate leaves, and terminal spikes bearing fragrant white to orange-yellow flowers. Traditionally, *H. spicatum* has been extensively used in indigenous systems of medicine to treat respiratory disorders, gastrointestinal ailments, inflammation, and pain, with its rhizome being the most therapeutically important part. In Ayurveda, it is incorporated into various formulations for managing asthma, cough, fever, and digestive disorders, reflecting its role in balancing bodily doshas. Pharmacological investigations have validated several of these traditional claims, demonstrating anti-inflammatory, hepatoprotective, antimicrobial, antioxidant, antidiabetic, anti-asthmatic activities attributed to bioactive constituents such as terpenoids, flavonoids and essential oils. Despite promising preclinical evidence, clinical studies on *H. spicatum* remain limited, highlighting a gap between traditional knowledge and clinical validation. Overall, this review consolidates current knowledge on morphology, ethnobotanical uses, Ayurvedic formulations, pharmacological potential and clinical evidence of *H. spicatum*, emphasizing its therapeutic relevance and the need for well-designed clinical trials to establish its efficacy and safety for modern drug development.

Keywords: *Zingiberaceae*, kapur kachari, inflammation, phytoconstituents, pharmacology

Introduction
Indian Himalayan Region (IHR) is the giant store house of plant biodiversity which is the outcome of extreme altitude ranges and extraordinary geographic zones and has been claimed to be the richest source of medicinal plants and aromatic plants. The flourishing diversity of plant biodiversity in IHR is backed up by several landscape features which offer a number of habitats. IHR covers up to an area of 5, 91,000 km^2 and comprises of five biogeographic provinces with an altitude range between 200-8000 m [2]. Amongst these geographical zones, Western Himalaya is the treasure house of medicinal and aromatic plant diversities. IHR is the home of 18,440 plants species including 8,000 angiosperms, 44 gymnosperms and 6001, 736, 1159 and 6900 Spp. of pteridophytes, bryophytes, lichens and fungi, respectively. These plant species are mostly used by the people of IHR for medicine, food, fuel, fodder and timber. Of all the species of vascular plants 1,748 species are medicinal and used in different types of medicines (Rasool & Maqbool., 2019) [1]. The family *Zingiberaceae* with 52 genera and more than 1500 species are known for their medicinal, cosmetic, perfumery and food value. This family is represented by 22 genera and 170 species in India. The important commercially grown species are *Zingiber officinale* (ginger), Curcuma longa (turmeric), *Amomum subulatum* (large cardamom), *Elettaria cardamomum* (small cardamom) and *Alpinia galanga* (Thai galangal). The genus *Hedychium* having more than 80 species known globally and reported to be used medicinally for the treatment of different diseases, is yet to be cultivated for commercial purposes. The systematic position of the genus *Hedychium* has been confusing since the mid-19th century and more than 115 names of the genus were published, but very few were found to be authenticated and biologically valid (Rawat *et al*.,2018) [2, 8].

Scientific Classification
Kingdom: Plantae
Phylum: Streptophyta
Class: Equisetopsida
Subclass: Magnoliidae
Order: Zingiberales
Family: *Zingiberaceae*
Genus: *Hedychium*
Species: *Hedychium spicatum*

Vernacular Names
English: Spiked ginger lily, Perfume ginger, Zedoaery Hindi: Kapur kachri, Sitruti, Kachoor, Van haldi Sanskrit :Palashi, Shatgrantha Subratha, Gandhmulika, Gandharika, Gandhvadhu and Prathupalashika, Shati, Gandhpalassi Bengali: Kapurakachri, Shati, Kachri Gujrati: Kapurkachli, Kapurkachari, Kapur krachari Kannada: Gandhasati, Seenakachora, Kachora, Kacchura Malayalam: Katcholam Oriya Gandha sunthi Punjabi: Khor, Kachoor, Kachur Tamil: Poolakizhangu, Kichilikizhangu Telugu: Gandha Kachurala Kashmir: Kapurkachara Marathi: Kapurkachri, Gabla kacheri Assamese: Katuri, Sati Arabic: Jaramdad

Morphology
Hedychium spicatum is an evergreen herb, the rhizomes of which are used in medicine that grows to a height of about 5-150 cm. It has an erect and leafy stem and the leaves are sessile, glabrous, ovate-lanceolate, broad and have clasping

sheaths measuring approximately 30 cm in length. The flowers are bisexual fragrant, white and have a base of orange-yellow or crimson. The dense and terminal flower spikes are 15-25 cm long. The flowers have large, oblong-shaped, green bracts, with a single flower. The flowers have a three-lobed, imbricated, white calyx, which is usually shorter than the bract. The size of the corolla is bigger than the calyx, about 5-6.3 cm. The flowers have a row of white petals. White lip, curate; with two elliptical lobes and a base of orange or yellow. The shorter stamens have red filaments. Its linear anthers are longer with a length of 6-8.5 mm. The globose fruit capsules are lined with orange-red. Arils have many black and white seeds. Horizontal, fleshy rhizomes 15-20 cm in length, 2.0-2.5 cm in thickness. Rhizomes initially appear yellowish-brown in colour, but dark brown in colour after storage. The one side of each part has a coarse reddish brown coating, full of numerous scars, rings and traces of roots (Lohani *et al*.,2015; Rasool & Maqbool., 2019) [1, 3]. Different parts of Hedychium spicatum has been shown in Figure 1.

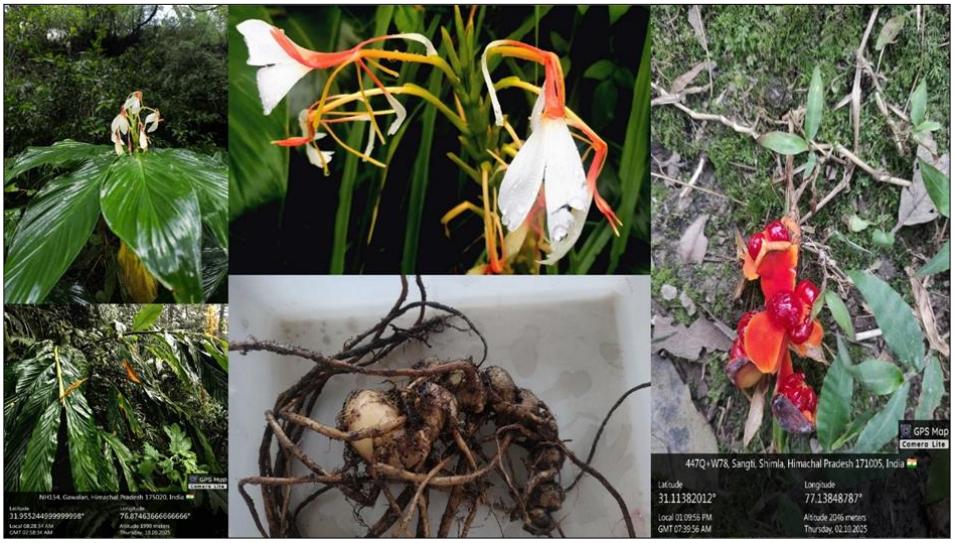


Fig1: Different parts of *Hedychium Spicatum*

Life cycle

The life cycle of *Hedychium spicatum* has been shown in the Figure.2.

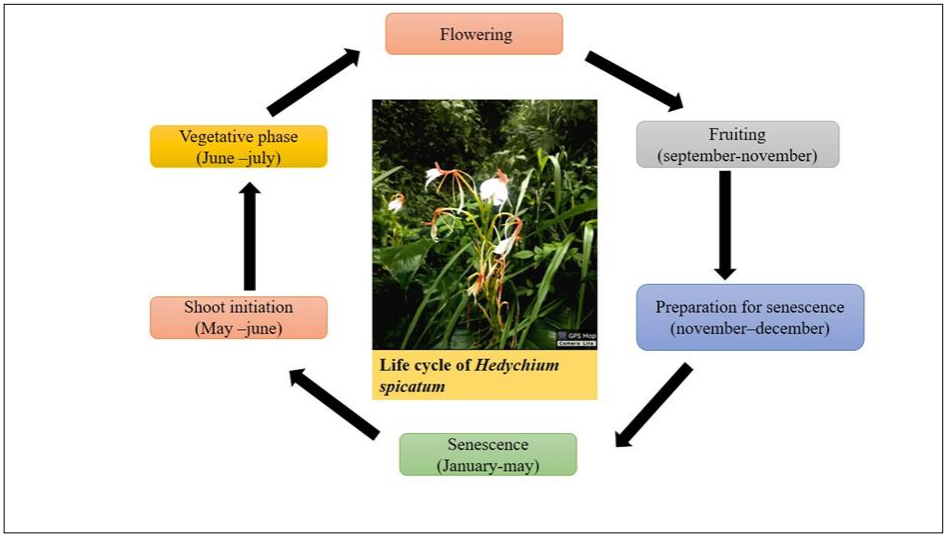


Fig 2: Life cycle of *Hedychium spicatum*

Geographical Distribution

Hedychium spicatum is indigenous herbaceous plant in south-east Asian countries and is almost endemic to the Himalayan region where it grows in various environments from sub-tropical to temperate. It is found in abundance in Bhutan, Nepal, Japan, Thailand, Pakistan and China. In India it is found in the states of Assam, Arunachal Pradesh, Uttarakhand and in the Hills of Kerala and Jammu and Kashmir (Raina & Negi., 2015) [4]. Geographical distribution has been shown in the figure 3.

Cultivation

These plants grow at an elevation of 1500 to 2800 m with a mild climatic condition, soil types ranging from sandy to clay. pH needed is Alkaline, neutral and acidic for the plants to grow (Prakash *et al*.,2010) [5]. It can be grown as a sub-tropical bedding plant in fertile and moist soil. It cannot grow in shade. It needs sunny climate but can endure temperature as low as -2°C. It has been reported to tolerate temperature down to -16°C in Germany. The plant flowers in July-August and sets seed in September - October. It is

easy to get and has been found in several natural populations in moist and shady rocky sites, along streams and in open or dense oak (Quercus) dominated or mixed forests in the Indian Central Himalayan region between elevations 1200-2400 m. (Negi *et al*.,2014) [6].

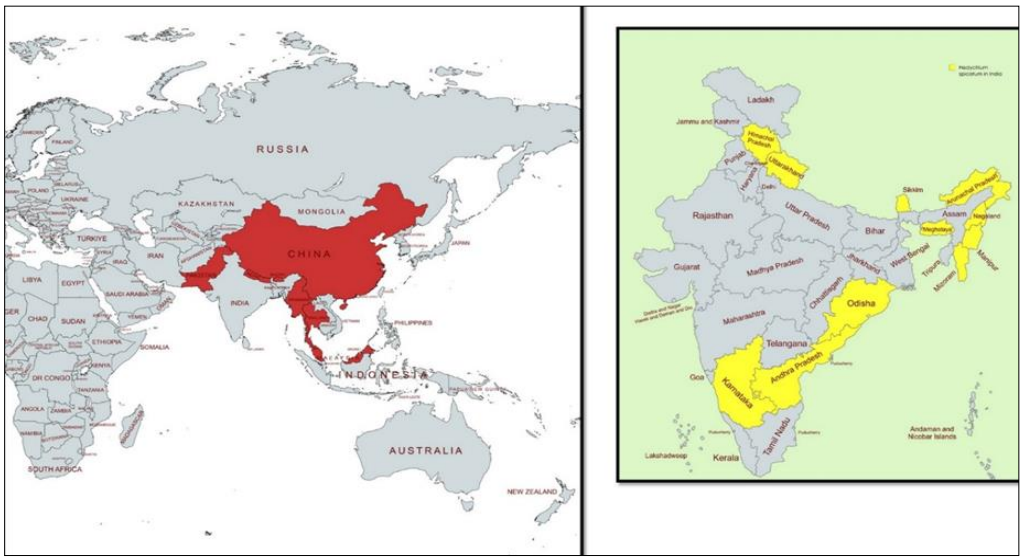


Fig 3: Geographical distribution of *Hedychium spicatum*

Ethnobotanical Uses

Table 1: Ethnobotanical uses of *Hedychium spicatum*

Plant Part	Geographic Region	Dose/mode of administration	Used in
Rhizome powder	Whole India	-	Antimicrobial agent, laxative to brain
Rhizome powder and decoction		A small cup twice a day	Expectorent, stomachic, stimulant, tonic, vasodilator, carminative, expectorant
Rhizome powder		One spoonful powder three times in a day	Liver complains, fever, vomiting, diarrhoea, pain and inflammation, indigestion, poor circulation of blood due to thickness of blood
Rhizome powder		4–5 mg three times in a day	Asthma, foul breaths, bronchitis, hiccough and vomiting,
Decoction of rhizome		With deodar sawdust	Tuberculosis
Rhizome decoction		-	Tonic to brain
Fruits		With lentils	Food
Fresh rhizome	Hills of Uttarakhand	Boiled with salt	Food
Roasted powder		-	Asthma
Rhizome powder	Andhra Pradesh	-	Asthma
Fresh rhizome	Manipur	Cooked for making chutney	Food
Root, rhizome powder	Nilgiri	Mixed in goat milk	For asthma and internal injury
Rhizome powder	Bhuvneshwar	-	Asthma
Rhizome powder	Mizoram, Sikkim, Himachal Pradesh	4 mg thrice a day	Vomiting
Paste of tubers	Koraput, Orissa	_	Loose motions
Rhizome	Uttarakhand	Decoction along with deodar sawdust	Tuberculosis

(Singh &Attri.,2014; Rawat *et al*.,2018) [2, 6, 8]

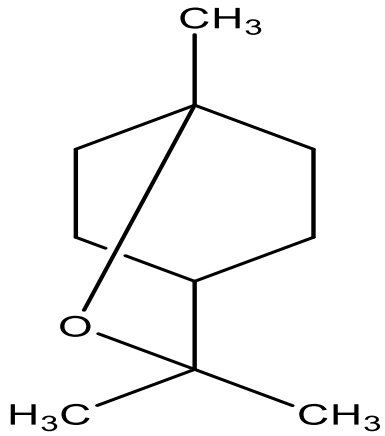
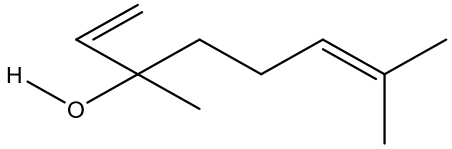
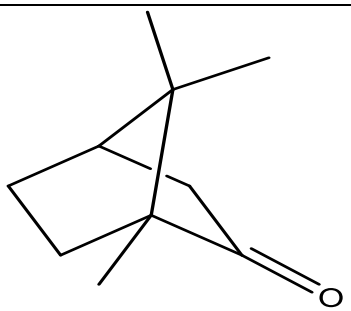
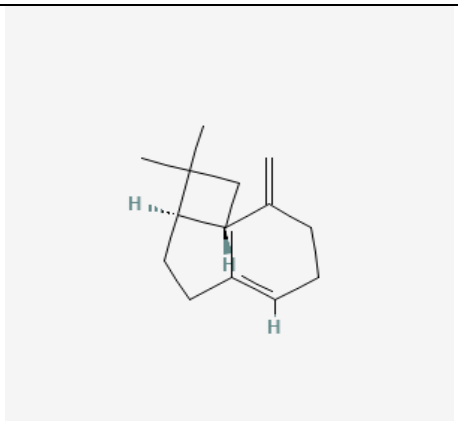
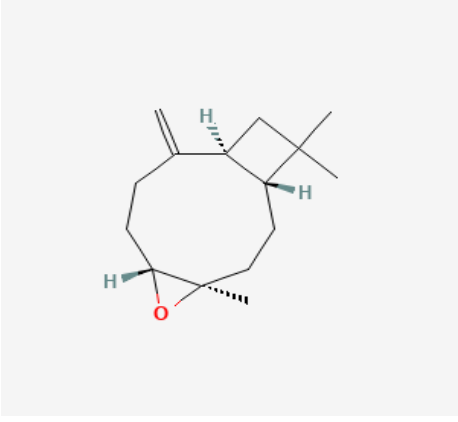
The traditional uses of the plant has been mentioned in the Table 1.

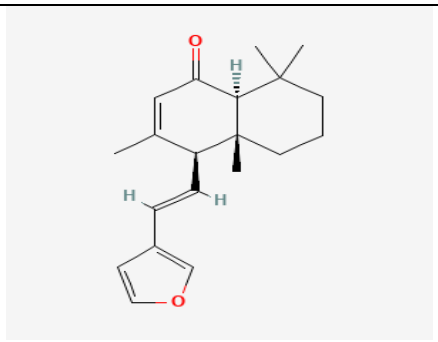
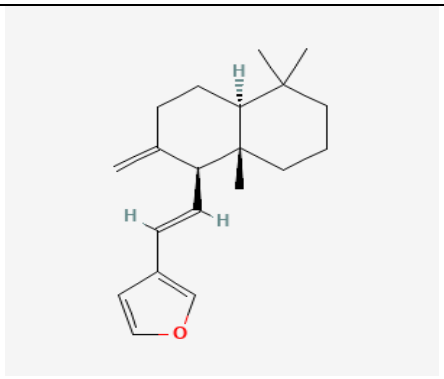
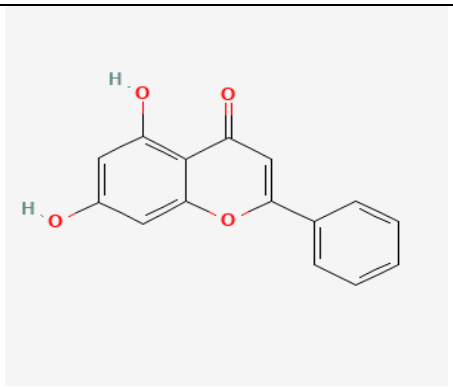
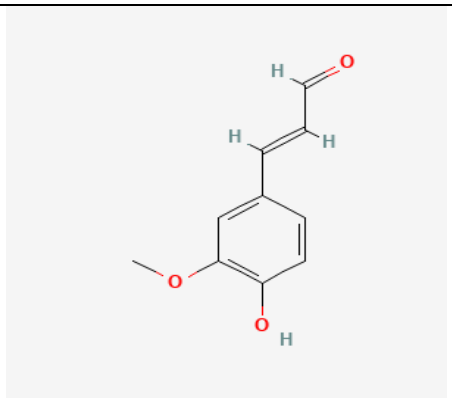
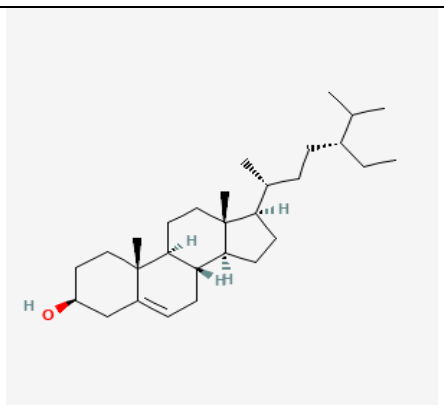
Ayurvedic Properties
Rasa: Katu, Tikta, Kashaya.
Guna: Laghu, Teekshna.
Veerya: Ushna. Vipaka - Katu.
Doshagnata: Kaphavatashamaka. Rogaghnata Sandhishoth a, Shoola, Dantashoola, Mukhadurgandha, Vrana, Apatantraka, Amavata, Aruchi, Agnimandhya, Adhamana, Udarashoola, Atisara, Arsha, Hriddaurbalya, Raktarikara, Pratishyaya, Kasa, Shwasa, Hikka, Twagdosha.

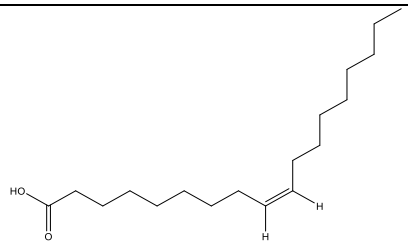
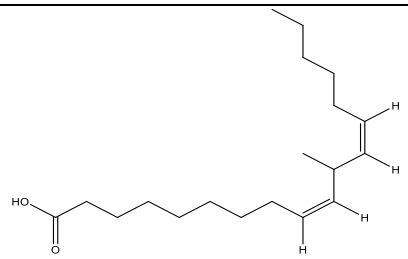
Karma: Shothakara, Vedansthapana, Durgandhanashana, M ukhashodhana, Keshya, Rochana, Deepana, Shoolaprashamana, Grahi, Uttejaka, Rakthashodhaka, Jwaraghna, Shwasahara, Hikkanigrahana (Sravani &Paarakh.,2011) [9]

Phytochemistry
Phytoconstituents of *Hedychium spicatum* with their structure and pharmacological activity has been mentioned in Table2.

Table 2: Phytoconstituents of Hedychium spicatum with their Pharmacological activities

Chemical compound	Class of compound	Structure	Pharmacological activities
1,8-Cineole	Monoterpene oxide		Strong antimicrobial, antioxidant, anti-inflammatory
Linalool	Monoterpene alcohol	 .Linalool	Antioxidant, antimicrobial, sedative
Camphor	Monoterpenoid ketone		Analgesic, antimicrobial
Caryophyllene	Sesquiterpene		Anti-inflammatory, analgesic
Caryophyllene oxide	Sesquiterpene oxide		Antifungal, anticancer

Hedychenone	Labdane diterpene		Strong anticancer, antimicrobial
Coronarin-E	Diterpene		Potent anticancer, antimicrobial
Chrysin	Flavonoid		Antioxidant, anticancer, anti-inflammatory
Coniferaldehyde	Phenolic aldehyde		Antioxidant, antimicrobial
β-Sitosterol	Phytosterol		Anti-inflammatory, cholesterol-lowering

Oleic acid	MUFA		Anti-inflammatory, cardioprotective
Linoleic acid	PUFA (ω-6)		Skin barrier support, anti-inflammatory

(Mishra *et al*.,2016; Verma & Padalia.,2010) [18, 24, 25]

Pharmacological Properties

The pharmacological activities of *Hedychium spicatum* has been shown in the figure 4 and table 2.

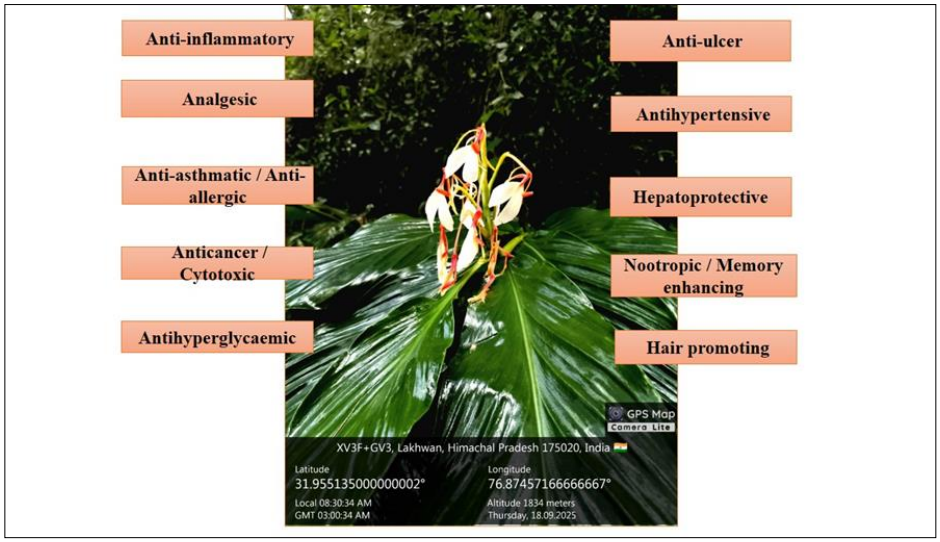


Fig 4: Pharmacological Activity of *Hedychium Spicatum*

Table 2: Different pharmacological activities of *Hedychium Spicatum*

Activity	Model / Study Type	Dose / Extract	Key Findings	References
Anti-inflammatory	Carrageenan-induced paw oedema (rats & mice)	Alcoholic, hexane, benzene extracts (100–200 mg/kg)	Hexane extract showed 42.16% inhibition (mice) and 27.2% (rats); comparable to indomethacin (37%) and phenylbutazone (27.2%)	(Srimal *et al*.,1984) [10]
	Granuloma formation assay	Hexane & benzene fractions (200 mg/kg)	Inhibition: 8% (hexane), 5% (benzene) vs 25% (phenylbutazone)	
	Carrageenan-induced oedema	Alcoholic extract (30 mg/kg)	64.2% inhibition vs 49.1% (aspirin 300 mg/kg)	(Tandan *et al*.,1977) [11]
	Carrageenan-induced inflammation	Aqueous & ethanolic extracts (200 mg/kg)	↓ paw volume (aqueous: 11.0–28.1%; ethanolic: 8.79–25.62%)	(Ghildiyal *et al*.,2012) [12]
	Mechanistic study	Diterpene (Hedychinone)	Anti-inflammatory activity attributed to hedychinone	(Sharma *et al*.,1975; [13] Srinivas *et al*.,2007) [14]
Analgesic	Acetic acid writhing & Randall–Selitto test	Hexane & benzene extracts	ED_{50}: hexane (284.53 mg/kg), benzene (93.28 mg/kg)	(Srimal *et al*.,1984) [10]
	Hot plate test	Extract (30–300 mg/kg)	No central analgesic activity (non-morphine type)	(Tandan *et al*.,1977) [11]
	Peripheral analgesic models	Extract (300 mg/kg)	↓ writhing (34.32%); aspirin showed 70.35% inhibition	
Anti-asthmatic /	Clinical (bronchial	Powder (10 g/day)	↓ dyspnoea, ↓ RR (25%), ↑ vital capacity	(Chaturvedi *et al*.,

Anti-allergic	asthma)		(20%), ↓ eosinophils (55.6%)	1975) [15]
	Clinical (pulmonary eosinophilia)	Powder (6 g b.i.d.)	↓ eosinophil count by 60.54%	
	Histamine-induced bronchospasm (guinea pigs)	Aqueous & ethanolic extracts (100–400 mg/kg)	↑ preconvulsive dyspnoea time (up to 75.1%); comparable to chlorpheniramine	
Anti-ulcer	Histamine-induced gastric ulcer	Aqueous & ethanolic extracts (200 mg/kg)	Protection: aqueous (75%), ethanolic (62.5%) vs chlorpheniramine (87.5%)	
Antihypertensive	Animal study (cats)	Benzene & hexane extracts (10–25 mg/kg, i.v.)	↓ BP up to 80 mm Hg; prolonged hypotensive effect	(Tandan *et al*.,1977) [11]
Hepatoprotective	CCl_4-induced hepatotoxicity (rats)	Ethyl acetate & alcoholic extracts	↓ SGOT, SGPT; comparable to standard drugs	(Joshi Uttara *et al*.,2011) [16]
	In vitro hepatocytes	Isolated diterpene	Restored liver enzymes & protein levels	
	Paracetamol/chloroform-induced toxicity	Hydroalcoholic extract (500 mg/kg)	Restored antioxidant enzymes; comparable to silymarin (100 mg/kg)	
Anticancer / Cytotoxic	*In vitro* (multiple cancer cell lines)	Labdane diterpenes & essential oil	Cytotoxic against THP-1, HL-60, A-549, MCF-7, HeLa etc.	(Reddy *et al*.,2009; Mishra *et al*.,2016) [17, 18, 24]
Antihyperglycaemic	*In vivo* & *in vitro*	Hexane extract (100 µg/ml)	↓ blood glucose spike; 21.2% α-glucosidase inhibition	(Reddy *et al*.,2009) [17]
Nootropic / Memory enhancing	Behavioral models (mice)	n-butanol fraction	Improved memory & cognitive performance; supports anti-Alzheimer's potential	(Shete& Bodhankar.,2010) [19]
Hair growth promoting	Experimental model	Hexane extract (33%), pentadecane (30%)	Promoted hair growth; less effective than minoxidil (47%) but safer	(Rao *et al*.,2011) [20]

Clinical studies

Various clinical trial studies has been mentioned in the table3.

Table 3: Different Clinical studies carried for *Hedychium spicatum*

Study Type	Sample Size	Intervention & Dose	Duration	Key Outcomes
Clinical (Powder)	25 patients (bronchial asthma)	10 g rhizome powder daily	4 weeks	↓ Dyspnea (36% patients symptom-free), ↓ respiration rate (25%), ↑ vital capacity (20%), ↓ eosinophils (55.6%)
Clinical (Powder)	16 patients	1 g powder, thrice daily	21 days	Relief in chest heaviness, cough, and breathing difficulty in all patients
Clinical (Powder)	15 patients (tropical pulmonary eosinophilia)	6 g b.i.d.	4 weeks	↓ eosinophil count by 60.54%
Clinical (Powder, pediatric)	Children (number not specified)	70 mg/kg body weight	1–3 weeks (symptoms); longer for radiology	Relief in symptoms; ↓ eosinophils; delayed normalization of radiological findings
Clinical (Polyherbal formulation: Sati + Puskaramoola + Amalaki)	12 patients (bronchial asthma)	9 g with honey	6 weeks	↓ eosinophil % (to 5.6, 7.25, 9.33); ↓ AEC (942.1 → 218.3); symptom relief
Clinical (Formulation: Swasawin Asthaloc tablet)	Not specified	Tablet (add-on therapy), twice daily	6 months	↑ FEV1, ↑ PEFR; improved spirometry and asthma symptoms
Preclinical (Formulation: Bharangyadi extract)	Animal study (mice)	500 mg/kg (oral)	16 days	↑ RBC, WBC, Hb; ↑ neutrophil adhesion (22.25% vs 14.44%); immunomodulatory effect
Preclinical (Bharangyadi extract)	*In vitro* / *in vivo*	500–1000 µg/ml	—	↓ mast cell degranulation (76% control); histamine inhibition up to 99.78%
Clinical (Formulation: Dusparshadi Yog)	30 patients (eosinophilia)	Polyherbal formulation	21 days	↓ eosinophils (16.83 → 9.17); ↓ AEC by 703.87; improved respiration rate & PEFR

(Prasad *et al*., 2018; Kajaria *et al*.,2013;Parlikar & Binorkar.,2014) [21, 22, 23]

Conclusion

Hedychium spicatum (Kapur-kachari) emerges from this review as a multifaceted medicinal plant of significant ethnopharmacological and therapeutic relevance. Morphologically, it is a perennial rhizomatous herb characterized by aromatic rhizomes, lanceolate leaves, and distinctive terminal inflorescences, features that not only aid in taxonomic identification but also correlate with its rich reservoir of bioactive compounds. The rhizome, being the principal medicinal part, serves as a major source of essential oils and secondary metabolites, including terpenoids and phenolic compounds, which underpin its pharmacological potential.

Ethnobotanical evidence highlights its extensive traditional usage across the Himalayan regions for treating respiratory disorders, gastrointestinal ailments, inflammation, and pain. These traditional practices are deeply embedded in indigenous knowledge systems and have been partially validated through modern scientific investigations. In Ayurveda, *H. spicatum* is incorporated into several classical

formulations and polyherbal preparations, particularly for managing asthma, cough, and digestive disorders, demonstrating its continued relevance in traditional healthcare systems.Pharmacological studies provide substantial support for its traditional claims, revealing a broad spectrum of biological activities, including anti-inflammatory, antioxidant, antimicrobial, analgesic, and anticancer properties. These effects are primarily attributed to its diverse phytoconstituents such as labdane diterpenes, flavonoids and essential oils. Despite promising preclinical findings, clinical evidence remains limited and fragmented, with a need for well-designed clinical trials to establish safety, efficacy, dosage standardization, and therapeutic mechanisms in humans. In conclusion, *Hedychium spicatum* represents a promising medicinal plant bridging traditional knowledge and modern pharmacology. While significant progress has been made in understanding its phytochemistry and biological activities, future research should prioritize advanced clinical validation, molecular mechanism studies, and biotechnological interventions for sustainable utilization. Strengthening these aspects will facilitate its integration into evidence-based medicine and support its potential role in novel drug development.

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Muskan Dhiman: Writing – review & editing, Writing – original draft, Jaya Thakur: Writing – review & editing, Writing – original draft, Harsharan Singh: Supervision, editing.

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The author declares no conflict of interest. The manuscript has not been submitted for publication in another journal.

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