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Review

Herbal Support for the Nervous System: The Impact of Adaptogens in Humans and Dogs

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Abstract: Plants have played a key role in natural therapies for centuries, and their impact on the nervous system and the treatment of neurological disorders is of growing interest to scientists. Modern research confirms that plant substances can modulate neurotransmitters, reduce oxidative stress and support cognitive functions. Like humans, dogs also respond to plant compounds, which opens up new perspectives in veterinary medicine. The most well-known adaptogen is ginseng, and others include Siberian ginseng, Chinese magnolia vine, maral root, and golden root. These plants support the regulation of cortisol levels, neurotransmission and neuroplasticity. Although research on adaptogens in humans is advanced, there is still a lack of data on their effects on dogs. Further research is necessary to confirm their effectiveness and safety in animal therapy.

Keywords: Chinese magnolia vine; dog; ginseng; golden root; human; maral root; nervous system; Siberian ginseng

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1. Introduction

For centuries, plants have been a fundamental element of natural therapies, and their impact on the nervous system, as well as their ability to alleviate symptoms of neurological disorders, has been attracting increasing interest from scientists and therapists [1–5]. Modern phytotherapy and research on biologically active compounds provide evidence that many plant-derived substances can influence the nervous system through mechanisms such as neurotransmitter modulation, oxidative stress reduction, and cognitive function enhancement. Similarly to humans, dogs also respond to plant-derived compounds, opening new perspectives for veterinary medicine and animal behavior studies [6–9].

Medicinal plants are well known for their calming and anxiolytic properties, and their extracts are frequently used in formulations supporting mental health in both humans and companion animals. Active compounds in these plants, such as linalool and rosmarinic acid, interact with the GABAergic system, leading to relaxation effects [10–12].

On the other hand, not all plant-derived substances are safe. Certain alkaloids present in some plants can cause severe neurotoxic reactions, disrupting cognitive and motor functions and even leading to poisoning. In dogs, whose metabolism differs significantly from that of humans, reactions to specific compounds can be more intense, necessitating particular caution when using phytotherapy [13,14].

Understanding the mechanisms through which plant-derived compounds affect the nervous systems of both humans and dogs is crucial for developing effective and safe therapies. An increasing number of studies confirm their potential in treating neurological,

anxiety, and depressive disorders, paving the way for new advancements in science and medical practice.

The most widely recognized adaptogenic plant is ginseng (*Panax ginseng* C.A. Mey, family: Araliaceae) [12,15]. Other widely studied adaptogens include Siberian ginseng (*Eleutherococcus senticosus* (Rupr. & Maxim.) Maxim., family: Araliaceae) [16,17], Chinese magnolia vine (*Schisandra chinensis* (Turcz.) Baill., family: Schisandraceae) [18–20], maral root (*Leuzea carthamoides* (Wild.) Iljin, family: Asteraceae) [21–23], and golden root (*Rhodiola rosea* L., family: Crassulaceae) [24–26]. This literature review will discuss the most significant adaptogens influencing the nervous systems of humans and dogs, focusing on those that are studied in humans but lack sufficient research in dogs, despite the potential for similar effects. The choice was based on their well-documented adaptogenic properties in human medicine and their emerging but understudied potential in veterinary applications, particularly for dogs.

1.1. Stress in Humans and Dogs

The modern pace of life promotes chronic stress, which is a significant risk factor for the development of numerous diseases of the nervous system [27,28]. More and more research indicates the role of adaptogens in reducing the effects of stress and their potential use in neurological therapy. Moreover, the strong bond between humans and dogs and the documented ability of dogs to feel human emotions emphasize the importance of therapy using adaptogens in animals as well. Importantly, dogs, like humans, can suffer from stress disorders, which suggests common neurobiological mechanisms [29,30]. Chronic stress has been identified as a risk factor for various adverse health effects, such as cardiovascular disease, gastrointestinal disorders and dysregulation of the immune system, as well as mental health problems such as depression and anxiety [31–34]. Stress is a physiological response of the body to threat, but its chronic form leads to dysregulation of the hypothalamic–pituitary–adrenal (HPA) axis, neurotransmission disorders and changes in brain structure [35]. The consequences are diseases such as depression and anxiety disorders [36,37].

The dog (*Canis lupus familiaris*) is a unique animal and the oldest domesticated species. Dogs are the second most popular companion animals in Europe, with their number in households estimated at 106 million [38]. Dogs have coexisted with humans for over 30,000 years and are woven into human society as bonding partners. Dogs have acquired communication skills similar to humans and, probably as a result of the domestication process, the ability to read human emotions [30].

Dogs, like humans, experience stress and its long-term consequences. In animals, chronic stress can lead to behavioral disorders, depression, and neurodegenerative diseases. Studies show that dogs feel human emotions, which can intensify their stress reactions [39–43].

One explanation for dogs' behavior toward stressed caregivers is that dogs feel negative emotions and therefore seek comfort or relief from stress [44]. For this reason, supporting their nervous system with adaptogens could be an innovative approach also in veterinary medicine.

1.2. Mechanism of Action of Adaptogens

Adaptogens are a class of plant-derived substances that support the body in adapting to stress and restoring homeostasis. Their mechanism of action involves effects on the HPA axis, the sympathetic nervous system, and a range of biochemical processes that regulate stress responses. In the context of nervous system support, adaptogens demonstrate the ability to modulate neurotransmitter levels, reduce oxidative stress, and influence neuroplasticity in both humans and dogs [45,46] (Figure 1).

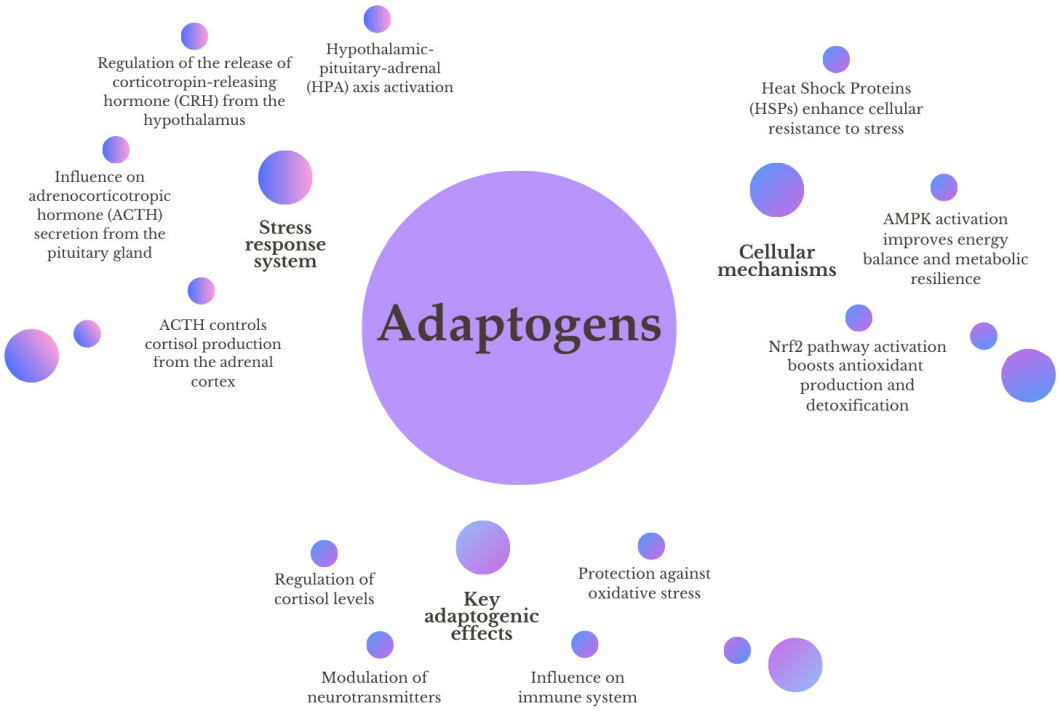


Figure 1. The main properties of adaptogens. Adapted from [45,46].

One of the key mechanisms by which adaptogens function is their role in cortisol regulation. Chronic stress leads to excessive activation of the hypothalamic–pituitary–adrenal (HPA) axis, resulting in elevated cortisol levels, which negatively affect the nervous system. Adaptogens have been shown to normalize cortisol levels, leading to a reduction in stress symptoms, improved mood, and enhanced cognitive function [47].

Additionally, adaptogens influence neurotransmission, which is crucial for proper nervous system function. Studies have demonstrated that compounds found in adaptogens can increase serotonin and dopamine levels, contributing to mood enhancement and greater resilience to stress [48]. In humans, this effect manifests as reduced fatigue and improved concentration, while in dogs, adaptogens may support the treatment of separation anxiety and other behavioral disorders [49].

Oxidative stress is another significant factor impacting nervous system health. Free radicals can damage neurons, leading to cognitive decline and an increased risk of neurodegenerative diseases [50]. Adaptogens possess strong antioxidant properties, protecting neurons from damage and supporting their regeneration. This mechanism is particularly relevant in aging organisms, both human and animal, where adaptogens may help slow down neurodegenerative processes [51,52].

Another crucial aspect of adaptogen activity is their impact on neuroplasticity—the brain's ability to adapt and regenerate. Research indicates that compounds in adaptogens can increase the expression of neurotrophic factors such as brain-derived neurotrophic factor (BDNF), which promotes neuronal regeneration and enhances cognitive function [53,54].

2. Ginseng (*Panax ginseng* C.A. Mey)

2.1. Aspects and Composition

Panax ginseng, commonly known as Korean or Asian ginseng, is a perennial plant from the Araliaceae family, highly valued in traditional East Asian medicine for its numerous health-promoting properties. Naturally, *P. ginseng* is found in Korea and China, thriving in cool, mountainous regions with well-drained, fertile soil. Due to excessive harvesting

in the past, wild populations of this plant have significantly declined, leading to the intensification of commercial cultivation to meet increasing demand [55].

P. ginseng grows to a height of 60 to 80 cm. It is characterized by a fleshy, often branched root measuring 5–6 cm in length, which is aromatic and varies in color from grayish-white to amber-yellow. The stem is erect, topped with a whorl of palmately compound leaves. The flowers are small, white or greenish, arranged in umbels, and the fruit is a red berry containing seeds [55].

The root of *P. ginseng* is rich in amino acids, including arginine, which plays a key role in protein biosynthesis and supports the immune system. It also contains water- and fat-soluble vitamins, such as B vitamins and vitamin C, which are essential for various physiological functions [56].

For centuries, ginseng has been valued in traditional East Asian medicine for its adaptogenic properties. The key compounds responsible for these effects include bioactive substances such as ginsenosides, polysaccharides, polyphenols, and peptides. Ginsenosides are triterpenoid saponins that constitute the primary active compounds in *P. ginseng*. To date, over 100 different ginsenosides have been identified, categorized into two main groups: protopanaxadiol (PPD) and protopanaxatriol (PPT). PPD ginsenosides, such as Rb1, Rb2 and Rc, and PPT ginsenosides, such as Re and Rg1, exhibit various pharmacological effects, including antioxidant, anti-inflammatory and neuroprotective properties. Their mechanism of action involves modulating signaling pathways related to stress response, contributing to the adaptogenic effects of *P. ginseng* [57] (Figure 2). The biological effects of ginseng are influenced not only by the total amount of ginsenosides but also by their specific proportions—and that individual ginsenosides can have distinct or even antagonistic effects [58,59].

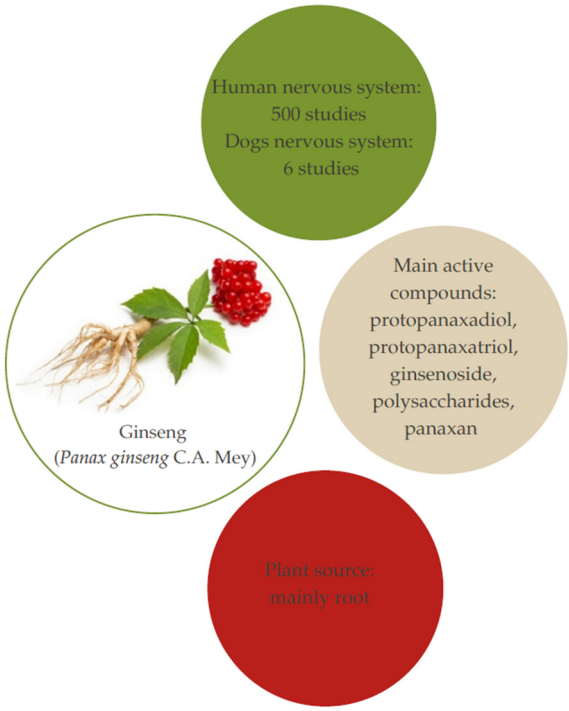


Figure 2. Characteristics of the plant and its principal active compounds [55–59] (search without time range in the Scopus database within, Article title, Abstract, Keywords, searching documents with the command, (adaptogen name) AND nervous AND human/dog, as of 30 March 2025 [60]).

Polysaccharides present in *P. ginseng* constitute another significant group of bioactive compounds. The main polysaccharides include ginsenan, ginsenoside polysaccharides, panaxan, arabinan, arabinogalactan, uronic acid, starch and pectins [61,62]. Research has

shown that they have the ability to modulate immune responses, potentially aiding the body in adapting to stress and counteracting its negative effects [63].

Polyphenols are another group of bioactive compounds found in *P. ginseng*. They exhibit strong antioxidant properties, neutralizing free radicals and protecting cells from oxidative stress [64]. This function is particularly relevant in the context of adaptogenic effects, as oxidative stress is one of the mechanisms leading to the disruption of the body's homeostasis.

In addition to the aforementioned compounds, *P. ginseng* also contains peptides such as panaxans, which may influence the functions of the nervous and immune systems, supporting the body's adaptation to stress [65,66]. The presence of these diverse bioactive compounds makes *P. ginseng* an effective adaptogen, helping the body cope with various stressors and contributing to the maintenance of internal balance [67].

Cho et al. [68] demonstrated that ginseng, particularly cultivated under the soil–substrate cultivation system in comparison to a deep-water cultivation system, exhibits significantly higher levels of total phenolic and flavonoid content, and key compounds such as chlorogenic acid and quercetin. These compounds correspond to enhanced antioxidant activities as measured by DPPH, ABTS, hydroxyl radical scavenging and FRAP assays.

2.2. Studies Related to Therapeutic Effects on Humans

Ramesh et al. [67] analyzed the effect of a water extract of *P. ginseng* reducing oxidative stress associated with aging. The main biologically active substances in the aqueous extract were saponins, including ginsenosides; for the study, 200 mg of aqueous extract per kilogram of body weight was administered for 4 weeks. The authors compared lipid peroxidation levels and antioxidant concentrations in both young and old rats. Older rats exhibited a significant increase in oxidative damage markers (e.g., lipid peroxidation) and organ damage markers such as aspartate aminotransferase, alanine aminotransferase, urea, and creatinine. This was accompanied by a notable decline in enzymatic antioxidants (superoxide dismutase, catalase, glutathione peroxidase, glutathione reductase and glutathione-S-transferase) as well as non-enzymatic antioxidants, including reduced glutathione, vitamin E, and vitamin C. In aged rats whose diet was supplemented with aqueous ginseng extract, oxidative damage was significantly reduced, likely due to an improvement in antioxidant balance through both enzymatic and non-enzymatic protective mechanisms.

Biological aging leads to increased susceptibility to several functional disorders, making elderly individuals more prone to various diseases compared to younger individuals. Alzheimer's disease (AD) is an age-related neurodegenerative disorder characterized by cognitive deficits and the formation of amyloid plaques due to the accumulation of amyloid-β peptides. A non-saponin fraction rich in polysaccharides (NFP) from ginseng significantly alleviated amyloid-β accumulation, neuroinflammation, neuronal loss, and mitochondrial dysfunction in the hypothalamus of an AD mouse model, administered for 8 weeks at a dose of 150 mg/kg. Furthermore, NFP treatment alleviated mitochondrial deficits in HT22 cells treated with amyloid-β. Additionally, NFP treatment significantly enhanced adult hippocampal neurogenesis (AHN) and neural stem cell neurogenesis in both healthy and AD-affected brains. Moreover, NFP administration markedly improved and restored cognitive function in both healthy and Alzheimer's disease-affected mice. Collectively, NFP treatment induced changes in proteins involved in central nervous system organization/maintenance in the aging brain and mitigated AD pathology. Therefore, the non-saponin fraction rich in polysaccharides from ginseng may be a potential therapeutic candidate for aging and AD treatment [69].

The optimal dose of ginseng for an adult described in the literature is 50 to 100 mg of extract standardized to 20% ginsenosides or 500 to 2000 mg of dried root [70–72].

2.3. Studies Related to Therapeutic Effects on Dogs

The Scopus database states that 500 articles have been published on the effects of ginseng on the nervous system in humans by March 2025 [60] (Figure 2). At the same time, it was checked in relation to dogs—the Scopus database indicates only 6 articles, the latest of which is from 2007; the rest are from 1955, 1963, 1964, and 1972, with one review article published in 1985. Only 3 full-texts are available. In the article from 1964, the authors demonstrated that direct measurements of cardiac contractile force indicate ginseng produces variable and insignificant cardiac actions. Moreover, recordings of heart rate, together with denervation studies, indicate that ginseng affects blood pressure in anesthetized dogs principally at the vascular level, administered in doses of 10 mg and 20 mg/kg [73]. The study from 1972 cites the findings of Wood et al. [73]. Furthermore, in animal studies, the authors demonstrated that ginseng may have analgesic and myorelaxant effects on the central nervous system and a stimulating effect on the central nervous system depending on the doses administered, ranging from 10 to 1000 mg/kg [74]. Another study found that ginseng combined with brewer's yeast can be an effective stimulant for geriatric dogs experiencing cognitive decline [75].

The latest scientific literature lacks studies directly examining the effects of ginseng on the canine nervous system. Most research on ginseng focuses on its effects in humans and laboratory animals. Studies in mice confirm that ginseng extracts can improve cognitive function and exert neuroprotective effects, suggesting that similar benefits could potentially be achieved in the treatment of neurodegenerative diseases in dogs.

3. Siberian Ginseng (*Eleutherococcus senticosus* (Rupr. & Maxim.) Maxim.)

3.1. Aspects and Composition

Eleutherococcus senticosus, also known as spiny eleuthero or Siberian ginseng, is a plant belonging to the Araliaceae family. It has been used for centuries in traditional medicine, particularly in Asia, as an adaptogen. In recent decades, scientific interest in this plant has increased due to its potential health benefits [76].

Siberian ginseng is a perennial, deciduous shrub that reaches a height of 2 to 3 m. It is characterized by thin, flexible stems covered with small spines, which facilitate its identification. The leaves are palmately compound, lanceolate in shape, with finely serrated edges. The plant's flowers are small, yellowish or purple, and grouped in umbels. The fruits of eleuthero are small, spherical, black berries that ripen in late summer or early autumn [77].

The chemical compounds and biological activity of plants depend on the geographical zone of growth. The natural range of *Eleutherococcus senticosus* includes Northeast Asia, primarily Russia (Siberia), China, Korea, and Japan. It prefers mixed and coniferous forests, often growing in sandy, well-drained soils. This plant is highly resistant to harsh climatic conditions, including frosts as low as −30 °C. Due to increasing demand, eleuthero is also cultivated on plantations, especially in China and Russia [76].

The root of *Eleutherococcus senticosus* is the most valuable part of the plant in terms of pharmacology and nutrition. It contains a rich array of bioactive compounds, including eleutherosides, polyphenols, flavonoids, coumarins, saponins and phytosterols [17,78] (Figure 3). Eleutherosides are the derivatives of lignans, coumarins, and phenylpropanoids. Main flavonoids include hyperin, rutin, afzelin, quercetin and kaempferol), Compounds isolated from the fruits belong to eleutherosides (eleutherosides B and E) [79].

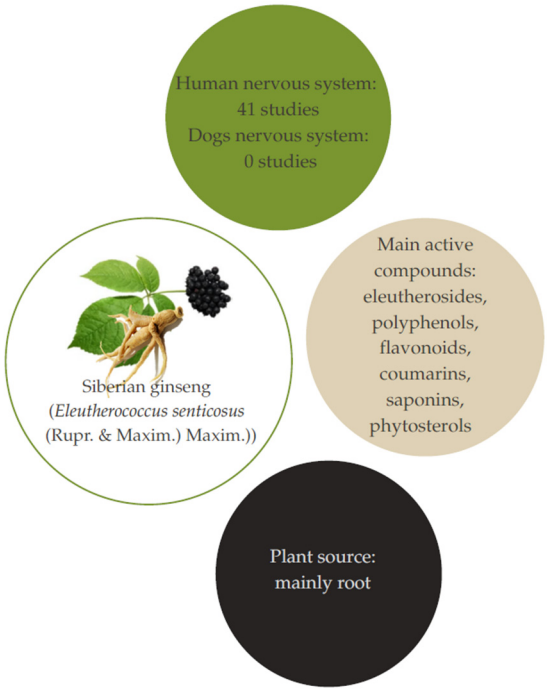


Figure 3. Characteristics of the plant and its principal active compounds [76–79] (search without time range in the Scopus database with Article title, Abstract, Keywords, searching documents with the following command: (adaptogen name) AND nervous AND human/dog, as of 30 March 2025 [60]).

The adaptogenic properties of *Eleutherococcus senticosus* result from the synergistic effects of its active compounds, which support the body's ability to counteract the effects of stress. Eleutherosides modulate the HPA axis, helping to maintain hormonal balance and enhance stress response management. Additionally, polyphenols and flavonoids reduce free radical levels, contributing to neuroprotection by preventing neuronal degeneration [80,81].

Kim et al. [82] assessed the in vitro radical scavenging activities of various edible tree sprouts, including Siberian ginseng, using assays such as DPPH, hydroxyl radical, and singlet oxygen radical scavenging. Siberian ginseng exhibited the highest DPPH scavenging activity among the tested plants. Additionally, Siberian ginseng contained the highest amount of stigmasterol (9.99 mg/g extract), a phytosterol associated with antioxidant effects. These findings suggest that this adaptogen possess potent antioxidant activity, supporting their potential use in functional foods or supplements aimed at mitigating oxidative stress. The high antioxidant properties of Siberian ginseng extracts have been confirmed by other authors [83,84]. Changes in the components and antioxidant activity of *Eleutherococcus senticosus* have been seen in relation to the harvest time. As shown by Yang et al. [85], the antioxidant activity was higher in July extract samples than in January extracts.

3.2. Studies Related to Therapeutic Effects on Humans

Jiang et al. [86] used a quantitative proteomics approach to study the effects of *E. senticosus* extract on nitrosative stress and inflammatory response in BV-2 microglial cells stimulated by lipopolysaccharide (LPS). The results showed that *E. senticosus* inhibits nitric oxide production induced by LPS, while exhibiting no significant toxicity in cells. These findings suggest that *E. senticosus* can suppress LPS-induced nitrosative stress in BV-2 cells and may provide valuable insights into the molecular mechanisms underlying its potential neuroprotective effects. This may help improve the understanding of its preventive mechanisms against neurological diseases.

Studies have shown that an aqueous extract of *E. senticosus* improves memory in mice, while its saponin fraction exhibits promising neuroprotective effects in vitro [87]. A series of memory and learning tests demonstrated a significant memory-enhancing effect. These studies confirm the neuroprotective properties of *E. senticosus*.

Furthermore, as demonstrated by Liu et al. [88] in mouse studies, the neuroprotective effects of spiny eleuthero extract administered at a dose of 45.5 mg/kg for 20 days are associated with protection against mitochondrial dysfunction and structural damage. Therefore, it is a promising candidate for preventing and treating mitochondrial neurodegenerative diseases, such as Parkinson's disease in humans.

According to Tan et al. [89], syringin is an active compound isolated from *E. senticosus*, which exhibits anti-inflammatory and neuroprotective properties. Syringin treatment significantly reduces infarct volume, brain water content, and improves neurological scores, while attenuating neuronal death. Additionally, syringin exerts a protective effect against brain damage by reducing inflammation associated with cerebral ischemia.

3.3. Studies Related to Therapeutic Effects on Dogs

The Scopus database states that 41 articles have been published on the effects of Siberian ginseng on the nervous system in humans by March 2025. At the same time, it was checked in relation to dogs—the Scopus database does not report any results [60] (Figure 3). However, one article was found in another database. Sadykova et al. [90] investigated the effects of natural supplements, such as eleuthero, on functional indicators in puppies and adolescent working dogs in uniformed services. In 6-month-old Malinois puppies, the use of "Eleutherococcus P" at a dose of 35 mg twice daily accelerated weight gain, improved red blood cell parameters by 20%, reduced glucose levels by 15%, decreased alanine aminotransferase activity by 10–18%, and regulated creatine kinase activity. The addition of eleuthero supplements for service dogs may be recommended as a source of essential compounds to maintain homeostasis during critical ontogenetic periods [90]. This could contribute to better well-being, leading to higher performance and greater achievements during work, thanks to a stable nervous system.

4. Chinese Magnolia Vine (*Schisandra chinensis* (Turcz.) Baill.

4.1. Aspects and Composition

Schisandra chinensis (Turcz.) Baill., commonly known as Chinese magnolia vine, is a perennial climbing plant from the Schisandraceae family. It is valued both in traditional Chinese medicine and modern scientific research for its numerous health benefits. Chinese magnolia vine is native to East Asia, particularly China and Russia. It grows in forests, mountain slopes, and humid climatic regions, preferring areas with good soil moisture and partial shade, which supports its optimal growth [91].

Schisandra chinensis is a climbing plant that can reach a length of 8 to 15 m. It is characterized by elliptical leaves, 5–10 cm long, with a glossy dark green surface. Its flowers are small, white or pink, and clustered together. The fruits are red, spherical berries with a diameter of approximately 5–10 mm, forming dense grape-like clusters [92].

The fruits of *Schisandra chinensis* are rich in bioactive compounds, including lignans, flavonoids, organic acids, polysaccharides and essential oils. Lignans, such as schisandrin, gomisin and deoxyschisandrin, are the primary compounds responsible for the plant's health benefits. Flavonoids, including quercetin and kaempferol, exhibit strong antioxidant activity (Figure 4). Organic acids, such as citric and malic acids, contribute to the fruit's characteristic taste and support metabolic processes. Polysaccharides present in the berries have immunomodulatory effects [92].

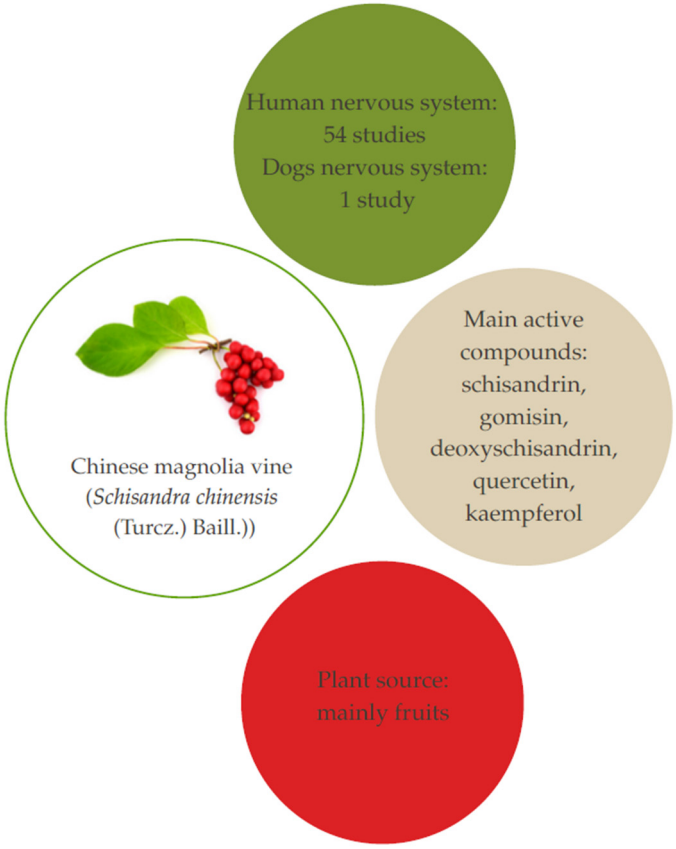


Figure 4. Characteristics of the plant and its principal active compounds [91–95] (search without time range in the Scopus database, with Article title, Abstract, and Keywords, searching documents with the following command: (adaptogen name) AND nervous AND human/dog, as of 30 March 2025 [60]).

Of particular note are the dibenzocyclooctadiene lignans, schizandrols (A and B) and schizandrins (A and B), which are the main biologically active substances responsible for the effects attributed to Chinese magnolia vine [93].

S. chinensis fruit extracts and their active compounds are potent antioxidants capable of scavenging ROS directly, activating the cellular antioxidant defense system components, and inhibiting prooxidant enzymes, thus suppressing inflammation signal transduction pathways and protecting from apoptosis [94]. Zagórska-Dziok et al. [95] assessed various extracts of *Schisandra chinensis* and found that they exhibit notable antioxidant activity, as evidenced by their performance in assays such as DPPH, ABTS and FRAP. These findings suggest that *Schisandra chinensis* extracts possess potent antioxidant activity, supporting their potential use in functional foods or supplements aimed at mitigating oxidative stress.

4.2. Studies Related to Therapeutic Effects on Humans

Research suggests that *S. chinensis* may protect against neuronal damage and enhance cognitive functions. The plant's bioactive compounds, particularly lignans, possess antioxidant properties that help reduce oxidative stress—a key factor in neurodegenerative diseases and cognitive decline [96]. The typical dosage for Schisandra extract is 100 mg twice daily [97].

Studies have shown that micrandilactone C (MC), a novel nortriterpenoid isolated from the roots of *Schisandra chinensis*, exhibits neuroprotective effects in models of Huntington's disease (HD). MC reduced neurological symptoms and mortality in animals treated with 3-nitropropionic acid (3-NPA), limiting neuronal death, microglial activation, and inflammatory mediator expression. The key mechanism of MC's action was the inhibition of

the STAT3 signaling pathway in microglia, leading to reduced inflammation. Additionally, MC prevented the accumulation of mutated huntingtin protein and protected neurons in cellular models. These findings suggest that MC may be a promising therapeutic strategy for treating HD [98].

Animal studies have demonstrated that extracts from *S. chinensis* can improve memory and learning ability. In one study, rats that received an *S. chinensis* extract showed enhanced spatial memory and learning abilities in maze tests, which are standard cognitive function assessments in animal models [99].

The cognitive benefits of *S. chinensis* are mediated through several mechanisms, including neurotransmitter modulation, enhancement of cholinergic function, and upregulation of neurotrophic factors such as BDNF, which plays a key role in neuronal growth and synaptic plasticity [100].

Although most evidence comes from animal studies, some human research also supports the cognitive benefits of *S. chinensis*. For instance, traditional uses of *S. chinensis* in Chinese medicine include enhancing mental clarity and reducing mental fatigue. Modern clinical studies, though limited, have shown improvements in cognitive performance and reduced stress symptoms in individuals consuming *S. chinensis* extracts [101].

4.3. Studies Related to Therapeutic Effects on Dogs

The Scopus database states that 54 articles have been published on the effects of *Schisandra chinensis* on the nervous system in humans by March 2025. At the same time, it was checked in relation to dogs—the Scopus database indicates only 1 article, which comes from 1955; however, its full-text is not available [60] (Figure 4). There is currently no recent research on the effects of this plant on the nervous system of dogs or its potential for treating neurological disorders in canines. However, given the promising results from laboratory studies on animals, it is possible that similar effects could be observed in dogs.

5. Maral Root (*Leuzea carthamoides* (Wild.) Iljin)

5.1. Aspects and Composition

Leuzea carthamoides, also known as maral root or Russian leuzea, is a perennial plant from the Asteraceae family, valued for its adaptogenic properties and rich bioactive compounds.

Leuzea carthamoides is an herbaceous plant reaching a height of 50 to 120 cm. It has a straight, upright stem, large pinnate leaves, and purple flower heads. It naturally occurs in mountainous regions of Siberia, particularly in the Altai and Sayan Mountains, at altitudes ranging from 1200 to 2000 m above sea level. It prefers sunny locations with well-drained soils [102].

The plant is rich in bioactive compounds, including ecdysteroids flavonoids (e.g., hispidulin, eriodictyol), lignans, triterpenoids, and phenolic acids (e.g., chlorogenic acid) (Figure 5). Ecdysteroids are particularly valued for their anabolic and adaptogenic properties [103]. Maral root is particularly abundant in various phytoecdysteroids, with 20-hydroxyecdysone (20E) being the most prominent. Concentrations of 20E in the plant can range from 0.1% to 1% of the dry root matter. Other notable ecdysteroids identified include turkesterone, integristerone A and B, makisterone C, taxisterone, and leuzeasterone. In total, up to 50 different ecdysteroid compounds have been isolated from *L. carthamoides*, underscoring its status as one of the richest plant sources of these bioactive molecules [104,105]. Flavonoids exhibit strong antioxidant activity, helping neutralize free radicals in the body [106].

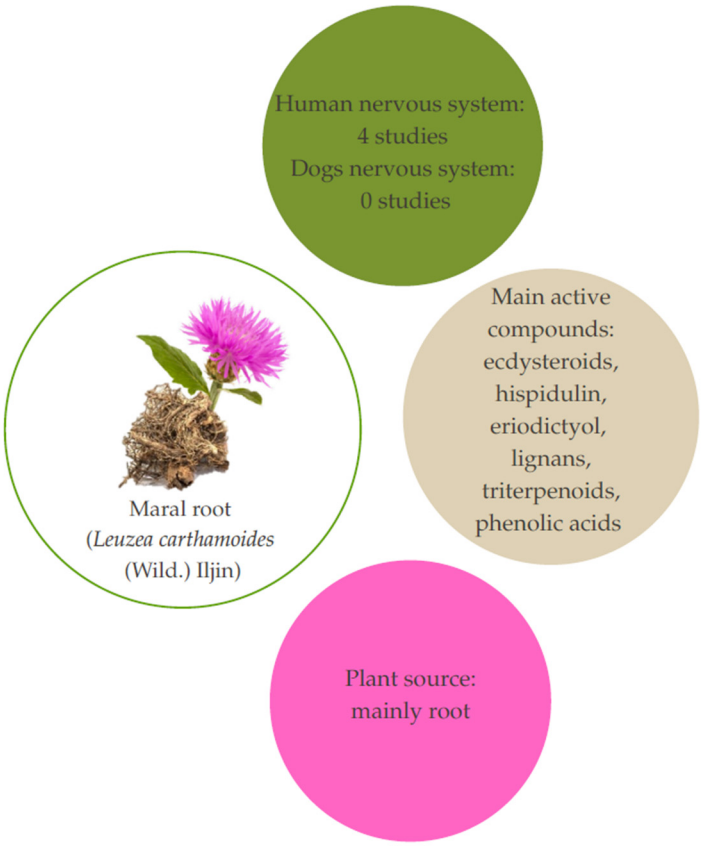


Figure 5. Characteristics of the plant and its principal active compounds [102–105] (search without time range in the Scopus database with Article title, Abstract, Keywords, searching documents with the following command: (adaptogen name) AND nervous AND human/dog, as of 30 March 2025 [60]).

Maral root extract demonstrates significant antioxidant properties. The study of Todorova et al. [105] assessed the effects of maral root extract on oxidative stress markers in Caenorhabditis elegans. The results indicated that treatment with the extract led to a reduction in reactive oxygen species levels and an increase in the expression of antioxidant enzymes such as superoxide dismutase and catalase. These findings suggest that maral root extract possesses potent antioxidant activity, supporting its potential use in functional foods or supplements aimed at mitigating oxidative stress.

5.2. Studies Related to Therapeutic Effects on Humans

Leuzea carthamoides is classified as an adaptogen, meaning it helps the body adapt to stress and restore homeostasis. Its compounds, such as ecdysteroids, enhance physical endurance, improve recovery, and support the immune system. Additionally, *L. carthamoides* extracts exhibit antibacterial activity against various Gram-positive and Gram-negative bacterial strains [106–108]. Due to its properties, *Leuzea carthamoides* has been used in traditional medicine and as an ingredient in dietary supplements supporting physical performance, immunity, and overall well-being. Studies indicate the pharmaceutical potential of compounds isolated from this plant, opening possibilities for their future applications as natural therapeutic agents [109]. Extracts from *L. carthamoides* roots stimulate the body after physical exertion and enhance resistance to long-term stress, making them a valuable addition to a dog's diet.

Nosal et al. [110] reported that compounds in *L. carthamoides*, such as *N*-feruloylserotonin, can inhibit oxidative bursts in human whole blood and isolated neutrophils, suggesting potential in reducing oxidative stress—a key factor in the pathogenesis of many neurodegenerative diseases.

The ecdysteroids in *Leuzea carthamoides* have anti-inflammatory effects, which may help protect neurons from inflammatory processes often associated with neurodegenerative diseases. Furthermore, the presence of compounds such as 20-hydroxyecdysone may contribute to protecting nerve cells from damage, which is relevant in the context of neurodegenerative disease prevention [111].

Compounds contained in *L. carthamoides* can stimulate neurogenesis, the process of creating new neurons, which is crucial for brain plasticity and cognitive functions. Studies on animal models suggest that extracts from *L. carthamoides* can improve cognitive functions, such as memory and learning, which may be related to the modulation of neurotransmitters and protection against oxidative stress [107]. The adaptogenic properties of *L. carthamoides* can improve mood and reduce symptoms of depression, which is important for overall mental health. Therefore, *L. carthamoides* can affect the regulation of the HPA axis, which is important in the context of stress response and maintaining the body's homeostasis [107].

Studies on rats have shown that extracts of *L. carthamoides* in a dosage of 0.2 mL per animal can stimulate protein and RNA biosynthesis in various organs, which may translate into improved cognitive functions [112]. Recommended doses of maral root extract range from 200 to 500 mg per day, divided into two or three servings, depending on individual needs and manufacturer recommendations. There is not enough scientific data to determine the appropriate dose of maral root [104].

5.3. Studies Related to Therapeutic Effects on Dogs

Currently, there is a lack of scientific studies on the effect of *L. carthamoides* on the nervous system of dogs. Most studies on this plant focus on its adaptogenic effect and its effect on the nervous system in humans and other animal models. However, it can be assumed that similar properties can also be observed in dogs. The Scopus database states that four articles have been published on the effects of *Leuzea carthamoides* on the nervous system in humans by March 2025. At the same time, it was checked in relation to dogs—the Scopus database does not report any results [60] (Figure 5).

6. Golden Root (*Rhodiola rosea*)

6.1. Aspects and Composition

Rhodiola rosea, which belongs to the Crassulaceae family, is characterized by fleshy, thick rhizomes with a pink color. The stems are straight, reaching a height of 10 to 35 cm, ending with clusters of yellow or yellowish-green flowers. The leaves are fleshy, alternate, lanceolate in shape and with serrated edges. This plant is adapted to harsh climatic conditions, which is reflected in its morphology [113]. *Rhodiola rosea* occurs in the subarctic regions of the northern hemisphere, mainly in high-altitude areas, such as the mountains of Siberia, Central Europe and North America [114]. Although *Rhodiola rosea* is not widely used as a food product, its roots contain phenolic compounds such as salidroside and tyrosol, which have antioxidant activity. These compounds may contribute to the protection of cells from oxidative stress [115,116].

R. rosea contains a number of bioactive compounds, including phenylpropanoids (rosavin, rosarin and rosin), tyrosol glycoside (salidroside) and tyrosol [117,118] (Figure 6). These compounds are responsible for its adaptogenic properties, helping the body adapt to stress and normalize physiological functions. They also exhibit antioxidant, immunomodulatory, anti-aging and anti-fatigue effects.

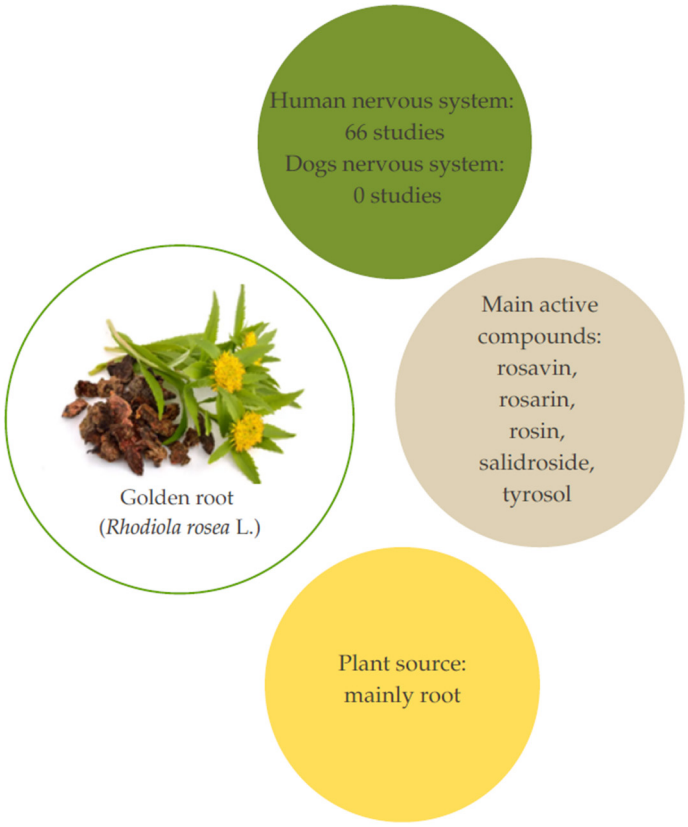


Figure 6. Characteristics of the plant and its principal active compounds [113–120] (search without time range in the Scopus database with Article title, Abstract, Keywords, searching documents with the following command: (adaptogen name) AND nervous AND human/dog, as of 30 March 2025 [Scopus]).

The adaptogenic effects of *R. rosea* are associated with its ability to modulate the levels of monoamines and opioid peptides, such as beta-endorphins, which affects the central nervous system. Studies have shown that extracts from this plant can affect serotonin and dopamine levels, which contribute to improving mood and reducing symptoms of depression [119].

Extracts from *Rhodiola rosea* demonstrates high antioxidant properties. The study of Zhumagul et al. [120] assessed the antioxidant activity of R. rosea essential oils using the FRAP assay. The results indicated that the essential oils exhibited antioxidant activity, although lower than that of the standard antioxidant butyl hydroxyanisole at concentrations ranging from 0.25 to 1.0 mg/mL. These findings suggest that *R. rosea* essential oils possess antioxidant activity, supporting their potential use in functional foods or supplements aimed at mitigating oxidative stress.

6.2. Studies Related to Therapeutic Effects on Humans

In traditional medicine, *R. rosea* has been used to relieve stress, fatigue and support physical and mental performance. Its roots have been used as a tonic, improving endurance, and reducing symptoms of fatigue [119].

Modern clinical studies confirm the beneficial effects of *R. rosea* in relieving symptoms of stress, fatigue, and improving cognitive function. Its adaptogenic properties make it a subject of interest. However, reports of studies in dogs are limited. Studies in mice have shown that *R. rosea* extract increases resistance to stress, which is characteristic of adaptogens. In one experiment, it was observed that the administration of an extract of this plant improved the ability of mice to cope with stressors, which suggests its potential use in

alleviating the symptoms of stress [121]. In animal models, such as mice, extract of *R. rosea* in a dosages of 10, 15 and 20 mg/kg showed anxiolytic effects. In the elevated plus maze test, which is a standard test assessing the level of anxiety in rodents, the administration of the extract of this plant resulted in a reduction in anxiety symptoms [121].

Extracts of *R. rosea* have shown antidepressant effects. Darbinyan et al. [122] conducted a randomized, double-blind, placebo-controlled phase III trial over 6 weeks to evaluate the efficacy and safety of a standardized *R. rosea* extract in patients with mild to moderate depression. The study found that both doses of *R. rosea* (340 mg/day and 680 mg/day) significantly improved depression symptoms, insomnia, emotional instability, and somatization. Additionally, a phase II trial by Mao et al. [123] compared *R. rosea* to sertraline in treating mild-to-moderate depression. Results showed that while *R. rosea* had a modest antidepressant effect compared to sertraline, it caused fewer side effects and was better tolerated, suggesting a more favorable risk-to-benefit ratio.

Studies in rats indicate that *R. rosea* may affect the levels of neurotransmitters, such as serotonin and dopamine, in the brain. These changes may be related to the observed antidepressant and anxiolytic effects obtained after administration of dry water extracts from roots of *Rhodiola rosea* (3% rosavins), where the extract concentration after rehydration was 80 mg/mL [48]. In animal models, *R. rosea* extract improved cognitive functions, such as memory and learning. In studies on memory-impaired rats, administration of an extract from this plant in a dosage of 300 and 500 mg/kg led to improved performance in behavioral tests assessing memory and learning [124]. Salidroside, the main active compound of *R. rosea*, has shown neuroprotective effects in studies on neurons. It protected cells from oxidative stress and apoptosis, suggesting potential use in protecting neurons from damage [125]. *R. rosea* extracts have shown the ability to inhibit enzymes such as monoamine oxidase A and B, responsible for the breakdown of neurotransmitters [126]. This effect may contribute to increased availability of neurotransmitters in the brain, which is important in treating mood disorders.

Studies in rats have shown that the administration of *R. rosea* extract reduces symptoms of fatigue. Rats given the extract showed increased physical activity and better performance in endurance tests [127]. In studies in rats with symptoms of depression, *R. rosea* extract promoted stem cell differentiation and proliferation in the hippocampus, suggesting its potential effect on neurogenesis and brain plasticity. Although studies in animal models are preliminary, the results suggest that *R. rosea* may have potential in treating neurodegenerative diseases such as Alzheimer's and Parkinson's disease through its neuroprotective and neuromodulatory properties [125,128].

6.3. Studies Related to Therapeutic Effects on Dogs

The Scopus database states that 66 articles have been published on the effects of *R. rosea* on the nervous system in humans by March 2025. At the same time, it was checked in relation to dogs—the Scopus database does not report any results [60] (Figure 6). Although there are no direct studies on the effects of *R. rosea* on the nervous system of dogs, results from studies in other animal models suggest that this plant may have a beneficial effect on the functioning of the nervous system. However, further studies are needed to confirm these effects in dogs.

7. Conclusions

In summary, adaptogens have a multifaceted effect on the nervous system, regulating cortisol levels, influencing neurotransmission, reducing oxidative stress, and supporting neuroplasticity. Their use in both humans and dogs is a promising strategy for supporting the treatment of stress-related disorders and neurodegeneration. Further research is

needed in the future to determine the precise mechanisms of action of individual adaptogens and their potential clinical application. Despite numerous studies confirming the efficacy and safety of adaptogens in humans, there is a lack of reliable data on their effects on dogs. In the face of the growing problem of diseases of the nervous system, a comprehensive approach to therapy, combining adaptogens and the positive influence of animals, seems to be a promising direction. Both humans and dogs can benefit from adaptogens, which suggests the need for further research on their use in the context of cross-species psychoneuroendocrinology. Therefore, further research is needed to assess their potential benefits and safety in canines.

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Abbreviations

The following abbreviations are used in this manuscript:

HPA	hypothalamic–pituitary–adrenal
BDNF	brain-derived neurotrophic factor
PPD	protopanaxadiol
PPT	protopanaxatriol
AD	Alzheimer's disease
NFP	non-saponin fraction rich in polysaccharides
AHN	adult hippocampal neurogenesis
LPS	lipopolysaccharide
MC	micrandilactone C
HD	Huntington's disease
3-NPA	3-nitropropionic acid

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