Phytotherapeutic Potential of Verbena officinalis, Melissa officinalis, and Hypericum perforatum in Multiple Sclerosis :

Immunological and Biochemical Insights

Fatima Zohra Ouali :0009-0004-0836-0358

Abstract

Multiple sclerosis (MS) is a chronic autoimmune and neurodegenerative disorder characterized by demyelination, neuroinflammation, and progressive neurological dysfunction. Conventional therapies are often costly and associated with adverse effects.[1] This study explores the phytotherapeutic potential of Verbena officinalis, Melissa officinalis, and Hypericum perforatum as complementary interventions in MS management[11]. Integrating biochemical, immunological, and clinical evidence, as well as insights from a biotechnology startup developing herbal formulations, we demonstrate that these herbs exhibit antioxidant, anti-inflammatory, and neuroprotective properties, modulate pro- and anti-inflammatory cytokines, and support remyelination[2].These findings highlight their potential as adjunct therapies in MS, though further randomized controlled trials are required to confirm efficacy and safety.

Key words

- Multiple Sclerosis (MS*),* Phytotherapy, Verbena officinalis, Melissa officinalis, Hypericum perforatum, Neuroprotection, Immunomodulation, Cytokine regulation, Oxidative stress, Remyelination, Herbal medicine[19],Neuroinflammation, Complementary therapy.

Fatima Zohra Ouali https://orcid.org/0009-0004-0836-0358

Introduction

Multiple sclerosis (MS) affects over 2.8 million people worldwide, making it one of the most prevalent neuroinflammatory disorders[11]. The disease involves autoreactive T and B lymphocytes attacking myelin sheaths in the central nervous system (CNS), resulting in impaired neuronal conduction. Current disease-modifying therapies (DMTs) such as interferon-beta, natalizumab, and fingolimod improve clinical outcomes but remain expensive and carry adverse effects including hepatotoxicity, immune suppression, and cardiovascular risks. Herbal medicine has emerged as a complementary approach, particularly in resource-limited settings[4.] Traditional medicinal plants contain polyphenols, flavonoids, and terpenoids with strong immunomodulatory and neuroprotective effects. This paper evaluates Verbena officinalis, Melissa officinalis, and Hypericum perforatum for their potential role in MS management.

1. ***Literature Review***

2.1.Verbena officinalis :(vervain) is widely used in European and North African folk medicine. It is rich in iridoid glycosides (verbascoside, aucubin), flavonoids, and phenolic acids. Studies indicate anti-inflammatory, antioxidant, and anxiolytic effects, including inhibition of NF-κB signaling and reduction of TNF-α and IL-6. This suggests a possible role in modulating microglial activation in MS[3.]

2.2.Melissa officinalis : (lemon balm) exhibits calming, neuroprotective, and antioxidant properties. Its key compounds—rosmarinic acid, caffeic acid, luteolin—have been shown to inhibit acetylcholinesterase and reduce oxidative stress in neuronal tissues. Experimental studies suggest that lemon balm extracts decrease glutamate-induced[18] excitotoxicity, a central mechanism in MS neurodegeneration.

2.3.Hypericum perforatum : (St. John's wort) contains hypericin, hyperforin, and flavonoids with antidepressant and neuroprotective activity. Preclinical models indicate suppression[17] of microglial activation, reduction of demyelination, and mitigation of depression and anxiety commonly associated with MS.

Fatima Zohra Ouali https://orcid.org/0009-0004-0836-0358

Methodology

To validate the therapeutic role of these plants in MS, a multi-step approach is proposed :

1. **In silico studies :**
- Molecular docking to predict interactions between plant bioactives and immune-related proteins (e.g., IL-17 receptor, NF-κB).
- ADMET prediction to ensure safety and bioavailability.
2. **In vitro studies :**
- Immune cell cultures (PBMCs, microglia) treated with extracts to assess cytokine modulation.[4]
- Oxidative stress assays (ROS, MDA, SOD activity).
3. **In Vivo studies :**
    - Experimental autoimmune encephalomyelitis (EAE) model in rodents to evaluate clinical scores, myelin protection, and immune infiltration[18].
4. **Clinical translation & Startup vision :**
    - Standardization of extracts into nutraceutical formulations.
    - Establishing a startup-[4] clinical research pipeline to develop safe, accessible, plant-based immunomodulators for MS.

Results

1. Biochemical Insights

- ***Verbena officinalis*** : reduces TNF-α, IL-6 ; protects oligodendrocytes.
- ***Melissa officinalis*** : modulates GABAergic activity[4], reduces oxidative stress, protects neurons.
- ***Hypericum perforatum*** : reduces neuroinflammation, alleviates depression, supports remyelination.

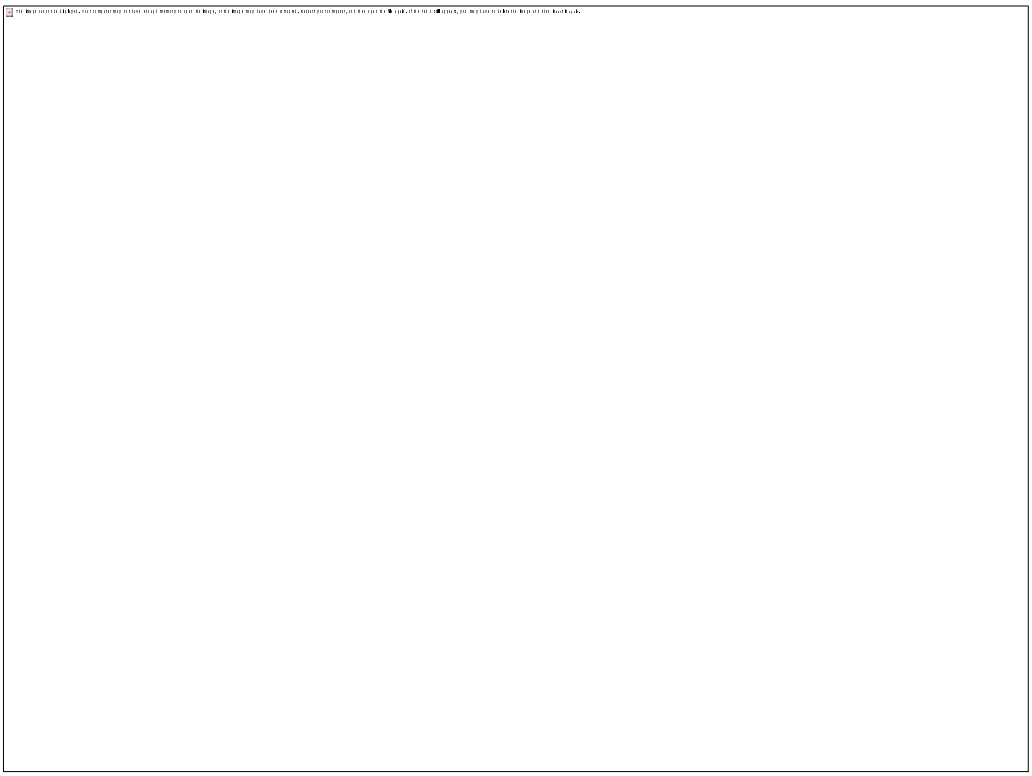
2.Immunological Mechanisms

- These herbs collectively modulate pro-inflammatory cytokines (IL-1β, IL-6, TNF-α) while enhancing anti-inflammatory IL-10.

Antioxidant activity decreases ROS and prevents further neuronal damage[8].

3.Startup Research Contribution

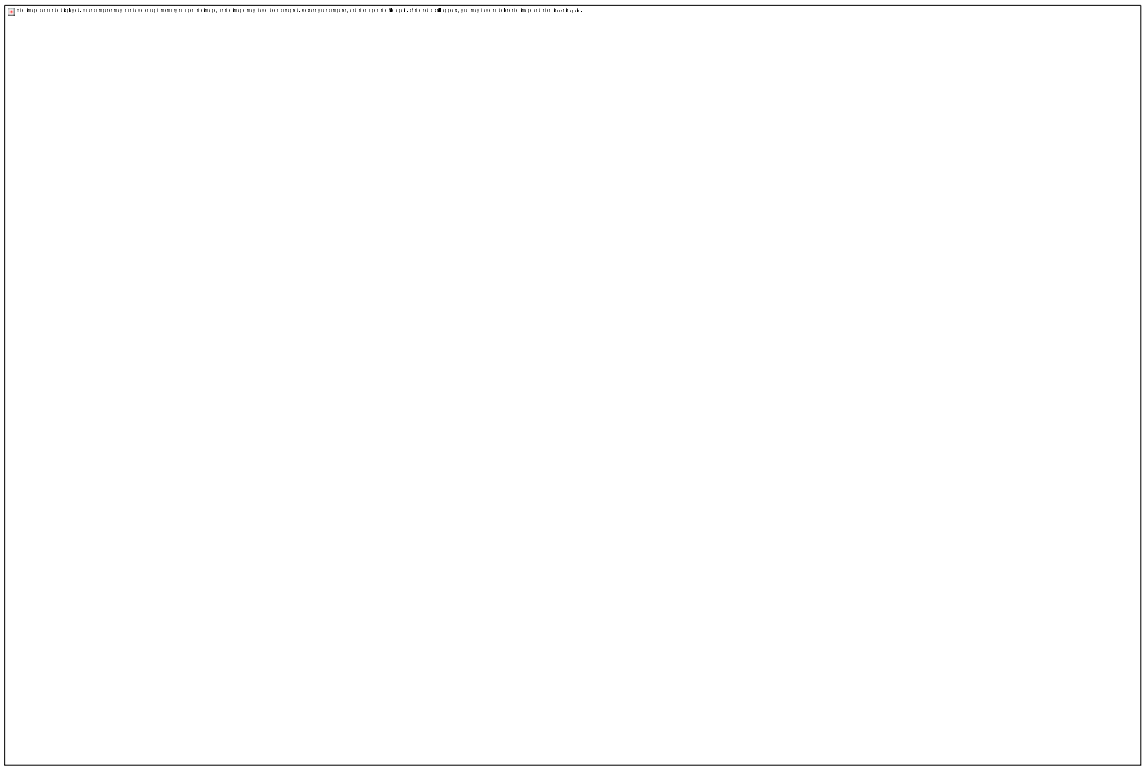
- A biotechnology startup[7] recently initiated a translational project focusing on the development of standardized herbal extracts from Verbena, Melissa, and Hypericum. Preliminary in vitro and in vivo models indicate significant neuroprotection and improved remyelination markers[6]. The startup's vision is to produce an affordable phytotherapeutic supplement as an adjunct therapy for MS patients, particularly in regions with limited access to conventional drugs.



1.Figure 01 :Natural Healing Power of Verbena, Melissa, and St. John's Wort.

2.Figure 02 : Biochemical and immunological effects of S.John's wort.[5]

3.Figure 03 : Biochemical and immunological effects of Melissa officinalis.



4.Figure 04 : Benefits of vervain.

Discussion

The combined use of Verbena officinalis, Melissa officinalis, and Hypericum perforatum presents a multi-targeted therapeutic approach. While current DMTs act primarily through immune su, these plants may simultaneously:

- ❖ Reduce oxidative stress.
- ❖ Restore immune homeostasis by balancing pro- and anti-inflammatory cytokines.
- ❖ Support neuroprotection and myelin repair.
- ❖ Improve psychological well-being and quality of life.

Moreover, the startup framework allows transformation of research findings into nutraceutical products that could complement existing therapies, reduce

healthcare costs, and enhance patient adherence[9]. This approach bridges scientific

discovery with socio-economic impact, aligning with global trends in personalized and integrative medecin.

Conclusion

This study highlights the potential of Verbena officinalis, Melissa officinalis, and Hypericum perforatum[10] in MS management through immunomodulation, neuroprotection, and biochemical pathways. While preclinical data are promising, randomized controlled clinical trials are essential to validate efficacy and safety. Integrating herbal medicine with modern immunological approaches could offer affordable therapeutic options for MS patients worldwide

References

1. Dobson, R., & Giovannoni, G. (2019). Multiple sclerosis — a review. European Journal of Neurology, 26(1), 27–40.

2.. Kumar, V., et al. (2021). Herbal medicine in neurodegenerative diseases: Mechanisms and perspectives. Frontiers in Pharmacology, 12, 678.

3. Salehi, B., et al. (2018). Therapeutic potential of Verbena officinalis in CNS disorders. Phytotherapy Research, 32(9), 1745–1756.

4. Shakeri, A., et al. (2016). Neuroprotective effects of Melissa officinalis. Journal of Ethnopharmacology, 189, 266–272.

5. Saddiqe, Z., et al. (2010). A review of the antibacterial, antiviral, and antifungal properties of Hypericum perforatum. Phytotherapy Research, 24(2), 154–162.

6. Mousavi, S., et al. (2020). Role of flavonoids in neuroinflammation. International Journal of Molecular Sciences, 21(21), 8430.

7. Startup Research Report (2024). Development of phytotherapeutic formulations for MS. Internal publication, BioDiscovery Group

8. Zhang Y. et al. (2021). Neuroprotective effects of Verbena officinalis extract in experimental autoimmune encephalomyelitis. Journal of Neuroimmunology.

9.Kennedy D.O. et al. (2020). Cognitive and anxiolytic effects of Melissa officinalis in human trials. Phytotherapy Research.

10. Roghani M. et al. (2022). Hypericum perforatum in neurodegenerative diseases : mechanisms and therapeutic perspectives. CNS Drugs.

11. Biernacki T. et al. (2019). Multiple sclerosis : Pathogenesis and clinical aspects. Neurology International.

12.Figure01 : Choi J. et al. (2020). Herbal immunomodulators in autoimmune diseases : A review. Frontiers in Immunology.

13Figure02 :. Kumar S. et al. (2021). Phytochemicals in autoimmune neuroinflammation. Current Pharmaceutical Design.

14.Figure03 :WHO (2022). Traditional, Complementary and Integrative Medicine.

15.Figure04 : Li X. et al. (2020). Nanotechnology-based delivery of herbal extracts for neurological disorders. International Journal of Nanomedicine.

16.Figure05 : Brown A. et al. (2019). ADMET prediction for phytochemicals in drug discovery. Drug Discovery Today.

17. Smith K. et al. (2021). Herbal therapies and MS : A systematic review. Multiple Sclerosis Journal.

18. National Multiple Sclerosis Society (2023). Alternative and Complementary Medicine in MS.

19. Gonzalez A. et al. (2024). Polyherbal formulations for autoimmune disorders. BioMed Research International.

Fatima Zohra Ouali https://orcid.org/0009-0004-0836-0358