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Dendrobium as Food Medicine Homology: Ornamental, Edible, and Neuroprotective Values

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ABSTRACT: *Dendrobium*, one of the largest genera in the *Orchidaceae*, represents a distinctive plant resource with ornamental, edible and medicinal value. Owing to its rich floral diversity and long history of dietary and medicinal use in East and Southeast Asia, *Dendrobium* has attracted sustained attention from horticulture, food science and pharmacological research. Ornamentally, this genus is characterized by diverse floral morphology, color variation, abundant germplasm resources, and well-established cultivation systems that support its widespread use. In terms of edible value, only certain species, especially *Dendrobium officinale*, have been formally incorporated into food use in China, with stems, flowers and leaves approved as food materials. These edible parts contain polysaccharides, flavonoids, alkaloids and phenolic compounds, providing a chemical basis for functional food development. Accumulating preclinical studies indicate that *Dendrobium*-derived constituents exert neuroprotective effects in experimental models of Alzheimer's disease, Parkinson's disease, aging, ischemic stroke and spinal cord injury. Reported mechanisms involve oxidative stress regulation, neuroinflammatory modulation, autophagy-lysosome pathways and gut-brain axis signaling. This review examines the ornamental, edible and neuroprotective value of *Dendrobium* from a food medicine homology, with emphasis on species-specific uses, edible-part composition, translational limits and future directions for rational development and application.

Keywords: *Dendrobium*; food medicine homology; functional foods; neuroprotection; Alzheimer's disease; Parkinson's disease

1. Introduction

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Plants that simultaneously possess ornamental, edible and medicinal functions represent a distinctive category of biological resources in both traditional and modern use systems^[1,2]. The genus *Dendrobium* (*Orchidaceae*), comprising more than 1,500 species distributed mainly across Asia and the Pacific region, exemplifies this multifunctionality^[3]. Historically, *Dendrobium* species have been valued for medicinal use in traditional Chinese medicine and related ethnomedical systems^[4,5], while selected species have also entered local diets as teas^[6], decoctions^[7] and culinary ingredients^[8]. In parallel, *Dendrobium* has achieved global prominence as a cultivated ornamental orchid, supported by extensive breeding, commercial production and international trade^[9].

The ornamental value of *Dendrobium* largely derives from its pronounced diversity in floral morphology, coloration, flowering behavior and growth habits^[9,10]. Advances in tissue culture, controlled-environment cultivation and cultivar selection have enabled large-scale, standardized production of ornamental *Dendrobium*, ensuring stable supply and phenotypic consistency^[11,12]. Although these characteristics primarily underpin the horticultural and commercial importance of *Dendrobium*, they also affect germplasm conservation, raw material traceability and cultivation management relevant to its sustainable use as a food and medicinal resource^[9,13].

Within food medicine homology, several *Dendrobium* species, particularly *Dendrobium officinale*, have a long history of dietary use and have been formally approved as edible materials in China^[14]. The stems, flowers and leaves of these species are incorporated into teas, beverages, solid preparations and other food forms^[6-8]. Chemical and nutritional studies indicate that these edible parts are rich in polysaccharides, flavonoids, alkaloids and phenolic compounds, providing a biochemical basis for their rational development as functional food materials beyond traditional medicinal use^[15].

Concurrently, an expanding body of pharmacological research has explored the neuroprotective effects of *Dendrobium*-derived constituents in experimental models of neurodegenerative and neurological disorders^[16-18]. Preclinical studies report beneficial effects in models of Alzheimer's disease (AD)^[18], Parkinson's disease (PD)^[19], brain aging^[20], ischemic stroke^[21] and spinal cord injury^[22], involving multiple pathogenic processes such as oxidative stress^[23], neuroinflammatory signaling^[24], autophagy-lysosome pathways^[25] and disturbances of the gut-brain axis^[26]. These findings suggest that *Dendrobium* may exert multi-target neuroprotective actions that are compatible with the complex etiology of neurological disorders^[27], although the available evidence remains largely preclinical.

In the context of food medicine homology, *Dendrobium* should not be treated as a homogeneous resource. Moreover, the broader concept of food medicine homology is also shifting from traditional experience-based understanding toward a more modern and prevention-oriented paradigm^[2]. *Dendrobium officinale* is discussed here primarily in relation to edible use and regulated food development, whereas *Dendrobium nobile* is more prominently represented in alkaloid-rich neuropharmacological studies, and *Dendrobium huoshanense* appears in selected studies on polysaccharides and phenolic constituents. By contrast, ornamental *Dendrobium* includes both nobile-type and phalaenopsis-type horticultural groups, which overlap only partially with edible

or medicinal resources at the species level. This distinction is important for understanding which cultivation systems, plant parts and bioactive constituents are relevant to each application. This review examines the ornamental, edible and neuroprotective value of *Dendrobium* within food medicine homology, with emphasis on species-specific use, species-part-component relationships and translational limits relevant to realistic food use.

2. Ornamental Value of *Dendrobium*

Dendrobium species are valued as ornamental orchids primarily for their diverse flower shapes, vibrant colors and long flowering period^[28]. The genus includes a broad range of species distributed across tropical and subtropical regions of Asia and the Pacific. This broad distribution has supported the development of distinct ornamental types adapted to different climatic and cultivation conditions^[9].

Cultivated *Dendrobium* is commonly classified into two major groups based on flowering habit and ecological adaptation (Fig 1). The spring-flowering group (Soft-caned *Dendrobium*), represented by *Dendrobium nobile* and related species, typically exhibits pseudobulbous canes with seasonal leaf loss and produces dense flowers along mature stems following exposure to cooler temperatures. These plants are mainly used as potted ornamentals and are intrinsically linked to the traditional orchid culture of East Asia. In contrast, the autumn-flowering or phalaenopsis-type group (Hard-caned *Dendrobium*) is derived largely from evergreen tropical species and is characterized by robust canes, persistent leaves and inflorescences that emerge from the upper nodes. Owing to their relatively stable flowering under warm conditions and long-lasting blooms, these cultivars dominate the international market for cut *Dendrobium* flowers.

The ornamental appeal of *Dendrobium* flowers is determined by variations in floral architecture, labellum structure and pigment composition. Flower color is mainly related to anthocyanin and flavonoid composition^[29-31], while differences in petal epidermal structure contribute to color intensity and visual stability^[32]. In addition, substantial interspecific and cultivar-level variation exists in flowering duration and postharvest longevity, which directly influences ornamental quality and commercial usability^[33].

As cut flowers, *Dendrobium* is recognized for its relatively long vase life compared with many other orchids. Flower longevity is closely related to temperature, water quality and ethylene sensitivity^[34,35]. Appropriate postharvest handling (Fig 1), including timely harvesting at partial bloom, water control^[36,37], maintenance at moderate temperatures^[38], controlled atmosphere storage^[39,40], irradiation^[41] and the use of preservative solutions containing sugars and antimicrobial agents^[42,43], can effectively delay petal senescence and extend display time. In some cultivars, inhibition of ethylene action further prolongs the vase life, making *Dendrobium* particularly suitable for transport and display over extended periods^[43,44].

Ornamental cultivation of *Dendrobium* prioritizes visual traits, yet decades of horticultural practice have generated mature technical systems for species identification, clonal propagation and postharvest handling. While these protocols primarily serve the flower trade, they offer transferable expertise for germplasm conservation and raw material standardization in food and pharmaceutical sectors. However, direct conversion of ornamental germplasm to edible or medicinal use requires rigorous species authentication, compositional

evaluation and regulatory compliance. Thus, the value of ornamental *Dendrobium* lies not in direct substitution but in providing cultivation infrastructure and supply-chain support for approved edible and medicinal species.

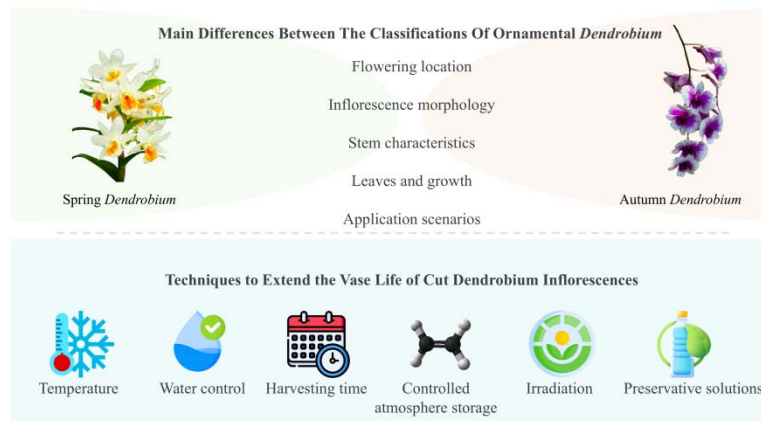


Fig 1. Differences in the classification of ornamental *Dendrobium* and techniques to extend the vase life of *Dendrobium* inflorescences.

3. Edible Value of *Dendrobium*

Dendrobium represents an important plant group within food medicine homology, with a documented history of both medicinal and dietary use in China and Southeast Asia^[45]. Traditionally, the stems of *Dendrobium*, particularly those of *Dendrobium officinale*, have been used as medicinal materials for nourishing yin and promoting fluid production^[46]. With the development of modern food regulations and growing interest in functional foods, additional plant parts, including flowers and leaves, have gradually been incorporated into edible applications^[11]. Contemporary studies on chemical composition and nutritional characteristics indicate that different edible organs of *Dendrobium* contain distinct profiles of bioactive constituents, supporting their rational utilization as food materials^[8,47].

3.1 Historical Use and Regional Dietary Culture

The use of *Dendrobium* as both food and medicine is deeply rooted in traditional dietary and medical systems of China and neighboring regions, where the boundaries between nourishment and therapy have historically been fluid^[48]. In the context of food medicine homology, *Dendrobium* served not only as a medicinal material but also as a dietary ingredient in everyday use within specific cultural traditions. In several regions of southern and southwestern China, sliced *Dendrobium* stems have long been consumed as herbal infusions or added to soups and congee, reflecting a dietary tradition that emphasizes mild, tonic foods intended for long-term consumption rather than acute treatment^[5].

The dietary use of *Dendrobium* is also reflected in local culinary customs and seasonal practices. In some areas, *Dendrobium* preparations were traditionally associated with convalescence, seasonal dryness or aging-related dietary adjustment, aligning with cultural concepts of balance and maintenance^[49]. In Southeast Asia, particularly in Thailand and parts of Malaysia, orchid flowers, including those of *Dendrobium*, have been used as edible garnishes or ingredients in desserts and beverages, contributing to the broader cultural acceptance of orchids as edible plants^[9,50].

At present, the transition of *Dendrobium* from traditional dietary use to regulated food material has been

formalized through modern food governance. In China, *Dendrobium officinale* stems were approved as a novel food ingredient in 2013, followed by the approval of leaves in 2017 and flowers in 2018^[46]. In 2023, these plant parts were further included in the national list of substances traditionally used as both food and medicinal materials, establishing a clear regulatory basis for their use in conventional and functional foods^[14]. Meanwhile, several provinces have issued local food safety standards for dried *Dendrobium* stems, flowers and leaves, covering processing requirements and safety indicators^[11]. This regulatory development also reflects the broader evolution of food medicine homology policy in China, in which traditionally used substances are being re-evaluated within more systematic and internationally informed regulatory frameworks^[51]. Together, historical dietary practices and contemporary regulatory frameworks provide complementary support for the current edible use of *Dendrobium*.

3.2 Edible Parts and Major Nutritional and Functional Components

The edible value of *Dendrobium* is species- and organ-dependent. Current discussion of food use is centered mainly on *Dendrobium officinale*, for which stems, flowers and leaves have been formally incorporated into regulated food use in China, whereas compositional data from other species are informative but should not be taken as directly interchangeable. For clarity, the major component classes discussed below should be interpreted in relation to specific species and plant parts rather than to the genus as a whole. The species-part-component correspondence and representative compositional characteristics of edible *Dendrobium* resources are summarized in Table 1.

Table 1. Species-part-component correspondence and representative compositional characteristics of edible *Dendrobium* resources

Species	Part	Major component	Content range	Representative food form	Refs.
<i>D. officinale</i>	Stem	Polysaccharides, flavonoids, phenolics, minor alkaloids/bibenzyls	Polysaccharides 20-35% dry weight (DW), with higher values reported in some sources or harvest periods	Slices, teas, decoctions, powders, solid beverages	[53,55,56]
<i>D. officinale</i>	Flower	Flavonoids, phenolic glycosides, polysaccharides, amino acids	Flavonoids around 1.4-1.8% DW; phenolic fraction prominent; polysaccharides up to 13.75% DW	Floral teas, dried flowers, soups, powders, functional beverages, edible garnishes	[59-61]
<i>D. officinale</i>	Leaf	Flavonoids, phenolics, polysaccharides	Polysaccharides 8.99-16.55% DW; total flavonoids 7.66-9.50 mg/g DW; rutin 1.33-2.89 mg/g DW	Leaf teas, powders, compound beverages	[60,67,71]
Selected non- <i>officinale</i> species (e.g., <i>D. nobile</i>)	Mainly stem or flower	Species-dependent polysaccharides, phenolics, alkaloids	Polysaccharides are a major constituent; total alkaloids are typically present at low levels, with dendrobine as a representative marker alkaloid; marked variation by source, growth stage, and harvest time.	Traditional medicinal use (not approved for food)	[4,15,54]

3.2.1 Stems

The stems, especially those of *Dendrobium officinale*, constitute the primary edible and medicinal parts and remain the most extensively studied food material within this genus. Chemical investigations indicate that

stems contain polysaccharides, flavonoids, phenolic compounds, alkaloids, bibenzyls and related secondary metabolites^[52-54]. Among these, polysaccharides are generally the most prominent food-related constituents in stems and largely account for the characteristic viscosity, aqueous extractability and textural properties of stem-based products^[55]. By contrast, alkaloids and certain bibenzyl-type constituents are more often emphasized in medicinal or pharmacological studies and may vary substantially across species, meaning that their presence should not be generalized across all edible *Dendrobium* materials.

Dendrobium officinale stems exhibit a mild and slightly sweet taste, which facilitates their incorporation into teas, beverages and solid food products^[45,56]. Safety evaluation studies, including acute toxicity and subchronic feeding assessments, have not revealed obvious toxicological concerns within recommended intake ranges^[47,57,58], supporting the suitability of *Dendrobium* stems as food raw materials under regulated conditions. Available comparative studies also suggest that stems are compositionally distinct from flowers and leaves, with greater relevance to polysaccharide-rich preparations used in teas, beverages and other water-based food forms. Accordingly, stems remain the most representative edible organ when discussing the food-grade development of *Dendrobium*.

3.2.2 Flowers

The flowers of *Dendrobium*, particularly those of *Dendrobium officinale* and some related edible species, have attracted increasing attention as edible flowers and functional ingredients. Chemical analyses indicate that flowers contain polysaccharides, flavonoids, phenolic acids, free amino acids and minor lipid components^[59,60]. Compared with stems, flowers generally show a greater relative contribution of flavonoids and phenolic compounds, whereas their polysaccharide profile is less emphasized in food research^[60]. This compositional tendency is consistent with the use of flowers in dried teas, floral beverages and other products in which aroma, color and polyphenol-related sensory attributes are important.

Edible flower products derived from *Dendrobium* are mainly used in the form of dried flowers, floral teas, powders or extracts^[6,61]. Experimental studies in animal models have suggested potential biological activities of flower-derived extracts^[62-64]; however, such findings should be interpreted cautiously, as they do not directly reflect nutritional outcomes at typical dietary intake levels. At present, the edible value of *Dendrobium* flowers is more appropriately understood in terms of their nutritional composition and suitability as food ingredients rather than confirmed health functions.

3.2.3 Leaves

Leaves were historically not recognized as major edible parts of *Dendrobium*, but recent studies indicate that they also contain polysaccharides, flavonoids and phenolic compounds^[60]. Compared with stems, leaves appear to have greater relevance to polyphenol-related antioxidant properties and to whole-plant resource utilization, although their food application remains less established^[65,66]. Based on compositional evidence and safety evaluations, *Dendrobium officinale* leaves have been approved for food use, and local standards have been formulated in certain regions to regulate quality parameters such as moisture content, impurity limits and heavy metal levels^[67].

The inclusion of leaves in food use may improve resource efficiency and reduce waste during cultivation and processing^[68]. However, their current role is still complementary rather than central, and they should not be regarded as interchangeable with stems in terms of compositional profile, historical dietary use or product maturity.

3.3 Major Forms of Consumption and Food Processing Applications

Traditional consumption of *Dendrobium* is primarily based on aqueous extraction, reflecting both historical dietary practice and the physicochemical characteristics of its major constituents^[60]. Sliced or dried stems are commonly infused or lightly decocted in water, allowing efficient extraction of water-soluble polysaccharides and other hydrophilic components. Flowers are typically prepared as floral teas or incorporated into soups and mild dishes, while leaves are less frequently used in traditional preparations. These practices align with the thermal sensitivity and solubility profiles of polysaccharides and polyphenolic compounds present in *Dendrobium* tissues^[8].

With the formal approval of *Dendrobium officinale* stems, flowers and leaves as food materials, modern processing methods have been developed to adapt *Dendrobium* to standardized food products. In contemporary applications, *Dendrobium* raw materials are commonly processed into dried teas, granulated products, powdered ingredients and solid beverages^[6,69,70]. Drying methods play a critical role in determining product quality. Low-temperature hot-air drying and freeze-drying are widely applied to preserve polysaccharides and flavonoids, whereas prolonged exposure to high temperatures may lead to partial degradation of heat-sensitive phenolic compounds^[71].

Powdered *Dendrobium* products are mainly used as ingredients in compound beverages and solid drink formulations, often in combination with other plant-based materials^[72]. In such applications, attention is paid to particle size distribution, hygroscopicity and dispersion properties to ensure product stability and sensory acceptability^[70,73]. Extraction-based ingredients, including aqueous concentrates and dried extracts, are also utilized in some formulations; however, their application is generally constrained by considerations of compositional consistency, processing cost and regulatory classification.

The stability of *Dendrobium*-derived components during processing and storage is an important quality consideration^[74,75]. Polysaccharides are generally better preserved by freeze-drying, whereas hot-air drying can reduce polysaccharide retention and related functional readouts. However, the extent of loss varies with plant part, drying conditions and the indicator measured. Flavonoids and phenolic compounds are also susceptible to oxidation and thermal degradation. Accordingly, packaging strategies that limit moisture ingress and oxygen exposure are commonly employed to maintain product quality^[39]. However, from the perspective of neuroprotective translation, stability should not be discussed only at the level of broad chemical classes. Many studies reporting neuroprotective effects have used enriched extracts, partially purified fractions or isolated compounds rather than conventionally processed food matrices. As a result, preservation of polysaccharides, flavonoids or phenolic compounds during drying and storage does not necessarily indicate preservation of neuroprotective efficacy after food processing. This issue is particularly relevant for phenolic

and other small-molecule constituents that may be sensitive to heat, oxidation and prolonged storage. Therefore, future work should distinguish compositional retention from functional retention and identify which food-compatible components remain biologically relevant after realistic processing and intake conditions. Currently, *Dendrobium*-based foods are positioned primarily as conventional or functional food ingredients, and their formulation is guided by compositional characteristics and safety assessments rather than by pharmacological efficacy.

In summary, the edible value of *Dendrobium* is supported by a combination of historical dietary use, regulatory recognition and chemical composition. The stems, flowers and leaves provide distinct but complementary sources of polysaccharides and polyphenolic compounds, enabling diversified food applications (Fig 2). Further work is required to establish standardized processing methods, intake guidelines and evidence-based evaluation of nutritional relevance, thereby supporting the rational development of *Dendrobium* as a food-derived resource within food medicine homology.

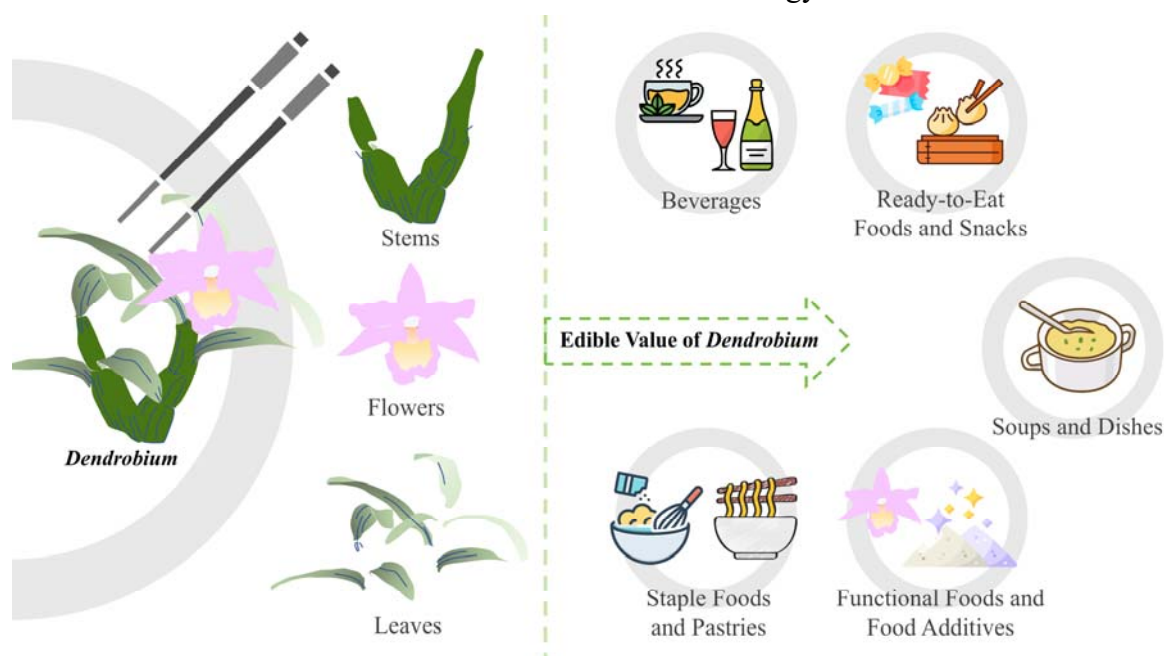


Fig 2. Edible value of *Dendrobium*: Edible parts and methods of consumption of *Dendrobium*.

4. Neuroprotective Effects of *Dendrobium*

In recent years, the neuroprotective effects of *Dendrobium* species and their derived constituents have been explored primarily in preclinical experimental systems^[76]. These studies have examined a range of materials, including alkaloids, polysaccharides, phenolic compounds and partially purified extracts, using diverse *in vitro* and *in vivo* models relevant to neurodegeneration, aging-related functional decline and acute neural injury (Fig 3)^[18,62,77]. Representative evidence differs across component classes, with *Dendrobium nobile* being particularly prominent in alkaloid-focused studies, *Dendrobium officinale* in polysaccharide-oriented and gut-related studies, and selected other species such as *Dendrobium huoshanense* contributing additional phenolic or small-molecule evidence.

Across these experimental contexts, *Dendrobium*-derived materials have been reported to influence several processes associated with neuronal vulnerability, including oxidative imbalance, inflammatory

responses, disturbances in protein homeostasis and mitochondrial dysfunction^[23,78,79]. Within food medicine homology, however, these findings are best interpreted as mechanistic evidence that may inform preventive food research and function-oriented ingredient development, rather than as direct support for therapeutic efficacy under ordinary dietary exposure. To facilitate horizontal comparison across major component classes, representative preclinical models, mechanisms and translational relevance to food use, the available evidence is summarized in Table 2.

Table 2. Comparative summary of major *Dendrobium*-derived component classes, neuroprotective mechanisms and food-use translational relevance

Component class	Species	Preclinical models	Main mechanisms	Translational relevance to food use and limitations	Refs.
Alkaloids	<i>D. nobile</i>	AD, PD, aging, ischemic injury	• Aβ-related pathology • Tau phosphorylation • Autophagy-lysosome function • Anti-neuroinflammatory signaling	Primarily studied as concentrated extracts or purified compounds; experimental doses generally exceed realistic food intake levels, which limits direct translation to food fortification	[16,18,79,100]
Polysaccharides	<i>D. officinale</i> <i>D. huoshanense</i> <i>D. nobile</i>	AD, aging, ischemic injury, SCI	• Gut-brain axis modulation • Systemic immunomodulation • Antioxidant enzyme activation • Cellular and mitochondrial protection	Relatively compatible with food matrices, but preparations are heterogeneous and structure-function relationships remain insufficiently defined	[21,22,26,94,106,116]
Phenolic compounds & Bibenzyls (erianin, moscatilin)	<i>D. officinale</i> <i>D. huoshanense</i> and selected other species	AD, PD, ischemic injury	• Antioxidant (ROS scavenging) • Tau phosphorylation • Anti-neuroinflammatory signaling • Mitochondrial protection	Mechanistically relevant to food-related polyphenol research, but their stability during processing and activity at realistic dietary exposure levels remain uncertain	[19,25,91]

4.1 Alzheimer's disease

Among neurological disorders investigated in relation to *Dendrobium*, AD has received the most extensive experimental attention. Preclinical studies have evaluated a range of *Dendrobium*-derived materials. These include *Dendrobium nobile* alkaloids (DNLA) and individual alkaloids such as dendrobine, polysaccharides from *Dendrobium officinale*, as well as phenolic and bibenzyl compounds^[79–81]. These materials have been examined across diverse AD-related models, including transgenic mice, chemically or diet-induced AD-like models, and cellular systems, consistently reporting improvements in cognitive performance or attenuation of neuropathological features^[16,82,83]. While these constituents share common neuroprotective targets, such as oxidative stress and inflammation, available studies suggest partially distinct mechanistic emphases. Alkaloid-rich preparations from *Dendrobium nobile* may act more directly in central models, whereas polysaccharides from *Dendrobium officinale* are more often discussed in relation to gut-brain interactions and systemic immunomodulation, and phenolic compounds are commonly linked to antioxidant

and anti-inflammatory effects.

In transgenic and induced animal models, DNLA has been shown to ameliorate learning and memory deficits, reduce amyloid beta (A β) deposition and preserve neuronal and synaptic integrity^[79,84]. Mechanistic investigations suggest that DNLA influences both A β generation and clearance by modulating key proteins involved in amyloid processing, including amyloid precursor protein (APP), beta-site amyloid precursor protein cleaving enzyme 1 (BACE1) and presenilin-1 (PS1), alongside increased activity of amyloid-degrading enzymes such as neprilysin and insulin-degrading enzyme^[82,85]. In addition, DNLA has been reported to enhance autophagy-lysosome function by improving lysosomal acidification and promoting degradation of aggregated proteins, thereby facilitating A β clearance within neurons^[86,87].

Dysregulated Tau phosphorylation represents another hallmark of AD pathology addressed in *Dendrobium*-related studies. DNLA and dendrobine have been reported to attenuate Tau hyperphosphorylation in aging and AD models through modulation of stress-associated signaling pathways, including endoplasmic reticulum stress-related protein kinase R-like endoplasmic reticulum kinase (PERK) activation and downstream kinases such as glycogen synthase kinase-3 β (GSK-3 β) and cyclin-dependent kinase 5 (Cdk5)^[16,88-90]. Through these mechanisms, neuronal loss and synaptic disruption in hippocampal regions were alleviated in preclinical systems. Complementary findings from phenolic and bibenzyl compounds, including moscatilin, indicate reduced Tau phosphorylation and aggregation, potentially related to antioxidant activity and kinase inhibition^[91].

Beyond A β and Tau pathology, *Dendrobium*-derived constituents have also been associated with modulation of neuroinflammatory responses and synaptic plasticity^[92,93]. DNLA suppressed microglial activation and inflammasome-associated signaling in inflammation-related AD models, accompanied by reduced release of proinflammatory cytokines^[24]. Additionally, improvements in synaptic structure and function were observed, including increased expression of synaptic proteins and normalization of neurotransmission-related pathways^[83,93]. Polysaccharides from *Dendrobium officinale* have further been implicated in regulating gut-brain interactions in AD models, with reported changes in intestinal barrier integrity and microbiota composition coinciding with cognitive improvement^[26,94]. Recent evidence that *Dendrobium officinale* oligosaccharides alleviate chronic colitis through concurrent modulation of inflammatory responses and gut microbiota further supports the plausibility that specific *Dendrobium*-derived carbohydrates may influence gut-derived inflammatory tone relevant to gut-brain axis signaling^[95], although direct neuroprotective evidence from this line of work remains limited.

Although these findings collectively suggest that *Dendrobium*-derived materials can influence multiple pathogenic processes relevant to AD, several limitations warrant consideration. The majority of evidence is derived from animal or cellular models, with substantial variability in experimental design, treatment duration and dosing strategies. In addition, the multifactorial and heterogeneous pathogenesis of AD further complicates mechanistic integration and therapeutic translation^[96-98]. Material composition is often heterogeneous, particularly for alkaloid mixtures and polysaccharide preparations, which complicates

reproducibility and cross-study comparison. Moreover, pharmacokinetic properties, brain exposure, blood-brain barrier relevance and long-term safety remain insufficiently characterized. It should also be noted that the tested materials were commonly administered as concentrated extracts, enriched fractions, purified compounds, or experimentally defined doses that are not directly comparable to ordinary dietary intake of *Dendrobium*-based foods. Consequently, current data are better interpreted as evidence of mechanistic neuroprotection in experimental AD models and as support for preventive food-oriented research, rather than as evidence of disease-modifying efficacy in humans.

4.2 Parkinson's disease

As another representative neurodegenerative disease, PD-related studies of *Dendrobium* have been conducted mainly in experimental models of dopaminergic neurodegeneration induced by neurotoxins or oxidative and inflammatory stress, reflecting the dominant pathological features targeted in current research^[19,99,100]. In these models, *Dendrobium*-derived materials are evaluated primarily for their ability to preserve nigrostriatal dopaminergic neurons and to modulate glia-associated pathological processes.

At the cellular level, several *Dendrobium*-derived small molecules and extracts have shown protective effects against oxidative injury in dopaminergic neuron-like systems. Compounds isolated from *Dendrobium nobile*, including alkaloid-related compounds, improved cell viability and reduced apoptosis in hydrogen peroxide-challenged PC12 or SH-SY5Y cells^[101,102]. Additionally, metabolites produced by *Dendrobium*-associated endophytic microorganisms demonstrated cytoprotective effects characterized by reduced reactive oxygen species accumulation, stabilization of mitochondrial membrane potential, and attenuation of inflammatory signaling, with activation of nuclear factor erythroid 2-related factor 2 (Nrf2)-associated stress response pathways frequently implicated^[103].

More disease-relevant findings have been obtained from toxin-based animal models. Alkaloid-enriched fractions from *Dendrobium nobile*, particularly DNLA, have been reported to alleviate dopaminergic neuron loss in the substantia nigra and to improve motor performance in 6-hydroxydopamine (6-OHDA) lesioned rodents. Mechanistic analyses indicate that these effects are associated with suppression of microglial activation and reduced production of proinflammatory mediators, suggesting that modulation of neuroinflammatory pathways contributes to the observed neuroprotection^[100,102]. Consistent with these observations, ethanol extracts of *Dendrobium nobile* have been shown to protect dopaminergic neurons and enhance stress resistance in *Caenorhabditis elegans* models, implicating conserved cellular defense mechanisms^[104].

Phenolic constituents, particularly bibenzyl derivatives, represent another important class of *Dendrobium*-derived compounds investigated in PD-related models. Compounds such as erianin have demonstrated protective effects in 1-methyl-4-phenyl-1,2,3,6-tetrahydropyridine (MPTP)-induced PD mouse models, accompanied by improved motor behavior and preservation of dopaminergic markers^[19]. In microglial activation systems, these compounds suppressed inflammatory signaling pathways, including nuclear factor- κ B (NF- κ B) and inflammasome-associated cascades, while reducing oxidative stress markers,

supporting a role for immunomodulation in their neuroprotective actions.

Despite these convergent findings, several limitations should be noted. Most studies rely on acute or subacute toxin-based models that reproduce selected aspects of dopaminergic degeneration but do not capture the chronic progression and etiological complexity of PD. In addition, heterogeneity in material composition, particularly among crude extracts and alkaloid mixtures, limits reproducibility and mechanistic resolution. Pharmacokinetic properties, blood-brain barrier penetration and long-term safety of *Dendrobium*-derived constituents remain insufficiently characterized. Importantly, the exposure conditions used in these studies often involve concentrated extracts, alkaloid-enriched fractions or isolated compounds at experimental doses that are not directly comparable to daily dietary intake. Accordingly, current evidence supports mechanistic neuroprotective potential in experimental PD models and may inform preventive food or ingredient research, but it does not yet provide a basis for therapeutic or disease-modifying claims in clinical PD.

4.3 Aging-Related Neuroprotection

Dendrobium has been examined in a range of experimental models that address age-associated changes in neural function, including cognitive performance, oxidative balance, inflammatory status and cellular stress responses^[20,80]. These studies address functional decline during aging and provide insight into how *Dendrobium*-derived constituents influence the aging nervous system.

Polysaccharides isolated from *Dendrobium officinale* and *Dendrobium huoshanense* have been widely evaluated in chemically induced aging models^[105], most commonly D-galactose-treated rodents^[80,106]. In these models, administration of *Dendrobium* polysaccharides was associated with improved learning and memory performance, increased activities of endogenous antioxidant enzymes and reduced accumulation of oxidative damage markers in brain tissues^[107,108]. Concurrently, decreases in proinflammatory mediators and improvements in mitochondrial-related indices have been reported, suggesting coordinated regulation of redox homeostasis and cellular energy metabolism during aging^[109–111].

Alkaloids from *Dendrobium nobile*, particularly DNLA, have also been investigated in aging-prone animal models such as senescence-accelerated mouse-prone 8 (SAMP8) mice. In these systems, DNLA treatment was associated with improvements in cognitive behavior and synaptic integrity. Mechanistic analyses indicated modulation of cellular stress-related pathways, including attenuation of excessive endoplasmic reticulum stress and partial normalization of autophagic activity, which may contribute to enhanced neuronal survival under aging-related stress conditions.

Additional experimental evidence from lower-order model organisms further supports the influence of *Dendrobium*-derived constituents on aging-associated neural phenotypes. Dendrobine has been reported to extend lifespan and enhance stress tolerance in yeast and invertebrate systems^[77,112], while extracts obtained from *Dendrobium* flowers and other plant parts have been shown to affect neurotransmitter balance and hippocampal morphology in senescent animals^[110].

Taken together, existing studies indicate that *Dendrobium*-derived polysaccharides and alkaloids modulate multiple biological processes associated with neural aging, including oxidative stress, inflammatory

responses and cellular stress pathways. However, the available evidence remains derived from preclinical models with variable experimental designs and material definitions. In addition, many studies employ concentrated extracts or purified constituents at doses that exceed ordinary dietary exposure, which limits direct nutritional interpretation. Therefore, these findings are more appropriately regarded as mechanistic support for the possibility that *Dendrobium*-derived food materials or ingredients may contribute to healthy aging research, rather than as direct evidence that routine dietary intake can reproduce the reported anti-aging neuroprotective effects.

4.4 Neuroprotection in Acute Neural Injury

In addition to chronic and aging-related contexts, *Dendrobium*-derived constituents have been investigated in experimental models of acute neural injury, including ischemic brain damage and traumatic spinal cord injury^[113,114]. These models are characterized by rapid neuronal loss and secondary injury cascades involving oxidative stress, mitochondrial dysfunction, and inflammatory responses. Studies in this area focus on the capacity of *Dendrobium*-related materials to mitigate early pathological events and to support structural and functional recovery following acute neural insult.

Compounds isolated from *Dendrobium nobile* and related species have demonstrated neuroprotective effects in experimental models of cerebral ischemia and reperfusion injury. In middle cerebral artery occlusion (MCAO) models, administration of *Dendrobium nobile* compounds was associated with reduced infarct volume, improved neurological scores and decreased neuronal apoptosis^[115]. Mechanistic investigations indicated that these effects were accompanied by suppression of ischemia-induced inflammatory responses and modulation of cell-survival-related signaling pathways^[113].

Studies on *Dendrobium officinale* polysaccharides have further suggested a supportive role in post-ischemic recovery through indirect mechanisms. *In vitro* experiments showed that these polysaccharides promoted neuronal differentiation of bone marrow-derived mesenchymal stem cells by regulating developmental signaling pathways. Transplantation of such induced cells into ischemic injury models was associated with reduced expression of inflammatory markers and partial functional recovery, indicating potential involvement in neural repair processes following acute injury^[116].

In addition to naturally occurring compounds, *Dendrobium*-derived phenolic structures have also inspired the development of bioactive derivatives targeting ischemic injury-related mechanisms^[117]. Modified bibenzyl compounds demonstrated protective effects in ischemic models through attenuation of oxidative damage, regulation of mitochondrial function and reduction of excitotoxic signaling, supporting the experimental neuroprotective potential of *Dendrobium*-associated chemical classes.

Neuroprotective effects of *Dendrobium* constituents have also been examined in experimental models of traumatic spinal cord injury. Administration of *Dendrobium nobile* polysaccharides in spinal cord contusion models improved locomotor function, reduced lesion cavity formation and preserved neuronal and glial architecture^[22]. These outcomes were associated with attenuation of secondary injury processes that contribute to progressive tissue damage after trauma. Mechanistic studies have implicated regulation of ferroptosis-

related pathways in these effects. Treatment with *Dendrobium*-derived polysaccharides was reported to restore glutathione levels, enhance antioxidant enzyme activity and maintain mitochondrial integrity within injured spinal cord tissue. By limiting iron-dependent lipid peroxidation and oxidative damage, these materials may help protect against secondary neuronal loss following spinal trauma.

Although these studies suggest that *Dendrobium*-derived materials may attenuate secondary injury cascades in acute neural damage, their interpretation requires particular caution. The relevant models involve severe and rapidly evolving pathological conditions, and the tested materials are usually administered as isolated compounds, enriched fractions or experimentally defined doses rather than as conventional foods. As a result, the observed benefits should not be directly extrapolated to daily dietary intake or to routine food use scenarios. At present, these findings are best understood as experimental evidence of neuroprotective potential in acute injury systems, with uncertain relevance to food-level exposure in humans.

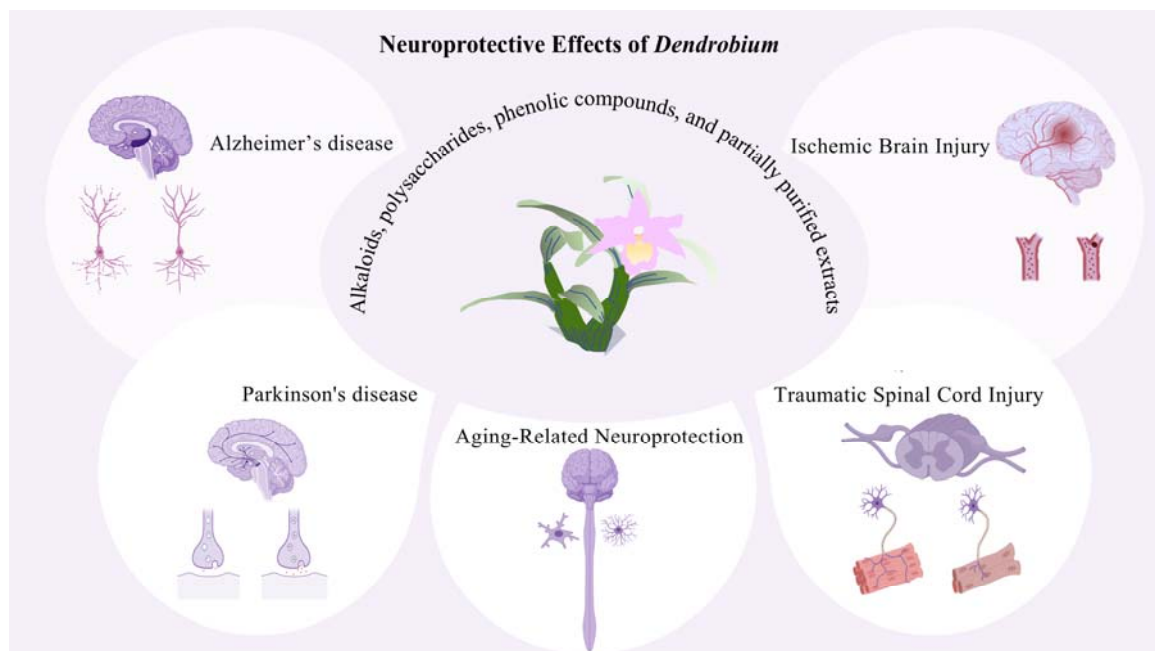


Fig 3. Neuroprotective Effects of *Dendrobium*.

5. Conclusions and Future Perspectives

Dendrobium represents a distinctive plant resource within food medicine homology, characterized by long-standing dietary use, formal regulatory recognition and increasing investigation of biological activities. However, this genus should not be treated as a homogeneous entity across ornamental, edible and neuroprotective contexts. Current evidence suggests that different species, plant parts and preparations contribute unequally to these applications. In particular, *Dendrobium officinale* is most relevant to regulated edible use, whereas *Dendrobium nobile* is more prominently represented in alkaloid-centered neuropharmacological studies.

Neuropharmacological studies suggest that *Dendrobium*-derived materials can modulate diverse processes involved in neuronal vulnerability, including oxidative stress, inflammatory signaling, autophagy-related dysfunction, mitochondrial injury and gut-brain interactions. These findings support mechanistic plausibility for neuroprotective actions in experimental systems, but important translational barriers remain.

Current evidence is dominated by preclinical studies with substantial heterogeneity in species, plant parts, extraction methods and chemical characterization. Oral bioavailability, tissue distribution and blood-brain barrier relevance of specific constituents remain insufficiently defined. In addition, the doses and administration routes used in experimental settings are often not comparable to exposures achievable through conventional food consumption, and long-term safety under realistic intake conditions remains inadequately characterized. Therefore, the present evidence should be interpreted as supporting biological plausibility and research value rather than clinical efficacy or dietary recommendations.

Future research on *Dendrobium* within food medicine homology should prioritize several issues. First, species-authenticated raw materials and species-part-component relationships should be more clearly established to improve reproducibility and avoid overgeneralization at the genus level. Second, standardized processing methods and quality markers should be developed to better preserve food-relevant active fractions and to improve batch-to-batch consistency. Third, future studies should distinguish compositional retention from functional retention and should evaluate whether food-compatible preparations retain biologically relevant activity after realistic processing and storage conditions. Fourth, more attention should be paid to exposure-relevant study designs, including pharmacokinetic evaluation, dose conversion and long-term nutritional safety^[118,119].

For future development, *Dendrobium* may be more appropriately advanced first as a preventive or health-supporting food resource rather than as a therapeutic intervention. Functional teas, beverages, powders and other food-grade ingredients derived from species with established edible use may represent the most realistic near-term direction. Ultimately, well-designed human studies, together with stronger integration of food science, phytochemistry, neuropharmacology and regulatory evaluation, will be necessary to define the appropriate scope and limitations of *Dendrobium* within modern food medicine homology.

Conflicts of interest

The authors declare that there are no conflicts of interest in this work.

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References

- [1] Yu Y-Y, Fu H-Q, Du H-Y, et al. Overview of research on the application of medicine food homologous bioactive ingredients to functional constipation[J]. Food Medicine Homology, 2024, 2(4): 9420057. doi: <https://doi.org/10.26599/FMH.2025.9420057>
- [2] Sun-Waterhouse D-X, Chen X-Y, Liu Z-H, et al. Transformation from traditional medicine-food homology to modern food-medicine homology[J]. Food & Medicine Homology, 2024, 1(1): 9420014. doi: <https://doi.org/10.26599/FMH.2024.9420014>
- [3] Zhang F-P, Deng J-J, Guo Y, et al. Comparative chloroplast genomic analysis of an important horticultural plant, *Dendrobium*

- sulcatum (Orchidaceae) and phylogenetic position in *Dendrobium*[J]. Horticulture, Environment, and Biotechnology, 2025, 66(1): 13-24. doi: <https://doi.org/10.1007/s13580-024-00634-2>
- [4] Jain A, Sarsaiya S, Gong Q, et al. Pharmacological and Therapeutic Biofunction of *Dendrobium nobile*: A Critical Review[J]. Natural Product Communications, 2024, 19(11): 1934578X241300010. doi: <https://doi.org/10.1177/1934578X241300010>
- [5] Jain A, Sarsaiya S, Gong Q, et al. Traditional Uses of *Dendrobium nobile* in Chinese Medicine[J]. *Dendrobium nobile: Research and Therapeutic Applications*, 2025: 15-28. doi: <https://doi.org/10.1079/9781800627987.0002>
- [6] Yang Y, Zhou H, Du Z. Effect of drying methods on aroma, taste and antioxidant activity of *Dendrobium officinale* flower tea: A sensomic and metabolomic study[J]. Food Research International, 2024, 187: 114455. doi: <https://doi.org/10.1016/j.foodres.2024.114455>
- [7] Chang Y, Zhou D, Tang Y, et al. An improved deep learning network for image detection and its application in *Dendrobium caulis* decoction piece[J]. Scientific Reports, 2024, 14(1): 13505. doi: <https://doi.org/10.1038/s41598-024-63398-w>
- [8] Wang M, Shao G, Song M, et al. Dynamic Changes in Functional Components of *Dendrobium officinale* and Their Applications in Food Science: A Review[J]. Plant Foods for Human Nutrition, 2025, 80(1): 59. doi: <https://doi.org/10.1007/s11130-024-01275-7>
- [9] Ketsa S, Warrington IJ. The *Dendrobium* orchid: botany, horticulture, and utilization[J]. Crop Science, 2023, 63(4): 1829-1888. doi: <https://doi.org/10.1002/csc2.20952>
- [10] Burzacka-Hinz A, Dudek M, Olędrzyńska N, et al. Evolution of morphological traits of *Dendrobium sensu lato* (Orchidaceae)—an attempt to resolve phylogenetic relationships in nominal and morphologically convergent sections[J]. BMC Plant Biology, 2025, 25(1): 239. doi: <https://doi.org/10.1186/s12870-025-06263-w>
- [11] Bao H, Bao H, Wang Y, et al. Challenges and Strategies in the Industrial Application of *Dendrobium officinale*[J]. Plants, 2024, 13(21): 2961. doi: <https://doi.org/10.3390/plants13212961>
- [12] Mehbub H, Akter A, Akter MA, et al. Tissue culture in ornamentals: Cultivation factors, propagation techniques, and its application[J]. Plants, 2022, 11(23): 3208. doi: <https://doi.org/10.3390/plants11233208>
- [13] Li P-Y, Li L, Wang Y-Z. Traditional uses, chemical compositions and pharmacological activities of *Dendrobium*: A review[J]. Journal of Ethnopharmacology, 2023, 310: 116382. doi: <https://doi.org/10.1016/j.jep.2023.116382>
- [14] China NHCotPsRo. Announcement Regarding 9 Newly Added Substances, Including *Codonopsis pilosula*, That Are Traditionally Both Food and Chinese Medicinal Herbs. In, 2023.
- [15] Wang G, Wang J, Deng Y, et al. Chemical constituents and nutritional health functions of *Dendrobium nobile*: a review[J]. Food Science and Technology, 2022, 42: e84522. doi: <https://doi.org/10.1590/fst.84522>
- [16] Huang J, Huang N, Qiu Y, et al. *Dendrobium nobile* Lindl. alkaloid decreases Tau hyperphosphorylation via regulating PI3K/Akt/GSK-3 β pathway in vitro and in vivo[J]. J Ethnopharmacol, 2024, 322: 117592. doi: <https://doi.org/10.1016/j.jep.2023.117592>
- [17] Huang J, Huang N, Mao Q, et al. Natural bioactive compounds in Alzheimer's disease: From the perspective of type 3 diabetes mellitus[J]. Front Aging Neurosci, 2023, 15: 1130253. doi: <https://doi.org/10.3389/fnagi.2023.1130253>
- [18] Li D-D, Zheng C-Q, Zhang F, et al. Potential neuroprotection by *Dendrobium nobile* Lindl alkaloid in Alzheimer's disease models[J]. Neural Regeneration Research, 2022, 17(5): 972-977. doi: <https://doi.org/10.4103/1673-5374.324824>
- [19] Yan C, Tian Z, Ruan W, et al. Erianin isolated from *Dendrobium huoshanense* alleviated neuroinflammation in MPTP-induced Parkinson's disease model via NF- κ B/NLRP3 pathway[J]. Journal of Ethnopharmacology, 2025, 345: 119620. doi: <https://doi.org/10.1016/j.jep.2025.119620>
- [20] Liu B, Lv L-I, Liu P, et al. Proteomic analysis of anti-aging effects of *Dendrobium nobile* Lindl. alkaloids in aging-accelerated SAMP8 mice[J]. Experimental gerontology, 2023, 177: 112198. doi: <https://doi.org/10.1016/j.exger.2023.112198>
- [21] Liu J, Han Y, Zhu T, et al. *Dendrobium nobile* Lindl. polysaccharides reduce cerebral ischemia/reperfusion injury in mice by increasing myeloid cell leukemia 1 via the downregulation of miR-134[J]. Neuroreport, 2021, 32(3): 177-187. doi: <https://doi.org/10.1097/WNR.0000000000001562>
- [22] Huang J, Luo J, Huang Y, et al. Mechanism of *Dendrobium nobile* polysaccharide inhibition of ferroptosis in rats with spinal cord injury[J]. Journal of Integrative Neuroscience, 2024, 23(3): 65. doi: <https://doi.org/10.31083/j.jin2303065>
- [23] Xu L, Zeng X, Liu Y, et al. Inhibitory effect of *Dendrobium officinale* polysaccharide on oxidative damage of glial cells in

- aging mice by regulating gut microbiota[J]. *International Journal of Biological Macromolecules*, 2023, 247: 125787. doi: <https://doi.org/10.1016/j.ijbiomac.2023.125787>
- [24] Li DD, Fan HX, Yang R, et al. *Dendrobium Nobile* Lindl. Alkaloid Suppresses NLRP3-Mediated Pyroptosis to Alleviate LPS-Induced Neurotoxicity[J]. *Front Pharmacol*, 2022, 13: 846541. doi: <https://doi.org/10.3389/fphar.2022.846541>
- [25] Yu Y-T, Lin H-R, Chen X-Y, et al. *Dendrobium officinale* phenolic extract maintains proteostasis by regulating autophagy in a *Caenorhabditis elegans* model of Alzheimer's disease[J]. *Fitoterapia*, 2024, 175: 105924. doi: <https://doi.org/10.1016/j.fitote.2024.105924>
- [26] Xu L, Zeng X, Liu Y, et al. Effect of *Dendrobium officinale* polysaccharides on central nervous system disease: Based on gut microbiota[J]. *International Journal of Biological Macromolecules*, 2023, 240: 124440. doi: <https://doi.org/10.1016/j.ijbiomac.2023.124440>
- [27] Sarsaiya S, Jain A, Gong Q, et al. Neuroprotective Effects of *Dendrobium nobile*[J]. *Dendrobium nobile: Research and Therapeutic Applications*, 2025: 198-217. doi: <https://doi.org/10.1079/9781800627987.001>
- [28] Zhang D, Zhao XW, Li YY, et al. Advances and prospects of orchid research and industrialization[J]. *Hortic Res*, 2022, 9: uhac220. doi: <https://doi.org/10.1093/hr/uhac220>
- [29] Qiu Y, Cai C, Mo X, et al. Transcriptome and metabolome analysis reveals the effect of flavonoids on flower color variation in *Dendrobium nobile* Lindl[J]. *Frontiers in Plant Science*, 2023, 14: 1220507. doi: <https://doi.org/10.3389/fpls.2023.1220507>
- [30] Kriangphan N, Vuttipongchaikij S, Kittiwongwattana C, et al. Effects of sequence and expression of eight anthocyanin biosynthesis genes on floral coloration in four *Dendrobium* hybrids[J]. *The Horticulture Journal*, 2015, 84(1): 83-92. doi: <https://doi.org/10.2503/hortj.MI-020>
- [31] Yin H, Wang Y, Li Y, et al. Characterization of the varied output from the anthocyanin pathway in *Phalaenopsis*-type *Dendrobium* hybrids and its relationship with flower coloration[J]. *Scientia Horticulturae*, 2024, 325: 112697. doi: <https://doi.org/10.1016/j.scienta.2023.112697>
- [32] Li J-W, Zhou Y, Zhang Z-B, et al. Complementary water and nutrient utilization of perianth structural units help maintain long floral lifespan in *Dendrobium*[J]. *Journal of Experimental Botany*, 2023, 74(3): 1123-1139. doi: <https://doi.org/10.1093/jxb/erac479>
- [33] Mehraj H, Shikha K, Nusrat A, et al. Growth and flowering behavior of *Dendrobium* cultivars[J]. *Journal of Bioscience Agriculture Research*, 2014, 2(2): 90-95. doi: <https://doi.org/10.18801/jbar.020214.24>
- [34] Yen CY-T, Starman TW, Wang Y-T, et al. Effects of cooling temperature and duration on flowering of the nobile *Dendrobium* orchid[J]. *HortScience*, 2008, 43(6): 1765-1769. doi: <https://doi.org/10.21273/HORTSCI.43.6.1765>
- [35] Wongjunta M, Wongs-Aree C, Salim S, et al. Involvement of ethylene in physiological processes determining the vase life of various hybrids of *Mokara* orchid cut flowers[J]. *Agronomy*, 2021, 11(1): 160. doi: <https://doi.org/10.3390/agronomy11010160>
- [36] Sukpitak C, Seraypheap K. Postharvest transient water deficit limits longevity of cut *Dendrobium* 'Khao Sanan' orchid[J]. *Scientia Horticulturae*, 2023, 309: 111637. doi: <https://doi.org/10.1016/j.scienta.2022.111637>
- [37] Sukpitak C, Munné-Bosch S, Seraypheap K. Brassinosteroids alleviate postharvest water deficit stress in cut *Dendrobium* 'Khao Sanan' orchid through modulation of protective mechanisms, osmotic regulation, and endogenous hormonal levels[J]. *Postharvest Biology and Technology*, 2024, 211: 112832. doi: <https://doi.org/10.1016/j.postharvbio.2024.112832>
- [38] Sarmah D, Gurung N, Saini DP, et al. Advances in orchid conservation: biotechnology applications and global trade dynamics[J]. *Frontiers in Conservation Science*, 2025, 6: 1653827. doi: <https://doi.org/10.3389/fcsc.2025.1653827>
- [39] Poonsri W. Effect of modified and controlled atmosphere storage on enzyme activity and senescence of *Dendrobium* orchids[J]. *Heliyon*, 2020, 6(9): e05070. doi: <https://doi.org/10.1016/j.heliyon.2020.e05070>
- [40] Poonsri W. Effects of active and passive modified atmosphere packaging on biochemical properties of cut *Dendrobium* orchid flowers[J]. *Heliyon*, 2021, 7(6): e07197. doi: <https://doi.org/10.1016/j.heliyon.2021.e07197>
- [41] Madhubala R, Sujeetha ARP, Rajasri M, et al. Effect of gamma irradiation and holding solutions on vase life of *Dendrobium* cut flowers[J]. *Indian Journal of Plant Protection*, 2022, 49(4). doi: <https://epubs.icar.org.in/index.php/IJPP/article/view/121807>
- [42] Rattanawisalanon C, Ketsa S, van Doorn WG. Effect of aminooxyacetic acid and sugars on the vase life of *Dendrobium* flowers[J]. *Postharvest Biology and Technology*, 2003, 29(1): 93-100. doi: [https://doi.org/10.1016/S0925-5214\(02\)00242-9](https://doi.org/10.1016/S0925-5214(02)00242-9)

- [43] Mohammadpour R, Buanong M, Jitareerat P, et al. Sodium nitroprusside an ethylene reduction inducer. An alternative that prolongs the shelf life of cut inflorescences of *Dendrobium* orchids[J]. Journal of the Selva Andina Research Society, 2025, 16(1): 3-20. doi: <https://doi.org/10.36610/j.jsars.2025.160100003>
- [44] Almasi P, Mohamed M, Ahmad S, et al. Postharvest responses of cut *Dendrobium* orchids to exogenous ethylene[J]. African Journal of Biotechnology, 2012, 11(16): 3895-3902. doi: <https://doi.org/10.5897/AJB11.3221>
- [45] Kirkwood A, Fisk I, Ayed C, et al. A flavour perspective of Tiejishihu (*Dendrobium officinale*)—an emerging food ingredient from popular traditional Chinese medicinal plants: a review[J]. International Journal of Food Science and Technology, 2023, 58(10): 4921-4930. doi: <https://doi.org/10.1111/ijfs.16608>
- [46] Chen W, Lu J, Zhang J, et al. Traditional uses, phytochemistry, pharmacology, and quality control of *Dendrobium officinale* Kimura et. Migo[J]. Frontiers in pharmacology, 2021, 12: 726528. doi: <https://doi.org/10.3389/fphar.2021.726528>
- [47] Susu X, Jinwei L, Ran P, et al. Chemical Composition, Edible Safety, and Antioxidant Activity Evaluation of Flowers in a Medicinal Plant *Dendrobium chrysotoxum*[J]. Food Science Nutrition, 2025, 13(4): e70067. doi: <https://doi.org/10.1007/s11694-025-03220-x>
- [48] Au CT. A review of medicine and food homology on traditional Chinese medicine as functional food[J]. Food & Medicine Homology, 2024. doi: <https://doi.org/10.26599/FMH.2026.9420091>
- [49] Cakova V, Bonte F, Lobstein A. *Dendrobium*: sources of active ingredients to treat age-related pathologies[J]. Aging disease, 2017, 8(6): 827. doi: <https://doi.org/10.14336/AD.2017.0214>
- [50] Tiwari P, Bose SK, Gautam A, et al. Emerging trends and insights into the cultivation strategies, ethnomedicinal uses, and socio-economic attributes of orchids[J]. The Journal of Horticultural Science Biotechnology, 2023, 98(3): 273-298. doi: <https://doi.org/10.1080/14620316.2022.2164524>
- [51] Sun X-Y, Xiang X-S, Zhou Y-J, et al. Global policy changes on homologous substances of food and medicine[J]. Food & Medicine Homology, 2026, 3(1): 9420126. doi: <https://doi.org/10.26599/FMH.2026.9420126>
- [52] Li C, Sun X, Song Z, et al. Chemical constituents from the stems of *Dendrobium gratiosissimum* and their biological activities[J]. Phytochemistry, 2022, 201: 113260. doi: <https://doi.org/10.1016/j.phytochem.2022.113260>
- [53] Yuan Y, Li C, Qiu S, et al. Exploring the medicinal potential of *Dendrobium*: Uncovering the spatial distribution of flavonoids and alkaloids in 15 species of *Dendrobium* using MALDI-MSI[J]. Scientia Horticulturae, 2024, 338: 113738. doi: <https://doi.org/10.1016/j.scienta.2024.113738>
- [54] Liu Q, Huang Y, Linghu C, et al. Metabolic profiling, in-situ spatial distribution, and biosynthetic pathway of functional metabolites in *Dendrobium nobile* stem revealed by combining UPLC-QTOF-MS with MALDI-TOF-MSI[J]. Frontiers in Plant Science, 2023, 13: 1125872. doi: <https://doi.org/10.3389/fpls.2022.1125872>
- [55] Wu W, Zhao Z, Zhao Z, et al. Structure, health benefits, mechanisms, and gut microbiota of *dendrobium officinale* polysaccharides: A review[J]. Nutrients, 2023, 15(23): 4901. doi: <https://doi.org/10.3390/nu15234901>
- [56] Asjad MA, Lou Z, Iqbal MW, et al. Formulation and sterilization of *Dendrobium officinale* stem-based drinks: assessing stability, antioxidant, sensory and microbial properties[J]. Journal of Food Measurement Characterization, 2025: 1-17. doi: <https://doi.org/10.1007/s11694-025-03220-x>
- [57] Hei JW, Hung W, Yanbo Z, et al. *Dendrobium* in diabetes: a comprehensive review of its phytochemistry, pharmacology, and safety[J]. Journal of Translational Science, 2021, 7(6): 1-10. doi: <https://doi.org/10.15761/JTS.1000456>
- [58] Xu X, Zhang C, Wang N, et al. Bioactivities and Mechanism of Actions of *Dendrobium officinale*: A Comprehensive Review[J]. Oxid Med Cell Longev, 2022, 2022: 6293355. doi: <https://doi.org/10.1155/2022/6293355>
- [59] Zhao M, Fan J, Liu Q, et al. Phytochemical profiles of edible flowers of medicinal plants of *Dendrobium officinale* and *Dendrobium devonianum*[J]. Food science nutrition, 2021, 9(12): 6575-6586. doi: <https://doi.org/10.1002/fsn3.2602>
- [60] Li Y, Chang Q-X, Xia P-G, et al. The different parts of *Dendrobium officinale* Kimura et Migo: traditional uses, phytochemistry, pharmacological activities, and product development status and potential[J]. Phytochemistry Reviews, 2025, 24(1): 985-1026. doi: <https://doi.org/10.1007/s11101-024-09973-5>
- [61] Zhang Z. Sensory evaluation of different drinks formulated from *dendrobium officinale* flowers using fuzzy logic[J]. Journal of Food Measurement Characterization, 2021, 15(4): 3060-3068. doi: <https://doi.org/10.1007/s11694-021-00877-y>
- [62] He XLS, Wang N, Teng X, et al. *Dendrobium officinale* flowers' topical extracts improve skin oxidative stress and aging[J].

- Journal of Cosmetic Dermatology, 2024, 23(5): 1891-1904. doi: <https://doi.org/10.1111/jocd.16210>
- [63] Zhang J, Fan J, Luo H, et al. Alleviation of alcoholic fatty liver by *Dendrobium officinale* flower extracts due to regulation of gut microbiota and short-chain fatty acids in mice exposed to chronic alcohol[J]. Foods, 2023, 12(7): 1428. doi: <https://doi.org/10.3390/foods12071428>
- [64] Jirasripongpun K, Jirakanjanakit N, Pola S, et al. Antioxidation and anti-melanogenesis of three colored flowers of *Dendrobium* hybrids[J]. Science, Engineering Health Studies, 2022, 16(2022): 22030006-22030006. doi: <https://doi.org/10.14456/sehs.2022.22>
- [65] Borah O, Das AK, Vijayan D. Chemical composition, antioxidant potential and GC–MS analysis of methanolic extracts of leaves and stems of *Dendrobium jenkinsii* Wall. ex Lindl.: a lesser known medicinal orchid from Northeast India[J]. Vegetos, 2025: 1-10. doi: <https://doi.org/10.1007/s42535-025-01260-8>
- [66] Liu J-J, Liu Z-P, Zhang X-F, et al. Effects of various processing methods on the metabolic profile and antioxidant activity of *Dendrobium catenatum* Lindley leaves[J]. Metabolites, 2021, 11(6): 351. doi: <https://doi.org/10.3390/metabo11060351>
- [67] Zhou M, Zhang Z, Zheng X, et al. Application value and development and utilization of *Dendrobium officinale* leaves[J]. Agricultural Products Processing, 2023, 17: 77-80. doi: [https://doi.org/10.16693/j.cnki.1671-9646\(X\).2023.09.019](https://doi.org/10.16693/j.cnki.1671-9646(X).2023.09.019)
- [68] Feng X, Wen L, Cui Y, et al. Advances and Perspectives in Comprehensive Assessment of Medicinal–Ornamental Multifunctional Plants[J]. Horticulturae, 2025, 11(12): 1454. doi: <https://doi.org/10.3390/horticulturae11121454>
- [69] Pan Y, Wang M, Wang Z, et al. A novel soluble powder containing high *Dendrobium huoshanense* polysaccharide and its in vitro hypoglycemic activities evaluation[J]. Bioactive Carbohydrates and Dietary Fibre, 2023, 30: 100362. doi: <https://doi.org/10.1016/j.bcdf.2023.100362>
- [70] Xiangkun L, Yihan Z. Optimization of compound beverage of *Dendrobium huoshanense* and passion fruit by response surface method and its anti-fatigue effect[J]. China Food Additives, 2023, 34(1): 272. doi: <https://doi.org/10.19804/j.issn1006-2513.2023.01.033>
- [71] Cai G, Dong H, Liu S, et al. Comparative evaluation of the physiochemical properties, and antioxidant and hypoglycemic activities of *Dendrobium officinale* leaves processed using different drying techniques[J]. Antioxidants, 2023, 12(11): 1911. doi: <https://doi.org/10.3390/antiox12111911>
- [72] Zhang Z, Yin Z, Wang Y, et al. Research on Fermentation Technology for a *Dendrobium officinale* Leaf–Sweet Potato Koji Compound Beverage[J]. Journal of Food Quality, 2024, 2024(1): 8127516. doi: <https://doi.org/10.1155/jfq/8127516>
- [73] JIA X, Li L, TAN D, et al. Effect of superfine-grinding on the physicochemical and antioxidant properties of *Dendrobium nobile* powders[J]. Food Science Technology, 2023, 43: e117322. doi: <https://doi.org/10.1590/fst.117322>
- [74] Wang J, Liu Z, Jiang X, et al. Effect of storage temperature on the long term stability of *Dendrobium catenatum* Lindl. blended liquor[J]. Journal of Food Measurement Characterization, 2024, 18(4): 2618-2630. doi: <https://doi.org/10.1007/s11694-023-02341-5>
- [75] Dong X, Tang J, Qin X, et al. Quality changes and path analysis of color degradation of *Dendrobium officinale* flower juice during storage[J]. Food Bioscience, 2023, 56: 103265. doi: <https://doi.org/10.1016/j.fbio.2023.103265>
- [76] Lu X, Yang X, Zhang J, et al. A novel extract of *Dendrobium flexicaule* flower: volatile components and neuroprotective potential[J]. The Journal of Supercritical Fluids, 2025, 229: 106840. doi: <https://doi.org/10.1016/j.supflu.2025.106840>
- [77] Wu E, Lian Y, Zhao S, et al. Involvement of the Sch9/Rim15/Msn2 signaling pathway in the anti-aging activity of dendrobine from *Dendrobium nobile* Lindl. via modification of oxidative stress and autophagy[J]. Chinese Medicine, 2023, 18(1): 111. doi: <https://doi.org/10.1186/s13020-023-00827-4>
- [78] Hui A, Chen J, Deng S, et al. Phytochemical profile of alkaloid extract from *Dendrobium huoshanense* and inhibitory effects against oxidative stress in H2O2-Induced PC12 Cells[J]. Chemistry Biodiversity, 2024, 21(2): e202301332. doi: <https://doi.org/10.1002/cbdv.202301332>
- [79] Zhang W, Huang J, Shi J. Dendrobine Ameliorates Alzheimer’s Disease-like Pathology and Cognitive Decline in 3× Tg-AD Mice[J]. Brain Sciences, 2024, 14(3): 231. doi: <https://doi.org/10.3390/brainsci14030231>
- [80] Liu B, Guo M, Li F, et al. *Dendrobium nobile* Lindl. alkaloids (DNLA) inhibits d-galactose-induced hippocampal neuronal senescence through the SIRT1-FoxO1-autophagy axis[J]. Pharmacological Research-Modern Chinese Medicine, 2023, 8: 100288. doi: <https://doi.org/10.1016/j.prmcm.2023.100288>

- [81] Ming M, Hu W, Xie G, et al. Dendrobium nobile polysaccharides attenuates ferroptosis and improves cognitive function in vascular dementia rats[J]. American Journal of Alzheimer's Disease Other Dementias, 2023, 38: 15333175231185236. doi: <https://doi.org/10.1177/15333175231185236>
- [82] Huang J, Huang N, Zhang M, et al. Dendrobium alkaloids decrease A β by regulating α - and β -secretases in hippocampal neurons of SD rats[J]. PeerJ, 2019, 7: e7627-e7627. doi: <https://doi.org/10.7717/peerj.7627>
- [83] Zhang W, Zhang M, Wu Q, et al. Dendrobium nobile Lindl. Alkaloids Ameliorate A β 25-35-Induced Synaptic Deficits by Targeting Wnt/ β -Catenin Pathway in Alzheimer's Disease Models[J]. Journal of Alzheimer's Disease, 2022, 86: 297 - 313. doi: <https://doi.org/10.3233/JAD-215433>
- [84] Nie J, Jiang L, Zhang Y, et al. Dendrobium nobile Lindl. Alkaloids Decreases the Level of Intracellular β -Amyloid by Improving Impaired Autolysosomal Proteolysis in APP/PS1 Mice[J]. Frontiers in Pharmacology, 2018, 9. doi: <https://doi.org/10.3389/fphar.2018.01479>
- [85] Pi T, Lang G, Liu B, et al. Protective effects of dendrobium nobile Lindl. Alkaloids on Alzheimer's disease-like symptoms induced by high-methionine diet[J]. Current neuropharmacology, 2022, 20(5): 983-997. doi: <https://doi.org/10.2174/1570159X19666210809101945>
- [86] Li LS, Lu YL, Nie J, et al. Dendrobium nobile Lindl alkaloid, a novel autophagy inducer, protects against axonal degeneration induced by A β (25-35) in hippocampus neurons in vitro[J]. CNS Neurosci Ther, 2017, 23(4): 329-340. doi: <https://doi.org/10.1111/cns.12678>
- [87] Wu Y, Liu X, Luo G, et al. DNLA Delayed the Appearance of Learning and Memory Impairment of APP/PS1 Mice: Involvement of mTOR/TFEB/v-ATPase Signaling Pathway[J]. CNS Neuroscience Therapeutics, 2025, 31(3): e70300. doi: <https://doi.org/10.1111/cns.70300>
- [88] Wang M, Huang W, Huang J, et al. Natural bioactive compounds form herbal medicine in Alzheimer's disease: from the perspective of GSK-3 β [J]. Frontiers in Pharmacology, 2025, 16: 1497861. doi: <https://doi.org/10.3389/fphar.2025.1497861>
- [89] Zhang CC, Kong YL, Zhang MS, et al. Two new alkaloids from Dendrobium nobile Lindl. exhibited neuroprotective activity, and dendrobine alleviated A β 1–42-induced apoptosis by inhibiting CDK5 activation in PC12 cells[J]. Drug Development Research, 2023, 84(2): 262-274. doi: <https://doi.org/10.1002/ddr.22030>
- [90] Wang M, Huang W, Huang J, et al. Traditional Chinese Medicine in Alzheimer's Disease: From the Perspective of GSK-3 β and Tau Hyperphosphorylation[J]. Pharmacological Research-Modern Chinese Medicine, 2024, 13: 100543. doi: <https://doi.org/10.1016/j.prmcm.2024.100543>
- [91] Huang JM, Huang FI, Yang CR. Moscatilin Ameliorates Tau Phosphorylation and Cognitive Deficits in Alzheimer's Disease Models[J]. J Nat Prod, 2019, 82(7): 1979-1988. doi: <https://doi.org/10.1021/acs.jnatprod.9b00375>
- [92] Touati I, Boulaamane Y, Britel MR, et al. Dendrobium nobile alkaloids modulate calcium dysregulation and neuroinflammation in Alzheimer's disease: A bioinformatic analysis[J]. Pharmacological Research-Modern Chinese Medicine, 2024, 12: 100495. doi: <https://doi.org/10.1016/j.prmcm.2024.100495>
- [93] Zhang W, Wu Q, Lu Y-l, et al. Protective effects of Dendrobium nobile Lindl. alkaloids on amyloid beta (25–35)-induced neuronal injury[J]. Neural regeneration research, 2017, 12(7): 1131-1136. doi: <https://doi.org/10.4103/1673-5374.211193>
- [94] Fu J, Liang Z, Chen Z, et al. Deciphering the Therapeutic Efficacy and Underlying Mechanisms of Dendrobium officinale Polysaccharides in the Intervention of Alzheimer's Disease Mice: Insights from Metabolomics and Microbiome[J]. Journal of agricultural food chemistry, 2024, 73(9): 5635-5648. doi: <https://doi.org/10.1021/acs.jafc.4c07913>
- [95] Shi D-C, Wang P-Y, Xu L, et al. Potential of Dendrobium officinale oligosaccharides to alleviate chronic colitis by modulating inflammation and gut microbiota[J]. Food & Medicine Homology, 2025, 2(3): 9420077. doi: <https://doi.org/10.26599/FMH.2025.9420077>
- [96] Zhou X, Lin X, He Y, et al. TDP-43 in Alzheimer's disease: pathophysiology and therapeutic strategies[J]. Pharmacol Res, 2025: 107977. doi: <https://doi.org/10.1016/j.phrs.2025.107977>
- [97] Huang W, Huang J, Huang N, et al. The role of TREM2 in Alzheimer's disease: from the perspective of Tau[J]. Front Cell Dev Biol, 2023, 11: 1280257. doi: <https://doi.org/10.3389/fcell.2023.1280257>
- [98] Chen W, Huang N, Huang W, et al. TREM2 as a possible link between Alzheimer's disease and diabetes mellitus[J]. Experimental Neurology, 2026: 115739. doi: <https://doi.org/10.1016/j.expneurol.2026.115739>

- [99] SHANG X, XU C, DONG J, et al. Mechanism of Dendrobium huoshanense Polysaccharide Against Neuroinflammation in Parkinson's Disease Model: Based on NLRP3 Inflammasome[J]. Chinese Journal of Experimental Traditional Medical Formulae, 2023: 97-105. doi: <https://doi.org/10.13422/j.cnki.syfjx.20230437>
- [100] Li Dd, Wang Gq, Wu Q, et al. Dendrobium nobile Lindl alkaloid attenuates 6-OHDA-induced dopamine neurotoxicity[J]. Biotechnology Applied Biochemistry, 2021, 68(6): 1501-1507. doi: <https://doi.org/10.1002/bab.2071>
- [101] Yoon M-Y, Hwang J-H, Park J-H, et al. Neuroprotective effects of SG-168 against oxidative stress-induced apoptosis in PC12 cells[J]. Journal of Medicinal Food, 2011, 14(1-2): 120-127. doi: <https://doi.org/10.1089/jmf.2010.1027>
- [102] Li Q-M, Li X, Su S-Q, et al. Dendrobine inhibits dopaminergic neuron apoptosis via MANF-mediated ER stress suppression in MPTP/MPP+-induced Parkinson's disease models[J]. Phytomedicine, 2022, 102: 154193. doi: <https://doi.org/10.1016/j.phymed.2022.154193>
- [103] tian Liang Y, meng Liu J, qi Qin L, et al. Neuroprotective effects of dendrobium endophytes metabolites in SH-SY5Y cells via the Nrf2/Keap1 pathway[J]. Heliyon, 2024, 10(6). doi: <https://doi.org/10.1016/j.heliyon.2024.e28222>
- [104] Li L, Liu Z, Hu H, et al. Dendrobium Nobile Alcohol Extract Extends the Lifespan of Caenorhabditis elegans via hsf-1 and daf-16[J]. Molecules, 2024, 29(4): 908. doi: <https://doi.org/10.3390/molecules29040908>
- [105] Fan W-Y, Fan X-X, Xie Y-J, et al. Research progress on the anti-aging effects and mechanisms of polysaccharides from Chinese herbal medicine[J]. Food & Medicine Homology, 2026, 3(1): 9420108. doi: <https://doi.org/10.26599/FMH.2026.9420108>
- [106] Ye M, Liu J, Deng G, et al. Protective effects of Dendrobium huoshanense polysaccharide on D-gal induced PC12 cells and aging mice, in vitro and in vivo studies[J]. Journal of food biochemistry, 2022, 46(12): e14496. doi: <https://doi.org/10.1111/jfbc.14496>
- [107] Liang C-y, Liang Y-m, Liu H-z, et al. Effect of Dendrobium officinale on D-galactose-induced aging mice[J]. Chinese journal of integrative medicine, 2017: 1-9. doi: <https://doi.org/10.1007/s11655-016-2631-x>
- [108] Chu W, Wang P, Ma Z, et al. Ultrasonic treatment of Dendrobium officinale polysaccharide enhances antioxidant and anti-inflammatory activity in a mouse D-galactose-induced aging model[J]. Food Science Nutrition, 2022, 10(8): 2620-2630. doi: <https://doi.org/10.1002/fsn3.2867>
- [109] Hu N, Wang K, Zhang X, et al. Effects of Dendrobium officinale Kimura & Migo flower flavonoids on cognitive function by regulating gut microbiota[J]. Frontiers in Pharmacology, 2025, 16: 1562775. doi: <https://doi.org/10.3389/fphar.2025.1562775>
- [110] Li L-Z, Lei S-S, Li B, et al. Dendrobium officinalis flower improves learning and reduces memory impairment by mediating antioxidant effect and balancing the release of neurotransmitters in senescent rats[J]. Combinatorial Chemistry High Throughput Screening, 2020, 23(5): 402-410. doi: <https://doi.org/10.2174/1386207323666200407080352>
- [111] Fu X, Chen S, Wang X, et al. Dendrobium nobile Lindl. alkaloids alleviate Mn-induced neurotoxicity via PINK1/Parkin-mediated mitophagy in PC12 cells[J]. Biochemistry Biophysics Reports, 2021, 26: 100877. doi: <https://doi.org/10.1016/j.bbrep.2020.100877>
- [112] Duan H, Yu Q, Ni Y, et al. Dose-dependent effect of Dendrobium officinale polysaccharide on anti-aging in Caenorhabditis elegans: A metabolomics analysis focused on lipid and nucleotide metabolism regulation[J]. Food Bioscience, 2024, 61: 104615. doi: <https://doi.org/10.1016/j.fbio.2024.104615>
- [113] Liu D, Dong Z, Xiang F, et al. Dendrobium alkaloids promote neural function after cerebral ischemia-reperfusion injury through inhibiting pyroptosis induced neuronal death in both in vivo and in vitro models[J]. Neurochemical Research, 2020, 45(2): 437-454. doi: <https://doi.org/10.1007/s11064-019-02935-w>
- [114] Li XL, Hong M. Aqueous extract of Dendrobium officinale confers neuroprotection against hypoxic-ischemic brain damage in neonatal rats[J]. The Kaohsiung Journal of Medical Sciences, 2020, 36(1): 43-53. doi: <https://doi.org/10.1002/kjm2.12139>
- [115] Li X-n, Shang N-y, Liu M-y, et al. NPB-1575 attenuates neuroinflammation and resists ferroptosis in rat ischemic stroke via IRS2 signaling pathway[J]. Acta Pharmacologica Sinica, 2025: 1-15. doi: <https://doi.org/10.1038/s41401-025-01590-y>
- [116] Dou R, Liu X, Kan X, et al. Dendrobium officinale polysaccharide-induced neuron-like cells from bone marrow mesenchymal stem cells improve neuronal function a rat stroke model[J]. Tissue Cell, 2021, 73: 101649. doi: <https://doi.org/10.1016/j.tice.2021.101649>

<https://doi.org/10.1016/j.tice.2021.101649>

- [117] Liu Y, Li X, Sui S, et al. Structural diversification of bioactive bibenzyls through modular co-culture leading to the discovery of a novel neuroprotective agent[J]. *Acta Pharmaceutica Sinica B*, 2023, 13(4): 1771-1785. doi: <https://doi.org/10.1016/j.apsb.2022.10.007>
- [118] Li M-Y, Wu G-F, Lu F, et al. Food and Medicine Homology Focus in 2026[J]. *Food & Medicine Homology*, 2026, 3(2): 9420133. doi: <https://doi.org/10.26599/FMH.2026.9420133>
- [119] Liu Z-H, Guo W-J, Meng X-J, et al. Exploration strategies for food and medicine homologous resources: future direction in food development[J]. *Food & Medicine Homology*, 2026. doi: <https://doi.org/10.26599/FMH.2026.9420134>