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REVIEW ARTICLE **OPEN ACCESS**

Hedychium spicatum: Boon for the medicinal field in future

Singh Shipra, Sharma Neelam and Nageswer Singh
Department of Chemistry and Biochemistry, College of Basic Sciences,
Chaudhary Sravan Kumar Himachal Pradesh Krishi Vishvavidyalya
Palampur-176062, H.P, India

ABSTRACT
Hedychium spicatum a medicinal plant is the richest source of antioxidants. The rhizome extract of *H. spicatum* is commonly used in preparation of indigenous medicine. It cures many diseases and help in blood purification, bronchitis, indigestion, treatment of eye disease and inflammations etc. Till date Total numbers of compounds identified in this plant are fifty five. Many phytochemical as well as volatile components are also present in its rhizome.
Keywords: *Hedychium spicatum*, Antioxidants, Chemical constituents, Phytochemical properties and volatile oil

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INTRODUCTION

The Indian Himalayan Region (IHR) is a rich reservoir of biological diversity in the world. From where over one thousand seven hundred and forty eight species of medicinal and aromatic plants (MAPs) have been reported and are used in different systems of medicine Among these, *Hedychium spicatum* Buch-Ham ex Smith (Family *Zingiberaceae)* is one of the most important aromatic and medicinal plant, commonly known as *Kapoor Kachri*, *Ban-Haldi* or *Spiked Ginger lily* [1]
H. spicatum is a tall perennial herb with leafy stems that grow beneath the forest cover on marginal land. Its roots and leaves are used in several Ayurvedic preparations, in Tibetan medicine and also in home remedies. The powder as well as decoction of root is carminative; digestive; emmenagogue. A small cup of root decoction twice in a day is expectorant; stimulant; stomachic; tonic; vasodilator and act as tonic to brain. The rootstock is acrid, bitter, pungent and astringent. The root powder 3-4 gm two times a day is used in treating asthma, foul breath, bronchitis, hiccough, vomiting, tridosha, diseases of blood (improve poor circulation due to thickening of the blood) [2]

BOTANICAL DESCRIPTION OF PLANT

H. spicatum commonly known as Kapoor Kachri or Ginger lilly is a Himalayan plant. It is distributed in subtropical Himalaya in the state of Assam, Arunanchal Pradesh, Himachal Pradesh and Uttarakhand within an altitudinal range of 1000 to 3000 m. It is tall stout herb with fleshy aromatic rhizomes, thick straight stem with broadly lanceolate leaves. [3-4]. Flowering in the plant occurs in the months of July-August and seed formation occurs in September -October. It has been a valued medicinal plant for possessing a variety of therapeutic properties like carminative, expectorant, tranquilizer, stomachic, antiseptic, vasodilator, analgesic, anti-inflammatory, antimicrobial, antifungal, antioxidant, pediculicidal, cytotoxic, anti-asthmatic, hypoglycemic, spasmolytic and hypotensive activities [5].

CHEMICAL CONSTITUENTS

Sravani and Paarakh identified several chemical compounds of *Hedychium spicatum* which are α - pinene, β - pinene, limonene, 1,8 - cineole, 2 - alkanones, linalool, camphor, linalyl acetate, β- terpineol, borneol, β - caryophyllene, γ - cadinene, humulene, terpinolene, p - cymene, benzylcinnamate, benzyl acetate, lindyl acteate, γ - terpinene, β phellandrene,methyl paracumarin acetate, cinnamic ethyl acetate, ethyl - p- methoxy cinnamate, ethyl cinnamate, d - sabinene, sesquiterpene - cadinene, sesquiterpene alcohols, sesquiterpene hydrocarbons, drimane and labdane derivatives, drim - 8(12) - en -11- al, 11-

nordermi - 8 - en -12 - al, trans - 5,5,8 - alpha - trimethyldecal - 2- one and γ - bicyclohomofarnesal (ambral), drim - 8(12) - ene, 15,16 - bisnorlabda - 8(17) - dien -14 - al (essential oil); diterpene 6 - oxo - labda, 7,11,13 - trien - 16 -oic acid lactone, hedychenone, 7 – hydroxyhedychenone; 6-oxo-labda-7, 11,13-trien-16- oic acid lactone; cineole, limonene, β - caryophyllene, β - terpineol, linalool, β-phellandrene ,pcymene; 7-hydroxy hedychenone, benzyl cinnamate, 1, 8-cineole, benzyl acetate and lindyl acetate; 7-hydroxyl hedychenal and spicatanoic acid and spicatanol and spicatanol methyl ether. [6]

PHYTOCHEMICAL PROPERTIES

Bhatt and co-workers [7] showed that antioxidants are the major compounds of *Hedychium spicatum* and reported that variation in phenolic compound , ascorbic acid equivalent antioxidant activity and total antioxidant potential by DPPH assay was 2.836–4.692 GAE/g dry weight , 1.910 - 2.581 mM AAE per 100 g and 0.549 - 1.059 mM AAE per 100 g dry weight respectively.

Phytochemical screening of *Hedychium spicatum* rhizome was carried out by TLC , HPTLC and DNA fingerprint(RAPD- PCR) from which it has been concluded that TLC showed the presence of fluorescence components, steroid and amino acid, HPTLC also confirm the presence of steroid in sample and DNA fingerprinting identified the genomic marker of genuine *H. spicatum* [8].

Singh and Bag carried out phytochemical analysis on the water extract of *H. spicatum* They showed that the phenolic compounds, flavonoids, reducing sugar (carbohydrate), protein, steroids and triterpenoids, cardiac glycosides, tannin, saponin and oil are the major phytochemical groups of *H.spicatum* and reported that the total phenolic contents of the water extracts of *H. spicatum*, *H. coronarium* and *H. rubrum* in terms of gallic acid equivalent were 29.39 ± 0.01, 34.93 ± 0.01 and 66.48 ± 0.01 mg/g of extract powder respectively. These phytochemical compounds are the major compounds (Table-1) which impart medicinal value of the plant [9]

Table-1: Analysis of phytochemical constituents of *Hedychium spicatum*:

Phytochemical constituents	**Chemical tests**	**Water extract of *H. spicatum***
Alkaloids	Hager's test	-
Carbohydrates (reducing sugar	Benedict's test Fehling's test	- +
Proteins	Xanthoproteic test	+
Flavonoids	Alkaline reagent test	+
Phenolic compounds	Lead acetate test	+
Tannins	Lead acetate test Ferric chloride test	+ –
Steroids andTerpenoids	Salkowski's test	+
Saponin	Froth test	+
Cardiac glycosides	Keller-killiani test	+
Oil		+
Phlobatannin		-

Where **+ means present** and **- means absent**

Bag and co-workers studied the methanolic extract of three *Hedychium* species for flavanoid content and antioxidant activity. They reported that methanolic rhizome (Table-2) extract of all the three *Hedychium* species are potential source of antioxidant which may be due to the presence of flavonoid (figure 1.) [10]

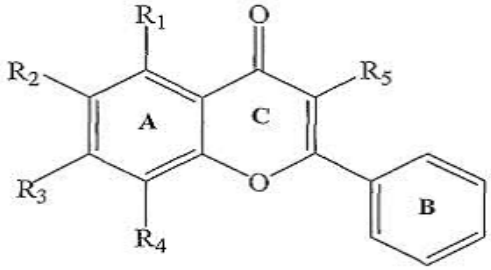

Figure 1: Basic structure of flavonoids

Table 2: Total flavonoid content and total antioxidant activity

Sample	Total flavonoid content in µg/100g of dried rhizome (in QE)	Total antioxidant activity in µg/ml of extract (in AAE)
H. spicatum	4.22 ± 0.425	224.4 ± 0.7
H. coronarium	2.47 ± 0.079	205.6 ± 0.84
H. rubrum	21.25 ± 0.295	279 ± 0.08

Sravani and Paarakh determined the antioxidant activity ,Total phenol ,Flavanoid content in *Hedychium spicatum* and found that antioxidant DPPH radical scavenging activity have IC_{50} value of 0.43, 259.1, 386.7, 414.3, 77.01 and 51.54 µg /ml for gallic acid,petroleum ether,benzene,chloroform, methanol,and aqueous extracts of rhizomes, total phenol content was 13,33,24, 32 and 35 mg equivalent to galllic acid per grawhereas flavanoid content was 4.6,7,7.5,34.5 and 40mg equivalent to rutin gallic acid,petroleum ether,benzene,chloroform, methanol,and aqueous extracts of rhizomes. (11)Bhaigyabati et al investigated the antioxidant activity of three Hedychium species namely *H. rubrum*, *H. coronarium* and *H. spicatum and found that the* Total antioxidant activity of aqueous rhizome extract of *H. rubrum*, *H. coronarium* and *H. spicatum* in terms of ascorbic acid equivalent (AAE) was 207.3, 157.5 and 102.6 µg/ml of extract. They concluded that that aqueous rhizome extract of all the three Hedychium species are potential source of antioxidant which may be due to the presence of flavonoid in the extracts and among the three Hedychium species, *H. rubrum* was found to have the highest total flavonoid content and antioxidant activity (12) DPPH radical scavenging activity of the studied samples is given in figure 2

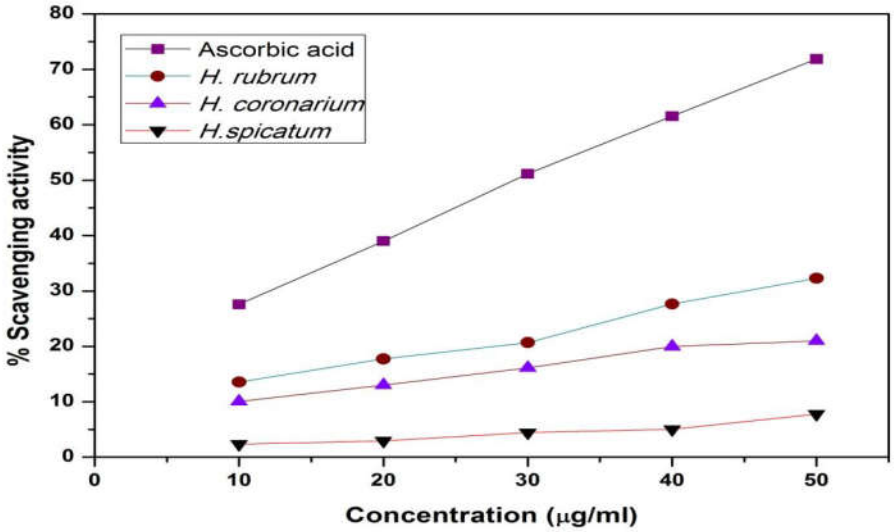

Figure 2 : DPPH radical scavenging activity of the studied samples

Meena et al. demonstrated that acid insoluble ash content in the plant sample was 1.88 % w/w and loss on drying at 105°C in (*Hedychium spicatium)* Ham ex Smith roots were found to be 11.24 % w/w. and concluded that the estimation of physicochemical parameters like pH, Loss on drying at 105°C, Water soluble extract, Alcohol soluble extract, Total Ash, Acid insoluble ash and thin layer chromatography profile (TLC) is highly essential for raw drugs or plant parts used for the preparation of compound formulation drugs. The periodic assessment is essential for quality assurance and safer use of herbal drugs.(13)

Bachheti et al. carried (14) out the Physico-chemical analysis of ash of *Rawolfia serpentine, Asparagus Racemosus, Hedychium spicatum, Nardostachys jatamansi, Clerodendrum indicum, Chlorophytum borivillianum Terminalia arjun, Withania Somnifera*, *Alpinia galangal, Adhatoda vasica, Zingiber officinal* and *Terminalia chebula,* and find out that the Percentage of loss on drying was highest in *Hedychium spicatum* root (0.94%) followed by *Nardostachys jatamansi* rhizome (0.57%). All the samples were found alkaline in pH. Conductivity was higher in *Hedychium spicatum* root (1136µs/cm).They also reported that *Hedychium spicatum* root contain minerals in ppm i.e. calcium (3400) , Phosphorus (8800) , Potassium (6600), Magnesium (5700) , Iron (440), Manganese (290) , zinc (155) and Nickel (12).

Anti-inflammatory properties:

Rawat et al. [15] found that alcoholic extract of the species possesses significant anti inflammatory activity against carrageenan-induced hindpaw oedema in rat and mice. Hexane soluble extract showed the maximum activity of 42.16% in mice (200 mg/ kg) and 27.2% in rats (100 mg/kg). The anti-

inflammatory activity of the species was reported to be localised mainly due to furanoid diterpene compound 'Hedychinone'.

Prakash et al. [16] extracted rhizome oil by hydro-distillation followed by diethylether treatment. Hydro distillation of the rhizome gave pale yellow iol with 0.35% (v/w). After oil was extracted it was analysed by GC and GC-MS and it showed the presence of thirty six compounds. 1,8-cineole (17.6 %) was the major compound followed by α-eudismol (17.0 %), 10-epi-γ-eudismol (9.8 %), 1-epi-cubenol (9.7 %), δ-cadinene (7.5 %), germacrene-D-4-ol (6.8 %), γ-cadinene (5.4 %), α-selinene (3.2 %), γ-muurolene (1.5 %), (*E)*-cayophyllene (1.5 %) and dehydroaromadendrane (1.1 %). The oil of *H. spicatum* is rich in sesquiterpene alcohols and poor in other terpenoids

Volatile components:

Volatile oils are widely used in soaps, cosmetics, toilet products, pharmaceuticals, parfumes and food. Plant organs that contain natural volatile oils are flowers, leaves, barks, roots, seeds, fruits, rhizomes and gums or oleoresin exudate. Hartati and co-workers [17] determined the composition of the rhizome volatile oils by GC-MS method.[18] .HPTLC finger printing profile of methanolic extract of *Hedychium spicatum* was performed to find out Rf value of present constituents in the extract by using the solvent system n-Butanol:acetic acid:water in the ratio 5:1:4. They reported that the chemical constituents of rhizomes of H. spicatum contain two new labdane-type diterpenes i.e.7-hydroxy hedichinal and spicatanoic acid and six known compounds that were yunnacoronarin D; coronarin E; 8(12) drimene; 4-methoxy ethyl cinnamate; ethyl cinnamate and chrysin29. [19]

GC analysis of dried rhizome showed the presence of 50 compounds out of which 26 were identified. The rhizome oil contains monoterpene hydrocarbons (42.31%), oxygenated monoterpenes (38.46%), sesquiterpene hydrocarbons (15.38%) and oxygenated sesquiterpenes (3.85%). The majority of the essential oil components were monoterpenes and the major constituents were β-pinene (18.30%), β-linalool (17.80%), 1, 8-cineole (12.0%), 4-terpineol (5.50%), α-pinene (4.9%), γ-terpinene (1.90%), borneol (1.60%), α-terpineol (1.60%) and camphene (1.40%). [20]. The rhizome extract, contains essential oil- cineole, terpinene, limonene, phellandrene, p-cymene, linalool and terpeneol (Table 3) as major constituents [21]

Verma and Padalia [22] analysed the Comparative essential oil composition of different vegetative parts of *Hedychium spicatum* Smith by gas chromatography (GC) and GC-mass spectrometry (MS) and reported that the essential oils of the roots and rhizomes contains high amount of oxygenated monoterpenoids (60.9% and 65.9%, respectively). The most abundant oxygenated monoterpenoid of these oils was 1,8 cineole (48.7% and 64.0%, respectively).

Bisht et al. a performed test for Antimicrobial activity of Hedychium spicatum and found that

Extracts from rhizomes of Hedychium spicatum showed antibacterial and antifungal activity against gram positive and gram negative bacteria [23].

Table 3. Chemical composition of essential oil from rhizome of *Hedychium spicatum*

Type	Garg *et al.* (1977)	Dixit *et al.* (1977)	Nigam *et al.* (1979)	Bottini *et al.* (1987)
Monoterpenes				
Δ3-carene		1.4		
1,8-cineole	56.2	37.2	27.1	29.7
p-cymene		5.0	9.6	
limonene		1.3	17.0	b
linalool	6.8	18.0	16.6	4.4
ß-phellandrene		4.5	7.0	
α-pinene		1.4	1.8	b
ß-pinene		1.4	4.5	b
terpinen-4-ol				0.7
α-terpineol	1.6		6.5	1.0
ß-terpineol			1.8	
Sesquiterpenes				
(-) – α- cadinol				5.3
ß-caryophyllene	0.1	24.1	3.5	
ß-caryophyllene oxide		0.5		
(+)- elemol		4.2		8.5
(-)_10-epi-eudesmol				5.1
(+)- α-eudesmol				4.8
(+)- ß-eudesmol				12.6
Seven unknown alcohols				
($C_{15}H_{26}O$)				6.2

CONCLUSION

The present review on *H. spicatum* presents a comprehensive account of antioxidant activity as well as chemical constituents. Total 55 chemical constituents have been reported to till date. The extract of rhizome is a good source of antioxidant as well as volatile oil.it has high medicinal value and many bioactive compounds present in rhizomes are revealed but some left .In future work on other bioactive compound is needed.

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