IJPSR (2021), Volume 12, Issue 12 (Review Article)

INTERNATIONAL JOURNAL OF PHARMACEUTICAL SCIENCES AND RESEARCH

Received on 09 December 2020; received in revised form, 02 April 2021; accepted, 28 May 2021; published 01 December 2021

AYURVEDIC ANTIVIRAL AGENTS: OVERVIEW OF MEDICINAL PLANTS PERSPECTIVE

Ranu Choudhary [*1], Laxmikant Borse [2] and Anil Jadhav [3]

Department of Quality Assurance [1], Department of Pharmacology [2], Department of Pharmacognosy [3], Sandip Institute of Pharmaceutical Sciences, Mahiravani, Nasik - 422213, Maharashtra, India.

Keywords:

Medicinal plants, Antiviral agents, Ttherapeutic window range, Viral infections, Phytochemicals, Ayurveda

Correspondence to Author:
Ms. Ranu Choudhary

Student of M. Pharmacy, Department of Quality Assurance, Sandip Institute of Pharmaceutical Sciences, Mahiravani, Nasik - 422213, Maharashtra, India.

E-mail: rakshachoudhary26@gmail.com

ABSTRACT: In recent years, it has been reported that many herbal plants contain antiviral agents which combat a human disease that is caused by pathogenic viruses. The natural products which are obtained from plants as antiviral agents against viruses have gone through researches to check the efficacy and potentials of the herbal products in the prevention of viral disorders. On the basis of randomized controlled studies and *in-vivo* studies, and *in-vitro* studies, some agents are utilized all across the globe. Progressively numerous studies on therapy of antivirals have been increased. Though, efficacy remains disputable for antiviral drugs that are employed for viral disorders. The viral diseases are challenging for the health of people around the world cause significant increase in mortality and enhance crises. There are many synthetic antiviral drugs that have a large number of side effects and have narrow therapeutic window range, while in the other hand herbal formulations have minimized side effects. The advantages of herbal formulation over synthetic drugs encourage us to devise and expand new herbal moieties against the emerging viral infections. The medicinal plants contain phytochemicals that have antiviral properties. In this paper, the activity of antiviral agents from medicinal plants which have importance in Ayurveda, are discussed along with their source.

INTRODUCTION: Viral diseases are more threatening to public health day by day. Many numbers of viral diseases have been reported from different regions of the world [1]. The therapeutic potentials of medicinal plants recapped by various research programs [2]. For humans, plants are the crucial source of medicine. Day by day the demand for traditional medicine is increased. To achieve the health goals it is important to use the traditional medicines as per World Health Organisation. There is about at least 35000 species of plants which are used for the purpose of medicine.

QUICK RESPONSE CODE

DOI: 10.13040/IJPSR.0975-8232.12(12).6214-20

This article can be accessed online on www.ijpsr.com

DOI link: http://dx.doi.org/10.13040/IJPSR.0975-8232.12(12).6214-20

About 700 herbal products are described along with their clinical effects and properties. Fifty categories of the herbs have been described according to their clinical effect as anti-inflammatory, antiviral, antiasthmatic, antihelminthic, antipyretic, anti-emetic, antipruritic, antidiarrhea, sedative, anti-epileptic, haemostatic, analgesic, haemopoietic, promoter of strength, semen and sperm, voice, complexion, wound healing *etc.* [3].

For primary health care, millions of people depend on the medicinal plant, but it is not limited to that; it is also for improvement of livelihood and generation of income [4]. Herbal formulations are the basic foundation in many traditional medicinal systems worldwide wide [5]. The active natural ingredients of higher plants have been studied for their potency against viruses on the basis of Siddha and Ayurveda traditional system of medicine; these studies revealed the virus's *e.g.*, feline immuno-

deficiency virus, coxsackievirus, herpes simplex virus, influenza virus, respiratory syncytial virus, par influenza virus, *etc*. The medicinal plants contain several of the phytochemicals constituents, which are responsible for their property to treat diseases.

Among them, some have antiviral properties. Nowadays, people demanding alternative medicines other than conventional medicine shown by a recent survey in developing countries.

What is a Virus: A virus is an infectious agent or parasite of small size that itself reproduces. Viruses are called a link between living and nonliving. The multiplication of viruses occurs only in living cells such as plant cells, animal cells, and bacterial cells [6].

The genetic material of viruses is DNA or RNA. The genome is encompassed within the protein sheath called a capsid. The genetic material may be double or single-stranded. Capsids of viruses are regular arrays of one or a few types of protein. Almost every ecosystem has viruses.

A non-bacterial pathogen infecting tobacco plants was described by Dmitri Wanovsky's 1892 article. Tobacco Mosaic virus was discovered by Martinus Beijerink in 1898 [7].

Emerging Pathogenic Viruses: The public threat of emerging viruses is increasing day by day. The viral diseases are very dangerous; hence the scientists are continuously involved in the researches for the discoveries of antivirals for curing the new pandemics. Nowadays, coronavirus is spreading increasingly, which is of unknown origin.

Newly Emerging Viruses are given as below:

Coronavirus: Coronavirus is a single stranded RNA virus. The coronavirus is included in coronaviridae family. In humans, it causes a common cold, and complications that include pneumonia and SARS can occur [8].

Ebola Virus: The Ebola virus's transferral occurs from the wild animals and in the humans by human to human transmission. It is Ebola hemorrhagic fever which causes fatal illness in humans. Ebola virus is a member of the filoviridae family.

West Nile Virus: It is an example of a mosquito-borne zoonotic virus caused by a change in the climate. It belongs to the family of Flaviviridae and is transmitted by mosquitoes.

Nipah Virus: It was first revealed in April 1999 in Malaysia on the pigfarm. It caused the outbreak of respiratory and neurological diseases. Symptoms of encephalitis in humans and respiratory in pigs were observed in outbreak [7].

Sin Nombre Virus: Sin Nombre virus is related to Hantavirus. The symptoms of the Hantavirus pulmonary syndrome (HPS) are fever, cough, headache, pulmonary edema, and death at the end. SNV belongs to the genus of Hantavirus of the family Bunyaviridae.

The reservoir of SNV infection is rodent carrier (the deer mouse); the inhalation of virus-contaminated deer mouse excretion is the mode of transmission of SNV about 66 [7]. percent fatality rate of SNV induced HPS reported in the United States.

SARS-coronavirus (SARS): It is caused by SARS-CoV. It is viral respiratory disease. In bats high probability of SARS-CoV is originated on the basis of phylogenetic analysis and in humans it spreads directly or indirectly *via* animals held in the Chinese market. 8273 cases and 775 deaths were reported in China in the middle of November 2002 & July 2003.

MERS-Corona Virus: MERS-CoV is a novel coronavirus. In 2012 in Saudi Arabia, it was isolated out of a patient who suffered from acute Pneumonia. The fatality rate of MERS - CoV is higher than SARS-CoV up to 30%. 1084 cases and 439 deaths were reported in March 2015. Through dromedary camel MERS-CoV spreads from bats to human here is the list of major zoonotic viruses [7, 8].

Natural Antiviral Agents: Natural antiviral agents are obtained from the medicinal plants which are described in Ayurveda along with their antiviral properties.

The extraction of the parts of medicinal plants gives the crude antiviral agents later; these crude products can be purified by using purification techniques such as chromatography [9].

These are obtained as active phytochemicals, including polyphenols, terpenoids, coumarins, alkaloids, phytosterols, glycosides, flavonoids, saponins, sulphides, lignans *etc.* [9, 10].

Some antiviral agents from medicinal plants, including their mechanism of action, are explained in **Table 2** [3, 4, 6, 11].

TABLE 1: LIST OF MAJOR ZOONOTIC VIRUSES [7, 8]:

S. no.	Family of virus	Zoonotic virus	Reservoir host	Origin of infection in human	Disease
1	Coronavirus	SARS-CoV	Bats	Bats	Rigorous acute respiratory syndrome
		MERS-CoV	Camel	Bats	SARS-like
2	Bunyavirus	Hantavirus	Wild mouse	Mouse	Hemorrhagic fever
		Sin Nombre Virus	Wild mouse	Mouse	Hantavirus pulmonary syndrome
3	Influenza virus	Avian influenza H5N1	Wild birds	chicken	Respiratory disease
		Avian influenza virus H7N9	Wild birds	Chicken	Respiratory disease
4	Paramyxovirus	Hendra virus	Bats	Horse	Hemorrhage in lung
		Nipah virus	Bats	Pigs	Encephalitis
5	Filovirus	Ebola virus	Bats	primates	Hemorrhagic fever
6	Rhabdovirus	Rabies virus	Wild animals (bats, racoonetc)	Animals(dog)	Paralysis and hydrophobia
7	Flavivirus	West Nile Virus	Birds	mosquito	Encephalitis
		Dengue virus	Monkeys	mosquito	Hemorrhagic fever
		Japanese encephalitis virus(JEV)	Birds, bats	mosquito	Encephalitis

TABLE 2: ANTIVIRAL AGENTS FROM MEDICINAL PLANTS, INCLUDING THEIR MECHANISM OF ACTION ON THE VIRUS

S. no.	Name of plant	Active antiviral agent	Parts of plant used/extract	Common name of plant	Botanical name of plant	Mechanism of targeting the virus	Activity of antiviral
1	Lahsun	Ajoene, allicin, allyl methyl thiosulfinate and methyl allylthiosulfinate	Bulb,oil macerates &fresh garlic extract	garlic	*Allium sativa*	Interferes with virus adsorption & penetration	Common cold virus ,influenza virus A, dengue virus, Herpes simplex virus1,Herpes simplex virus2,HIV,coxsackie virus, infectious bronchitis virus
2	Palandu	Quercetin	Leaves	onion	*Allium sepa*	Inhibits viral entry or inhibiting components required by viral replication	Poliovirus ,hepatitis. influenza A
3.	Ghritakumari	Anthraquinones: aloe emodin	Flowers	Aloe vera	*Aloe barbedensis*	Partially destroys the viral envelope & inactivate them	Influenza virus, herpes simplex -1
4	Neem	N/A	Neem bark extract	Neem tree	*Azadirachtaindica*	Blocks HSV-1entry into glycoprotein D(gD) receptors expressing CHO-K1 cells	Dengue virus, pox virus(DNA), small pox virus(DNA)
5	Suryakanthisoppu	Triterpene saponin	N/A	Scarlet pimpernel, red pimpernel	*Anagallisarvensis*	In *vitro* inhibits virus replication	HSV, poliovirus
6	Pashanbheda	N/A	Methanolic extract	Hairy bergenia	*Bergeniaciliata*	N/A	Influenza virus A, HSV-1
7	Mulethi	Glycyrrhizic	Roots	Liquorice	*Glycyrrhiza*	GL interfere with an early	EBV(Epstein-Barr

		acid		root	*radix*	step of EBV replication cycle	Virus)
8	Swarnapatri	Anthraquinones	Hot glycerine extract	Senna, indiansenna	*Cassia angustifolia*	Partially destroy the vial envelope & inactivate them	HSV
9	Asishimbi	Lectins	N/A	Sword bean	*Canavaliagladiata*	In vitro inhibits virus penetration	HSV ,HIV, influenza virus
10	Naaranga	Tangeretin and nobiletin (polymethoxylated flavones)	Pericarps	Mandarine orange	*Citrus reticulate*	Affects the intracellular replication of RSV. Teregerin down regulated the expression of RSV phosphoprotein	Respiratory Syncytial Virus(RSV)l
11	Rathnagandhi	Quercetin derivative	Aqueous extract of fruit,stem,leaf,fruit&, seed	Peacock flower, red bird of paradise	*Caesalpinia pulcherrima*	Inhibits the viral replication at early stages of cycle	HSV
12	Toona	Acid polysaccharides	Leaves fraction extracts	White cedar, cedrobatata	*Cedrelatubiflora*	Inhibits virus replication	HSV, Vesicular Stomatitis virus
13	Ustukhudus	Lignin-carbohydrate complex	Fruit spikes	woundwort, carpenter's herb	*Prunella vulgaris*	Inhibits penetration of HSV-1 & blocks binding to vero cells	HSV-1, HSV-2
14	Guanandi	Apetalicacid,calanolide band C	Hexane extracts of leaves	Brazil beauty leaf	*Calophyllum brasiliense*	Inhibitory effect on reverse transcriptase	HIV
15	Chanaka	Phenolic compound	Seed,fruit skin ,aerial parts	Chick pea	*Cicerarietium*	N/A	HSV
16	Narikela	Catechin,epicatechine& B type procyanidins	Husk fiber's water extract	Coconut	*Cocosnucifera*	N/A	HSV
17	Mahinimba	Meliacarpin	Ethyl acetate extracts of leaves	Indian lilac,china berry tree	*Meliaazedarach*	Inhibits the virus replication	HSV
18	Kumkum	Crocin, picrocrocin	N/A	kesar	*Crocus sativus*	Inhibition of viral replication at begining & later when virions incorporated into vero cells ,inhibit viral entry & replication	HSV-1 HIV-1
19	Kataphala	Tannin(prodelphinidin B-2,3,3'-di-O-gallate)	Bark	Red bayberry	*Myricarubra*	Inhibits the viral attachment with cell	HSV
20	Bililotan	N/A	Volatile oils	Lemon balm,balm mint	*Melissa officinalis*	Inhibits virus replication	HSV
21	Punnaga	Inophyllum, calanolide A coumarins	N/A	Alexandrian laurel,balltree	*Calophyllum inophyllum*	Inhibitory effects on reverse transcriptase	HIV
22	Rajamasha	Unguilin	seed protein	Cowpea	*Vignaunguiculata*	inhibiting effect on reverse transcriptase and the glycohydrolases alpha and beta-glucosidase	HIV
23	Simdalu	Quercetin 3rhamnoside(Q3R)	Aerial parts	chameleon plant	*Houttuyniacordata*	Inhibit replication in initial stage of viral infection by direct interaction with virus particle	Ant-influenza
24	Asmagnhni	Scopadulcic acid B	Whole plant	Broom weed	*Scopariadulcis L.*	Inhibit the viral replication	HSV-1

25	Bhora	Polysaccharide	Alkaline extract	Asiastic mangrove	*Rhizophora mucronata*	Inhibited the viral binding to cell	HIV
26	Amla	N/A	Solvent extract of dried fruits	Indian gooseberry	*Phyllanthuse mblica*	Inhibits HIV reverse transcriptase	HIV
27	Tulsi	Apigenin, ursolic acid	Methanolic holy basil extract	holy basil	*Ocimumtenu iflorum*	Viral adsorption & penetration	HSV, hepatitis,enterovirus
28	Kalmegha	Diterpeneandro grapholide, neoandrographo lide&14-deoxy-2911-1230didehydroa ndrographolide	N/A	Green chireta	*Andrographi spaniculata*	N/A	HSV
29	Adrak	Beta-sesquiphellandr ene	Fresh rhizomes	ginger	*Zingiberoffic inalis*	Blocks viral attachment &internalization	Reapiratory syncytial virus(RSV)
30	Yashtimdhu	Glycyrrhizin, licorice	N/A	liquorice	*Glycyrrhizag labra*	N/A	Japanese Encephalitis Virus
31	Haritaki	Chebulagic acid, chebulinic acid	Chebula extract	Chebulicmyr obalan	*Terminaliac hebula*	Inhibits viral attachment& penetration	HSV-2,HIV
32	Sarifa	N/A	Peel extract	Custard apple	*Annonaretic ulata*	Inhibition of HIV-1 reverse transcriptase	HIV
33	Syamapatri	Epigallocatechi ne 3-gallate	Leaves	Green tea	*Camellia sinensis*	Inhibition of primitive stages of infection such as attachment and entry &inhibit membrane fusion by interfering with viral membrane protein	Dengue,Hepatitis B Virus,hepatitis C virus,HIV,HSV,EB V
34	Eranda	Lectin	N/A	Castor oil plant	*Ricinuscom munis*	Inhibits reverse transcriptase &N-glycohydrolases	HIV
35	Haridra	Curcumin	Root	turmeric	*Curcuma longa*	Reduction of RNA expression,protein synthesis &virus titer	Coxsackievirus
36	Lavanga	Eugenol	Flower bud extract	clove	*Eugenia caryophyllus*	Direct inactivation of virus	HSV
37	Vasa	Vasicine	Leaf/justicia adhatoda crude extract	adusa	*Adhatodavas ica*	Inhibits viral replication	Influenza, HSV-1
38	Ashwagandh a	Withaferin A		ashwagandh a	*Withaniasom nifera*	Inhibits neuraminase of H_1N_1 influenza virus and inhibits viral release from host cell	Influenza virus
39	Chandana	Beta- santalol	Stem	sandlewood	*Santalum album*	Inhibition of viral mRNA synthesis of influenza A/HK(H_3N_2)	Influenza A
40	Aaavartaki	N/A	Leaves/bark extract	Babul tree	*Acacia nilotica*	In vitro inhibit viral attachement&replication,I nhibit influenza A virus infection by interacting with viral hemagglutinin	Influenza, hepatitis C virus

N/A=Not Available, HIV=Human Immunodeficiency Virus, HSV=Herpes Simplex Virus, EBR=Epstein Barr Virus, RSV=Respiratory Syncytial Virus.

Mechanism of Action of the Antivirals Obtained from Plants: The natural antiviral agents obtain from plants as phytochemicals [9]. This phyto-chemicals acts on the virus during the infection of the host cell by the virus & inhibits further viral infection. The infection of the host cell by virus

involves the following steps refer **Fig. 1.** The first step is the adsorption of the virus on the surface of the host cell. This occurs due to the interaction of glycoprotein present on the surface of the virus with a transmembrane receptor on host cell surface.

- After adsorption, penetration of virus through cell wall occurs.
- Then the uncoating of the virus involves the deliverance of genetic material.
- This delivered genetic material integrates, or it may remain exist in the nucleus with the host's genetic material, and this interferes with replication, transcription, and translation processes and protein synthesis occurs.
- These proteins assemble and form virions and release by the process of exocytosis [3].

The natural antiviral drugs can act on different steps as given above and inhibit viral replication in viral synthesis. The adsorption of virus on the surface of host cell in first step. Inhibition of these step occurs by natural agents such as Quercetin, epigallocatechine-3-gallate, Ajoene, allicin tannin such as prodelphinidin B-2, 3, 3'-di-O-gallate *etc.* [6, 12] penetration through a cell wall is inhibited by apigenin, ursolicacid, lectins, lignin-carbohydrate complex *etc* [4]. After uncoating, the early enzymes and gene products are formed for control of nucleic acid synthesis. This step is inhibited by antiviral agents such as calanolide a, inophyllum, *etc* [4, 13]. Which inhibit the reverse transcriptase enzyme. The inhibition of transcription, translation, DNA replication process can be done by Triterpene saponin, glycyrrhizic acid, meliacarpin, vasicine, scopadulcic acid, acid polysaccharides, quercetin and its derivatives, meliacarpin, scopadulcic acid B *etc* [12, 13]. The viral neuraminase resonsible for release of virus from host cell, this neuraminase is inhibited by with aferin. One more recognised mechanism of action of opposing viruses carrying DNA as genome is the demolition of coating of virus facilitated by natural antivirus such as anthraquinones like aloe emodin.

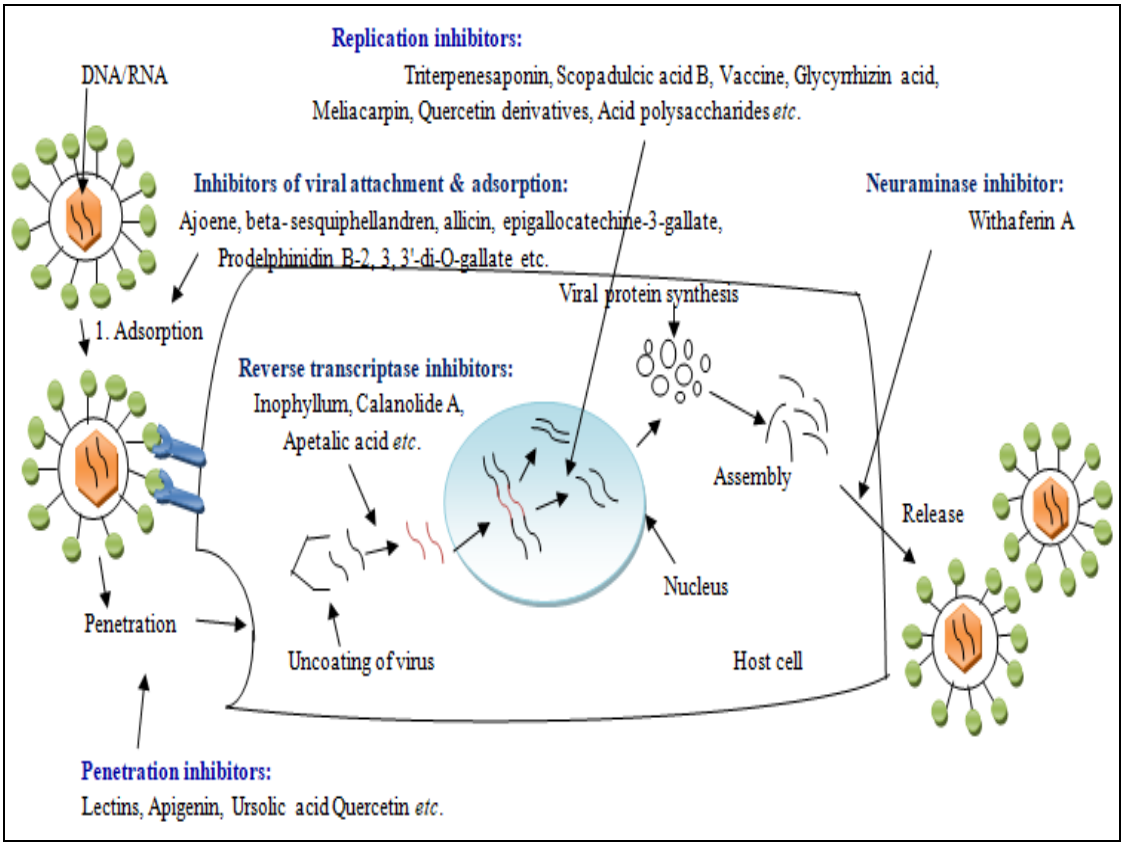

FIG. 1: MECHANISM OF ACTION OF ANTIVIRALS OBTAINED FROM PLANT SOURCE

CONCLUSION: Keeping in view it has been concluded that in Ayurveda, many of the medicinal plants contain similar phytochemicals that are responsible for their antiviral property.

The enzymes which are essential for viral replication are targeted by phytochemicals procured from plants and acts on different stages of viral replication. The mechanism to target the virus of many phytoconstituents has not been discovered yet. The discoveries & researches on these phytochemicals for their mechanisms to target the viruses are in progress throughout the globe. In this era of emerging viral infections, new bioactive moieties should be discovered. The medicinal plants are taken as a source for a finding of new antiviral agents with potent antiviral activity than conventional antiviral compounds.

ACKNOWLEDGEMENTS: I acknowledge support from my guide Dr. Laxmikant Borse and co-guide Dr. Anil Jadhav.

CONFLICTS OF INTEREST: The author declares no conflicts of interest.

REFERENCE:

1. World Health Statistics. World Health Organization 2012.
2. Gupta YK, Briyal S and Gulati A: Therapeutic Potential of Herbal drug in Cerebral Ischemia. Indian Journal Of Physiology And Pharmacology 2010; 54(2): 99-122
3. Kalyani P and Kamaruz Z: Antiviral Activity of some Indian Medicinal Herbs. Journal of Pharmacy Practice 2013; 2-6.
4. Pushpa R, Nishant R, Navin K and Pankaj G: Antiviral Potential of Medicinal Plants: An Overview. International Research Journal of Pharmacy 2013; 4(6): 2230-07.
5. Rathore B, Mahdi AA, Paul BN, Saxena PN and Das SK: Indian Herbal Medicines: Possible Potent Therapeutic Agents for rheumatoid arthritis. Journal of Clinical Biochemistry and Nutrition 2007; 12-41.
6. Sohail MN, Attitalla I and Rasul F: Plant as a Source of Natural Antiviral agents. Asian Journal of Animal & Veterinary Advances 2011; 6(12): 1683-19.
7. Buhner SH: Herbal Antivirals, Storey publishing 210 MASS MoCAWay, and North Adams 2013.
8. Liang-TzungLin, Wen-Chan Hsu and Chun-Ching Lin: Antiviral Natural Product and Herbal Medicine. Journal of Traditional and Complimentary Medicine 2014; 4: 24-35.
9. Hafidh RR, Abdulamir AS, Jahanshiri F and Bakar AF: Asia is the Mine of Natural Antiviral Products for Public Health. The Open Compleme Medicine J 2009; 1: 58-68.
10. Perez RM: Antiviral Activity of Compounds Isolated from Plants. Pharmaceutical Biology 2008; 1388-0209.
11. Kotwal GJ: Natural Antivirals against Human Viruses. Virology & mycology 2014; 3(2): 2161-0517.
12. Sharma N: Efficacy of Garlic and Onion against virus. International Journal of Research in Pharmaceutical Sciences 2019; 0975-7538.
13. Kapoor R, Sharma B and Kanwar S: Antiviral Photochemical: An Overview. Biochemistry& Physiology 2017; 2168-9652.
14. Jassim SSA and Naji MA: Novel antiviral Agents: A medicinal plant perspective. Journal of Applied Microbiology 2003; 412-27.
15. Sasidharan H, Venkatesh S, Prabhu M, Koppala S and Kumar NS: Identity Parameters on Traditionally Used Antiurolithiatic Herb-Scopariadulcis Linn. J of Ayurveda and Integrated Medical Science 2017; 2456-3110.
16. Damle M: *Glycyrrhiza glabra* (Liquorice)-a potent medicinal herb. International J of Her Med 2017; 0255-22.
17. Pal SK and Shukla Y: Herbal Medicine: Current status and the future. Asian Pacific Journal of Career Prevention 2003; 281-88.
18. Zhang Y, Nagao T, Tanaka T, Yang C, Okabe H and Isao Kouno: Antiproliferative activity of the main constituents from phyllanthusemblica. Biol Pharm Bull 2004; 251-55.
19. Sohail MN, Attitalla I and Rasul F: Plant as a Source of Natural Antiviral agents. Asian Journal of Animal & Veterinary Advances 2011; 1683-19.

How to cite this article:
Choudhary R, Borse L and Jadhav A: Ayurvedic antiviral agents: overview of medicinal plants perspective. Int J Pharm Sci & Res 2021; 12(12):6214-20. doi: 10.13040/IJPSR.0975-8232.12(12).6214-20.