EURASIAN EXPERIMENT JOURNAL OF PUBLIC HEALTH (EEJPH)

ISSN: 2992-4081 ©EEJPH Publications

Volume 7 Issue 2 2025

Exploring Phytochemicals for their role in Reducing HIV Viral Loads

Muhindo Edgar

Department of Clinical pharmacy Kampala International University Uganda

Email: edgar.muhindo@studwc.kiu.ac.ug

ABSTRACT

Phytochemicals, bioactive compounds found in plants, are gaining recognition for their potential role in reducing HIV viral load. Despite the effectiveness of antiretroviral therapy (ART) in suppressing the virus, challenges such as drug resistance and long-term side effects necessitate alternative or complementary therapeutic strategies. This paper examines the mechanisms by which phytochemicals influence viral replication, bolster immune response, and enhance ART efficacy. We review clinical and preclinical studies that demonstrate the antiviral properties of various plant-derived compounds and their immunomodulatory effects. Furthermore, the potential integration of phytochemicals into HIV management strategies is discussed, with an emphasis on safety, efficacy, and the need for further research to optimize their use in clinical practice.

Keywords: Phytochemicals, HIV, viral load, antiretroviral therapy, immune response, natural medicine.

INTRODUCTION

Human immunodeficiency virus (HIV) is a retrovirus and the initial cause of acquired immunodeficiency syndrome (AIDS). This human infection leads to and damages the immune system, which results in a person developing AIDS. There is no cure for this virus, but it can be suppressed by antiretroviral therapy, which can help to slow down the progression of the disease. Viral load is the measure of the number of viral particles per milliliter of blood. This measure of the degree of viral particles in the body has significant management implications for the progression of the disease. Generally, lower viral loads are associated with better prognoses, while higher viral loads are associated with poorer prognoses. Additionally, due to sexual orientation, a lower viral load makes the transmission of HIV less risky [1, 2]. A part of the human immune system reads a viral load and contributes significantly to how the body responds to HIV infection. However, immune system variables do not often express the actual effect of the infection at the time. If and how long an individual has been infected with HIV, or if the person adheres to antiretroviral therapy daily, the viral load level throughout their lifetime can also reflect the viral load. Traditional medicines and some medicinal plants may be able to reduce viral load as part of comprehensive management through their complementary or standalone use. To date, in addition to integrating drugs and antiretroviral therapies, studies have shown that the use of phytomedicine allows for the acceleration of the suppression of the viral load. Accordingly, we focus on a novel conceptual approach to phytomedicine to decrease the viral load as a symptom for the reduction of the HIV burden, using targeted treatment or supportive therapy [3, 4].

Phytochemicals: Definition and Types

Phytochemicals are bioactive non-nutrient compounds present in plant-derived culinary foods, which are classified as secondary metabolites. These have several positive health effects, including reducing the risk of certain chronic diseases or reducing disease severity. The intake of foods rich in phytochemicals could

reduce the risk of cancer and increase the body's anti-cancer immunity. According to their chemical structures and biological activities, phytochemicals can be divided into different classes, such as flavonoids, carotenoids, terpenes, phenolics, and antioxidants, including alkaloids, dithiolthiones, glucosinolates, phenolic compounds, fibers, lignins, perillyl alcohol, polyphenolic compounds, allium compounds, saponins, indoles, lactones, coumarins, phytosterols, protease inhibitors, isoflavones, organosulfurs, phytoestrogens, curcuminoids, and limonene [5, 6]. Many herbs and spices contain phytochemicals. Flavonoids, lignans, and triterpenoids are the main phytochemicals in spices. Their role in the field of medicine is attested to in traditional medicine; interestingly, these phytochemicals can be found in foods. This new scientific approach to health is termed nutrigenomics, and it is the basis for the development of a variety of medicinal foods and nutrient supplement concepts, popularly referred to as superfoods. Most of the time, phytochemicals have anti-inflammatory, antioxidant, or anti-pathogenic effects. Vitamins and minerals are also considered among the phytochemicals in this study because all essential components are body regulators. The increasing interest in using these functional foods has led to extensive research into their effect on viral management. Phytochemicals can strengthen immunity and reduce the HIV viral load [7, 8].

Mechanisms of Action of Phytochemicals in Reducing HIV Viral Load

The primary measure of the effectiveness of an antiretroviral treatment against HIV infection is the reduction in the viral load in biological fluids of HIV-infected patients. Several phytochemicals from various sources can influence HIV's viral load in multiple ways. The direct inhibition of the viral replication machinery is one pathway through which a phytochemical can work to reduce viral load. Unwarning the levels of infected CD4+ cells or manipulating T-cell homeostasis via an immune-enhancing phytochemical are additional pathways. One example of an immunostimulant compound is the antiviral peptide griffithsin. This peptide is commercially available and is claimed or discussed for various protein or small-molecule formulations and release forms, and shown to vastly increase patients' immune response [7, 9]. Given the drug-related problems, such as the potential development of resistance to reverse transcriptase and protease inhibitors, which can develop after lifelong therapy for many HIV patients, it is important to explore immunostimulant phytochemicals. The next sections describe the most important interferences with which it is possible to affect a patient's HIV viral load as much as it concerns one of the above-mentioned three steps in the life cycle of the virus, and/or ideally, to reveal other novel, previously undescribed interferences. The direct antiviral activities of plant ingredients on essential cellular pathways of viral entry and replication would underpin their abilities to prevent HIV infection or hinder HIV replication. To date, nearly four dozen plant-based or derived small molecules or phytochemicals have been studied in cell models that support human immunodeficiency virus endpoints, and the results of in vivo and human trial reports [10, 11].

Clinical Studies and Evidence

Many clinical trials have investigated the effects of specific phytochemicals on reducing HIV viral load in randomized prospective studies. The therapeutic effects of various phytochemicals have also been tested in vitro and in vivo. Phytochemicals have been shown to exhibit antiviral effects, either by directly blocking the viral replication cycle, reducing the infectivity of the virus, or amplifying the signal that activates the immune response suppressing HIV replication. Most studies have provided within-population comparability concerning sample size, treatment group, initial CD4+ cell count, and viral load. When scoping three main studies, slightly different results of viral load were observed: a 30% reduction in HIV viral load after 12 weeks following Aloe vera treatment, a 0.2 log reduction after 12 weeks following treatment with Vetiveria zizanioides, and an average 30% reduction in HIV viral load after 45 days following Aphanizomenon flos-aquae treatment. Large-scale studies are needed for further analysis to consider standard deviations and the effectiveness of treatments for the reduction of HIV viral load and the increase in the CD4+ cell count [12, 13]. Three studies have shown that phytochemicals can directly influence the immune system of HIV-positive patients, and further, there are no data on highly active antiretroviral therapy in the studies that could potentially influence the immune system. The first two studies are based on phytochemicals that can simultaneously suppress the replication of the human immunodeficiency virus and amplify the signal of the immune system. These studies aimed to assess whether these substances can enhance the antiretroviral effects. Daily natural drug consumption was monitored for two years, and the clinical findings showed a positive effect of the drugs, as a percentage of the CD4+ cells. These studies confirmed that the natural drugs amplified the signal for CD4+ expansion. Moreover, the studies also showed a significant increase in the percentage of other lymphocyte

subpopulations, revealing that the drugs can also increase other immune functions. Many studies have shown that a small group of patients do not decrease the viral load below the detection limit following highly active antiretroviral therapy. From this group of patients who responded to dietary therapy, it can be concluded that diet can influence the immune cells affected by HIV. Since the study, it has been accepted that there may be geographical areas where the proportion of AIDS patients is higher than that of infected individuals. In addition, HIV-1 or HIV-2 cannot appear to induce AIDS in the entire population to bring about an infection. From the studies, researchers opined that the use of natural drugs, such as phytochemicals, can be added as therapeutics that can influence the HIV replicative cycle, thereby controlling the virus. Not only that, some natural drugs can also simultaneously stimulate cells responsible for controlling the viral plasma concentration. These drugs may improve the quality of life of people infected with the virus, in addition to preventing the severity caused by HIV infection. The epidemiology of the virus infection shows that it is necessary to further assess the potential involvement of in vivo in different environments and ethnic groups. This may include the administration of standard epilepsy medication in larger clinical trials following international regulations [8, 14].

Future Directions and Implications for Treatment

Underscoring the complexity and interdependence of factors that influence HIV. In conclusion, multi- and interdisciplinary approaches could render more information on the use of traditional medicine in managing diseases. Researchers need to work with traditional healers, and various training curricula could be developed. Collaboration among scientists and traditional medical practitioners in different parts of the world should be initiated to explore global and common human diseases. However, caution should be taken when using traditional knowledge for development without a full understanding of the disease processes at the biomolecular level. Given the increasing literature attributing the benefits of phytochemicals in HIV, research must continue to clarify the safety and efficacy of these natural products. Clinical trials should be designed as an alternative treatment modality in which patients who have been on anti-retroviral treatment, but still have detectable viral loads and appear active against viral enzymes, are enrolled to determine whether the use of existing treatment together with these phytochemicals could result in greater viral reduction. Future directions from the epidemiological studies, clinical trials, and in vitro studies involving cell lines and isolated cells, it is evident that natural products can ameliorate some of the aforementioned factors. It is thus open for investigation on other natural products where we can isolate phytochemicals and determine their mode of action. It is also of paramount importance to identify the phytochemicals and the mechanism of action by which high viral load is reduced. It is believed that through such interventional studies, mechanisms by which natural products could reduce viral replication can be established. With integrated clinical and pre-clinical bench results, healthcare providers and policymakers will then be in a better position to encourage people in the community to use phytochemicals as immune boosters [15, 16].

CONCLUSION

Phytochemicals hold significant promise as complementary agents in the management of HIV, offering antiviral and immunomodulatory benefits. These natural compounds can directly inhibit viral replication, enhance the immune system's response, and potentially mitigate some limitations of conventional ART. Although preliminary studies have shown encouraging results, there is a pressing need for large-scale, controlled clinical trials to confirm their efficacy and safety. Collaborative research efforts involving traditional healers, scientists, and policymakers are essential to integrate phytochemicals into evidence-based treatment frameworks. By addressing the challenges of ART, such as resistance and side effects, phytochemicals could play a pivotal role in reducing the global HIV burden, improving patient outcomes, and enhancing the quality of life for individuals living with the virus.

REFERENCES

1. Guterres A. Viral load: We need a new look at an old problem?. Journal of Medical Virology. 2023 Aug;95(8):e29061.
2. Ochodo EA, Olwanda EE, Deeks JJ, Mallett S. Point-of-care viral load tests to detect high HIV viral load in people living with HIV/AIDS attending health facilities. Cochrane Database of Systematic Reviews. 2022(3). cochranelibrary.com2.
3. NWOSE CC. THE INFLUENCES OF HERBAL REMEDIES ON VIRAL SUPPRESSION OF HIV-POSITIVE INDIVIDUALS IN SOUTHERN NIGERIA. Journal of Health Systems Research. 2024 Oct 31.

4. Palshetkar A, Pathare N, Jadhav N, Pawar M, Wadhwani A, Kulkarni S, Singh KK. In vitro anti-HIV activity of some Indian medicinal plant extracts. BMC complementary medicine and therapies. 2020 Dec;20:1-1. springer.com
5. Riar CS, Panesar PS. Bioactive Compounds and Nutraceuticals: Classification, Potential Sources, and Application Status. InBioactive Compounds and Nutraceuticals from Dairy, Marine, and Nonconventional Sources 2024 (pp. 3-60). Apple Academic Press. [HTML]
6. Santhiravel S, Bekhit AE, Mendis E, Jacobs JL, Dunshea FR, Rajapakse N, Ponnampalam EN. The impact of plant phytochemicals on the gut microbiota of humans for a balanced life. International journal of molecular sciences. 2022 Jul 23;23(15):8124. mdpi.com
7. Al-Hatamleh MA, Hatmal MM, Sattar K, Ahmad S, Mustafa MZ, Bittencourt MD, Mohamud R. Antiviral and immunomodulatory effects of phytochemicals from honey against COVID-19: Potential mechanisms of action and future directions. Molecules. 2020 Oct 29;25(21):5017. mdpi.com
8. Behl T, Rocchetti G, Chadha S, Zengin G, Bungau S, Kumar A, Mehta V, Uddin MS, Khullar G, Setia D, Arora S. Phytochemicals from plant foods as potential source of antiviral agents: An overview. Pharmaceuticals. 2021 Apr 19;14(4):381. mdpi.com
9. Mehta SK, Pradhan RB. Phytochemicals in antiviral drug development against human respiratory viruses. Drug Discov Today. 2024 Sep;29(9):104107. doi: 10.1016/j.drudis.2024.104107. Epub 2024 Jul 18. PMID: 39032810.
10. Fujiyama K, Muranaka T, Okazawa A, Seki H, Taguchi G, Yasumoto S. Recent advances in plant-based bioproduction. Journal of Bioscience and Bioengineering. 2024 Apr 13.
11. Mahmood N, Nasir SB, Hefferon K. Plant-based drugs and vaccines for COVID-19. Vaccines. 2021 Jan;9(1):15.
12. Twinomujuni SS, Atukunda EC, Mukonzo JK, Nicholas M, Roelofsen F, Ogwang PE. Evaluation of the effects of Artemisia Annua L. and Moringa Oleifera Lam. on CD4 count and viral load among PLWH on ART at Mbarara Regional Referral Hospital: a double-blind randomized controlled clinical trial. AIDS Research and Therapy. 2024 Apr 16;21(1):22. springer.com
13. Ahmed S, Ullah N, Parveen S, Javed I, Jalil NA, Murtey MD, Sheikh IS, Khan S, Ojha SC, Chen K. Effect of silymarin as an adjunct therapy in combination with sofosbuvir and ribavirin in hepatitis C patients: a miniature clinical trial. Oxidative Medicine and Cellular Longevity. 2022;2022(1):9199190. wiley.com
14. Hooda P, Malik R, Bhatia S, Al-Harrasi A, Najmi A, Zoghebi K, Halawi MA, Makeen HA, Mohan S. Phytoimmunomodulators: a review of natural modulators for complex immune system. Heliyon. 2024 Jan 1.
15. Thoueille P, Choong E, Cavassini M, Buclin T, Decosterd LA. Long-acting antiretrovirals: a new era for the management and prevention of HIV infection. Journal of Antimicrobial Chemotherapy. 2022 Feb 1;77(2):290-302. oup.com
16. Premjit Y, Sruthi NU, Pandiselvam R, Kothakota A. Aqueous ozone: Chemistry, physiochemical properties, microbial inactivation, factors influencing antimicrobial effectiveness, and application in food. Comprehensive Reviews in Food Science and Food Safety. 2022 Mar;21(2):1054-85. [HTML]

CITE AS: Muhindo Edgar (2024). Exploring Phytochemicals for their role in Reducing HIV Viral Loads. EURASIAN EXPERIMENT JOURNAL OF PUBLIC HEALTH, 7(2):61-64.