ISSN 0975 - 6299 Vol 2 / Issue 3 / Jul - Sept 2011

International Journal of Pharma and Bio Sciences

REVIEW ARTICLE

PHARMACOGNOSY

ANTI-HIV POTENTIAL OF MEDICINALLY IMPORTANT PLANTS

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ABSTRACT

The acquired immunodeficiency syndrome (AIDS) is a result of human immunodeficiency virus (HIV) infection which leads to severe suppression of immune functions. AIDS is a real threat to the health of mankind, and the search for effective therapies is still of great importance. However besides the high cost, there are adverse effects and limitations associated with chemotherapy applied. Thus herbal medicines are frequently used as an alternate therapy by individuals living with HIV. Numerous plant derived compounds have been evaluated for inhibitory effects on HIV replication, and many have been found to inhibit different steps in HIV replication cycle. The aim of this review is to list research findings for herbal medicines which are endowed with the ability to inhibit HIV.

KEYWORDS

immunosuppressive, reverse transcription, pharmacognosy.

INTRODUCTION

The control of viral diseases has been the subject of intense scientific endeavour, with special attention being devoted to those having retroviruses as etiological agents, including acquired immunodeficiency syndrome (AIDS)[1]. Acquired immunodeficiency syndrome (AIDS) crisis is one of the greatest public health and humanitarian challenges in our time. In the two decades since the disease was first diagnosed, 20 million lives have been succumbed of AIDS. Currently, over 30.8 million people are infected with HIV/AIDS and 95% of them live in the developing countries (UN-AIDS Report, 2005 and 2007). The causative organism in AIDS is the human immunodeficiency virus type 1 (HIV-1) which is the member of retrovirus family[2].

AIDS is a pandemic immunosuppresive disease which results in life-threatening opportunistic infections and malignancies. Since a retrovirus, designated human immunodeficiency virus (HIV), has been clearly identified as the primary cause of this disease[3,4]. Numerous compounds have been evaluated for their inhibitory effects on HIV replication *in vitro*. HIV has two main targets *in vivo*: CD4 lymphocytes and tissue macrophages. Treatments aimed at the control of HIV replication in both cell types are envisaged. According to De Clercq the replicative cycle of HIV comprises ten steps that could be considered suitable targets for chemotherapeutic intervention[5]. A number of laboratories are actively involved in the development of antiviral agents that interfere with HIV at different stages of viral replication[6,7]. Most of the anti-HIV compounds can be assigned to one of these ten classes of HIV inhibitors, according to the stage at which they interfere with the HIV replication cycle, *e.g.*, adsorption, fusion, uncoating, reverse transcription, integration, DNA replication, transcription, translation, maturation and budding (assembly/release). However, only three groups of drugs (nucleoside and non-nucleoside analogs of reverse transcriptase and protease inhibitors) have been approved for general application, although prolonged use of these agents is limited because of their toxicity and the development of drug resistance. The high mutation rate of HIV frequently results in the rapid development of resistance towards the drugs used, and an attempt has been made to circumvent this problem by using a combination of drugs[8]. AIDS therapy may require the use of a combination of agents that exhibit synergistic antiviral effects to prevent the emergence of drug-resistant HIV mutants. Combination of three or more drugs reduces the viral load to undetectable levels and results in the prolonged survival of treated patients. A phytotherapeutic approach to modern drug development can provide many invaluable drugs from traditional medicinal plants. Over the last decade, antiviral researchers have also turned to many traditional folk medicines, invariably a “cocktail” of natural products, to uncover the scientific basis of their remedial effects. Many plant products are being used by patients with AIDS in some countries without any scientific proof that they possess anti-HIV activity. Traditional healers are now offering their remedies for scientific evaluation, and a number of studies provide information on the inhibitory activity against HIV of selected plants[9-11]. A large number of plant-derived substances have been described that exhibit anti-HIV activity, *e.g.*, alkaloids, polysaccharides, lignans, flavonoids, coumarins and terpenes[12-14]. Some of the compounds that have been reported to inhibit HIV replication cannot be unequivocally allocated to one of the ten classes of HIV

inhibitors, primarily because their target of action has not been elucidated.

Besides HIV/AIDS affects individuals in prime working age group which has a large negative effect on domestic as well as national income. Mother to child transmission is resulting in increasing number of orphans and children living with HIV that makes HIV/AIDS more of social, emotional than more economical burden[15]. Thus there is a need for the discovery of novel therapeutic strategies. One of the strategies has been to identify anti HIV compounds from natural sources, particularly from plants. Traditional medicine has serve as a source of alternative medicine, new pharmaceuticals and healthcare products. Considerable research on pharmacognosy, phytochemistry, pharmacology and clinical therapeutics has been carried out potential Ayurvedic medicinal plants. Numerous molecules have come out of Ayurvedic experimental base, examples include Rauwolfia alkaloids for hypertension, guggulsterons on hypolipidemic agents, picrosides in hepatic protection, phyllanthins as antivirals, curcumine in inflammation and withanolides and many other steroidal lactones and glycosides as immunomodulators[16].
In the present review, data on anti HIV active plants was collected from literatures.

List of Table of Medicinal Plants with Anti HIV Activity (17-63)

S. No.	Name of Plant	Active Constituent	Class
1.	*Agastache rugosa* (Lamiaceae)	Agastanol	Terpenoid
2.	*Alpinia galanga* (Zingiberaceae)	1'S-1'-acetoxychavicol acetate	Phenylpropanoids [17]
3.	*Andrographis paniculata* (Acanthaceae)	Andrograpanin , Bis-andrographolide ether	Diterpene lactones
4.	*Anisomeles indica* (Lamiaceae)	Ovatodiolide	Terpenoid
5.	*Ardisia japonica* (Myrsinaceae)	Ardimerin digallate	Lactone
6.	*Artemisia capallaris* (Compositae)	Artemisidin A, Artemicapins A,B	Flavonoid
7.	*Boesenbergia pandurata* (Zingiberaceae)	Panduratin C, Uvangoletin	Chalcones
8.	*Calophyllum brasiliense* (Clusiaceae)	Calanolide A,B	Caumarins

9.	*Calophyllum inophyllum* (Clusiaceae)	Inophyllum B,P	Caumarin[18]
10.	*Calophyllum lanigerum* (Clusiaceae)	Calanolide A	Caumarin
11.	*Calophyllum teysmannii* (Clusiaceae)	Calanolide B, Saulattrolide	Caumarin
12.	*Caranga rosea* (Fabaceae)	Scirpusin A,B	Stilbenes [19]
13.	*Celastrus hindsii* (Celastraceae)	Celasdin B	Terpenoid
14.	*Chrysanthemum morifolium* (Asteraceae)	Apigenin 7-O-β-D(4 caffeoyl) glucuronide	Flavonoid [20]
15.	*Clausena excavata* (Rutaceae)	Clausenolide-1 ethylether	Terpenoid
16.	*Coleus forskohlii* (Labiateae)	Forskolin, 1-deoxyforskolin	Terpenoid [21]
17.	*Coleus parvifolius* (Labiateae)	Rosmarinic acid, Rosmarinic acid methyl ether	Phenols
18.	*Combretum molle* (Combretaceae)	Punicalagin	Phenols
19.	*Crataegus pinnatifida* (Rosaceae)	Ursolic acid, Uvaol	Terpenoid
20.	*Cratoxylum arborescens* (Clusiaceae)	1,3,8-trihydroxy-2,4-dimethoxyxanthone	Xanthone [22]
21.	*Croton tiglium* (Euphorbiaceae)	12-O-tetradecanoylphorbol-13-acetate	Terpenoid
22.	*Detarium microcarpum* (Fabaceae)	Epicatechin	Flavonoid [23]
23.	*Drymaria diandra*	Drymaritin	Alkaloid [24]

	(Caryophyllaceae)		
24.	*Dryopteris crassirhizoma* (Dryopteridaceae)	Dryopteric acid A, B	Terpenoid [25]
25.	*Eclipta prostrata* (Asteraceae)	Orobol, Wedelolactone	Flavone, Caumarin
26.	*Epinetrum villosum* (Menispermaceae)	Cycleanine	Alkaloid
27.	*Erythrina senegalensis* (Fabaceae)	Auriculatin, erysenegalensein	Flavonoid [26]
28.	*Euchresta formosana* (Leguminosae)	Formosanatin C, Euchretin M	Flavonoid [27]
29.	*Eugenia caryophyllata* (Myrtaceae)	Tellimagrandin I	Phenol
30.	*Euphorbia poisonii* (Euphorbiaceae)	12-deoxyphorbol-13-phenylacetate	Terpenoid
31.	*Ferula sumbul* (Umbelliferae)	Heraclenol, Imperatorin	Caumarin [28]
32.	*Garcinia hanburyii* (Clusiaceae)	Epoxymorellic acid	Xanthone [29]
33.	*Gingko biloba* (Ginkgoaceae)	Cardanols, Bilobals	Phenol
34.	*Garcinia mangostana* (Clusiaceae)	Mangostin	Xanthone [30]
35.	*Glycosmis montana* (Rutaceae)	3-(3-hydroxymethyl-2-butenyl)-7-(3-methyl-2-butenyl)-1indole	Alkaloid
36.	*Glycyrrhiza glabra* (Fabaceae)	Glycyrrhizin	Terpenoid [31]
37.	*Hemsleya endecaphylla* (Cucurbitaceae)	Cucurbitacin B	Terpenoid

38.	*Humulus lupulus* (Cannabaceae)	Xanthohumol	Flavonoid
39.	*Illicium verum* (Illiciaceae)	Illicinone A	Terpenoid [32]
40.	*Jatropha curcus* (Euphorbiaceae)	Corilagin	Phenol [33]
41.	*Juglans mandshurica* (Juglandaceae)	Taxifolin	Flavonoid
42.	*Kadsura angustifolia* (Schisandraceae)	Binankadsurin A	Lignan [34]
43.	*Kadsura longipedunculata* (Schisandraceae)	Kadlongirins B, Longipedunins A B C	Lignans [35]
44.	*Kaempferia parvifolia* (Zingiberaceae)	5-hyroxy-7-methoxyflavone, 5,7-dimethoxyflavone	Flavonoid [36]
45.	*Leucojum vernum* (Amaryllidaceae)	Lycorine, Homolycorine	Alkaloids
46.	*Ligularia kanaitizensis* (Aspidiaceae)	9 alpha-angloyloxypinoresinol	Lignan
47.	*Lindera chunii* (Lauraceae)	Hernandonine, Laurolistine	Alkaloid [37]
48.	*Lomatium suksdorfii* (Apiaceae)	Suksdorfin	Caumarin
49.	*Litsea verticillata* (Lauraceae)	Isolitseanes B, Oxyphyllenodiol B	Terpenoids
50.	*Lycopodium japonicum* (Lycopodiaceae)	Lucojapodine A	Alkaloid [38]
51.	*Marila pluricostata* (Clusiaceae)	Mesuol	Caumarin
52.	*Millettia erythrocalyx*	Millettocalyxin, Oxyresveratrol	Flavonoid

	(Leguminoceae)		
53.	*Momordica charantia* (Cucurbitaceae)	Kuguacins F-S	Terpenoids
54.	*Monotes africanus* (Dipterocarpaceae)	Lonchocarpol A	Flavonoid [39]
55.	*Murraya siamensis* (Rutaceae)	Siamenol	Alkaloid [40]
56.	*Musa acuminata* (Musaceae)	BanLec	Lectin [41]
57.	*Ochna integerrima* (Ochnaceae)	Ochnaflavone 7''O-methylether, 2'',3''-dihydroochnaflavone 7''-O	Flavonoids [42] methylether
58.	*Peltophorum africanum* (Caesalpiniaceae)	Catechin, betulinic acid	Flavonoid [43]
59.	*Pericampylus glaucas* (Menispermaceae)	Norruffscine, 8-oxotetrahydropalmatine	Alkaloid [44]
60.	*Phenax angustifolius* (Urticaceae)	Phenaxolactones	Lignans [45]
61.	*Phyllanthus amarus* (Phyllanthaceae)	Geraniin, Corilagin	Phenol
62.	*Phyllanthus myritifolius* (Phyllanthaceae)	Retrojusticidin B	Lignan
63.	*Pragnos tschimganica* (Umbelliferae)	Psolaren, Bergapten	Caumarin [46]
64.	*Psiadia dentata* (Asteraceae)	Isoobtusitin	Caumarin
65.	*Psychotria leptothyrsa* (Rubaceae)	Psyles A-F	Cyclotides
66.	*Rhus chinensis* (Anacardiaceae)	Rhuscolide A, Moronic acid	Lactone [47]

67.	*Ridolfia segetum* (Apiaceae)	Phellandrene, Terpinolene	Terpenoid [48]
68.	*Rosa damascena* (Rosaceae)	Tetrahydroxyflavonol	Flavonoid
69.	*Rosa woodsii* (Rosaceae)	Oleanolic acid	Terpenoid [49]
70.	*Salvia miltiorrhyza* (Lamiaceae)	Lithospermic acid	Phenol
71.	*Salvia officinalis* (Lamiaceae)	Ferulic acid, isoferulic acid	Caumarins [50]
72.	*Salvia yunnanensis* (Lamiaceae)	Methyl salvianolate Cis-lithospermic acid	Phenol [51]
73.	*Saururus chinenisis* (Saururaceae)	Manassantin A, Saururin B	Lignan [52]
74.	*Schisandra lancifolia* (Schisandraceae)	Lancifoic acid, Nigranoic acid	Terpenoids [53]
75.	*Schisandra propinqua* (Schisandraceae)	Tiegusanins G	Lignans [54]
76.	*Schisandra rubiflora* (Schisandraceae)	Rubrisandrins A B	Lignans [55]
77.	*Schisandra sphenanthera* (Schisandraceae)	Sphenadilactone C	Terpenoid
78.	*Schisandra wilsoniana* (Schisandraceae)	Wilsonilignans A B C	Lignans [56]
79.	*Stauntonia obovatifoliola* (Malvaceae)	16beta-hydroxylupane-1,20(29) -diene-3one	Terpenoids [57]
80.	*Scutellaria baicalensis* (Lamiaceae)	Baicalin	Flavonoid
81.	*Stephania cepharantha*	Aromoline	Alkaloid [58]

	(Menispermaceae)		
82.	*Strychnos vanprukii* (Loganiaceae)	3-beta-O-trans-feruloylbetulinic acid 3-beta-O-trans-coumaroylbetulinic acid	Furans
83.	*Thalassia testudunium* (Hydrocharitaceae)	Thalassiolins	Flavonoid [59]
84.	*Tieghemella heckelii* (Sapotaceae)	Arganine C	Terpenoid
85.	*Trigonostemon thyrsoideum* (Euphorbiaceae)	Trigonothyrins C	Terpenoid [60]
86.	*Trigonostemon lii* (Euphorbiaceae)	Trigonoliimines A	Alkaloid [61]
87.	*Tripterigium hypoglaucam* (Berberidaceae)	Triptonine B	Alkaloid [62]
88.	*Tripterigium wilfordii* (Celastraceae)	Trifordine A B C	Alkaloid [63]

CONCLUSION

Medicinal plants maintain the health and vitality of individuals and also cure various diseases. In this review, some anti HIV plants have been presented. The herbal products today symbolize safety in contrast to the synthetics that are regarded as unsafe to humans. Natural plant derived drugs continue to be excellent source of new drug candidates with anti HIV effect. At present, herbal kingdom should be explored for discovery and development of anti HIV agents and these investigations should be encouraged and continued. A number of natural products mainly derived from plants have proven effective in suppressing HIV replication and progress. The results and experiences with many of the anti HIV natural products will inspire and motivate even more researchers to look for new leads from plants and natural sources.

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