

Nepalese Medicinal Plants Which Can Develop Immune and Inhibit Viral Growth

Mitra Lal Pathak^{1*}, Muhammad Idrees², Hem Raj Poudel³, Amrit Bahadur Nagarkoti⁴ & Anu Shrestha⁵

¹National Botanical Garden, Department of Plant Resources, Godawari, Lalitpur, Nepal

²College of Life Sciences, Neijiang Normal University, Neijiang (641000) Sichuan, China

³National Herbarium and Plant Laboratories, Department of Plant Resources, Godawari, Lalitpur, Nepal

⁴Godawari-1, Godamchaur, Lalitpur, Nepal

⁵Department of Plant Resources, Thapathali, Kathmandu, Nepal

* Email: scientistdmitra@gmail.com

Abstract

This paper aims to review and enumerate the top Nepalese medicinal plants which are helpful to develop immune to the body against viral diseases including SARS-CoV-2 (Covid-19) and prevent viral growth after confirmation. For this, recent research about the title was reviewed. Scientific name, common name, family, distribution or habitat range, parts used, chemical compounds and their role for immune system or inhibit viral growth were enumerated and analyzed. The result shows that including some daily uses spices (Garlic, Onion, Ginger, Turmeric etc), common seasonal fruits (Mango, Papaya, Pomegranate, Sweet orange) to high value medicinal plants are important to develop resistant power and fight with SARS-CoV-2 (Covid-19) after confirmation. Altogether, 41 medicinal plants (belongs to 30 families) to develop immune and to inhibit viral growth after confirmation are recorded through the reviews and analysis. Amaryllidaceae, Fabaceae and Lamiaceae were three larger families with three species in each. Whereas, Combretaceae, Piperaceae, Rutaceae, Solanaceae and Zingiberaceae were found with two useful plants in each family. Other 23 families were reported with single species.

Keywords: Antiviral property, Nepal Himalaya, SARS-CoV-2 (Covid-19)

Introduction

Covid-19, a disease induced by SARS-CoV-2 (Severe Acute Respiratory Syndrome Coronavirus-2), has been the cause of a worldwide pandemic. Though extensive research works have been reported in recent days on the development of effective therapeutics against this global health crisis, there is still no approved therapy against SARS-CoV-2. According to WHO, 213 countries and territories are affected by Corona Virus and 26 million people are died around the world till date; 13 March 2021 (www.worldometers.info/coronavirus/), whereas the death number is 3012 out of 275,118 cases in Nepal (till 13 March 2021). Daily confirmed cases and death were increasing few months before (Figure 1 and 2). However, recently the data is in decreasing order. Though, different vaccines are in trial phase recently, this paper will be important for the future to know about useful plants to resist from similar diseases and for future medicine related research belongs to different viral diseases.

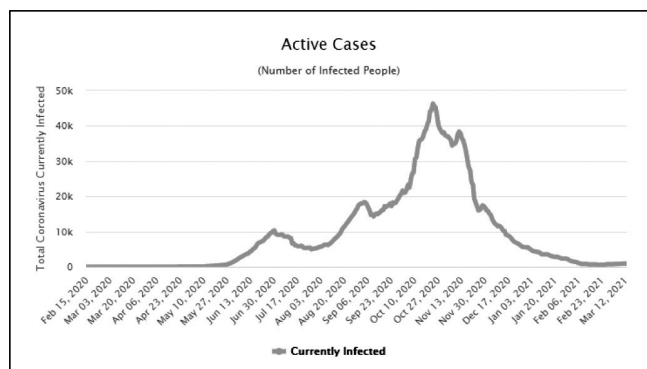


Figure 1: Daily new confirms cases up to March 12, 2021 (Source: <https://www.worldometers.info/coronavirus/country/Nepal>)

Vaccines still in trial phase yet and people all around the world are still worried. Some countries are already returned at normal daily life and recaptured their previous moment. Specific vaccines against SARS-CoV-2 are also being developed in many laboratories across the world. However, a recent review (Yang et al., 2020) and many others underline the role of traditional Chinese medicine in treating SARS-

CoV-2 patients. The case study with each selected medicinal plants and their positive effect for COVID patient was noted in Bangladesh too (Azam et al., 2020). Though there are not such comprehensive studies available in Nepal, However, we have a long history of using medicinal plants for treating broad-spectrum diseases since ancient times (References). Recently, some attempts from Ayurveda hospital in Nepal viz. Community Nature cure Hospital Rajahar, Nawalapur (Gandaki Province, Nepal), Ayurveda teaching hospital Kirtipur, Kathmandu) have found more efficient to develop immune system of patients and to cure positive cases without serious symptoms (is it personal communication, references). Some other research also has reported some plants and their compounds used against viral diseases (Taylor et al., 1996; Rajbhandari et al, 2009; Joshi et al 2020).

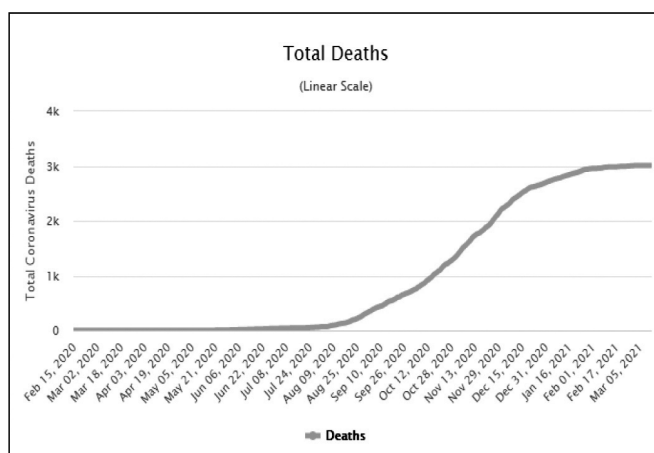


Figure 2: Death cases in Nepal up to March 05, 2021 (Source: worldometers.info/coronavirus/country/Nepal)

In this context, this paper aims to enumerate the plants from Nepal Himalaya (wild as well as cultivated) which develop immune system and used to inhibit viral replication of Covid-19 after positive confirmation. Hope, this review paper will help to enhance similar studies including screening of plants which can be used against viral diseases.

Materials and Methods

The study is based on literature review. For this, the information about medicinal plants was gathered from published books (DPR, 2016), scholar articles, reports and different health blogs using different search engines. The data were organized

and analyzed in Microsoft Excel (2010) software and then summarized in to tables and figures. For the taxonomic treatment of the documented plant species, the online botanical databases ‘IPNI’ (International Plants Name Index), ‘The Plant List’ (Royal Botanic Gardens, Kew, UK and Missouri Botanical Garden, USA) and ‘Tropicos’ (Missouri Botanical Garden, USA) and online version of Annotated checklist of the flowering Plants (www.Efloras.org) were used.

Results and Discussion

There is a well said in the society that ‘Prevention is better than cure’. So, the Plants or food items used before infection of any diseases are crucial in our daily life. Many common spices and daily used 41 plants are described in this revision work.

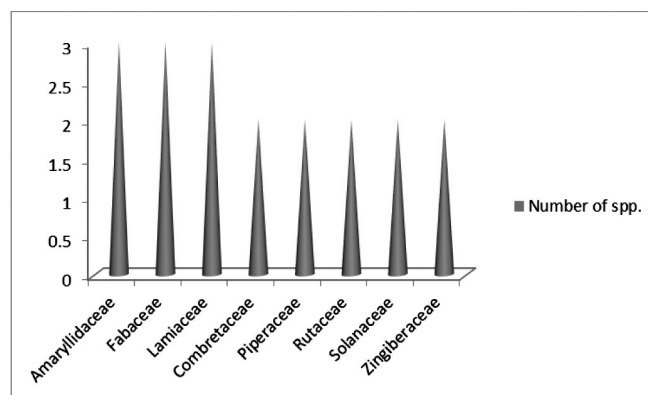


Figure 3: Number of useful species in eight larger families.

Among them, 26 are as preventive and immune system developing plants and other 14 are viral growth inhibiting plants after infection by SARS-CoV-2 (Covid-19). Fabaceae (*Cassia tora*, *Glycyrrhiza glabra* and *Psoralea corylifolia*) Amaryllidaceae (*Allium cepa*, *A. sativum* and *Lycoris radiata*) and Lamiaceae (*Ocimum tenuiflorum*, *Origanum vulgare* and *Rosmarinus officinalis*) are larger families with three useful plant species in each (Figure 3). Combretaceae (*Terminalia chebula* and *T. billerica*), Piperaceae (*Piper longum* and *P. nigrum*), Rutaceae (*Citrus aurantifolia* and *Citrus sinensis*) Solanaceae (*Lycium barbarum* and *Withaina somnifera*) and Zingiberaceae (*Curcuma longa* and *Zingiber officinale*) were found with two species in each family. Other 23 plants species were from single species in each family (Table 1 and 2).

Table 1: List of plants which develop immune to resist COVID-19.

S.N.	Name of Plants	Family	English name	Compound	Distribution in Nepal	Parts used	For what (Mode of action)	References
1	* <i>Allium cepa</i> L.	Amaryllidaceae	Onion	Quercetin, Thiosulfinates and anthocyanins	Cultivated and common as vegetable spice	Bulb	Develop immune system	Harazem et al. 2019
2	* <i>Allium sativum</i> L.	Amaryllidaceae	Garlic	Diallyl disulphide, allin, Poliphenols proteins	Cultivated and common as vegetable spice	Bulb	Develop immune system	Fani et al. 2007
3	* <i>Aloe vera</i> L.	Asphodelaceae	Aloe	Amino acids, Anthraquinones, Enzymes, sugar, Vitamins A, B, C, E, B12	Cultivated	Whole plant	Antioxidant, Aniti viral activity	Sahu et al. 2013
4	<i>Berberis Aristata</i> DC.	Berberidaceae	Barberry	berberine	1800–3000 CW	Fruit, stem and root	Antioxidant/ antiviral/develop immune	Dehar et al. 2013
5	* <i>Camellia sinensis</i> (L) Kuntze	Theaceae	Tea plant	Catechins, quercetin, gallic acid, Theaflavin-3,3' digellate	cultivated	Leaf	antioxidant	Perva-Uzunalić et al. 2006
6	* <i>Carica papaya</i> L.	Caricaceae	Papaya	Caricaxanthin, Violaxanthin, Zeaxanthin, carpaine	Cultivated terai and hilly region	Leaves Juice, Fresh fruit	Antioxidant and develop immune system in body	Kala 2012
7	* <i>Citrus × limon</i> (L.) Burm.f.	Rutaceae	Lemon	Polysaccharides, polyphenolic compounds	cultivated	Fresh fruit /peel	Antioxidant/ develop immune	Shen et al. 2017
8	<i>Lycium barbarum</i> Lam.	Solanaceae	Wolfberry	Polysaccharides proteins, phenolic compounds	1600 C	Fruit	develop immune	Tang et al. 2012
9	* <i>Mangifera indica</i> L.	Anacardaceae	Mango	Flavonoides, Phenolic acid	Cultivated terai and mid hills	Bark, leaf, root, flowers	develop immune	Makare et al. 2001
10	<i>Moringa oleifera</i> Lam.	Moringaceae	Drumstick	oleic acid, ascorbic acid- 2, 6-dihexadecanoate, 9-octadecenoic acid, methyl ester-hexadecanoic acid and 9-octadecenamide	Rarely found in marginal land as wild and widely cultivated CE 150-1100	Leaf, fruit	Antioxidant, anti-viral activity and used as super food	Moyo et al. 2011
11	<i>Morus serrate</i> Roxb.	Moraceae	Mulberry	Carotene, Vitamin B1, Vita.-D, Folic acid, Folinic acid	WC 1600-2400	Fruit, leaf, root	Develop immune	Bagachi et al. 2013
12	* <i>Nigella sativa</i> L.	Ranunculaceae	Black cumin	Quinones, alkaloids, saponins	cultivated	Seeds	Immune boosting and antioxidant	Ahmad et al. 2013
13	<i>Panax pseudo-ginseng</i> C.A. Mey.	Araliaceae	Ginseng	Ginsenosides and more 40 compounds	Temperate to sub alpine	Root	Immune boosting and antioxidant	Li et al. 2013 Lü et al. 2009

S.N.	Name of Plants	Family	English name	Compound	Distribution in Nepal	Parts used	For what (Mode of action)	References
14	<i>Piper longum</i> L.	Piperaceae	Long peeper	piperine	WCE 200-800	Fruit	Antiviral activity	Hamidi et al. 1996 Priya et al. 2017
15	<i>Piper nigrum</i> L.	Piperaceae	Black peeper	Chloroform extract	Widely cultivated	fruit	Antiviral activity	Priya et al. 2017
16	<i>Prunus cerasifera</i> Ehrh.	Rosaceae	Cherry plum	polysaccharides, Acetonitrile	E 1800	Fruit	Antiviral activity	Stacewicz-Sapuntzakis et al. 2001
17	* <i>Psidium guajava</i> L.	Myrtaceae	Guava	tannins, guajavins, psidinins and psiguavin	cultivated	Fruits, shoots and leaf	Antiviral activity	Balasubramanian et al. 2007
18	* <i>Punica granatum</i> L.	Punicaceae	Pomegranate	ellagic acid, ellagitannins, punicic acid, flavonoids, anthocyanidins, anthocyanins	cultivated	Fruit, seed and bark	Immune boosting and antioxidant	Zhang et al. 1995
19	* <i>Rosmarinus officinalis</i> L.	Lamiaceae	Rosemary	Rosmanol, Carnosol	cultivated	leaf	Antioxidant and Antiviral activity	e Silva et al. 2020
20	<i>Tinospora cordifolia</i> (Willd.) Hook. f. & Thoms	Menispermaceae	Heart leaved moonseed	alkaloids, glycosides, steroids, aliphatic compounds, essential oils, mixture of fatty acid, calcium, phosphorous, protein and polysaccharides	Subtropical to temperate	Stem, leaf	Boost immune	Tiwari et al. 2018
21	* <i>Zingiber officinale</i> Roscoe	Zingiberaceae	Zinger	Essential oils, crude fiber, proteins, fatty oils and carbohydrates	cultivated	Root	Antiviral activity	Sahoo and Banik 2019
22	<i>Azadirachta indica</i> A. JUSS. <i>Ocimum tenuiflorum</i> L. <i>Withania somnifera</i> (L.), Dunal <i>Terminalia chebula</i> Retz. <i>Terminalia bellerica</i> (Gaertn.) Roxb. <i>Phyllanthus emblica</i> (Gaertn.) Kurz, <i>Curcuma longa</i> L.	Meliaceae Lamiaceae Solanaceae Combretaceae Combretaceae Euphorbiaceae Zingiberaceae	Neem tree, Holybasil, Awshwagandha, Chebulic Myrobalan, Myrobalan, Indian gooseberry, Tumeric	Flavonoids, alkaloids, glycosides, steroids, eugenol, linalool, apigenin, and ursolic acid, aliphatic compounds, essential oils, mixture of fatty acid, curcuminoids and so on.	Tropical to subtropical	Leaf, root, fruit	Immune body systems, antioxidant, and anti-viral activity	https://pharomeasy.in/blog

Note: * = cultivated; C = Central; W = Western; E = Eastern

Carica papaya (Papaya), *Psidium guajava* (Guava), *Punica granatum* (Pomegranate), *Mangifera indica* (Mango) are common daily used seasonal fruits. From different research it was found that the plants like drumstick (*Moringa oleifera*) and *Camellia sinensis* (as green tea) and spinach and other green vegetables (which are not included in this review work) which have lots of vitamins, minerals and especially antioxidant properties have the sufficient strength to fight against different virus and other infectious diseases like SARS-CoV-2 (Covid-19) and many others (References).

Plants used against Covid-19 after confirmations were found out from different recent research. Many scientists believed that the traditional used plants from ancient time have played very important role to cure from SARS-CoV-2 (Covid-19) in China (Yang

et al. 2020). During the finding Nepalese medicinal plants effective for SARS-CoV-2 (Covid-19), three plants were found from family Fabaceae (*Glycyrrhizaglabra*, *Cassia tora* and *Psoralea corylifolia*). Out of these three, *Glycyrrhiza glabra* and *Cassia tora* are common in Nepal, whereas *Psoralea corylifolia* is reported in online checklist (www.Efloras.org) and might be cultivated. Also, it is found as herbal dietary supplements in the market. *Cassia tora* is common as roadside shrub in terai region. Other important plants which play important role for antiviral activity and even to inhibit the further growth of SARS-CoV-2 (Covid-19) virus in the human body are explained with common name, family, chemical constituents found in the plants, distribution or habitat status and their used parts (Table 2).

Table 2: List of the plants used against Covid-19 after confirmation

S.N.	Name of Plants	Family	English Name	Compound	Distribution in Nepal	Parts used	For what (Mode of action)	References
1	<i>Glycyrrhiza glabra</i> L.	Fabaceae	Liquorice	glycyrrhizin, glycyrrhetic acid, isoliquiritin, isoflavones	Subtropical to temperate	Root	Inhibiting viral replication	Cinatl et al. 2003
2	<i>Arabidopsis thaliana</i> (L.) Heynh.	Brassicaceae	Thale cress	12-oxophytodienoic acid (OPDA) and dinor-oxophytodienoic acid	2300 W	Leaf extracts	Immunogenic activity against the virus.	Gómez et al. 1998
3	<i>Rheum australe</i> D.Don	Polygonaceae	Himalayan Rhubarb	anthraquinones, stilbenes, anthrones, oxantrone ethers and esters, chromones, flavonoids, carbohydrate, lignans, phenols and sterols	CW 3200-5200	Root, bark and leaf	ACE2 and S-glycoprotein interaction is blocked	Rokaya et al. 2012 Zargar et al. 2011 Ho et al. 2007
4	<i>Origanum vulgare</i> L.	Lamiaceae	Oregano	carvacrol, β -fenchyl alcohol, thymol, and γ -terpinene etc	WC 600-4000	Leaf	Antiviral and antioxidant activity	Zhang et al. 2014
5	<i>Rauvolfia serpentina</i> (L.) Benth. ex Kurz	Apocynaceae	serpentine wood	reserpine	CE 100-1000	Root	inhibiting viral replication	Wu et al. 2004
6	* <i>Lonicera japonica</i> Thunb.	Caprifoliaceae	Japanese honeysuckle	Linalool, hexadecanoic acid, octadecadienoic acid, ethyl palmitate and dihydrocarveol	C 1400, mostly cultivated	flower buds, stems, and leaves	Inhibit viral activity	Shang et al. 2011
7	<i>Dendrobium nobile</i> Lindl.	Orchidaceae	<i>Dendrobium</i>	Vitamin A Aldehyde; Longifolene; 1-	E 500-1700	Stem, leaf,	Antiviral activity	Song et al. 2013

S.N.	Name of Plants	Family	English Name	Compound	Distribution in Nepal	Parts used	For what (Mode of action)	References
				Heptatriacotanol; Z, Z-6, 28-Heptatriactontadien-2-One and Dendroban-12-One		flower		Yang Y. et al. (2020) Xia et al. 2020
8	<i>Verbena officinalis</i> L.	Verbenaceae	common verbena	Verbenin, verbenalin, hastatoside, alpha-sitosterol, ursolic acid, oleanolic acid	WCE 900-2400	Leaf, stem	Antiviral activity	Kubica et al. 2017
9	<i>Phragmites australis</i> (Cav.) Trin. ex Steud	Poaceae	common reed	aurantiamide acetate, 2,3-dihydroxy-1-(4-hydroxy-3,5-dimethoxyphenyl)-1-propanone, ferulic acid, p-coumaric acid, syringic acid, vanillic acid, p-hydroxy benzoic acid, p-hydroxybenzaldehyde, palmitic acid, heptadecanoic acid, β -sitosterol, stigmasterol, α -D-glucose and β -D-glucose	CE 3000-3600	mostly Rhizome	Antiviral activity	Zhu et al. 2017
10	<i>Cassia tora</i> (L.) Roxb.	Fabaceae	sickle pod	Anthraquinone glycosides, Naphthopyrone glycosides, Phenolic compounds, Flavonoids	WCE 100-1300	Dried seed	Inhibit growth and replication of SARS-CoV	Wen et al. 2011
11	* <i>Paulownia tomentosa</i> (Thunb.) Steud.	Paulowniaceae	princess tree/ Empress tree	flavonoids, lignans, phenolic glycosides, quinones, terpenoids, glycerides, phenolic acids	Cultivated	seed	SARS-CoV papain-like protease	Cho et al. 2013
12	* <i>Psoralea corylifolia</i> L.	Fabaceae	babchi	dioscin and angelicin, Psoralen, terpenophenol	Native of India and Shrilanka, cultivated in Nepal	seed	Crude ethanol extract of the seeds Inhibit viral growth	Alam et al. 2018 Kim et al. 2013
13	* <i>Citrus sinensis</i> (L.) Osbeck	Rutaceae	Sweet Orange	Polyphenols	cultivated	Fruit	Control replication	Ulasli et al. 2014
14	* <i>Lycoris radiata</i> (L'Héritier) Herbert	Amaryllidaceae	red spider lily	Lycorine, Crinine, Galanthamine, Tazettine, Narciclasine, Lycorenine, Homolycorine and Montanine	Cultivated	Herbal extract	Control replication in vitro (raw Plant's bulb are poisonous for human and animals)	Li et al. 2005

Note: * = cultivated, WCE = West, Central and East

Among them, *Citrus sinensis* (can be used as fresh fruit), *Cassia tora* (Seeds can be used as coffee; also see the side effect below), *Rauwolfia serpentina* and *Glycyrrhiza glabra* (dried root can be used as green

tee) are the common plants (even common people may know) which can be used by the Covid-19 infected not serious patients during isolation period. However, the scientific confirmation is necessary for

all mentioned plants. If we are not familiar, better to confirm. Some plants like *Lycoris radiata* (Red spider lily) as raw form of plant's parts (bulbs) are poisonous for human being and animals. Similarly, *Senna* (Cassia) poisoning is rarely reported, and its potential for toxicity greatly underestimated. Clinical presentation mimics acute liver failure, which is very difficult to attribute to this seemingly innocuous agent (Ish et al., 2019). Therefore, precaution is necessary and random uses of medicinal plants are also not good.

Conclusion

From this study it can be concluded that the Nepal Himalaya is the worldwide recognized center and rich diversified place for high value medicinal plants including several infectious diseases like SARS-CoV-2 (Covid-19) too. Described 41 plants, are just the initiation not the final list of plants which are effective for viral infectious diseases from Nepal. So, in Nepalese context, the screening and compound isolation of medicinal plants (including reported in this review work) against viral diseases is foremost necessary and baseline for the further compound isolation. However, drugs identification, designing, development and clinical trial are badly needed for future generation.

Recommendations

Though medicinal plants have been used from prehistoric time based on traditional knowledge. In contrast, recently many scientists believe that the use of some medicinal plants as raw form might be side effects and even some chemical compounds are found as carcinogenic and lethal. So, Author highly recommends using plants and their parts after confirmation and consulting with experts and Ayurveda specialists.

Author Contributions

Author first develop the concept and find the different literature about introduction and recent update and prepare first and final draft. Authors second, third, fourth and fifth help to develop Table 1 and 2 with references.

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