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TRADITIONAL AND MODERN MEDICINAL USES OF *DENDROBIUM*: A CRITICAL REVIEW

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ABSTRACT

The Dendrobium genus is part of the orchid family and includes 800-1400 species. These orchids grow in many places like Korea, Japan, Southeast Asia, the Himalayas, the Philippines, Indonesia, the Pacific Islands, New Zealand, and Australia. New Guinea has over 150 species. Dendrobium orchids are admired for their beauty and value. They are used as potted plants and cut flowers, and some have medicinal uses. Orchids grow well in tropical areas with lots of rain and no long dry spells. Malaysia's weather is perfect for them. But identifying Dendrobium species is tricky because they look and grow in many different ways. Older methods that focused on how they look don't work well. Now, scientists use DNA and genetics to study them. These modern studies help us understand their relationships and unique traits, making it easier to classify and protect rare or endangered species. Medicinal Uses of Dendrobium Orchids - Orchids are loved for their beauty and are used to decorate spaces like homes and offices. They have been used in traditional medicine by different cultures. Fewer people use orchids for medicine today because of a lack of scientific studies. There isn't enough proof about how effective they are or their possible side effects. More research is needed to understand their medicinal uses and risks. Orchids are admired worldwide for their beauty and often decorate homes, offices, and other places. They have a history of being used in traditional medicine by various cultures. However, the use of orchids for medicinal purposes has declined over time due to limited scientific studies.[6]

KEYWORDS: Dendrobium, Orchidaceous, Medicinal, Orchids.

INTRODUCTION

Orchids, belonging to the Orchidaceae family, represent the largest and most diverse group within the plant kingdom. As monocots, they sprout from seeds with a single juvenile leaf, known as a cotyledon. These perennial plants are characterized by fleshy roots or tubers and long, narrow leaves with parallel veins, which lack stalks and are undivided. Their remarkable diversity spans colors, shapes, sizes, habitats, and fragrances. Orchid flowers showcase an incredible variety, from dull, muted colors to vibrant, striking blooms, from tiny, delicate forms to large, show-stopping sizes. They may emit sweet, pleasing scents or, conversely, have strong, unpleasant odors.[7,8,2,3] The adaptability of orchids allows them to thrive in a wide range of habitats, making them cosmopolitan plants. They are found across the globe, growing in environments from tropical rainforests to high-altitude regions, at elevations ranging from sea level to 4,200 meters. However, they are notably absent in regions that are extremely cold or arid. Orchids generally favor wetter conditions, especially in tropical regions, where they flourish and exhibit maximum diversity.[9,10,5,6] With over 10% of higher plants classified within the Orchidaceae family, this group holds a significant place in the plant kingdom. In Malaysia, orchids are particularly abundant, forming the largest family of flowering plants. Within this family, the Dendrobium genus is notably prominent, second only to the genus Bulbophyllum in terms of the number of plant.[11,12,31,32]

The Dendrobium Genus

- Dendrobium is one of the largest groups in the orchid family, with 800–1,400 species worldwide.
- The genus was first identified in 1799. The name “Dendrobium” means “living on trees” in Greek.
- They are found in tropical and subtropical areas like Asia, Australia, and New Zealand. Most grow on trees (epiphytes), but some grow on land (terrestrial) or rocks (lithophytic).
- Dendrobium orchids are valued for their medicinal and commercial uses.[13,33,34,35]

Distribution

Dendrobium orchids are found in many parts of the world, especially in wetter, tropical regions with high rainfall. They grow in places like Southeast Asia, the Himalayas, Indonesia, New Guinea, and Australia. New Guinea has over 150 species. Examples include:[14]

- **Dendrobium anosmum:** Found in India, Southeast Asia, and New Guinea.
- **Dendrobium erosum:** Found in Thailand, Malaysia, and New Guinea.

Vegetative and Floral Features

- **Roots:** Dendrobium orchids grow symbiotic fungi on their roots, which help them absorb nutrients and water quickly.
- **Stems:** Their stems (pseudobulbs) store water and nutrients, and they vary in shape and size depending on the species.
- **Flowers:** Dendrobium flowers last from a few hours to a few months. They range in size and structure, adding to their beauty. Some flowers attract pollinators like bees.
- **Seeds:** Their fruits are capsules with tiny seeds that ensure the plant’s survival.[15,36,38,39]

Economic Value

- **Medicinal Uses:** Around 40 species of *Dendrobium* are used in traditional Chinese medicine for conditions like cataracts, gastritis, and immune system support. Some species have significant medicinal value and are even considered rare and endangered.
- **Economic Importance:** *Dendrobium* orchids are widely traded, with strong markets in the USA and Malaysia. In 2005, 90% of imported orchids in the USA were *Dendrobium*, generating millions in revenue.[16]
- **Orchid Trade in Malaysia:** Malaysia exports *Dendrobium* orchids, contributing to an expanding floriculture industry. However, competition from neighboring countries poses a challenge.
- **Hybrid Development:** Over 8,000 *Dendrobium* hybrids have been created through crossbreeding to improve flower shape, size, and color, enhancing market demand.
- **Cultural Uses:** In Papua New Guinea, *Dendrobium* fibers are used for decoration and binding in artifacts.[17]
- **Conservation & Research:** Many species face threats due to habitat destruction. Genetic studies and molecular techniques help in conservation and better classification of the species.

Dendrobium orchids are used in traditional medicine. Around 40 species are part of Chinese medicine, helping with health problems like gastritis, circulation issues, and eye conditions. Products made from Dendrobium include health supplements and medicines.[18,40,41,42]

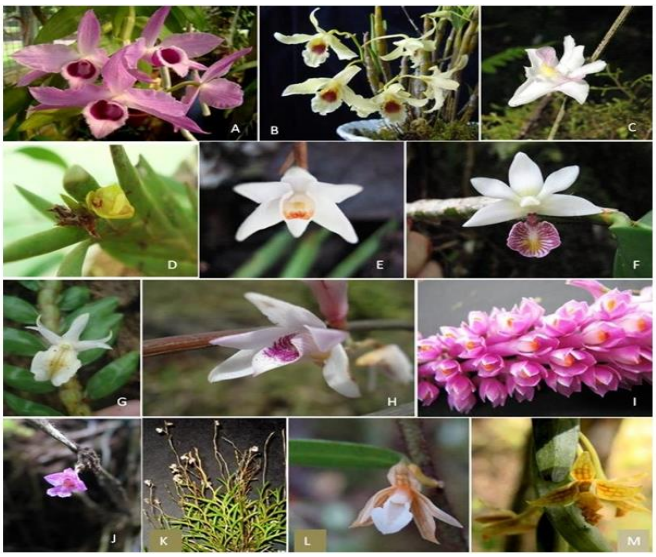

Figure 1: Different species of Dendrobium.

The genus **Dendrobium** consists of orchids that are popular worldwide due to their variety of colors, shapes, sizes, and long-lasting flowers. These orchids are not only visually appealing but also commercially significant. Countries like the USA and Malaysia benefit significantly from cultivating and exporting Dendrobium orchids. For instance, in 2005, the USA imported 90% of its orchid stems from Dendrobium, valued at USD 3.6 million. In Malaysia, Dendrobium orchids contribute significantly to the floriculture industry, with rising exports to meet international.[19,43,44,45]

Chemical Components of D. nobile

1. Sesquiterpenoids: These rare and complex molecules contribute to the plant's medicinal effects, potentially offering anti-inflammatory and antioxidant benefits.

2. Flavonoids: Commonly found in herbal medicines, flavonoids play a major role in protecting cells, neutralizing harmful free radicals, and regulating immune responses. Flavonoid glycosides (flavonoids bound to sugars) further enhance their pharmacological effects.
3. Bibenzyls: With two benzene rings linked by an ethyl group, bibenzyls are rare but potent compounds known for their antioxidant and antimicrobial properties.
4. Phenols: Dendrobium nobile contains a diverse range of phenols that, while not the primary active ingredients, support its medicinal profile and contribute to its overall complexity.
5. Other Organic Compounds: Additional substances such as malic acid, dimethyl malate, N-phenylacetamide, isopentyl butyrate, and shikimic acid add to the plant's diverse chemical makeup, further enhancing its therapeutic potential.

Conservation and Research

- Conservation efforts focus on protecting the genetic diversity of Dendrobium orchids.
- Scientists are studying their DNA to better understand and preserve the species.
- Over 8,000 hybrids of Dendrobium orchids have been developed, improving their flower size, shape, color, and quantity.[21,49,50]

Market Competition Countries like Thailand, Singapore, and Taiwan compete with Malaysia in orchid production. Innovative hybrid development is essential to remain competitive in the global market.

Cultural Importance Yellow fibers from Dendrobium orchids are used in Papua New Guinea for decorations and traditional artifacts.

Classification

- Dendrobium orchids belong to the large Orchidaceae family, which includes around 25,000 species.
- Within this family, Dendrobium is among the most diverse genera, with nearly 1,200 species globally.[23,51,52]

Noble Dendrobium

Properties

- Flavor: Sweet
- Nature: Slightly cold
- Benefits: Affects stomach, lungs, and kidneys.
- Key Uses: Helps produce body fluids, nourish Yin, clear excess heat, moisturize lungs, strengthen kidneys, improve eyesight, and support the lower back and knees.

Best Conditions for Growth

Healthy Dendrobium plants rely on their environment to produce the beneficial compounds they're known for.[29,73]

1. Temperature
   - 18–35°C supports balanced growth and bioactive compound production.
   - Too much heat or cold stresses the plant, affecting its medicinal quality.

2. Humidity
   - Best range: 70–80%. It keeps the plant hydrated and able to create healing compounds.
   - Low humidity disrupts growth, while adequate moisture supports its productivity.

3. Light
   - Essential for energy (photosynthesis) that powers the production of alkaloids and phenolic compounds.
   - Balanced light ensures better compound synthesis.

4. Stress Levels
   - Moderate stress can improve secondary compounds (like alkaloids) as part of the plant's defense.
   - Severe stress harms growth and reduces the plant's quality.

Common Uses

1. Thirst/Dehydration: Caused by fever or heat.
2. Stomach Issues: Nausea, pain, weak digestion due to low Yin.
3. Lung Dryness: Dry cough, thirst, etc.
4. Persistent Fever: From Yin deficiency.
5. Weak Eyesight: Related to poor Yin.
6. Lower Back & Knee Weakness: Linked to kidney issues.

Highlighted Remedies

- Remedy for Fever/Thirst: Mix Dendrobium with Trichosanthes Root, Fresh Rehmannia, and Ophiopogon Tuber.
- Eye Health: Combine Dendrobium with Goji Berries, Rehmannia, and Dodder Seed.
- Diabetes Management: Use Dendrobium with Calcined Gypsum, Trichosanthes, Adenophora, and Mondo Grass.
- Night Blindness/Eyesight: Blend Dendrobium with Epimedium and Atractylodes.

Clinical and Traditional Uses

- General Use: Treats pharyngitis, arthritis, skin infections, and lung dryness.
- Traditional Remedies: Benefits stomach, kidneys, lungs, and boosts immunity.[53,53,55]
- Other Uses: Energy booster, pain relief for lower back/legs, and eye care.

Additional Uses

- Ornamental: Popular houseplant.
- Culinary: Flowers and stems are edible—used in snacks, pickles, and garnishes.
- Emergency Food: Consumed by aboriginal communities during scarcity.

Anti-inflammatory Properties of Dendrobium nobile

- Key Compounds: Dendrobium orchids contain helpful substances like alkaloids and polysaccharides.
- How They Work: These compounds reduce inflammation by stopping certain inflammatory chemicals in the body, such as TNF-α and IL-6.
- Additional Benefits: They also target other inflammation-causing chemicals like IL-8 and IL-10 and block enzymes that cause inflammation.[24,58,59,60]

Anti-inflammatory Benefits

- Dendrobium orchids contain special compounds like alkaloids and polysaccharides. These compounds stop inflammation-causing chemicals (More Effects: They also reduce other inflammation triggers like IL-8 and IL-10.[27,67]

Tissue Healing and Homeostasis

Dendrobium nobile stands out for its ability to support the body in repairing damaged tissues and maintaining cellular balance (homeostasis).[28,68] Collagen Boost: Collagen is the protein responsible for keeping tissues strong and flexible. By promoting collagen production, Dendrobium nobile ensures wounds heal faster and better.

- Skin Cell Growth: It stimulates the growth and multiplication of new skin cells, essential for smooth and healthy wound closure.
- Gene Activation: Its impact on the Wnt/β-catenin pathway stabilizes β-catenin, which turns on healing-related genes. This helps new cells grow and damaged tissues repair efficiently.

Applications

The regenerative properties of Dendrobium nobile offer promise in:

- Skin Wounds: Faster healing with healthier tissue formation.
- Complex Repairs: Could help repair damaged organs and tissues.
- Long-term Health: Ensures cells remain healthy over time. [70,72]
- Its potential use in regenerative medicine might revolutionize treatments for injuries and internal damage, blending natural remedies with cutting-edge science.

Pharmacological action

Immune System Support

- D.nobile bioactive compounds improve T-cell immune responses, enabling the body to better recognize and eliminate cancer cells.
- Enhanced immunity also plays a role in preventing cancer metastasis, reducing the risk of cancer spreading to other areas.
- Inhibition of Angiogenesis: By suppressing angiogenesis (the growth of new blood vessels), the plant deprives tumors of the nutrients required for growth and survival, effectively halting their expansion.
- Selective Toxicity: Extracts from D. nobile have shown the ability to specifically target cancer cells, such as HeLa (cervical cancer) cells, while minimizing damage to healthy cells.

Polysaccharides' Role in Fighting Cancer

- Compounds like cDHPS are particularly effective against gastric cancer, demonstrating abilities to:
- Block cancer cell proliferation.
- Disrupt pathways essential for tumor survival.
- Enhance targeting mechanisms for cancer therapy.
- The molecular structure of these polysaccharides (e.g., molecular weight and O-acetyl groups) significantly influences their anticancer properties, highlighting the importance of structural optimization for treatment development.

Plant Age and Antitumor Activity

- The maturity of Dendrobium nobile plants is critical for their medicinal potency. Extracts from 3-year-old plants have consistently shown the highest antitumor activity, making them preferable for therapeutic use. Younger plants, in contrast, contain lower levels of bioactive compounds.

Broad Scope for Research and Applications

- Beyond cervical and gastric cancer, Dendrobium nobile is being investigated for its potential effects on other types of tumors. Its diverse chemical composition suggests wide-ranging medicinal applications.
- Future research priorities include detailed studies of compound interactions with cancer cells, clinical trials to validate findings, and sustainable cultivation methods to reduce costs and improve accessibility.

Pharmacological Highlights

- Variety of Active Compounds: D. huoshanense contains sesquiterpenoids, flavonoids, bibenzyls, phenols, and other small organic molecules, each contributing unique properties to its medicinal effects.
- Health Benefits:
  - The active ingredients support the immune system, protect cells, and reduce inflammation.
  - Many compounds act as antioxidants, helping to neutralize harmful free radicals in the body.
- Complex Action Mechanisms:
  - The compounds interact with various biochemical pathways, such as regulating metabolism, influencing enzymes, and modulating gene expression and cellular signaling.
- Traditional and Modern Applications:
  - Historically, D. huoshanense has been used to boost energy, enhance skin health, and promote vitality.

Medicinal Uses

- *Dendrobium officinale*: Known as a powerful medicinal herb in China, it boosts immunity, reduces stress, and prevents blood clots.
- Other species like *D. bifarium*, *D. planibulbe*, and *D. purpureum* are used in traditional medicine across Southeast Asia.[20,46,47,48]

CONCLUSION

Over the past decade, advances in molecular techniques have greatly expanded our understanding of orchid genetic diversity. Techniques like analyzing nuclear, plastid, and ribosomal genes, as well as molecular markers, help track DNA variations among orchid species and varieties. These studies play a key role in conservation, ensuring the survival of endangered orchids. DNA fingerprinting creates genetic profiles of rare and unique orchids for future reference. Molecular methods also help assess the health of orchids and support efforts to grow healthy populations through seed production and tissue culture. These techniques are vital for reintroducing orchids into their natural habitats and increasing their population numbers. Additionally, genetic profiling helps identify the origins of orchid species, aiding in efforts to prevent illegal collection and trafficking. Molecular studies also assist in accurately classifying and distinguishing species.

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