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# Description of Medicinal Herb, Perfume Ginger: *Hedychium spicatum* (Zingiberales: Zingiberaceae)

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**ABSTRACT:**

**Background:** *H. Spicatum* is referred to locally as Gulbakawali or butterfly lily and may contain medicinal chemicals. It is a member of the Zingiberaceae family. This plant most likely originated in the Himalayas. Tropical and subtropical climates, like those in India, Brazil, Japan, and South China, are where the plant is typically found.

**Main body of the abstract:** Asthma, bad breath, fever, vomiting, diarrhoea, bronchitis, hiccoughs, and inflammation have all been traditionally treated and managed with *H. Spicatum*. Additionally, it is employed in the management of analgesic, anti-asthmatic, and anti-inflammatory conditions. Many scientists today are studying things like antidiabetic, cytotoxic, antibacterial, and anthelmintic activities. Hedychinone, polyphenols, terpenoids, and the labdane terpene appear to be the species' main chemical components. Despite the species' promising recent study, it is too early and sometimes too vague to be utilised to explain and support some of the ethno medicinal uses.

**Conclusion:** This review addressed all of the known and traditional applications of *H. Spicatum*. This knowledge is incredibly beneficial to researchers and the search for novel medicines.

***Keywords:*** *H. Spicatum*, traditionally polyphenols, phytochemicls, standardizations, antidiabetic, cytotoxic, antimicrobial, and anthelmintic.

## INTRODUCTION

**Fig.1- *H. Spicatum***

Since ancient times, medicinal plants have been a significant source of medicine. Due to the harm caused by urbanisation, reckless deforestation, and unchecked collecting of herbal plant materials, a number of plant species with medicinally significant chemicals are vanishing (Srimal et al., 1984, Reddy et al., 2009, Bapat et al., 2008). For the evaluation of the safety, effectiveness, and quality of herbal medicines, the World Health Organization (WHO) designated herbal plants as having bioactive chemical ingredients. A specific set of recommendations has been established by the WHO (WHO). Medical plants pose a hazard to both plant biodiversity and conservation since they are directly

used by people (Kala et al., 2007).About 52 genera and 1500 species of plants that have been utilised for food, cosmetics, scent, and medicine make up the Zingiberaceae family (Prakash et al., 1995).Hedychium, a genus with 80 species believed to be used medicinally for a variety of illnesses, has not yet entered commercial production (Wood et al., 2000, Basak et al., 2014).*H. Spicatum*, also known as Gulbakawali or butterfly lily in some regions, may contain therapeutic chemicals (Molur et al., 1998, Chadha et al., 2005, Singh et al., 2010).It is a member of the Zingiberaceae family. This plant's likely place of origin is in the Himalayas. (Soares et al., 2008).Tropical and subtropical climates, like those in India, Brazil, Japan, and South China, are where the plant is typically found (Lu et al., 2009).

## GEOGRAPHICAL SOURCE OF PLANT

Known as a green leafy herb, *H. Spicatum* grows to a maximum height of 2 metres. *H. Spicatum* plant's rhizome is camphoraceous, with sessile lanceolate leaves that are up to 10 cm broad and 30-60 cm long with lengthy clasping sheaths. The figure A of *H. Spicatum* represents the stage of flowering and seed development, and Figure B is displayed below. Figure B depicts different stages of *H. Spicatum's* growth, including (a) the developing plant and its environment; (b) the species' various inflorescences, which have pale yellow flowers with pink bases; (c) the mature spike, which stands in for the ripened seeds; (d) the species' rhizome; and (e) the numerous small seeds enclosed in a red aril. *H. Spicatum's* blossoms are fragrant and pale yellow in colour. Up to 5 cm long corolla tubes with a pink base make up a flower's length. The *H. Spicatum* bloom has red anthers and white staminoides. Hermaphrodite flowers are the type that they are (Jain et al., 1995, Anonymous et al., 1959).When the fruits are fully ripe, they have a globose capsule, three valves, and countless tiny seeds that are enclosed in a scarlet aril. June to October is when flowers bloom, and October to November is when fruit ripens (Chopra et al., 1986). Geographically, the species of *H. Spicatum* are found all over the world, including in China, Arunachal Pradesh, Kerala, Nepal, Bhutan, Myanmar, North Thailand, and parts of Jammu-Kashmir (Shu et al., 2000, Sahu et al., 1979).It loves sandy to sandy clay soil that is high in moisture, naturally acidic, and low in organic carbon (Bisht et al., 2015). The fragile parenchyma seen in rhizomes was reflected in the histological examinations of the *H. Spicatum* species. Rhizome cells are stuffed with of essential oil, yellow resin, and starch grains. Several rows of compressed, practically empty, reddish-brown cells make up the rizome's epidermis (Nag et al., 2011, Dymock et al., 1976).

## TRADITIONALLY USES

*H. spicatum* medicinal plants have been used to cure a variety of disorders, including edoema, asthma, fever, and pain, according to the Indian medical system known as ayurveda. The *H. Spicatum* herbal plant, often known as "Shati," was first introduced by ayurveda (*H. Spicatum*). In Sanskrit, *H. Spicatum* is also known as Palashi, Shatgrantha Subratha, Gandhmulika, Gandharika, Gandhvadhu, and Prathupalashika (Dymock et al., 1976, Srivani et al., 2011).It has pungent, light, bitter, strong, heating properties and used in grime of mouth, swelling, cough, asthma, pain and hiccough (21A picture of the bloom and seed of the medicinal plant *H. Spicatum* is displayed in Fig. 1.

*H. Spicatum* plant, including (a) the plant's natural growth in its natural environment; (b) the flowering stage, which is represented by the plant's inflorescence, which has light yellow flowers with a pink base; (c) the mature spike, which displays the well-developed seeds; (d) the species' rhizome; and (e) the numerous small seeds embedded in a red aril.

Since ancient times, several portions of the Indian subcontinent have employed the *H. Spicatum* medicinal plant, which is known by many different names around the world. According to ayurveda literature and other traditional systems, it is known as "Rasa" (tastes), "Katu" (pungent), "Tikta" (bitter), "Tikta" (tends to mildly dry), and "Kashaya" (astringent-effect). Other qualities of this plant include "Laghu," which means "light," which is good for clearing bodily channels and enhancing vitality and joy, "Teekshna," which means "penetrating," which is quick to act and aids in removing the body, "Veerya," which means "potency," which can be used for health improvement, and "Ushna," which means "heating" (Srivani et al., 2011).It has been possible to create formulations that are palatable and consumable by living things thanks to the extensive usage of herbal medicine. The growing use of herbal remedies has demonstrated the need for additional study to develop standardised, affordable products that are readily accessible to the poor. Over the course of millennia, every single part of the plant including the seed, leaf, stem, bark, roots, flowers, and twigs has been used for medicinal purposes, including those that are antimicrobial, anti-asthmatic, anti-diabetic, analgesic, sedative, anti-inflammatory, antispasmodic, anti-anxiety, anti-fertility, etc. The elegant and amiable benefits of herbal medications, such as their eco-friendliness, low cost, high strength, increased safety, quick availability, and improved tolerance, speak for themselves. Herbal medications have a number of drawbacks, including the inability to handle the majority

of emergency situations, accidents, risk with self-dosing, and difficulties in standardizations (Atmakuri et al., 2010). The list of traditional remedies for *H. Spicatum* disease therapy is provided below.

**Table 1: Traditional uses of *H. Spicatum* in different parts of India (Rawat et al., 2011, Chauhan et al., 2006).**

| Plant part | Dose/mode of administration | Traditionally used |
|---|---|---|
| Rhizome | Oral and topically | Antimicrobial agent, laxative |
| Rhizome | Oral and topically | Various acnes and pains |
| Rhizome | A small cup twice a day | Expectorant, increase stomachic, Health tonic, Decease blood pressure, carminative agent. |
| Rhizome | One spoonful powder three times in a day | Liver disorders, fever, vomiting, diarrhoea, pain and inflammation, dyspepsia, reduced thickness of blood |
| Rhizome | 4-5 mg three times in a day | Asthma, foul breaths, bronchitis, hiccough and vomiting, |
| Rhizome | With deodar sawdust | Tuberculosis |
| Rhizome | Orally | Tonic to brain |
| Fruits | With lentils | Food |
| Rhizome | Burnt | Incense |
| Rhizome | Isolated oil | Scent |
| Rhizome | Abir | Dye |
| Rhizome | Topically | Hair loss |
| Rhizome | Paste | Heating impotency of female |
| Rhizome | Boiled with salt | Food |
| Roasted | Orally | Asthma |
| Rhizome | Orally | Asthma |
| Root | With milk Chewed | for asthma and internal injury |

A native of Himachal Pradesh, the plant *H. Spicatum* var. Acuminatum J. L. Stewart, ex Brandis is also said to contain terpenoids, alkaloids, tannins, steroids, and flavonoids [Chauhan et al., 2006]. In plants like *H. Spicatum*, terpenoids and volatile principles have significant potential that has to be assessed. Despite their extensive medicinal uses in cough and asthma-related illnesses, the plant has not yet been properly investigated. Therefore, it is important to determine the requirement for standardised, scientifically-evaluated herbal products with little or no side effects and sensible dosage (Bhatt et al., 2008).Reported activities of *H. Spicatumare* shown in below Table 2.

**Table 2: Reported pharmacological activities:**

| Activity | Parts of plant | Reported activities |
|---|---|---|
| Anti-diabetic activity | essential oil of rhizomes | Reduced the blood glucose and urea level significantly as compared to the normal control (Kaur et al., 2017). |
| Tranquilizing activity | Essential oil of rhizomes | phenobarbitone induced hypnosis and morphine analgesia in rats(Chopra et al., 1979). |
| Antihistaminic, anti-inflammatory and ulcer protective activity | Aqueous and ethanolic extracts of the dried rhizome | *In-vitro* model (Tandon et al., 1997). |
| Pediculicidal activity | rhizome essential oil | *In-vitro* pediculicidal activity at 5 %, 2 %, 1 % (Jadhav et al., 2007). |
| Antimicrobial activity | Dried rhizomes, Essential oil, petroleum ether and chloroform extracts | *In-vitro* model (Bishit et al., 2006). |
| Antioxidant and hepatoprotective activity | methanolic extract of rhizomes | $CCl_4$-induced hepatotoxicity model in rat (Joshi et al., 2008, Ray et al., 1976). |
| Antimalarial activity | 50 % extract of the rhizome | *In-vitro* model (Misra et al., 1991). |
| Cytotoxic activity | chloroform extract of rhizomes | Cancer cell lines by MTT assay (Reddy et al., 2009). |
| Hypocholesterolemic Activity | | *In-vitro* model (Malini et al., 1990). |
| Anthelmintic activity | Methanol extract | *In-vitro* model (Sravani et al., 2011). |

## CHEMICAL COMPOSITION OF *H. SPICATUM*

The principal bioactive components of *H. spicatum* are primarily found in the roots as essential oils. The monoterpenoids, sesquiterpenoids, and diterpenoids 1, 8-cineole, 2-alkanones, linalool, camphor, linalyl acetate, -terpineol, and borneol are among the terpenoids found

in the essential oil of *H. spicatum* root. Additionally, it contains hedychenone, 7-hydroxyhedychenone, spicatanoic acid, spicatanol, spicatanolmethyl ether, and other derivatives of the labdane molecule.1, 8-cineole (21.18% and 21.81% respectively) and -cadinol were the main chemical components of H. spicatum essential oil during the rainy and summer seasons (18.43 percent and 17.49 percent). While significant amounts of elemol (16.44%) and α-cadinol (15.99%) were discovered during the autumn season (Raina et al., 2015, Gunia-Krzyżak et al., 2018, Arumugam et al., 2021, Bhardwaj et al., 2019, Ghildiyal et al., 2012). Important for reducing bronchoconstriction, inflammation, and accompanying pain, *H. spicatum* would appear to support its long-standing usage in respiratory inflammatory disorders, such as asthma (Chauhan et al., 1999, Joshi et al., 2011, Singh et al., 2018, Rawat et al., 2020).

*H. puerense* as a result processes behind the antibacterial and anti-inflammatory properties of EO as well as its in vivo activities. Essential oil (EO) exhibits antibacterial, enzyme-inhibitory, and anti-inflammatory actions in vitro. It has a great deal of promise for use in the food, cosmetics, and pharmaceutical industries as a bioactive natural product (Kalagatur et al., 2018).

## INDUSTRIAL USE OF *H. SPICATUM*

In a number of herbal preparations, its powdered rhizome, extract, and essential oil are combined. The rhizome of *H. spicatum* is the source of many secondary metabolites, including terpenes, alcohols, aldehydes, and phenols as well as essential oil (Hong et al., 2021, Joshi et al., 1992, Negi et al., 2014, Joshi et al., 2008).It's essential oils contain a variety of medical benefits, such as analgesic and anti-inflammatory properties. Its use as a moderate tranquillizer, CNS depressive, antibiotic, and antibacterial, as well as an in-vitro pediculicidal and in-vivo antifungal Hepatoprotective drugs and their use in cosmetics drive up industrial demand for basic materials (Reddy et al., 2009, Dixit et al., 1979, Bisht et al., 2006, Tandon et al., 1997, Joshi et al., 2011). We have also shown that *H. spicatum* rhizome extracts have anti-diabetic properties. In molecular docking tests, the 7-hydroxyhedychenone molecule revealed a promising binding affinity toward various proteins, and their drug-like properties were confirmed using auto dock analysis. Using the chemical 7-hydroxyhedychenone, we might be able to create a diabetic illness treatment that works (Mittal et al., 2022).

The current paper offers an overview of the research on the species that has been done to yet, together with information on patents that have been obtained for poly-herbal compositions incorporating *H. spicatum*. In Table 4, the reported patents are displayed.

**Table 4: the patents for *H. spicatum* describing its important medicinal characteristics**

| S.N. | Application no. | Title | Formulation and use |
|---|---|---|---|
| 1 | WO/2006/082481 | Tinea infection herbal treatment | 10% *H. Spicatum* oil containing cream has anti-dermatophytic and melanogenesis-inhibiting properties. The suppression of tumour necrosis factor-alpha (TNF-alpha) may be the cause of the anti-melanogenasis activity. Additionally, the mixture included deodorising qualities (Chauhan et al., 2006). |
| 2 | WO2010004355 | Herbal skin lightening ingredients, manufacturing processes, and cosmetic applications | The hot soxhalation method of extracting n-hexane from *H. Spicatum* has been reported to yield a cinnabloc compound with some non-volatile material that functions as a sunscreen and skin-lightening agent (Bordoloi et al., 2018). |
| 3 | US20180078494A1 | Combined anti-inflammatory effects of herbal essential oils | The combination of *Cymbopogon citratus* oil, *Zanthoxylum armatum* oil, and *H. spicatum* oil (0.5 to 6% by weight of essential oil) in the invention demonstrated topical analgesic and anti-inflammatory synergy (Kumar et al., 2008). |
| 4 | US20080095721 | Natural sunscreen ingredients and methods for making them | *H. spicatum* extract (0.001% to 20%) has been discovered to be a safe and reliable natural sunscreen composition that shields the skin from UV light of both long and short wavelengths (Mitra et al., 2005). |
| 5 | US20050266101A1 | composition of a natural sedative, method of acquiring it, and pharmaceutical preparations of it | *H. spicatum's* has been used to treat schizophrenia as well as work as an antidepressant and sleep-inducing agent (Mitra et al., 2005). |

| | | | |
|---|---|---|---|
| 6 | N2900/DEL/2008 | Herbal remedy for treating corns and other skin conditions, along with instructions for making it | *H. spicatum* extract has been used in herbal formulations at a rate of 1 to 5 percent by weight. The topical lotion helped remove corns and also helped itchy, cracked, and hardened skin from returning (Singh et al., 2010). |
| 7 | CN104784613A | Metrorrhagia and metrostaxis medications for spleen deficiency types, as well as their preparation methods | *H. spicatum* has been used in the preparation of the treatment, which was intended to treat metrorrhagia. The medication treated the condition quickly and prevented relapses even after several months (Liu et al., 2015). |
| 8 | IN1959/CHE/2009 | composition of hair growth having hydrocarbons in it | The *H. spicatum* Linn., root extract/concentrate has been found effective for hair growth (Rao et al., 2011). |
| 9 | GEP20115183B | Herbal remedy for illness caused by dermatomycosis | Dermal allergies were treated with a herbal mixture that included *H. spicatium* as a pharmaceutically approved carrier in addition to other herbal ingredients (Kadam et al., 2011). |
| 10 | IN2301/DEL/2009 | A herbal mixture and its preparation | The herbal mixture contained 0.8 to 1.08 percent [w/w] alcoholic extract of *H. spicatium*, and the cream's formulation was found to protect against sunburn, dry skin, and frostbite (Pandey et al., 2015). |
| 11 | WO2005077393 | herbal preparations cough medicine that contains Adhatoda, *H. spicatum*, and Curcuma extracts | Hedychenone and 7-hydroxyhedychenone, furanoid diterpenes that were extracted from H. spicatum rhizomes extract, were the primary active components of the 50% alcoholic extract (Singh et al., 2005). |
| 12 | IN201631031742 | Combined anti-inflammatory effects of herbal essential oils | *H. spicatium* oil exhibited synergistic anti-inflammatory composition. The mixture was seen to reduce discomfort from rheumatoid arthritis, fibromyalgia, and other conditions (Mitra et al., 2010). |
| 13 | N201941017194 | a combination of nutritional drinks to treat diabetes, heart disease, and obesity | The nutritional beverage is typically tasty and helpful for addressing a variety of health issues, including obesity, cardiac issues, and hyperglycemia (Kolkar et al., 2019). Making green tea with the *H. spicatium* might be advantageous (Rabade et al., 2016). |
| 14 | US20020155138 | *H. spicatium* extract-containing products and their uses | It is can used in amounts ranging from 0.2% to 6% to lessen, for the treatment of wrinkles, enhance skin quality, and limit the penetration of UV rays. (Martin et al., 2002). |

## FUTURE PROSPECTS OF *H. SPICATUM*:

The many researchers' studies have shown that this plant's roots contain highly potent bioactive substances (Shukla et al., 2019), particularly the plant's essential oil. This plant's oil can be utilised for skin care, cosmetic product development, and formulation (Shukla et al., 2019). This plant's essential oil has strong antimicrobial activity against a variety of microorganisms that cause skin conditions. As a result, the rhizome of *H. spicatum* oil has developed into a valuable source of bioactive chemicals and is freely accessible throughout India. Additionally, *H. spicatum* oil has a wide range of therapeutic properties, including analgesic and anti-inflammatory actions. It could be employed on a wide scale in industry to produce topical dosage formulation. A number of other bioactive compounds are found in different natural plants that could be used at large scale for the development of herbal formulation which would be very effective and safe and less toxicity (Shukla et al., 2019). Herbal products could be good alternative drug for the treatment and management of number of diseases like *H. spicatum* oil. Therefore need to do more research work for suitable products development in future (Pawar et al., 2021, Shukla et al., 2019, Bishnoi et al., 2019, Tiwari et al., 2020).

**Declaration:** *We also declare that all ethical guidelines have been followed during this work and there is no conflict of interest among authors.*

## CONCLUSION:

The number of bioactive compounds that are present in a species determines how successful a plant is as a medicine, and these molecules can be considerably increased by a variety of factors, including the plant's genetic make-up, altitude, sunlight exposure, and culture conditions. 25 As a result, choosing elite plants with high herbal chemical content and potent pharmacological activity is vital for maximising advantages. Therefore, it is critically necessary for detailed studies to be done to understand its

therapeutic characteristics. In order to harness as many authentic species as possible, it would be beneficial to launch focused scientific experiments and research on advanced cultivation technologies, genetic inheritance of traits, phytochemical investigation, bioactivity, and pharmacology.

## Competing interests

The authors state that there is no conflict of interest for this review.

## REFERENCES


Anonymous. (1959). The Wealth of India: A Dictionary of Indian Raw Material and Industrial Products Raw Material. New Delhi, India: *Council of Scientific and Industrial Research*, **5**:13.

Arumugam, I., Krishnan, C., Ramachandran, S., Krishnan, D., Das, D., Thamankar, V. (2021). Phytochemical investigation and in-vitro antimicrobial activity of the essential oil from rhizomes of Hedychium spicatum, *International Journal of Pharmaceutical Sciences and Research.*, **12**(2): 853-858.

Atmakuri, L.R., Dathi, S. (2010). Current trends in herbal medicines. *J Pharm Res*., **3**:109-113

Bapat, V.A., Yadav, S.R., Dixit, G.B. (2008). Rescue of endangered plants through biotechnological applications. *Sci Lett*., **8**:201-210.

Basak, S. (2014). Genetic diversity and relationship of Hedychium from Northeast India as dissected using PCA analysis and hierarchical clustering. *Meta Gene*., **2**:459-468.

Bhardwaj, S., Rashmi, Parcha, V. (2019) Effect of Seasonal Variation on Chemical Composition and Physicochemical Properties of Hedychiumspicatum Rhizomes Essential Oil, Journal of Essential Oil Bearing Plants, **22**:6:1593-1600

Bhatt, I.D. (2008). Evaluation of antioxidant phytochemical diversity in Hedychium spicatum: a high value medicinal plant of Himalaya. *Pharmacog Mag*., **4**:202-205.

Bishit, G.S., Awasthi, A.K., Dhole, T.N. (2006). Antimicrobial activity of Hedychium spicatum. *Fitoterpia*., **77**(3):240-42.

Bishnoi, R.S., Kumar, M., Shukla, A.K., C.P. Jain. (2019). Comparative fingerprint and extraction yield of Prosopis cineraria (Lin.) Druce. Leaves with phenolic compounds (Gallic acid) & flavonoids (Rutin). *J. of Drug Delivery & Therapeutics.* 2250-1177

Bisht, A.S. (2015). Ecological analysis of Hedychium spicatum Buch in temperate region of Garhwal Himalaya, Uttarakhand, India. Med Plants-*Int J Phytomed Relat Ind*., **71**:20-127.

Bordoloi, B.K., S. K. (2018). Inventor; Bordoloi Binoy Kumar, assignee. Anti-inflammatory activity with synergism of herbal essential oils. *Indian Patent* IN201631031742; 23.

Chadha, S. (2005). Vulnerable and threatened plants of economic value. Hedychium coronarium Koenig. *MFP news*, **15**:19-20.

Chauhan, N.S. (1999). Medicinal and aromatic plants of Himachal Pradesh. *Indus Publishing*., 632.

Chauhan, V.S. (2006) Standardizing herbs and intermediates-newer approaches. *The Pharma Review*. **2**:37-44.

Chauhan, V.S., S. K., Kadam, K.P. (2006). Inventor; Nicholas Piramal India Limited, assignee. Herbal composition for Tinea infection. *Indian Patent* WO200608248; 10.

Chopra, N. (1979). Tranquilising action of essential oils of Hedychium spicatum. *Indian J Pharmacol*., 11:147.

Chopra, R.N. (1986). Glossary of Indian Medicinal Plants. New Delhi. India: *Council of Scientific and Industrial Research*, 130-131.

Dixit, V.K., Varma, K.C. (1979). Effect of essential oils of rhizomes of Hedychium spicatum on central nervous system. *Indian Journal of Pharmacology*. **1**(2):147-149.

Dymock, W. (1976). Pharmacographia India: A History of Principle Drugs of Vegetable Origin. *Book on Demand Ltd*, 417-420.

Ghildiyal, S., Gautam, M.K., Joshi, V.K., Goel, R.K. (2012). Pharmacological evaluation of extracts of Hedychium spicatum (Ham-ex-Smith) rhizome. Anc Sci Life, **31**(3): 117-122.

Gunia-Krzyżak, A., Słoczyńska, K., Popiół, J., Koczurkiewicz, P., Marona, H., Pękala, E. (2018). Cinnamic acid derivatives in cosmetics: current use and future prospects. *International Journal of Cosmetic Science*., **40**(4): 356-66.

Hong, Yi., Liu, Xiongli., Wang, Huijuan., Zhang, Min., Tian, Minyi. (2021). Chemical Composition, Antibacterial, Enzyme-Inhibitory, and Anti-Inflammatory Activities of Essential Oil from Hedychium puerense Rhizome. *Agronomy*, **11**; 2506:1-13.

Jadhav, V., Kore, A., Kadam, V.J. (2007). In vitro pediculicidal activity of Hedychium spicatum essential oil. *Fitoterpia*., 78(7-8):470-73.

Jain, S.K., Prakash, V. (1995). Zingiberaceae in India: phytogeography and endemism. *Rheedea*., **5**(2):154-169.

Joshi, M., Singh, S.P., Rawat, Y.S. (1992). Plant forms and sesonality of leaves in herb layer of sites with varying lavel of deforestation. *J. Trop. For. Sci.* **6**(4):508-522

Joshi, S., Chanotiva, C.S., Agarwal, G., Prakash, O. (2008). Terpenoid compositions and antioxidant and antimicrobial properties of the rhizome essential oils of Hedychium spicatum. *Chem Biodivers*., **5**(2):299-309.

Joshi, S., Chanotiya, C.S., Agarwal, G., Prakash, O., Pant, A.K., Methela, C.S. (2008). Terpenoids compositions and antioxidant and antimicrobial properties of the rhizome essential oil of different Hedychium species. Chemistry and Biodiversity. **5**:299-309.

Joshi, U.P., Mishra, S.H. (2011) In-vitro hepatoprotective activity of isolated diterpene from Hedychium spicatum. *Pharmacologyonline*., **1**:990-9.

Joshi, U.P., Mishra, S.H. (2011). In-vitro hepatoprotective activity of isolated diterpene from Hedychium spicatum. *Pharmacologyonline*, **1**:990-997.

Kadam, K.P., S. K., Chauhan, V.S. (2011). Inventor; Piramal Life Sciences Limited, assignee. Herbal composition for dermatomycosis infection. *Georgia Patent* GEP20115183B; 25.

Kala, C.P., Sajwan, V.S. (2007). Revitalizing Indian systems of herbal medicine by the National Medicinal Plants Board through intuitional networking and capacity Building. *Curr Sci*., **6**:797-806

Kalagatur, N.K., Kamasani, J.R., Siddaiah, C., Gupta, V.K., Krishna, K., Venkataramana, Mudili. (2018). Combinational Inhibitory Action of Hedychium spicatum L. Essential Oil and γ-Radiation on Growth Rate and Mycotoxins Content of Fusarium graminearum in Maize: Response Surface Methodology. Front Microbiol. **9**: 1511.

Kaur, H., Richa,.R. (2017). Antidiabetic Activity of Essential Oil of Hedychium spicatum. *International Journal of Pharmacognosy and Phytochemical Research*, **9**(6): 853-857.

Kolkar, S, I., Sandeep P Kolkar, assignee. A composition of nutraceutical beverage for treating obesity, heart diseases and diabetes. *Indian patent* IN201941017194. 2019 April 30.

Kumar, M.S., V. B., Venkata, R.M. (2008). Inventor; Knobbe Martens Olson & Bear LLP, assignee. Natural sunscreen compositions and processes for producing the same. *United States of America Patent* US20080095721; 24.

Liu, H., G. Y., Li, L., Cheng, X. (2015). Inventor. Medicine for treating spleen-deficiency type metrorrhagia and metrostaxis and preparation method thereof. *China patent* CN104784613A; 22.

Lu, Y., Zhong, C.X., Wang, L., Lu, C., Li, XL., Wang, P.J. (2009). Anti-inflammation activity and chemical composition of flower essential oil from Hedychium coronarium. Afr. *J. Biotech*., **20**:5373-5377.

Malini, T., Vanithakumari, G. (1990). Rat toxicity studies with β-sitosterol. *J Ethnopharmacol*., **28**(2):221-34.

Martin, K.M., S. C. (2002). Audley A. Ciamporcero JR. Johnson & Johnson, assignee. Composition containing Hedychium extract and use thereof. *US Patent* US20020155138; 24115.

Misra, S.B. (1991). Antimalarial activity of Traditional plants against erythrocytic stages of Plasmodium berghei. *Int J Pharmacog*., **29**:19-23.

Mitra, S, S. E., Ranganna, M. (2005). Inventor; Himalaya Global Holdings Ltd, assignee. Natural sedative composition, process for obtaining the same and pharmaceutical formulations thereof. *US Patent* US20050266101A1; 12.

Mitra, S.K., B. U., Saxena, E. (2010). Inventor; Himalaya Global Holdings LTD, assignee. Herbal Skin Lightening Composition, Methods of Production and Cosmetic Use Thereof. *Indian Patent* WO2010004355; 14.

Mittal, R., Verma, V., Kaur, H. (2022). A Molecular modeling study of phytoconstituents analysed via gc-ms technique in the rhizome part of hedychium spicatum (Zingiberaceae). *International Journal of Pharmaceutical Sciences and Research*, **13**(6): 2441-2449.

Molur, S., Walker, S. (1998). Biodiversity conservation prioritization project (BCPP) India, *Endangered species project*., 1-62.

Nag, A. (2011). Estimation of nuclear genome size of important medicinal plant species from western Himalaya using flow cytometry. *J Cell Plant Sci*., 219-23.

Negi, K.S., Koranga, .SS., Ojha, S.N., Pandey, M.M., Rawat, A.K.S., Raina, A.P., Rayal, A. (2014). Spiked Zinger Lily (Hedychium spicatum): Identification of superior genotypes from Indian Himalayan region. *Indian Forester*. **140**(4): 363-367

Pandey, H.K., A. Z., Rawat, P.S., Meena, H., Arya, M.C. (2015). Inventor; director general, defence research & development organization, assignee. Herbal composition and preparation thereof. *Indian Patent* IN2301/DEL/2009:31.

Pawar, N., Maurya, R., Ramteke, S., Bishnoi, R.S., Shukla, A.K. (2021). Design, Characterization and evaluation of curcumin-loaded mesoporous silica-Nanoparticles based topical drug delivery system for treatment of wrinkles. *J. of Medical P'ceutical & Allied Sci*. 2320-7418.

Prakash, V., Mehrotra, B.N. (1995). Zingiberaceae of north-east India: diversity and taxonomic status. In: *Proceedings of the 2nd Symposium on the Family Zingiberaceae*., 262-273.

Rabade, V. S.; Gurunani, S. G.; Chaple, D. R. (2016). Appraising Herbal Tea as a Medicated and Nutritive drink. *Resear. J. of Pharm. and Tech*. **9** (5):613-616.

Raina, A.P., Negi, K.S. (2015). Essential oil composition of Hedychium spicatum Buch.-Ham. ex Smith from Uttarakhand, India. *Journal of Essential Oil Bearing Plants*. **18**(2):382-8.

Rao, G.V., M. T., Rao, K.S., Madhavi, M.S.L. (2011). Inventor; Cavinkare Pvt. Ltd, assignee. Hair growth composition containing hydrocarbons. *Indian patent* IN1959/CHE/2009; 25.

Rawat, S., Bhatt, I.D., Rawal, R.S. (2020). Variation in essential oil composition in rhizomes of natural populations of Hedychium spicatum in different environmental condition and habitats. *Journal of Essential Oil Research*, 1-3.

Rawat, S., Rawal, R.S. (2011). Total phenolic compounds and antioxidant potential of Hedychium spicatum Buch. Ham. Ex D. Don in west Himalaya, *India. J Food Compos Anal*., **24**:574-579.

Ray, P.G., Majumdar, S.K. (1976). Antimicrobial activity of some Indian plants. *Economic Botany*, **30**:317-320.

Reddy, P.P., Rao, R.R., Rekha, K. (2009). Two new cytotoxic diterpenes from the rhizomes of Hedychium spicatum. *Bio Org Med Chem Let*., **19**(21):192-95.

Reddy, P.P., Rao, R.R., Rekha, K., Babu, K.S., Shashidhar, J., Shashikiran, G., Lakshmi, V.V., Rao, J.M. (2009). Two new cytotoxic diterpenes from the rhizomes of Hedychium spicatum. *Bioorganic & medicinal chemistry letters*. **19**(1):192-195.

Reddy, R.P. (2009). New labdane diterpenes as intestinal a- glocosidase inhibitor from antihyperglycemic extract of Hedychium spicatum (Ham. Ex Smith) rhizomes. *Bioorgan Med Chem Lett*., **19**:2562-2565.

Sahu, R.B. (1979). Clinical trial of Hedychium spicatum in tropical pulmonary eosiniphilia. *J Nepal Pharmacist Assoc*., **7**:65-72.

Shu, J.H. (2000). *Hedychium*, In: Wu, C.Y., P.H. Raven, D.Y. Hong. Flora of China, Science Press & Missouri Botanical Garden Press, Beijing & St. Louis., **24**:370-377.

Shukla, A.K., Kumar, M., Bishnoi, R.S., Jain C.P. (2019). Development of Natural Gum Based Sustained Release Tablets of Propranolol hydrochloride. *Res. J. Pharm. and Tech.* 2019:0974-360X.

Shukla, A.K., Kumar, M., Bishnoi, R.S., Jain C.P. (2019). Development of natural and modified gum based sustained-release film-coated tablets containing poorly water-soluble drug. *Asian J Pharm Clin Res*. 2455-3891.

Shukla, A.K., Kumar, M., Bishnoi, R.S., Jain C.P. (2019). Isolation and characterization of natural and modified seed gum. *Asian J. of Pharm. and Pharmaco.* 2455-2674.

Shukla, A.K., Yadav, A., Vishwakarma, R.K., Mishra, S.K. (2019). Applications, isolation and characterization of fenugreek seed gum as pharmaceutical excipient. *J. of Medical P'ceutical & Allied Sci*. 9(2):2484-2491.

Singh, N.R., Singh, S. (2009). Wild medicinal plants of Manipur included in the red list. *Asian Agri History*., **13**(3):221-225.

Singh, P.K., S. V. (2010). Inventor; Hiran Biotech (a division of Hiran Agritech Products Private limited, assignee. Herbal formulation useful for treatment of corns and other skin disorders and process of preparation of the same. *Indian Patent* IN2900/DEL/2008; 02.

Singh, R., P. A., Kanaujia, A., Sharma, N.K. (2005). Inventor; Ranbaxy laboratories limited, assignee. Herbal formulation comprising extracts of Adhatoda, Hedychium and Curcuma as cough syrup. *WO patent* WO2005077393; 25.

Singh, S., Sharma, N., Nageshwar, S. (2018). Hedychium spicatum a boon for medicinal field in future. *Bulletin of Environment Pharmacology and Life Sciences*, **11**:188-92.

Soares, D.J., Barreto, R.W. (2008). Fungal pathogens of the invasive riparian weed Hedychium coronarium from Brazil and their potential for biological control. *Fungal Diversity*, **28**:85-96.

Sravani, T., Padmaa, M.P. (2011). Evaluation of anthelmintic activity of rhizomes of Hedychium spicatum Buch. Ham. *Int. J. Res. Pharm. Sci*., **2**(1):66-68.

Srimal, R.C. (1984). Anti-inflammatory and other pharmacological effects of Hedychium spicatum. *Indian J Pharmacol*., **16**:143-147.

Srivani, T., Paarekh, P.M. (2011) Hedychium spicatum Buch. Ham. An overview. *Pharmacognosyoneline*., **2**:633-642.

Tandon, S.K., Chandra, S., Gupta, S., Lal, J. (1997). Analgesic and antiinflammatory effects of Hedychium spicatum. *Indian J Pharma Sci*., **59**(3):148-50.

Tandon, S.K., Chandra, S., Gupta, S., Lal, J. (1997). Analgesic and antiinflammatory effects of Hedychium spicatum. *Indian J Pharma Sci*., **59**(3):148-50.

Tiwari, R., Jain, R., Agrawal, O.P., Shukla, A.K. (2020). Metallic-nano-particles: encapsulated-form of bioactive compounds, types of carriers, advantages, toxicity, future prospects and their role in the treatment of acne disease. *Journal of Advanced Scientific Research*. 11 (4) 8: 01-07.

Wood, T.H. (2000). Phylogeny of Hedychium and related genera (Zingiberaceae) based on ITS sequence data. *Edinburgh J Bot*., **57**:261-270.