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Review

Antiviral potentials of medicinal plants

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Abstract

Medicinal plants have been widely used to treat a variety of infectious and non-infectious ailments. According to one estimate, 25% of the commonly used medicines contain compounds isolated from plants. Several plants could offer a rich reserve for drug discovery of infectious diseases, particularly in an era when the latest separation techniques are available on one hand, and the human population is challenged by a number of emerging infectious diseases on the other hand. Among several other ailments, viral infections, particularly infections associated with human immunodeficiency virus type 1 (HIV-1) and 2 (HIV-2), and newly emerging infectious viruses have challenged mankind survival. Of importance, a variety of medicinal plants have shown promise to treat a number of viral infections, and some of them possess broad-spectrum antiviral activity. In the past, exploration into the antiviral activity of various promising medicinal plants was limited due to: (a) highly infectious nature of viruses and (b) lack of appropriate separation techniques for the identification of antiviral components from plants. Development of vector-based strategies, in which non-infectious molecular clone of a virus could be used for antiviral screening purposes, and advancement in separation technologies offers promise for medicinal plants usage in modern drug discovery. This article describes potential antiviral properties of medicinal plants against a diverse group of viruses, and suggests screening the potential of plants possessing broad-spectrum antiviral effects against emerging viral infections.

Keywords: Medicinal plants; Traditional medicine; Viral infections; Antivirals

Contents

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1. Introduction

The history of medicinal plants dates back to the origin of human civilization on earth. Several of these may have been used to treat viral infections in the past, however, first recognized interest in their development as antiviral agent is the efforts of the Boots drug company (Nottingham, England) to screen 288 plants for anti-influenza activity (Chantrill et al., 1952). Later studies have reported the inhibitory effects of medicinal plants extracts on the replication of several viruses. Particularly herpes simplex virus type 2 (HSV-2) (Debiaggi et al., 1988), HIV (Asres and Bucar, 2005; Vermani and Garg, 2002), hepatitis B virus (HBV) (Huang et al., 2006; Kwon et al., 2005), and emerging viral infections associated with poxvirus and severe acute respiratory syndrome (SARS) virus (Kotwal et al., 2005) were strongly inhibited by various plants extracts. Most of these studies have utilized either water soluble or alcoholic extracts of medicinal plants, and limited efforts have been directed toward the identification of active natural ingredient exhibiting antiviral effects. Moreover, recent studies showing antiviral potential of plant extracts against viral strains resistant to conventional antiviral agents (Serkedjieva, 2003; Tolo et al., 2006) have challenged the modern drug discovery practices, and deem a very careful look toward exploring natural antiviral components of medicinal plants.

The molecular mechanisms associated with the antiviral effects of plant extracts may vary among different viruses. However, the potentials of plant extract to boost inherent antiviral defense of human body which involves an intricate immune system might utilize common pathways. In recent past, a number of studies have explored immunostimulatory properties of plant extracts having antiviral properties (Webster et al., 2006). The root extracts of medicinal plant *Heracleum maximum* Bartr. (Umbelliferae) which possess antiviral effects besides antifungal and antibacterial properties, stimulated Interleukin 6 (IL-6) production in the macrophage activation assay, confirming antiviral effects association with the immunostimulatory properties (Webster et al., 2006). Furthermore, *Plantago major* Linn. and *P. asiatica* Linn. *(Plantaginaceae)* commonly used plants as folk medicine in Taiwan for the treatment of infectious diseases, exhibited lymphocyte proliferation and secretion of interferon-gamma (IFN-γ) at low concentrations. Both lymphocyte proliferation activity and induced secretion of interferon-gamma (IFN-γ) are indicators of cell-mediated immune response modulation (Chiang et al., 2003). Along with similar lines, Sambucol, a product isolated from *Sambucus nigra* L., which is effective against various strains of influenza had shown to boost immune responses by secreting inflammatory cytokines (IL-1 beta, TNF-alpha, IL-6, and IL-8) (Barak et al., 2001).

Besides immunomodulatory effect, another intriguing finding is the broad-spectrum antiviral nature of plant extracts (Pompei et al., 1979). This could be associated with a single phytochemical, or a number of different plant constituents. Among several such observations few are: (i) an extract of the *Trifollium* species Secomet-V exhibited antiviral effect against a number of infectious viruses such as human papillomavirus, Marburg, influenza, HIV, HBV and HCV (Kotwal et al., 2005), (ii) Pandanin, a lectin isolated from the saline extract of the leaves of *Pandanus amaryllifolius* Roxb. showed antiviral effect against HSV-1 and influenza virus strain H1N1 (Ooi et al., 2004), (iii) crude extract of hop showed antiviral effect against a diverse group of viruses, suggesting the presence of broad-spectrum antiviral phytochemicals in various parts of the plants (Buckwold et al., 2004).

Medicinal plants have been used throughout the world, however, their wide usage had been limited to China, India, Japan, Pakistan, Sri Lanka, Thailand and a number of African countries. A detailed review has previously described national activities around the globe relevant to medicinal plants usage priorities (Hoareau and DaSilva, 1999). Developed countries are also turning to encourage the usage of plant-based natural medicinal product in their healthcare systems. The Natural Health Product Regulations of Canada promulgated in January 2004 is an important step toward modernization of plant-based product usage in healthcare. This regulation encourages usage of modern technology and evidence-based scientific support toward promoting medicinal plants and the associated products (Siow et al., 2005) (Table 1).

2. HIV/AIDS and medicinal plants

The first International Conference on Traditional Medicine and AIDS held in Dakar, Senegal in the year 1999, organized by the Association for the Promotion of Traditional Medicine (PROMETRA) generated considerable support for the usage of medicinal plants among HIV-infected individuals. Based on the recommendations of this meeting, parallel sessions of The Fifth Conference of Parties (COP-5) to the Convention on Biological Diversity and the International Conference on Medicinal Plants, Traditional Medicine and Local Communities in Africa for the first time placed the role of traditional medicine and HIV/AIDS on the international biodiversity agenda, and suggested the decade 2000–2010 as "Decade for the Development of African Traditional Medicine" (2000). Moreover, HIV/AIDS was selected as priority for future research and development in the area of medicinal plants in Africa. The most important recommendation of this conference was an HIV/AIDS Research Initiative on Traditional Healthcare in Africa (HARITHAF), entrusted with the responsibility of developing controlled clinical protocols for evaluating the safety and efficacy of potential phytomedicines for HIV/AIDS.

Another major interest in medicinal plants is efforts of the Canadian AIDS Treatment Information Exchange (CATIE), an organization involved in improving the health and quality of life for people living with HIV/AIDS in Canada. The CATIE has prepared a list of medicinal plants showing potential beneficial effects for HIV-infected individuals (Table 2) (2005b). The CATIE's "Practical Guide to Herbal Therapies for People Living with HIV" is very informative document, detailing potential role of medicinal plants in the lives of HIV-infected individuals. However, healthcare individuals should be very cautious in practicing plants/phytochemicals medicinal usage in AIDS afflicted individuals, as the information collected by the CATIE