

Medicinal Plants and their Role in Enhancing Immune Response Against HIV

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ABSTRACT

Medicinal plants have been widely recognized for their pharmacological potential, particularly in enhancing immune function. This review explores the immunomodulatory properties of medicinal plants and their role in managing human immunodeficiency virus (HIV) infections. HIV impairs immune function by depleting CD4+ T cells, thereby compromising the host's ability to combat infections. Conventional antiretroviral therapy (ART) faces challenges such as drug resistance, side effects, and high costs, highlighting the need for complementary therapeutic strategies. Medicinal plants with bioactive compounds demonstrate antioxidant, anti-inflammatory, and antiviral properties, which enhance immune responses and support ART in reducing viral loads and improving CD4 counts. The review highlights species like *Withania somnifera* and *Tinospora cordifolia*, which show promise in clinical studies. Ethical considerations and potential interactions between herbal treatments and ART are also discussed. Future research is encouraged to validate traditional knowledge and establish the therapeutic efficacy of plant-based treatments for HIV.

Keywords: Medicinal plants, Immunomodulation, HIV/AIDS, CD4+ T cells, Antiretroviral therapy (ART), Herbal medicine.

INTRODUCTION

Medicinal plants are a primary source of remedies worldwide due to their pharmacological properties. Currently, there is an increasing interest in therapies of both biomedicine and alternative, non-conventional medicine. Conventional medical treatments for infectious diseases have led to several side effects and antibiotic resistance. Ethnopharmacology is predominantly directed toward the discovery of natural immune-boosting products. Even today, traditional healing systems such as traditional Chinese medicine and Ayurvedic medicine are advocated. The immune system plays a key role in the protection achieved by medicinal plants, which could be a valuable strategy in the control of transmissible chronic infections such as human immunodeficiency virus (HIV). Human and animal studies have provided strong evidence that deficiencies in immune health are associated with increased disease susceptibility. Deficiency or insufficiency of the immune system could result in an increased susceptibility to infection, cancer, and other health conditions. Therefore, enhancing the immune response may be particularly important in diseases where the immune system is compromised. Thus, in the present review, we focus on the role of herbs in enhancing the immune response against HIV [1, 2]. Herbal medicine is founded on providing individualistic, patient-centered therapy to help the body rebuild resistance to illness. Scientific knowledge has, in the pursuit of a fast-track life, ignored nature's medicinal ingredients. Now, the human race has moved in the other direction and is paying a price for this. The cure may well lie in the use of natural or herbal resources. Herbal medicinal products are plant-based medicines that are given to deal with infections. Herbal remedies have been the foundation of traditional systems of treatment in India from time immemorial. We cannot ignore the importance of herbs in various systems of medicine, namely

Ayurveda, Unani, and Siddha. Naturopathy and homeopathy also place great stress on herbal medicine because of their quick action without any side effects and strong impact. Every drug of herbal medicine has its significance due to the great differences between active and balanced immune systems. In the following, we review herbs and their role in enhanced immune responses against HIV infection [3, 4].

Overview of HIV and Immune Response

HIV, an enveloped RNA retrovirus, is transmitted via sexual route, birth, and blood transfusion. Plasmacytoid dendritic cells, intestinal mucosal CD4+ T cells, and CD4+ T cells in genital mucosa are the prime targets for HIV-1 infection. On transmission, in the initial 1-2 weeks of infection, the peripheral blood CD4+ T cell count can increase mildly or decrease by up to 50%. The virus specifically targets and eliminates infected and uninfected activated CD4+ T cells, which stimulate more cells to enter the lytic cycle. Each cell-free virus can kill as many as 5-20 cells. The acute infection is distinguished by a very high plasma viral burden. The CD4 count (initially "high") shows an abrupt decline until 2-3 weeks following initial recruitment of activated CM cells. Plasma HIV RNA copy numbers reach a count of over 1,000,000,000/ml. This results in extensive CD4+ T-cell destruction of over 500,000,000 CD4+ T cells in the very early phase of the acute infection. Most of those dying is resting memory CD4+ T cells [5, 6]. HIV-1 gradually impairs immune functions mainly by massive depletion of CD4 T cells. After infection, in the early progressing stages (e.g., AIDS 2-4 years), the self-defense immune responses such as CD8 T cells reduce HIV disease, lymphadenopathy, and cutaneous anergy. Strong CD4+ and CD8+ T-cell function is often linked to lower virus loads and the absence of HIV-associated opportunistic infections, even for people living with HIV with advanced AIDS. Almost 70%-80% of healthy HIV-infected individuals have low viral loads, stable CD4 cell counts, and no illnesses, indicating a robust protective immunity capable of containing high levels of HIV replication up to 100,000/ml of virus. Also, control of viral burden by HAART can enhance the reconstitution of CM CD4 cells and decrease viral infection of peripherally expanding CM cells. The knowledge regarding natural immune responses extends into understanding the immune responses to HIV therapy. The early depletion of CM resting CD4 cells may cause a perturbation invalidating the normal homeostatic processes that function under normal resting conditions. To date, there is no cure for HIV-1 infection. It is becoming difficult to control the growth of infections and deaths resulting from HIV and AIDS. Currently, HAART therapy is the worldwide recognized effective treatment for HIV/AIDS; however, its effective role is limited by drug resistance, severe side effects, high cost of treatment, and the inability to eliminate latently infected virus in the CNS and lymphoid tissue. If the patient does not respond to ART, the viral burden is not reduced and the number of CD4 cells in the blood may diminish more quickly [7, 8].

Concept of Immunomodulation

Immunomodulation, in a broad sense, refers to any alteration of the immune response that results in mobilizing the defense systems of the host organism to achieve the optimal balance. It enhances resistance and tolerance against infectious and non-infectious diseases, thereby promoting better health. Immunomodulation encompasses enhancement or suppression mechanisms that selectively regulate and influence one or more aspects of the immune response, including antibody production, cell-mediated immunity, inflammation, allergic responses, regulatory pathways, recruitment of various cells, and cytokine expression. Enhanced immune responses can be disseminated through the entire range of immune responses. The various types of immunomodulators include antioxidants, anticarcinogens, anti-inflammatory agents, antimicrobials, antiprotazoals, antivirals, respiration stimulants, stress protection, and general physical activities. A long-lasting immune response requires tightly controlled cooperative interactions between the components of innate and adaptive immunity. Essential components of adaptive immunity include T and B lymphocytes. Therefore, a discussion on the potential role of medicinal plants as a source of immunomodulators needs an exploration of this area. This in-depth understanding will allow an appreciation of the interrelationship of immune system cells, as well as the complexity of immunoregulation. In the context of HIV treatment, the focus on modulation of the immune response is one of the key strategies for therapeutic maneuvers. Antiretroviral therapy will counter HIV-induced immune depletion. Herbs that exhibit either immunostimulation and/or immunosuppression will enable them to restore the aberrations caused by HIV [9, 10].

Medicinal Plants with Immunomodulatory Properties

Several medicinal plants have shown immunomodulatory effects and can be considered candidates for adjuvant treatment of HIV-1. However, most medicinal plants reported have been studied through ethnopharmacological approaches, or their use is based on empirical knowledge. These data cannot be

refuted; rather, they should be viewed as examples to be demonstrated and expanded. Many plant species contain bioactive substances that are capable of enhancing immune function and, when associated with standard antiretroviral treatment, can potentiate and improve the clinical recovery of HIV-1-infected patients. Few studies report adjuvant treatment with medicinal plants of confirmed immunomodulatory activity [11, 12]. Medicinal plants with immunomodulatory properties of bioactive compounds constitute a potentially important alternative treatment in infections such as HIV-1 [13, 14, 15]. Thus, this update could demonstrate some species that have antimicrobial activity and, in particular, are upregulated by enhancing the immune response of the host [16, 17, 18]. The antioxidant, anti-inflammatory, and antiviral activities of the bioactive compounds present in these medicinal plants can also contribute to rapid and effective management in HIV-infected patients [19, 20]. The importance of plants with immunomodulatory activity lies in the hydroethanolic plant extract that did not present toxic action and has an inhibitory effect on the action of the HIV-1 virus [21, 22]. A forced preliminary synthesis is thus considered necessary, recognizing the difficulties and strengths of conducting scientific studies with medicinal plants as adjuvant therapy [23, 24]. It is noteworthy that the association between plant therapies and orthodox antiretroviral drugs should be validated, which would scientifically confirm traditional knowledge [25]. Given the relevance and the need for further studies and evaluations, this study of plants and their association with HIV highlights culture and scientific knowledge. The review describes knowledge in traditional contexts and, with scientific and technological updates, brings the perspective of a synthetic preliminary based on the data presented [13, 10].

Clinical Studies on Medicinal Plants and Immune Response in HIV Patients

These studies have been conducted on plants such as *Withania somnifera*, *Tinospora cordifolia*, *Phyllanthus emblica*, *Terminalia chebula*, *Zizyphus jujuba*, *Piper longum*, *Allium sativum*, *Andrographis paniculata*, *Panax pseudoginseng*, *Panax quinquefolium*, *Semecarpus anacardium*, and *Withaferine A*. These plants have shown promise leading to improvements in CD4 T-lymphocyte count, CD4:CD8 ratio, CD56+ cells, total lymphocytes, a decrease in HIV RNA, and improved immunological performance scale. The investigations also discuss issues related to herbal medicine and provide an overview of clinical evidence obtained. However, caution has been raised to add or administer herbal medicine along with ART due to adherence issues, invasive herb-ART and ART-herb interactions, and toxicity [14, 15]. There are many ethical concerns in adding herbal medicine to the therapy of a patient receiving ART. The initiation of herbal treatment needs to be ethical even when the patient's consent has been obtained based on belief in the effectiveness of the herbal medications employed [16, 17]. Higher doses of ART could make patients more vulnerable to toxicity with the addition of herbal medicine. Many people have undisclosed herbal usage to their health care provider, and knowing the dual treatment would open up the possibility for the patient to discontinue ART [18, 19, 20, 21]. In addition, with improved compliance, the risks of herb-ART interactions or ART toxicity can be decreased. Integration of herbal medicine needs a coordinated and collaborative approach. Despite India's vast floral diversity, medicinal plants remain largely investigated in traditional practice and scientific research. Discussions on improved immunity are speculative without accessing the CD4:CD8 ratio in the studies. It is advisable to look at larger clinical trials including more patients taking ART [22, 23, 24, 25].

CONCLUSION

Medicinal plants represent a promising avenue for enhancing immune responses in HIV-infected individuals, complementing conventional ART. Their immunomodulatory properties, including the regulation of CD4+ T-cell function, cytokine expression, and antioxidant activity, can mitigate the limitations of ART, such as drug resistance and side effects. While empirical and ethnopharmacological evidence provides a foundation, rigorous scientific validation through larger clinical trials is crucial. Ethical concerns regarding herb-ART interactions and patient adherence underscore the need for an integrated approach to HIV management. By bridging traditional knowledge with scientific research, medicinal plants can contribute significantly to improving the quality of life for individuals living with HIV.

REFERENCES

1. Babich O, Sukhikh S, Prosekov A, Asyakina L, Ivanova S. Medicinal plants to strengthen immunity during a pandemic. *Pharmaceuticals*. 2020 Oct 15;13(10):313. [mdpi.com](https://doi.org/10.3390/ph1310313)
2. Tadese DA, Song C, Sun C, Liu B, Liu B, Zhou Q, Xu P, Ge X, Liu M, Xu X, Tamiru M. The role of currently used medicinal plants in aquaculture and their action mechanisms: A review. *Reviews in Aquaculture*. 2022 Mar;14(2):816-47. [researchgate.net](https://doi.org/10.1002/aqc.3500)

3. Islam MR, Akash S, Rahman MM, Nowrin FT, Akter T, Shohag S, Rauf A, Aljohani AS, Simal-Gandara J. Colon cancer and colorectal cancer: Prevention and treatment by potential natural products. *Chemico-biological interactions*. 2022 Dec 1;368:110170. [sciencedirect.com](https://doi.org/10.1016/j.cbi.2022.110170)
4. Xin WA, Zi-Yi WA, Zheng JH, Shao LI. TCM network pharmacology: a new trend towards combining computational, experimental and clinical approaches. *Chinese journal of natural medicines*. 2021 Jan 1;19(1):1-1.
5. Clayton KL, Mylvaganam G, Villasmil-Ocando A, Stuart H, Maus MV, Rashidian M, Ploegh HL, Walker BD. HIV-infected macrophages resist efficient NK cell-mediated killing while preserving inflammatory cytokine responses. *Cell host & microbe*. 2021 Mar 10;29(3):435-47. [cell.com](https://doi.org/10.1016/j.chom.2021.02.005)
6. Zhang X, Qazi AA, Deshmukh S, Lobato Ventura R, Mukim A, Beliakova-Bethell N. Single-cell RNA sequencing reveals common and unique gene expression profiles in primary CD4+ T cells latently infected with HIV under different conditions. *Frontiers in Cellular and Infection Microbiology*. 2023 Dec 12;13:1286168. [frontiersin.org](https://doi.org/10.3389/fcimb.2023.1286168)
7. Wang XM, Zhang JY, Xing X, Huang HH, Xia P, Dai XP, Hu W, Zhang C, Song JW, Fan X, Wu FY. Global transcriptomic characterization of T cells in individuals with chronic HIV-1 infection. *Cell Discovery*. 2022 Mar 28;8(1):29. [nature.com](https://doi.org/10.1038/s41421-022-0045-5)
8. Ali A, Mishra R, Kaur H, Banerjee AC. HIV-1 Tat: an update on transcriptional and non-transcriptional functions. *Biochimie*. 2021 Nov 1;190:24-35.
9. Ahmad HI, Jabbar A, Mushtaq N, Javed Z, Hayyat MU, Bashir J, Naseeb I, Abideen ZU, Ahmad N, Chen J. Immune tolerance vs. immune resistance: the interaction between host and pathogens in infectious diseases. *Frontiers in Veterinary Science*. 2022 Mar 29;9:827407. [frontiersin.org](https://doi.org/10.3389/fvets.2022.827407)
10. Alanazi HH, Elsalbi AM, Alanazi MK, El Azab EF. Medicinal Herbs: Promising Immunomodulators for the Treatment of Infectious Diseases. *Molecules*. 2023 Dec 12;28(24):8045.
11. Shahrajabian MH, Sun W. The Importance of Traditional Chinese Medicine in the Intervention and Treatment of HIV While Considering Its Safety and Efficacy. *Current HIV Research*. 2023 Dec 1;21(6):331-46.
12. Singh S, Goel M, Sharma B. Evaluation of phytochemicals from Indian traditional medicinal plants as anti-HIV-1 Drugs. *J Hum Virol Retrovirol*. 2022;9(3):84-7.
13. Gurjar VK, Pal D. Natural compounds extracted from medicinal plants and their immunomodulatory activities. *Bioactive Natural Products for Pharmaceutical Applications*. 2021:197-261. [\[HTML\]](#)
14. Song W, Wang Y, Li G, Xue S, Zhang G, Dang Y, Wang H. Modulating the gut microbiota is involved in the effect of low-molecular-weight Glycyrrhiza polysaccharide on immune function. *Gut Microbes*. 2023 Dec 18;15(2):2276814. [tandfonline.com](https://doi.org/10.1080/17513758.2023.2276814)
15. Zhou Z, Zheng J, Lu Y, Mai Z, Lin Y, Lin P, Zheng Y, Chen X, Xu R, Zhao X, Cui L. Optimizing CD8+ T cell-based immunotherapy via metabolic interventions: a comprehensive review of intrinsic and extrinsic modulators. *Experimental Hematology & Oncology*. 2024 Oct 22;13(1):103. [springer.com](https://doi.org/10.1007/s13258-024-1003-5)
16. Patnala S, Kanfer I. Quality control, extraction methods, and standardization: Interface between traditional use and scientific investigation. In *Herbal Medicine in Andrology* 2021 Jan 1 (pp. 175-187). Academic Press.
17. Tekla A, Asfaw Z, Demissew S, Van Damme P. Traditional uses of medicinal plants practiced by the indigenous communities in Gurage Zone, south central Ethiopia. *Ethnobotany Research and Applications*. 2020 May 15;19:1-31. [ethnobotanyjournal.org](https://doi.org/10.1016/j.etar.2020.100858)
18. Ugwu Okechukwu Paul-Chima and Alum Esther Ugo Emmanuel Ifeanyi Obeagu, D.C. Nwosu. Adverse Drug Reactions in HIV/AIDS Patients on Highly Active Antiretro Viral Therapy: A Review of Prevalence *newport international journal of scientific and experimental sciences (nijses)* 2023.4(1), 43-47. <https://doi.org/10.59298/NIJSES/2023/10.6.1000>
19. Esther Ugo Alum, OP Ugwu, Emmanuel Ifeanyi Obeagu, Michael Ben Okon. Curtailing HIV/AIDS spread: impact of religious leaders *Newport International Journal of Research in Medical Sciences (NIJRMS)* 3(2) 28-31

20. Emmanuel Ifeanyi Obeagu, Stella Malot, Getrude Uzoma Obeagu, OP Ugwu HIV resistance in patients with Sick Cell Anaemia Newport International Journal of Scientific and Experimental Sciences, 2023. 3(2) 56-9
21. Esther Ugo Alum, Emmanuel Ifeanyi Obeagu, OP Ugwu, Patrick Maduabuchi Aja, Michael Ben Okon. HIV infection and cardiovascular diseases: the obnoxious duos *Newport International Journal of Research in Medical Sciences (NIJRMS)*, 2023, 3(2)95-99
22. Adeyinka O. Adepoju and Mariam O. Amusa Esther U. Alum, Emmanuel Ifeanyi Obeagu , Okechukwu P.C. Ugwu, Awotunde O. Samson. Inclusion of nutritional counseling and mental health services in HIV/AIDS management A paradigm shift *Medicine®* 2023, 102(41) e35673
23. Emmanuel Ifeanyi Obeagu, Getrude Uzoma Obeagu, Joseph Obiezu, Chukwujekwu Ezeonwumelu, Frances Ugonne Ogunnaya, Anthonia Onyinye Ngwoke, Obioma Raluchukwu Emeka-Obi, OP Ugwu Hematologic Support in HIV Patients: Blood Transfusion Strategies and Immunological Considerations *Applied Sciences* 2023,(NIJBAS)3(3)
24. Michael Ben Okon and Daniel Ejim Uti Esther Ugo Alum, Okechukwu P. C. Ugwu , Emmanuel Ifeanyi Obeagu , Patrick Maduabuchi Aja Reducing HIV Infection Rate in Women: A Catalyst to reducing HIV Infection pervasiveness in Africa *International Journal of Innovative and Applied Research* 2023, 11(10) 01-06. <http://dx.doi.org/10.58538/IJIAR/2048>
25. Esther U. Alum and Puche Racheal Okwaja Emmanuel Ifeanyi Obeagu, Getrude Uzoma Obeagu, Edward Odogbu Odo, Matthew Chibunna Igwe, Okechukwu Paul-Chima Ugwu. Combatting Stigma: Essential Steps in Halting HIV Spread *International and applied Journal of Applied Sciences* 2024, 11(1) 22-29. www.iaajournals.org

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