

Phytotherapy in neurology: a review of the therapeutic potential and toxicological risks of natural remedies

Phytotherapy in neurology: the dual face of natural medicines – a review of the therapeutic potential and toxicological risks

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ABSTRACT:

The use of herbal remedies and medicinal plants has become increasingly popular due to the perception that they represent safer and more affordable alternatives to conventional medications. However, despite their benefits, the toxicity of these treatments, often underestimated, can pose significant health risks. This study aimed to investigate the therapeutic potential and toxicological risks of herbal remedies and medicinal plants used in the treatment of neurological diseases such as epilepsy, Alzheimer's disease, Parkinson's disease, and others.

The research was conducted through an integrative literature review, selecting recent scientific studies evaluating the benefits and adverse effects of these compounds. The main factors contributing to toxicity, such as inadequate dosages, drug interactions, and lack of professional guidance, were analyzed. Data were collected from reliable sources such as PubMed, SciELO, Scopus, and Google Scholar, using the descriptors: toxicity, natural product, phytotherapy, nervous system, and adverse effects. The results of this review highlight the need for a broader understanding of the risks associated with the indiscriminate use of herbal remedies and medicinal plants, emphasizing the importance of a cautious and controlled approach by healthcare professionals. Furthermore, the findings contribute to the development of more rigorous guidelines on the use of these natural compounds, promoting greater safety and efficacy in the treatment of nervous system diseases. The results include the need for patient re-education and guidance, as well as practical guidelines for healthcare professionals, aiming for monitored use, caution, and appropriate intervention in cases of adverse effects.

Keywords: toxicity, natural product, phytotherapy, nervous system, adverse effects.

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use of phytotherapics and medicinal plants has become increasingly popular due to the perception that they offer safer and more affordable alternatives to conventional drugs. However, despite their benefits, the toxicity of these treatments, often underestimated, can pose significant health risks. This study aimed to investigate the therapeutic potential and toxicological risks of phytotherapics and medicinal plants used in the treatment of neurological disorders such as epilepsy, Alzheimer's disease, Parkinson's disease, and others. The research was conducted through an integrative literature review, selecting recent scientific studies that evaluate the benefits and adverse effects of these compounds. The main factors contributing to toxicity were analyzed, including inappropriate dosages, drug interactions, and the lack of professional guidance. Data were collected from reliable sources such as PubMed, Scopus, and Google Scholar, using the descriptors: toxicity, natural product, phytotherapy, nervous system, and adverse effects.

The results highlight the need for a broader understanding of the risks associated with the indiscriminate use of phytotherapics and medicinal plants, highlighting the importance of a cautious, evidence-based approach supervised by healthcare professionals. Furthermore, the findings contribute to the development of more rigorous guidelines for the use of these natural compounds, promoting greater safety and efficacy in the treatment of nervous system disorders. The study also reinforces the importance of patient education and the establishment of practical guidelines for healthcare providers to ensure monitored use and appropriate intervention in cases of adverse reactions.



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Keywords: Toxicity. Biological Products. Phytotherapy. Nervous System. Adverse Drug Events

INTRODUCTION

The use of medicinal plants and phytotherapeutics in the treatment of neurological diseases has grown significantly in recent decades, driven by the realization that these therapies natural products represent safer, more accessible and culturally accepted alternatives compared to synthetic medicines. However, the increased popularity of these practices does not eliminate the risks associated with self-medication, lack of professional guidance and lack of scientific evidence regarding the safety and efficacy of many compounds used (Almeida et al, 2022; Freitas; Souza, 2021).

According to the Ministry of Health, medicinal plants are those that contain substances with therapeutic properties in their constituent parts, while herbal medicines correspond to the products obtained from them, and can be presented in different forms pharmaceuticals, such as capsules, tablets, syrups and creams (Brazil, 2023).

Phytotherapy has accompanied humanity since the dawn of civilization. Records Historical records indicate that, since 2300 BC, Egyptians, Assyrians and Hebrews cultivated various herbs and used them in medical treatments, establishing the foundations of phytotherapy as we know it today (Rocha, 2021).

Scientific and traditional literature recognizes the therapeutic potential of different species vegetables in the management of neurological disorders, due to their anxiolytic properties, antidepressants, neuroprotectors, and modulators of cognitive function. Studies have shown promising results with the use of *Passiflora incarnata* and *Valeriana officinalis*, associated with effects anxiolytics and sedatives; *Ginkgo biloba*, related to improved memory and neuronal protection; *Curcuma longa*, with antioxidant and anti-inflammatory action; and *Bacopa monnieri*, investigated for its positive influence on cognition and synaptic plasticity (Borges et al, 2022; Lima et al., 2021; Fatima, 2022; Genchi et al., 2024; Desai et al., 2025).

The lack of professional guidance, combined with the belief that natural products are free risks lead to the inappropriate use of these substances, leading to serious adverse effects, such as hepatic and neurological toxicity, in addition to drug interactions that compromise therapies conventional pharmacological (Silva; Castro, 2019; Moreira; Gomes, 2023).

Many herbal medicines still lack robust clinical studies to prove their effectiveness. and safety. The lack of standardization of doses and the variability in the chemical composition of plants make it difficult to obtain consistent results, such data reinforce the need for scientific research that supports the rational use of these products (Chandran, 2020).



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In recent years, advances in neuroscience and pharmacognosy have driven the search for new bioactive molecules of plant origin, especially in a scenario where diseases neurodegenerative diseases, such as Alzheimer's and Parkinson's, are showing increasing prevalence worldwide. according to the World Health Organization (WHO, 2023), neurological diseases represent a leading cause of global disability and mortality, affecting millions of people and generating a major socioeconomic impact. In this context, phytotherapy emerges as an alternative promising complementary therapy, capable of providing natural compounds with neuroprotective potential and neurotransmitter modulator (Costa; Almeida, 2022; Sousa et al., 2022).

At the same time, it is necessary to consider the regulatory and cultural context surrounding the use of medicinal plants in Brazil. The National Policy on Medicinal Plants and Phytotherapeutics (PNPMF), established in 2006 and updated in 2023, seeks to promote the safe and rational use of these therapies in Unified Health System (SUS), in addition to encouraging studies on efficacy, standardization and toxicity of natural compounds (BRASIL, 2023). However, the lack of product standardization, the absence quality control and empirical use still represent significant challenges for safe consolidation of phytotherapy in the clinical context (Barbosa; Pereira, 2020).

Neurological phytotherapy also has increasing relevance in the field of biomedicine, as it allows integration between scientific knowledge and traditional therapeutic practices. Professionals in this area play a fundamental role in investigating the mechanisms of action, in the analysis of toxicity and in providing safe guidance to patients regarding the use of natural medicines. This multidisciplinary approach contributes to more humanized and knowledge-based care. evidence, respecting the biological and cultural particularities of individuals (Mendonça Neto et al., 2022; Carvalho et al., 2025).

In the field of neurology, interest in natural compounds has grown, especially for the search for alternatives with less toxicity for the treatment of neurodegenerative disorders and psychiatric conditions. The ability of certain plants to modulate neurotransmitters and protect neurons against oxidative stress makes them promising candidates in research on Alzheimer's, Parkinson's, epilepsy and anxiety disorders (Chandran, 2020).

Thus, the objective of this work was to research the therapeutic potential of plants medicinal plants in the neurological context, highlighting their bioactive properties, as well as the risks and associated adverse effects.

1. METHODOLOGY

This research was characterized as an integrative literature review, whose objective was analyze the therapeutic benefits and toxicity of medicinal plants and phytotherapeutics used in treatment of neurological diseases.

The selection of articles was carried out in the PubMed, SciELO, Scopus and Google databases Scholar, using the following descriptors in Health Sciences: toxicity, drugs natural, phytotherapy, nervous system and adverse effects.

The inclusion criteria adopted were: articles that addressed the proposed theme, published in the period from 2015 to 2025, in Portuguese or English, and available in the full version (full text). Studies with a publication date greater than 10 years ago and those that did not addressed the topic of this work. 23 articles were analyzed and chosen that fit in the inclusion criteria.

Data collection involved critical reading of the selected articles, with analysis of their methods, results, and conclusions. Content analysis was applied to categorize the data, referring to the most commonly used substances, their therapeutic benefits and the toxicity of the compounds. In addition, specific factors such as dosage, common and main forms of use were evaluated, potential risks reported in the studies.

3. RESULTS AND DISCUSSION

Analysis of the data collected revealed a significant diversity of medicinal plants and herbal medicines used in the context of neurology, each presenting different profiles of therapeutic effects and associated risks. The information compiled in Table 1 summarizes the observed benefits, potential toxic effects and the most common forms of use of these substances, allowing a critical evaluation of their clinical applicability.

In table 1, we can see that plants like *Bacopa monnieri* have a large potential in neurological therapy, its neuroprotective effects can protect neuronal cells against damage induced by γ -amyloid aggregates (A β 25–35), common in diseases such as Alzheimer's, however, its misuse is marked by adverse effects such as gastrointestinal disorders; and hepatotoxicity in cases of overdose, mainly associated with low-dose products qualities (Desai et al, 2025).

Ginkgo biloba also showed clear benefits, such as improved cognition and effects neuroprotective, antioxidant and anti-inflammatory agents that can protect or reduce cell damage

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neuronal, as far as its risks are concerned, is contraindicated for people with bleeding disorders, pregnant or lactating women, because its composition contains ginkgolides, substances that inhibit platelet aggregation, that is, they make blood clotting difficult, increasing bleeding, especially in those who already use anticoagulants (Tan et al., 2015).

Other herbal remedies, notably Valerian (*Valeriana officinalis*), Lavender (*Lavandula angustifolia*) and Melissa (*Melissa officinalis*), present benefits in cases of anxiety, insomnia, improved sleep quality, and agitation. However, its possible risks interactions with conventional drugs are significant, and can potentiate effects and cause drowsiness and excessive sedation, which requires clinical observation and dose adjustment (Lopes et al., 2017; Almeida et al., 2024; Velasquez et al., 2024).

This potentialization is directly linked to its chemical composition, which reveals a common mechanism of action in the modulation of the Central Nervous System (CNS). Bioactive compounds such as valepotriates and valerenic acid from Valerian, linalool and linalyl acetate from Lavender, and rosmarinic acid from Melissa, act as allosteric modulators of the Gamma-Gamma receptor. Aminobutyric acid (GABA-A). By intensifying the activity of the main inhibitory neurotransmitter of CNS, promote the desired anxiolytic and sedative effect (Lopes et al., 2017; Almeida et al., 2024; Velasquez et al., 2024).

Toxicologically, concomitant use with drugs that share this mechanism (such as benzodiazepines, barbiturates, or alcohol) leads to synergistic toxicity. In cases of overdose or unsupervised association, excessive neuronal inhibition does not restricted to intense sedation, which may progress to central depression respiratory system in the brainstem, resulting in life-threatening complications. This serious risk of central toxicity is often underestimated by the patient, reinforcing the need for intervention rigorous professional (Carvalho et al, 2025).

Table 1 – Plants and herbal medicines researched, benefits, potential risks and use.

Plant and/or phytotherapeutic	Benefits found in neurological therapy	Potential toxic and general risks	Forms of common uses.
Popular name: Brahmi Scientific name: (<i>Bacopa monnieri</i>) Author: Desai et al., 2025	Neuroprotective and neurorescue effects; modulation of neuroinflammation in Alzheimer's and Parkinson's diseases; improvement of cognitive function and memory.	Possible drug interactions with anxiolytics and sedatives; gastrointestinal disorders attributed to the action of saponins present in BME; hepatotoxicity and kidney damage at doses higher than the safe dosage.	Teas or infusions; Dust under food; Capsules; Fortified foods.



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<p>Popular name: Lemongrass</p> <p>Scientific name: <i>Cymbopogon citratus</i></p> <p>Author: Mendonça Neto et al., 2022</p>	<p>Citral (main active compound) has anxiolytic and sedative properties, acting on the central nervous system</p> <p>to promote relaxation and reduce anxiety.</p>	<p>Allergic reactions; possible drug interactions with anxiolytics, sedatives or anticoagulants, potentiating effects; risks of hypoglycemia in high doses in people prone to them.</p> <p>or</p>	<p>Teas; Essential oil (aromatherapy or topical).</p>
<p>Popular name: Ginkgo or Japanese walnut</p> <p>Scientific name: <i>Ginkgo biloba</i></p> <p>Author: Tan et al., 2015</p>	<p>Improves cognitive function in the elderly, may stabilize cognitive performance or delay decline; has neuroprotective, antioxidant, and anti-inflammatory effects.</p>	<p>Possible drug interactions: may interact with anticoagulants, increasing the risk of bleeding; contraindicated for people with bleeding disorders, pregnant or lactating women.</p>	<p>Teas or infusions of dried leaves; Standardized extract; capsules</p> <p>Liquid extract;</p>
<p>Popular name: Lavender or lavender</p> <p>Name scientific: <i>Lavandula angustifolia</i>, formerly <i>Lavandula officinalis</i></p> <p>Author: Lopes et al., 2017</p>	<p>Compounds such as linalool and linalyl acetate modulate the activity of GABA, a neurotransmitter responsible for neuronal inhibition, promoting relaxation and reducing anxiety.</p>	<p>Possible drug interactions, potentiates the effect of benzodiazepines or other sedatives; slightly anticoagulant effect, interfering with antiplatelet anticoagulants;</p> <p>allergic reactions such as skin rash or irritation.</p>	<p>Teas; Infusions; Oil (aromatherapy); Capsules.</p> <p>essential</p>
<p>Popular name: Lemon balm or melissa</p> <p>Scientific name: <i>Melissa officinalis</i></p> <p>Author: Almeida et al., 2024</p>	<p>Contains bioactives such as rosmarinic acid and flavonoids that modulate the activity of GABA, which reduces anxiety and decreases agitation in adults</p>	<p>Possible drug interaction that may enhance the effect of benzodiazepines, barbiturates or other sedatives.</p>	<p>Infusion of leaves; Standardized extracts; Capsules.</p>
<p>Popular name: Valerian or St. George's wort</p> <p>Scientific name: <i>Valeriana officinalis</i></p> <p>Author: Velasquez et al., 2024</p>	<p>Contains valepotriates and valerenic acid that modulate GABA, a neurotransmitter responsible for neuronal inhibition, resulting in reduced anxiety, improved relaxation and aided sleep.</p>	<p>Drug interactions: may enhance the effects of benzodiazepines, barbiturates, and other sedatives; may interact with alcohol, increasing the effects and risk of accidents.</p>	<p>Infusion of dried roots; Standardized extracts; Capsules.</p>

Source: prepared by the authors.

Furthermore, it was possible to identify the contexts in which these herbal medicines are most frequently used, whether in conventional or complementary therapies, as well as the limits



recommended daily dosage and possible administration errors that may contribute to adverse effects.

Table 2 presents this data in summary form, facilitating the understanding of the risks and benefits associated with the use of these substances in different therapeutic contexts.

The main dosage errors found were the excess intake of plants in tea form, exceeding more than 2 cups/day, which in cases of use of *Cymbopogon citratus*, *Passiflora incarnata*, *Piper methysticum* cause sedation and extreme drowsiness. In *Piper methysticum*, it is still possible to observe an aggravating factor in overdose or prolonged use, due to its hepatotoxic potential, which may require urgent medical intervention (Souza et al., 2019; Mendonça Neto et al., 2022; Borges et al., 2022).

In *Curcuma Longa* and *Lavandula angustifolia*, the effects were discomfort gastrointestinal, nausea and dizziness, also due to excess standardized extract and capsules. The curcumin, a food spice from turmeric, also showed an inhibitory effect on the factor platelet activation and arachidonic acid-mediated platelet aggregation through inhibition thromboxane formation and Ca²⁺ signaling, increasing the risk of bleeding, and in *Lavandula angustifolia*, the ingestion of essential oil, which is strictly contraindicated, due to oils essential to have a high concentration of bioactives, and their use is recommended in aromatherapy alone is a risk factor for gastrointestinal health leading to toxic effects quickly (Lopes et al., 2017; Genchi et al., 2024)

Table 2 – Types of therapy, dosage limit and possible errors.

Plant / Phytotherapeutic	Type of Therapy	Possible Daily Dosage Limit	Errors of Dosage
Popular name: Grass Lemon Name scientific: <i>Cymbopogon citratus</i> Author: Mendonça Neto et al., 2022	Complementary, traditional herbal medicine	Tea: 1–2 cups/day; essential oil: topical use or aromatherapy (do not ingest neat)	Ingestion of pure essential oil, excess tea causing intense drowsiness or hypotension
Common name: Turmeric or Turmeric Scientific name: <i>Curcuma Longa</i> Author: Genchi et al., 2024	Complementary, phytotherapy	Powder: 1–3 g/day; standardized extract: 500–1500 mg/day	High dose supplements in may cause increase gastrointestinal and risk discomfort of bleeding in anticoagulated patients
Popular name: Kawa-kawa or kava Scientific name: <i>Piper methysticum</i> Author: Souza et al., 2019	Complementary, traditional herbal medicine (Pacific)	Standardized extract: 120–250 mg kavalactones/day	Prolonged or excessive use may cause hepatotoxicity and intense sedation; combination with alcohol or sedatives increases the risk of serious adverse effects.
Popular name: Lavender or lavender	Complementary aromatherapy, or herbal medicine	Capsules/extract: 80–160 mg/day; essential oil:	Excess capsules causing nausea or dizziness; incorrect use of the

Scientific name: <i>Lavandula angustifolia</i> , formerly <i>Lavandula officinalis</i>	aromatherapy or topical use	high intake of essential oils in aromatherapy	by or doses
Author: Lopes et al., 2017			
Popular name: Flower-of-Passion or Passion Fruit Name scientific: <i>Passiflora incarnata</i> Author: Borges et al., 2022	Complementary, phytotherapy	Tea: 1–2 cups/day; extract: 200–400 mg/day	Excess tea or extract leading to drowsiness

Source: prepared by the authors.

According to Tables 1 and 2, the widespread use of medicinal plants and herbal medicines with therapeutic potential in the field of neurology, especially in conditions related to anxiety, depression and cognitive decline. Among the most studied species, *Bacopa monnieri*, *Curcuma longa*, *Ginkgo biloba* and *Piper methysticum*, whose bioactive compounds have neuroprotective, antioxidant and neurotransmitter modulating effects. These mechanisms contribute to the improvement of cognitive and emotional functions, demonstrating relevance in both the prevention and treatment of neurodegenerative diseases (Desai et al, 2025; Genchi et al., 2024; Souza et al., 2019; Tan et al., 2015).

However, although the results indicate promising therapeutic benefits, the use of these substances require caution. Several studies report that high doses, prolonged use without professional monitoring and drug interactions with conventional drugs can generate significant adverse effects, such as hepatotoxicity, gastrointestinal disorders, drowsiness excessive and increased risk of bleeding. Thus, the need for a adequate clinical monitoring and awareness regarding the safe use of these compounds (Desai et al, 2025; Genchi et al., 2024; Souza et al., 2019; Tan et al., 2015).

The data analyzed also indicate that the use of herbal medicines occurs predominantly as complementary therapy, usually in pharmaceutical forms such as infusions, extracts standardized and capsules. This context reinforces the importance of ensuring product quality and the standardization of dosages, so that the treatment is effective and safe (Carvalho et al, 2025).

Based on the evidence gathered, it is possible to propose practical recommendations to health professionals responsible for guiding patients who use herbal medicines and plants medicinal products. These recommendations aim to optimize therapeutic effects and reduce the risk of adverse events. First, it is recommended to perform a detailed clinical evaluation of the patient before any prescription or indication of herbal medicines, considering the history of use



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of conventional medications, the presence of comorbidities and possible allergies. This step is essential to prevent drug interactions and unwanted reactions.

Furthermore, it is essential that professionals provide guidance on the appropriate dosage, adjusting it according to the age, weight and clinical conditions of each patient, and warn about the dangers of overdose. Excessive use of concentrated teas, indiscriminate intake of oils essential and self-medication with multiple herbal remedies can cause serious adverse reactions. Continuous monitoring should also be encouraged, since prolonged use without medical supervision may result in toxicity, as observed in cases related to *Kava-kava*, whose prolonged use is associated with liver damage.

Another essential aspect is patient education and awareness. It is necessary to reinforce that, despite being natural products, herbal medicines are not risk-free, and that safety depends on correct use. Therefore, the patient must be guided on the appropriate forms of preparation, dose, frequency and possible interactions with food or medications. Finally, in case of appearance of adverse effects, such as nausea, dizziness, liver changes or symptoms exacerbated neurological symptoms, use should be immediately discontinued and the patient should seek medical attention. medical care for evaluation and appropriate management.

Overall, the evidence points to the importance of responsible clinical practice, based on the integration of traditional knowledge and evidence-based medicine. As also the need for long-term studies (*in vivo*) to investigate chronic hepatotoxicity in therapeutic doses (especially for *Piper methysticum*) and the urgency of research to elucidate the toxicokinetics and toxicodynamics of the metabolites that cause adverse effects on the system central nervous system. The recommendations presented here can help promote more effective use safe and effective use of medicinal plants and phytotherapeutics, in line with the principles of biomedicine and of clinical pharmacy and contributing to the consolidation of a more therapeutic approach humanized and scientific in the care of neurological diseases.

4. CONCLUSION

This integrative review allowed us to identify that herbal medicines and medicinal plants have relevant therapeutic potential in the management of neurological diseases, including neurodegenerative disorders such as Alzheimer's and Parkinson's, epilepsy and disorders



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psychoneurological. The observed mechanisms of action, such as anxiolytic, antioxidant, anti-inflammatory, neuroprotective and modulatory of cognitive function, show that these substances can act as a complement to conventional therapies, especially when used rationally and respecting appropriate dosage protocols, as per observed in *Bacopa monnieri*, *Curcuma longa*, *Ginkgo biloba*, *Piper methysticum* and *Passiflora incarnate*.

The data analyzed indicate, however, that the inappropriate or indiscriminate use of these products may result in significant adverse effects, including hepatotoxicity, disorders gastrointestinal disorders, neurological changes and drug interactions, which can compromise the effectiveness of conventional treatments and patient safety. These findings reinforce the need individualized clinical evaluation, continuous monitoring and professional guidance, especially in more vulnerable populations or those who use pharmacological medications concomitantly.

Additionally, the review highlights the existence of gaps in regulation, standardization and scientific proof of the efficacy and safety of these compounds. Thus, the development of rigorous clinical studies and the development of protocols becomes essential standardized therapeutics and the expansion of the dissemination of information on toxicity, interactions medication and dosage limits between healthcare professionals and patients.

In summary, although herbal medicines and medicinal plants demonstrate therapeutic benefits relevant, their use must always be based on scientific evidence, monitoring professional and appropriate patient education. The responsible integration of these practices into health care neurological health makes it possible to maximize desirable clinical effects and minimize associated risks and ensure safety and effectiveness in treatment, contributing to the consolidation of more comprehensive guidelines safe and well-founded for clinical practice and scientific research.

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