



# The Revitalizing Potential of *Crepidium Acuminatum* (D. Don) Szlach.: A Comprehensive Review

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## KEYWORDS

Traditional, ashtavarga, ayurveda, pharmacology, ethnobotany, conservation.

## ABSTRACT:

**Introduction:** *Crepidium acuminatum*, commonly known as “Jeevak” is an endangered medicinal orchid that thrives in shady regions of semi-evergreen to shrubby woods and found exclusively in small patches. It is an important orchid with remarkable medicinal qualities, so there is a need for its conservation because of its ecological significance and scarcity.

**Objectives:** To summarize a systemic review of the ethnobotanical uses, ayurvedic formulations, phytoconstituents, and pharmacology. Various phytochemical components are found in *Crepidium acuminatum*. These ingredients enhance the plant's antibacterial, anti-inflammatory, and antioxidant properties, which are consistent with its traditional uses in the management of wounds, TB, skin infections, etc.

**Results:** *C. acuminatum* rich source of phytochemicals such as piperitone, 1,8-cineole,  $\beta$ -Sitosterol, O-Methylbatatasin, eugenol, Caryophyllene, humulene, 2,5 Octadecadiynoic acid, etc which are responsible for its anti-inflammatory, antioxidant, anti-aging, antimicrobial properties. The pseudobulb and leaves are considered as excellent rasayanas with rejuvenating and health-promoting qualities and a remarkable potential for cell regeneration and used to prepare energetic tonics with immunomodulatory, revitalizing, and other Ayurvedic formulations.

**Conclusions:** *C. acuminatum* is a powerful natural remedy with antimicrobial, anti-inflammatory, antioxidant, and anti-inflammatory qualities and other beneficial therapeutic effects. This study is an attempt to compile an up-to-date review of *C. acuminatum* covering its ethnobotany, phytochemistry, ayurvedic formulations, and pharmacology. It will encourage future researchers to investigate its active phytoconstituents and pharmacological activities.

## 1. Introduction

Orchids are members of the Orchidaceae family, which is the most varied and largest group of flowering plants. The Orchidaceae family includes around 8,000 genera and 35,000 species that are found all over the world [1]. Orchids are found across the globe, ranging from tropical to alpine regions, and they have specific microhabitat requirements [2]. *Crepidium acuminatum* is a terrestrial orchid with a distinct rhizome [3]. It is an endangered orchid that grows on moss-covered rocks or damp areas [4]. It produces numerous, tiny seeds, and for their germination as well as growth they need a fungal

partner that is compatible with them [5]. The life cycle of terrestrial orchids is complex with a long juvenile vegetative phase, a short reproductive period, and reliant on mycorrhizal partners and pollinators. Traditionally, they grow vegetatively by splitting the rhizome, which is a slow process and unable to meet high market demand, which eventually leads to the excessive harvesting of this highly valued medicinal herb from the wild [6].

The term "Ashtavarga" was originally used in the ancient textbook “Paryayaratnamala” which offers comprehensive information on the herbal descriptions of Ashtavarga plants [7]. The Ashtavarga plants are



considered to be part of the Rasayana category, possessing health-promoting and rejuvenating qualities. They are also believed to boost immunity and have enormous potential for cell regeneration [8]. *Crepidium acuminatum* is included in Ashtavarga plants and is used traditionally in treating headaches, fatigue, lowering fever, and raising white blood cell counts [9]. In Ayurveda, it is used medicinally to prepare energetic tonics with immunomodulatory, revitalizing, adaptogenic, and other health benefits [4]. Therefore, this medicinal orchid have widespread uses in a variety of herbal and nutraceutical preparations [10]. The pseudobulbs in dried form are a key components of the century-old ayurvedic medication “Ashtavarga” as well as the polyherbal formulation “Chyavanprash,” which is renowned for reviving vitality and vigor [11]. It contains a variety of phytochemical molecules, including alkaloids, phenol, glycosides, flavonoids, piperitone, 1,8-cineole,  $\beta$ -Sitosterol, etc which are known for various pharmacological properties such as anti-inflammatory, antioxidant, antiproliferative, anti-aging, etc [12].

*Crepidium acuminatum* is included in the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) Appendix II, which carefully regulates and maintains records of international trade in endangered species of wild flora and fauna [13]. For legal commercial purposes and conservation, international organizations such as CITES have stepped up to address issues related to the illegitimate worldwide trade and the indiscriminate use of orchid varieties [14]. There is an urgent need to conserve this precious orchid species which is in the urge of extinction due to rapid anthropogenic activities, overexploitation, and demand in pharmaceutical as well as cosmeceutical industries [15]. The goal of this review is to gather information on *C. acuminatum* by giving a thorough explanation of its botany, ethnobotanical uses, ayurvedic formulations, phytoconstituents, and pharmacological activities. Healthcare practitioners may utilize this data to treat patients which could lead to better health results. Therefore, this review will be beneficial to both society as well as researchers by integrating all aspects of this plant.

## 2. Taxonomic Classification

Kingdom: Plantae

Phylum: Tracheophyta

Class: Liliopsida

Order: Asparagales

Family: Orchidaceae

Genus: *Crepidium*

Species: *acuminatum*

## Botanical description

*Crepidium acuminatum* is a medium-sized terrestrial orchid with approximately 30 cm in height. It has a pseudobulbous stem that is 3-9 cm long and a diameter is 1-3 cm with old leafy scales covering it at the base (Figure 1). They are usually conical, fleshy, and smooth. They grow in pairs, and the young ones resemble garlic cloves; they are greenish-white in color with a membrane sheath covering them which is slightly mucilaginous, and live longer. Pseudobulbs are generally succulent stems that store water, minerals, and carbohydrates [16]. The whorls of leaves on nodes directly raised vertically, angular and attenuate, generally 2-4, petioled or sessile, ovate-lanceolate, 7.5-12.5 cm long, often light greenish, acute with pronounced veins, stem is tubular and covered by basal leaves [17]. The flower is pale green with a tinge of purple, 1-1.2 cm across, with a short stalk, and is found on several spikes that are 8-10 cm long. The bracts are linear and tiny. Sepals are oblong with short, broad lateral edges that are recurved. Unlike sepals, petals are linear and longer. Lip shield-like, widely oval, with a notched tip and straight or overlapping auricles at the base [18].





Figure 1: A. *C. acuminatum*; B. Pseudobulbs; C. Leaves; D. Flower.

### Ethnobotanical Uses

A World Health Organization (WHO) research states that more than three-quarters of the world's population must use traditional medicine derived from plants since they cannot afford the products of modern medicine. Every plant has some intrinsic medicinal qualities. Traditional medicine is used by the locals to treat illnesses. They employ various plant parts in varying proportions to treat illnesses and ailments. The natural healthcare system is attracting tremendous attention these days [19]. *Crepidium acuminatum* has been explored for its ethnobotanical uses and reported that each plant part has various ethnobotanical uses as mentioned in Table 1.

Table 1: Ethnobotanical uses of various parts of *Crepidium acuminatum*.

Sr. No.	Part Used	Ethnobotanical Uses	References
1.	Whole plant	Restore vitality, enhance longevity, and improve strength and endurance.	[20]
2.	Leaves	Cooling, wound healing, febrifuge and spermopiotic.	[21]
3.	Pseudobulb	Tuberculosis, treat bleeding diathesis, burning sensation, fever, phthisis, used against cancers of the liver, breast, cervix etc.	[22,23]

### Ayurvedic Formulations

Ayurveda is part of India's traditional medical system which originated 5,000 years ago and its basic ideas were first documented during the Vedic era. "Ayurveda" refers to longevity and knowledge of life. Ayurveda aims to restore the balance of a person's body, mind, and spirit to extend and preserve their life through the use of natural remedies. In herbal formulations, the potential of orchids as medicinal and nutraceutical agents is becoming more and more prominent. *C. acuminatum* is valued significantly because it addresses the preventive, promotional, and curative aspects of health. The dried underground pseudobulb is a key component of Aṣṭāvarga

traditionally emphasized as an aphrodisiac and tonic [24]. Both dried pseudobulb and leaf have been used as a cooling, febrifuge, spermopiotic, pleasant to taste, cold in potency, and known to calm Vata dosha in Ayurveda [25]. In combination with other herbs found in the ashtavarga group, it provides energy, endurance, and rejuvenates dead cells of the body [26]. In the Ayurvedic system of medicines, it is used to treat Vata, Pitta, and Kapha-related issues. Due to their strong medicinal potential, *C. acuminatum* is utilized in a variety of polyherbal formulations (Table 2), such as lehya (paste), ghrita (medicated clarified butter), or churna (powder) [27,28].

Table 2. Major Ayurvedic products along with therapeutic uses of *C. acuminatum*

Sr. No.	Product	Price	Therapeutic uses	Reference
1.	Astavarga churna	Rs. 465/100gm	Used to cure bronchitis, sterility, galactic, hyperdypsia, haematemesis, fever.	[29]
2.	Chayawanprash	Rs. 34.42/100gm	Used to treat heart, urinary problems, memory, anti-aging.	[30]
3.	Jivaniya ghrit	Rs. 300/100ml	Useful in treating asthma, thirst, epilepsy, fever,	[31]



			cough, skin diseases, anorexia, joint pain and herbal powder is used to cures blood diseases and prepare rejuvenating tonics.	
4.	Vajikaran rasayana	Rs. 495/300gm	Used to cure sexual debility, anorexia, fever, worms and skin problems.	[32]
5.	Jivaniya	Rs. 690/100gm	Used to boost vitality and preserve the harmony of the three doshas-Pita, Kapha, and Vāta. This boosts the body's vitality, strength, and other attributes.	[33]
6.	Vacadi-tailam	Rs. 75/100ml	It helps with urinary incontinence, distention, gulma, and problems related to the vata.	[34]

### Phytoconstituents

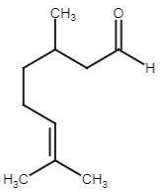
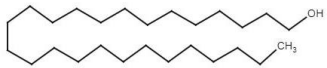
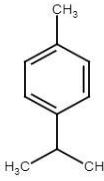
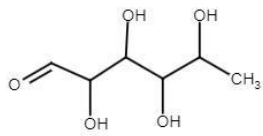
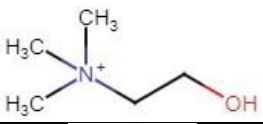
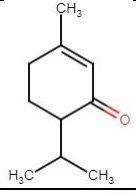
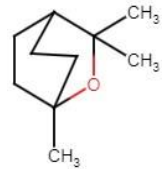
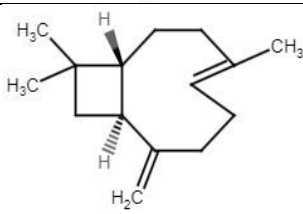
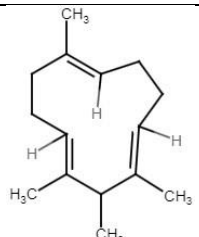
Orchids have therapeutic value as they contain phytochemicals such as flavonoids, glycosides, and alkaloids. The secondary metabolites have been identified to have pharmaceutical and therapeutic significance [35]. They have been reported to provide antioxidant, Jeevaniya (vitality), and Vayashapan (revival of youthful conditions) properties [36]. The dried leaves of Jeevak contain piperitone, 1,8-cineole, citronellal, eugenol, limonene, and p-cymene while pseudobulbs contain  $\beta$ -Sitosterol, rhamnase, choline, ceryl alcohol, etc [37]. The Dichloromethane (DCM) extracts were analyzed for essential oils using GC-MS and 6 phytoconstituents were reported in the DCM

pseudobulbs extract of *C. acuminatum*. Eugenol, caryophyllene, phenol, 2,4 bis (1,1 dimethylethyl), humulene, 2,5 Octadecadiynoic acid, methyl ester, and caryophyllene oxide were the main essential oils found in DCM extract [38]. The fingerprint profile of *C. acuminatum* reported various phytochemicals such as 2,3- dimethoxy- 9,10- dihydrophenanthrene-4,7-diol, liparacid C, lusianthridin, pyromeconic acid, O-methylbatatasin, gigantol, batatasin, coelonin, bulbophythr in A, etc [39,40]. The pseudobulb of *C. acuminatum* contains the long chain 22C fatty acid erucic acid [41]. The major chemical constituents of *C. acuminatum* are mentioned in Table 3.

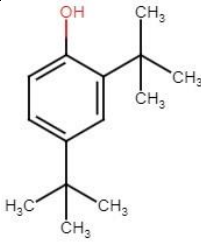
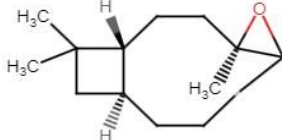
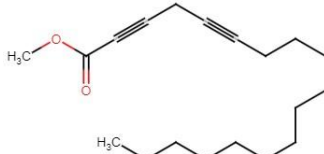

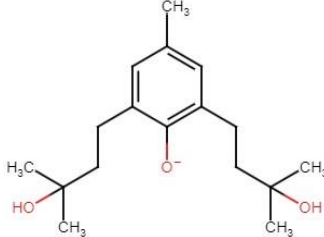
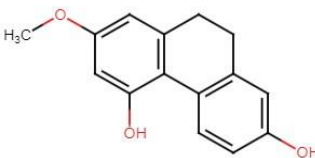
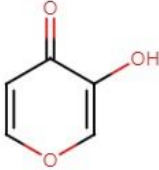
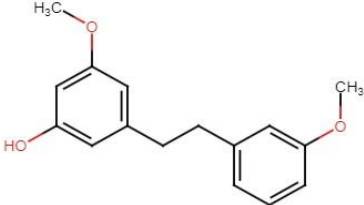
**Table 3. List of important phytoconstituents found in *C. acuminatum***

Sr. No.	Name of Chemical Compound	Plant Part	Structure of Chemical compound	Reference
1.	Eugenol	Leaves		[37]
2.	Limonene	Leaves		[37]
3.	$\beta$ -sitosterol	Pseudobulb		[37]



4.	Citronellal	Leaves		[37]
5.	Ceryl alcohol	Pseudobulb		[37]
6.	p-cymene	Leaves		[37]
7.	Rhamnose	Pseudobulb		[37]
8.	Choline	Pseudobulb		[37]
9.	Piperitone	Pseudobulb		[37]
10.	1,8-cineole	Pseudobulb		[37]
11.	Caryophyllene	Pseudobulb		[38]
12.	Humulene	Pseudobulb		[38]



13.	Phenol, 2,4bis(1,1dimethylethyl)	Pseudobulb		[38]
14.	Caryophyllene oxide	Pseudobulb		[38]
15.	2,5 Octadecadiynoic acid, methyl ester	Pseudobulb		[38]
16.	2,3- dimethoxy- 9,10- dihydrophenanthrene-4,7-diol	Pseudobulb		[40]
17.	Liparacid C	Pseudobulb		[40]
18.	Lusianthridin (7-methoxy-9,10- dihydrophenanthrene-2,5-diol	Pseudobulb		[40]
19.	Pyromeconic acid	Pseudobulb		[40]
20.	O-Methylbatatasin	Pseudobulb		[40]



21.	Gigantol (3,4-dihydroxy-3,5-dimethoxybibenzyl)	Pseudobulb		[40]
22.	Batatasin	Pseudobulb		[40]
23.	Coelonin (4-methoxy-9,10-dihydrophenanthrene-2,7-diol)	Pseudobulb		[40]
24.	Bulbophythrins A	Pseudobulb		[40]
25.	Pseudobulb		[41]	

### Pharmacological Properties

*C. acuminatum* is an important medicinal orchid with significant commercial value. It has been utilized in traditional medicine due to its immunomodulatory, antimicrobial, anti-inflammatory, antioxidant, anti-aging properties etc [42].

### Immunomodulatory

Chyawanprash, a traditional immune-booster, has a long history of ethnic origin and has numerous health benefits [43]. It is an herbal supplement and recommended in Ayurveda to boost immunity, replenish depleted energy, maintain vigor, strength, endurance, and slow down the aging process. A remarkable increase of approximately 30 to 40 percent

in the chyawanprash market has occurred during the era of increasing coronavirus incidence [44]. It is a highly concentrated mixture of plants that are high in nutrients. It has been used extensively as a health supplement and medicine to increase longevity and immunity [45]. *Crepidium acuminatum*, one of the ingredients of chyawanprash, is processed along with approximately fifty other medicinal plants, and their extracts are used in the formulation. Its medicinal activity is due to numerous physiologically active phenolics such as vanillic acid, caffeic acid, rutin, ferulic acid, gallic acid, protocatechuic acid, catechin, and quercitrin [46].



## Anti-inflammatory activity

A pathogen or tissue harm triggers inflammation. Immune cells, including leukocytes, mast cells, neutrophils, and macrophages, are drawn to the injury site when they detect cellular damage or pathogen-associated molecular patterns (PAMPs) generated by pathogens. The inflammatory mediators that are subsequently released by these cells include nitric oxide, histamine, cytokines, and leukotrienes [47]. The enzyme, 5-lipoxygenase (5-LOX), is responsible for converting arachidonic acid into leukotrienes, which are considered to be key mediators in a variety of inflammatory and allergic reactions. The extract of *C. acuminatum* exhibits significant anti-5-LOX action. The hyaluronidase breaks down hyaluronic acid and causes enhanced fibrosis, inflammation, angiogenesis, and collagen deposition [48]. The spectrophotometric evaluation of the hyaluronidase inhibitory activity of *C. acuminatum* extract involved assessing the production of N-acetylglucosamine from hyaluronate sodium [49].

## Anti-ageing activity

The process of skin aging is a multifaceted phenomenon influenced by several internal and external factors, leading to a gradual deterioration of the skin's structural and physiological integrity. Extrinsic factors, such as exposure to ultraviolet radiation, cause oxidative damage to the skin's lipids, proteins, as well as DNA by releasing reactive oxygen species and activating numerous enzymes such as collagenase, elastase, etc [50]. Collagen is the fundamental and most prevalent protein in the extracellular matrix. It maintains elasticity, strength, and flexibility of the skin [51]. Collagenase is the class of matrix metalloproteinases (MMPs) that can degrade collagen fibrils, disrupting the scaffold and mechanical support that helps cells connect [52]. The hydroxylation of polyphenols and the flavonoid B-string interact with side chains of collagenase to cause conformational modifications that block the enzyme [53]. Another extracellular matrix protein elastin, which is present in connective tissues, gives elasticity to the skin and lungs. Skin aging results from the intracellular serine protease, elastase, and progressively breaking elastin. Thus, blocking elastase function may have therapeutic benefits in preventing photoaging and structural deterioration of the extracellular matrix (ECM) [54]. Collagen and elastin deficiencies lead to

wrinkles and aging of the skin as they are primarily responsible for maintaining the skin's structural integrity. The extracts of *C. acuminatum* are rich in  $\alpha$ -hydroxy acids (AHAs), which are utilized in numerous cosmetic formulations to treat UV-induced photodamage, hyperpigmentation, and acne scars. It is believed that AHAs stimulate the synthesis of hyaluronic acid and collagen, which increases the thickness of the skin [55]. Both the leaf and stem extracts of *C. acuminatum* include gluconolactone, a naturally occurring antioxidant with an anti-wrinkle activity which is a commercialized cosmetic product [42].

## Antioxidant activity

The Reactive oxygen species oxidize DNA, proteins, and carbohydrates, cellular biomolecules and result in a variety of degenerative illnesses. These are produced inside the cell as a byproduct of aerobic respiration, which harms cells by altering protein and gene function, causing mitochondrial and DNA damage, and synthesizing lipid peroxide [51]. The antioxidant properties present among numerous chemical groups, such as phenol, flavonoids, isoflavones, flavones, anthocyanins, etc are generally responsible for controlling attributes related to vitality strengthening and anti-aging. These compounds are known to scavenge Reactive Oxygen Species (ROS) species [56]. 2,2-Diphenyl-1-picrylhydrazyl (DPPH) and 2,2-azino-bis-3-ethylbenzothiazoline-6-sulphonic acid (ABTS) assays were used to evaluate the antioxidant potential of both leaves and pseudobulb of the mother as well as *in-vitro* grown *C. acuminatum*. In the DPPH assay, it was reported that pseudobulb of *M. acuminata* (mother) have the lowest activity ( $IC_{50} = 3.56 \pm 0.18$  mg/gm) and leaves (mother) showed the highest activity ( $IC_{50} = 0.44 \pm 0.018$  mg/gm). While in ABTS assay leaves (*in-vitro*) have the lowest activity ( $IC_{50} = 1.02 \pm 0.05$  mg/gm) and pseudobulb (*in-vitro*) have the highest activity ( $IC_{50} = 0.33 \pm 0.02$  mg/gm). A high degree of radical scavenging capacity is linked to the accumulation of several secondary metabolites in the leaf of *C. acuminatum*, which are known to scavenge ROS and are responsible for controlling vitality-boosting and anti-aging traits [51,57].



## Antimicrobial activity

Pharmacognostic evaluation serves a vital part in the quality control of crude medication. *C. acuminatum* has antimicrobial properties on a broad range of pathogens. Poor hygiene is contributing to the rise in microbial infections, which leads to infectious diseases. Five extracts of *C. acuminatum* pseudobulb *i.e.* hexane, ethanol, chloroform, aqueous and ethyl acetate were evaluated against 4 bacterial strains viz. *P. aeruginosa* (MTCC 424), *E. coli* (MTCC 40), *B. subtilis* (MTCC 121), *S. aureus* (MTCC 87). To test for antibacterial activity, the well diffusion method was used. The crude extract was tested in three duplicates at doses of 100 mg/ml each well. The highest ZOI, 20 mm, was recorded against *E. coli* using chloroform extract. The chloroform, ethanol, and ethyl acetate extracts have demonstrated more promising outcomes than hexane and aqueous extracts. It was concluded that the ZOI in chloroform extract (20 mm) is significantly higher than that of the common medication streptomycin against *E. coli* MTCC 40. The findings justified the use of pseudobulbs in the traditional healthcare system to treat a range of microbial diseases [58].

## Anti-Parkinson's activity

Parkinson's disease (PD) is a progressive neurodegenerative illness that is characterized by the spread of the intracellular protein alpha-synuclein (αSyn), apoptotic cell death in dopamine neurons in the pars compacta, and a section of the substantia nigra in the midbrain (SNpc). Using the SH-SY5Y cell line, the study was conducted to examine *in-vitro* screening of the entire *Malaxis acuminata* plant for anti-Parkinson's efficacy. The Soxhlet method was used to extract the powdered *Malaxis acuminata* plant utilizing nonpolar to polar solvents. SH-SY5Y cell lines were made lethal by rotenone (10 μM). Following treatment with 100 μg, 50 μg, 25 μg, 12.5 μg, and 6.25 μg of *Malaxis acuminata* ethanolic extract, the cell lines were inoculated at 37°C in a humidified 5% CO<sub>2</sub> incubator. The percentage viability of the cells decreased as the doses were gradually raised over 24-hour period. The highest efficient concentration for preventing cell proliferation was found to be 6.25 g/ml. Thus, the ethanolic extracts of *Malaxis acuminata* demonstrated anti-parkinsonian effects on SH-SY5Y cell lines [59].

## Anti-Proliferative activity

Cancer is a serious disease and has become the most common cause of mortality in the entire world. The Sulphorhodamine B assay was carried out to determine antiproliferative activity against four human cancer cell lines: MCF-7 (human breast adenocarcinoma), DLD1 (human colorectal adenocarcinoma), DU145 (human prostate carcinoma), and A549 (non-small cell lung cancer cells). It was concluded that a moderate antiproliferative effect was induced by the ethanol extract and its n-butanol fraction. However, when compared to standard doxorubicin (A549: 80.13%, DLD1: 64.45%, MCF-7: 79.82%, and DU145: 89.26% inhibition), the ethyl acetate fraction from the methanolic extract demonstrated strong antiproliferative activity against cancer cell lines (A549: 70.29%, DLD1: 73.12%, MCF-7: 79.10%, and DU145: 68.65% inhibition) [4].

## 3. Conclusion

Orchids of "Astavarga" have a long history of use as chief ingredient for multiple medicinal preparations in Ayurveda and Chinese medicine. Ashtavarga is a key ingredient in the manufacture of numerous herbal remedies in Ayurvedic medicine. *Crepidium acuminatum* is the ingredient of the traditional medication, and the pseudobulb contains a variety of phytoconstituents responsible for its antimicrobial, antioxidant, antiaging, rejuvenator, energy booster, anti-inflammatory, antiparkinson, anti-proliferative activities, etc. The habitat destruction, overexploitation, and use of this orchid in Ayurveda have led to a rapid decline in their population. A protected area must be established, and degraded habitats must be restored to preserve the natural environment of orchids. Therefore, it is vital to take every possible step to preserve the naturally dwindling population of this priceless plant using both *in-situ* and *ex-situ* methods. This study suggests that a better understanding of *Crepidium acuminatum* may lead to the development of novel compounds with potential applications in medicine. The multi-faceted approach that combines scientific research, conservation practices such as tissue culture, public engagement, and policy support will be essential to effectively conserve orchid species and ensure their survival for future generations. The integration of bioinformatics with botanical research improves the



safety, efficacy, and standardization of herbal remedies as they play a significant role in healthcare, offering potentially cost-effective and natural treatments. Further, research should be done to identify these compounds and develop them into new pharmaceuticals.

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