

Review of Literature of *Canna indica* and its Potential Use as an Antiviral Agent for COVID-19

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ABSTRACT

Plants are irrefutably the most promising natural resource used in the treatment of various ailments since ages. In the ongoing pandemic situation, it would be beneficial to develop a cure to combat corona virus using such natural resources. There is an exigent need to come up with a non-invasive and effective treatment over vaccines to fight the coronavirus. Natural treatments are the best alternative to pharmaceutical drugs, which may damage the host and cause various adverse side effects. The plant *Canna indica* consists of phytochemicals such as flavonoids, alkaloids and terpenoids which may aid in the development of a potential antiviral agent in the future. The ongoing research and the widespread application of flavonoids, alkaloids and terpenoids mainly, have shown their effectiveness against the SARS covid 19 virus. Further, preclinical trials must be conducted on the phytochemicals present in *Canna indica* which may prove to be a promising factor in future. This article aims to provide information required to explore and claim the antiviral properties of the plant against SARS-COV. The phytochemicals flavonoids, alkaloids and terpenoids present in *C. indica* have significant antiviral properties that can potentially help humanity fight this virus. Thus, it is essential to broadly study *Canna indica* for further research aspects.

Keywords- *Canna indica*, Virus, COVID-19, Antiviral, Vaccine.

I. INTRODUCTION

In the recent era, viral infections are responsible for causing numerous public health problems globally. According to WHO, infectious diseases kill over 17 million people a year. COVID-19 has become the greatest health hazard globally to the human race. Despite the availability of antiviral drugs and vaccines against such viruses, there are many downsides to the treatments involved, which include various side-effects and active mutation resulting in drug resistance. By observing the global scenario, scientists have discovered herbs as one of the sources for the discovery of efficient novel antiviral

agents (Mohan, S., Elhassan Taha, M.M., Makeen *et al.* 2020). Plants have been known to be used as traditional medicine since primeval times as they are affordable, safer, culturally preferred, effective and accessible at all times. As reported by WHO, the proportion of population still dependant on traditional medicine is as high as 40% in China and 80% in Africa (Thorsen & Pouliot *et al.* 2015). Due to lack of true scientific knowledge before nineteenth century, treatments were based upon experience of herbal medicine (Al-Snafi *et al.* 2015). *Canna indica*, commonly known as the Indian shot or African arrowroot, is a perennial plant belonging to the cannaceae family which, has a long history of human cultivation. The cannaceae family is known to be a part of the Angiosperms (flowering plants) and has about 19 species (Dinh Hai *et al.* 2015). The plant yields maximum on deep sandy loam, rich in humus. The plant produces a cluster of stems ranging from 150-300cm long and possesses large leaves going up to 50cm and 25cm in length and width respectively. The flowers are showy with a wide range of colours - yellow, red, orange or pink. The genus *Canna* has a wide range of applications: ornamental due to their colourful flowers, medicinal and edibles because of starchy rhizomes (underground stems) seen in one species *C. edulis*, so far. The plant is indigenous to south eastern states of US (Texas, Florida, South Carolina and Louisiana), Central America, Mexico, West Indies and majority of South America (O'Brien, C. W., & Wibmer, G. J. *et al.* 1982). Generally, it starts off as purplish or green and gradually turns bronze/yellow at maturity. The flowers are born as single or in pairs and visible as a cluster at the tip of flowering stems. Every flower emulates the appearance of five 'petals' whereas in reality two to three out of them are sterile stamens (staminodes) and petaloid filaments (6). The papery capsules (1.5-3 cm length and 1.5-2 cm width) fluctuation between almost rounded shape and oval is crowned by persistent sepals. The immature fruit is purple or greenish and covered with tiny projections. On maturation, they turn brown and loose some of these projections. Finally, they burst open to release various smooth, black, hard and

rounded or oval shaped seeds, mostly in summer or early autumn. This plant reproduces either by seed or its underground stems vegetatively. The most common mode of dispersion of seeds is through birds and the rhizomes by floods and dumped garden waste (7).

In plants, different compounds and secondary metabolites are present known as phytochemicals such as anthocyanins, carotenoids and flavonoids, indigoids, etc. which provide some special properties to the plant. Phytochemicals are non-nutritive plant chemicals that have defensive as well as medicinal properties. A plant naturally produces these chemicals to protect itself from any type of infection, but recent research demonstrates that many phytochemicals can protect humans against viruses. The phytochemical analysis of *Canna indica* showed the presence of alkaloids, carbohydrates, proteins, flavonoids, terpenoids, cardiac glycosides, oils, steroids, tannins, saponins, anthocyanin pigments, phlobatinins and many other chemical compounds which could potentially be responsible for the medicinal properties of the plant (Kanase V. & Vishwakarma S. *et al.* 2018).

Different types of plant compounds can potentially be discovered and used to help protect human lives from the deadly COVID-19 virus. In the enormous scientific database, there are lots of scientific articles that describe the discovery and development of antiviral treatments through natural herbs. It has been suggested that terpenoids, alkaloids, stilbenes, and flavonoids are the main biological active compounds being used for the development of antiviral plant-based drugs. Herbal medicines provide an alternative way for boosting immunity to help fight the coronavirus (Freeman, B.C. & Beattie, G.A., *et al.* 2008).

Substantial metal contamination is known to be the most genuine and serious ecological issue today. Remediation of substantial metal contaminated soils is thus one of the critical points in ecological reclamation. As a plant-based innovation, the accomplishment of phytoremediation is naturally reliant upon appropriate plant choice (Subhashini, V., & Swamy, A. V. V. S. *et al.* 2014). *Canna indica* is one such plant that can assist in phytoremediation of metal (Pb, Ni, Zn, Cd and Cr) contaminated soils. Phytoremediation is an innovation that utilizes the innate capacity of green plants to eliminate pollutants from the environment or render poisonous mixtures innocuous. Phytoremediation stands out as a fast and reasonable plant-based innovation. Plant species fluctuate fundamentally in the capacity of amassing metals from tainted soils as an equilibrium is required between the take-up of essential metal particles to keep up development and nourishment and the capacity to shield sensitive constructions and activity from enormous degrees of essential and insignificant metals. (Carbisu, C. & I. Alkorta *et al.* 2001). The present review presents detailed characteristics of the medicinal plant *Canna indica*.

Traditional use

Canna indica is known to be used traditionally for the treatment of various diseases like diarrhoea, malaria, fever and dropsy. Different parts of the plant can be used to treat different ailments, namely a root decoction for the treatment of fever, dropsy, and dyspepsia; seed juice to relieve ear-aches and flowers are used to cure eye diseases. The pharmacological studies showed that the *Canna indica* plant exerted antiviral, anthelmintic, anti-inflammatory, antibacterial, antioxidant, molluscicidal, cytotoxic, hepatoprotective, analgesic immunomodulatory, haemostatic, anti-diarrheal and other effects (Dike, I. P., Obembe, O. O., & Adebisi, F. E. *et al.* 2012).

Origin & Habitat

It is known to have originated in tropical America, Mexico, Central America, the Caribbean and tropical South America. On the other hand, the main sites for the growth are swamp and wetland edges, streambanks and other moist areas. Sometimes they are also found growing in old gardens, disturbed sites and waste areas (Lusweti, A., Wabuyele, E., Ssegawa, P. *et al.* 2011).



Chemical constituents (Indrayan, A. K., Bhojak, N. K., Kumar, N., Shatru, A., & Gaur, A. *et al.* 2011).

S. No.	Plant part (<i>Canna indica</i>)	Chemical
1.	Aerial part	Betulinic acid, oleonic acid and traxaxer-14-en-3-one
2.	Flower	lutein, β -carotene, violxanthin
3.	Leaves	lignin, furfural and hemicelluloses.
4.	Rhizome	5, 8- hencosdine, tetracosane and Tricosane
5.	Root	Triacontanal & mixture of stigmaterol, β sitosterol, campesterol & β lectin & traces of Alkpiels

II. DESCRIPTION

Leaves: Leaves are dark green with purple brown margins and veins. The leaves are 10cm long lanceolate or ovate in shape having large laminae measuring up to 60 cm long. They are large and foliaceous reaching up to 65-70cm in length and 30-35 cm width. These leaves have various medical uses. For example, the leaves are used for the treatment of malaria; freshly squashed leaves are used in baths against rheumatic pains, arthritis, alleviating ulcers, etc Cheng, S., Ren, F., Grosse, W., & Wu, Z. (2002).

Flowers: Flowers are red, solitary or in branch, the bract being about 1.3 cm long. The diameter of the flowers is between 4-6 cm. Sepals are 1 to 1.5 cm long and are whitish green to red or purple in colour. Corolla tube is 2.5 to 3 cm long and reddish in colour. The staminodes are bright red and the flowers are hermaphrodite. The flowers have been known to cure eye diseases. Additionally, a decoction of flowers is used for external wound bleeding (Srivastava, J., & Vankar, P. S. 2010).

Roots: The roots are thick, tubular, and creamy white with a diameter of 2-5 mm with numerous root hairs. The root is used in various kinds of treatments like gonorrhoea, amenorrhoea, diarrhoea, dysentery, etc. It is also used as a diaphoretic, diuretic, stimulant, and demulcent and is administered in fevers and dropsy. Tripathi, S. M., & Singh, D. K. (2000).

Fruits: Fruits are oblong bright green capsules, softly echinate (spiny) & 2 to 2.5 cm long. Capsules are roughly about 40 × 25 mm. They are covered by green to purple tubercles with outer tepals (sepals) persistent at the apex (Tripathi, S. M., & Singh, D. K. (2000).

Seed: Seeds are almost the size of a pea initially white & when mature, black with chestnut brown spots protected with a smooth coat. (FALLAH, I. A., SALEHI, S. A., & Shahdadneghad, M. 2014).

Stem: Stem is erect, herbaceous, sturdy & cylindrically enveloped by the sheathing leaf bases. A pseudo stem is present which reaches up to 1.5-2 cm in height.

Rhizomes: Rhizomes may be monopodial or sympodial with stoloniferous or tuberous rhizomes being sympodial with Y-shaped axes. Young rhizomes are yellowish white or pinkish on the outside and yellowish-white inside. At maturity, they turn brownish externally due to a thick outer covering. Rhizomes are used to cure dropsy, dyspepsia, diuretic, antipyretic, gonorrhoea, and help women with irregular menses. Rhizomes are also used with other medicinal plants for cancer treatment (Kanase, V., & Vishwakarma, S. 2018).

Table 1: Taxonomical hierarchy (Sultana, N., Akhi, et.al 2019)

Domain:	Eukaryota
Kingdom:	Plantae
Phylum:	Spermatophyta
Subphylum:	Angiospermae

Class:	Monocotyledonae
Order:	Zingiberales
Family:	Cannaceae
Genus:	Canna
Species:	Canna indica

Table 2: Various phytochemicals present in *Canna indica*

S. No.	Metabolites	Results
1	Alkaloids	+++
2	Flavonoids	++
3	Terpenoids	++
4	Fixed oils	++
5	Phytosterols	+
6	Saponins	-
7	Phenolic compounds	++
8	Fats	++
9	Carbohydrates	++
10	Proteins	++
11	Glycosides	++
12	Tannins	+

+++ present in high concentration, ++ present in medium concentration, + present in low concentration- not present in the sample (Jeyaraman, V., Muthukkumarasamy, S. and Antony, J.V.A., 2011).

Table 3: Physicochemical Properties (Kanase, V. & Vishwakarma, S., et al. 2018)

Taste Sweet-tasting
Nature slightly cooling-natured
PH value (ethanol, methanol, and water) 8.0, 4.0, and 6.0%, respectively
Loss of weight on drying 4.1%
Total ash 17.98%
Acid-insoluble ash 69.2%
Water-insoluble ash 48%
Alcohol soluble extractive value 3.86%
Water-soluble extractive 6.31%

Phytoremediation properties of canna indica

Canna indica displayed irrational inclination in the retention of metals. Among all the major plant parts, leaves amassed nickel, stems accumulated lead and chromium, whereas roots gathered cadmium and zinc in the most elevated amounts (Subhashini & Swamy et al. 2014).

1. Lead Accumulation in plant parts

The pattern of movement uncovered that lead moved from roots to stem successfully while movement was poor from stem to leaves and thus the all-out collection was more in the stem than the leaves and roots.

2. Nickel Accumulation in plant parts

Nickel may be used by plant in digestion and most elevated aggregation in roots revealed that the movement from roots to stem and leaves was poor.

3. Zinc Accumulation in plant parts

Zinc is known to help in actual security of the plant and the higher aggregation in roots and stem likewise uncovers that equivalent while zinc is utilized in less amounts in the digestion in leaves.

4. Cadmium Accumulation

At the start, it shows retention in leaves, stem and roots but at moderate scale and later on after a month the accumulation reached maximum in all the plant parts.

5. Chromium Accumulation in plant parts

The presence of chromium in the stem of *Canna indica* was most evident in the initial 20 days of the analysis. Between 20-40 and 40-60 days the expansion of fixation was low and predictable.

Such metals when present in excessive amounts in plants pose a toxic effect on the overall growth and metabolism of plants. Also, there is a risk posed on human health if such heavy metals are bioaccumulated. At long last it was inferred that *Canna indica* was an acceptable aggregator of Pb, Ni, Zn, Cd and Cr (De Las Mercedes Ciciarelli, M. 2012).

Alkaloids

Alkaloids are a class of naturally occurring organic nitrogen-containing bases. They are present in the highest concentration out of all other phytochemicals in the plant. They are most commonly found in plants, especially in some families of flowering plants. Almost 25 percent of the plants contain alkaloids and thousand different types of plants have been identified till now. Alkaloids have been discovered in all parts of the plant, but are usually located in the bark or the seeds. Within the plant, alkaloid can have different concentrations from part to part –some parts may contain no alkaloids at all. Occasionally, different alkaloids also form in different parts of the plant (Uzor, P.F. *et al.* 2020) (18). Numerous studies have been conducted to assess the potential antiviral activity of alkaloids. Previously, scientist assumed that alkaloids were a waste product of the plant's metabolic activities. But later, evidence showed that they have certain biological functions. It is estimated that they possess antiviral activity at different stages of replication of the virus such as during the inhibition of production of envelope proteins, but the steps are not known yet. Certain alkaloids have the capacity to inhibit enzymes like reverse transcriptase that is necessary for viral replication and translation (Kumar A., Singh A.K., Tripathi G. *et al.* 2020). Various studies assumed that plants producing alkaloids can be used for the development of novel

antiviral drug for Covid19 (Wink M. *et al.* 2020) as chloroquine (helpful against SARS-CoV-2) is known to be a chemical derivative of alkaloids. Further screening analysis revealed that 10-Hydroxyusambarensine and Cryptoquindoline—two alkaloid compounds isolated from African medicinal plants showed anti-SARS CoV and anti-SARS CoV-2 activity through inhibition of their Mpro (Bhuiyan, F.R., Howlader, S., Raihan, T., Hasan, M. *et al.* 2020).

Flavonoids

Flavonoids are found in various kinds of herbal flowering plants and are also present in *Canna indica* at medium concentration. Flavonoid is a polyphenolic biomolecule responsible for various biological functions acting at different stages of viral infection specifically at the molecular level. Flavonoids possess various medicinal properties such as antioxidant, anti-inflammatory, anticancer, antimicrobial, antiviral and immunomodulatory functions. This paper mainly focuses on the antiviral properties (Godos, J., Caraci, F., Castellano, S., Currenti *et al.* 2020). Flavonoids also inhibit the key proteins involved in the coronavirus infection cycle such as PLpro, 3CLpro and NTPase/helicase. Flavonoid and their derivatives, due to their pleiotropic activities and lack of systemic toxicity may represent as target compounds to be tested in future clinical trials to enrich the drug arsenal against coronavirus infections (Russo, M., Moccia, S., Spagnuolo, C., Tedesco, I. and Russo, G.L., 2020).

Flavonoid's basic structure consists of 15 carbon atom (C6-C3-C6) and there are various types of flavonoids present in plants such as flavanols, flavanones, isoflavones, flavones, and anthocyanidins. In some flavonoid compounds, the C2 carbon atom is linked directly to the oxygen which results in a furan type molecule called aurone. This molecule is of interest in natural drug discovery as it can block the attachment and eventually the entry of viruses into the host cells by binding to specific extracellular regions of the virus like the viral protein. In some cases, it can bind to virions and modify the virus structure. Aurone is an early-stage replication inhibitor also blocking the transcription and translation process of the virus. Flavonoids eventually inhibit the late stages of maturation such as assembly/packaging and release (Lalani, S. and Poh, C.L., 2020). Additionally, according to *in silico* analysis, flavonoid compounds can terminate the activity of Mpro of SARS CoV-2 Mpro (Bhuiyan, F.R., Howlader, S., Raihan, T. and Hasan, M., 2020). A particular flavonoid called Quercetin also has shown capacity to inhibit numerous viruses including the SARS-CoV by inhibiting SARS-CoVPLpro (IC₅₀ of 8.6 ± 3.2 μM) and SARS-CoV helicase (Attia, Y.A., Alagawany, M.M., Farag, M.R., *et al.* 2020). Also, two small molecules from extracts of Chinese herbs, i.e., TGG and luteolin, have proven to be highly effective in inhibiting the entry of both wild-typed SARS-CoV and HIV-luc/SARS pseudotyped virus.

Terpenoids

Terpenoids are very essential compounds which are also referred to as isoprenoid made up of five-carbon isoprene units with a diverse structure. This phytochemical plays a very crucial role in the growth and development of the plant. Terpenoid is widely used in making drugs because it possesses antitumor, anti-inflammatory, antibacterial, antiviral, antimalarial properties, has hypoglycaemic activities, promotes transdermal absorption, prevents and helps in treating cardiovascular diseases (Yang, W., Chen, X., Li, Y., *et al.* 2020).

More than 220 phytocompounds (including ten diterpenoids, two sesquiterpenoids, and two triterpenoids) have been screened for activity against SARS-CoV by cell-based assay. As a result, a cytopathogenic effect on Vero E6 cells was seen which indicates excellent antiviral activity against SARS-CoV. Anti-SARS-CoV activity in the μM range included abietane-type and labdane-type diterpenes sesquiterpenes and lupane-type triterpenes (Naithani, R., Mehta, R.G., Shukla, D., Chandrasekera, *et al.* 2010).

III. CONCLUSION

We have tried to summarize all the basic knowledge obtained from various studies on *Canna indica* all over the world. Being a flowering plant, it has come up with some blooming discoveries. It is said that every cloud has a silver lining, similarly our selected study on *Canna indica* has uncovered some vital information. It has been found that *Canna indica* possesses a lot of fruitful qualities. It is vital not only in the field of diet and supplement but also in the field of medicinal science. As it has the ability to nourish the human body with various macro and micro nutrients and helps in treatment of various ailments, it surely would help in defending our body from various infections including the coronavirus. Moreover, in recent studies it has been established that it holds antiviral properties too, which can be used in continuing research and experimentation to eventually discover medicines for various viral diseases. Moreover, it has been observed that this plant also plays an important role in cleansing the soil. Because of mining and faulty methods of handling some toxic metal contaminate the soil. Then this soil loses its ability to care the plant roots instead its poison many plants and crop. This plant has been found to hold the quality of phytoremediation which is another specialty of this plant. Hence, this makes this plant an instrument of remarkable cleansing, both for animal as well as for environment.

We understand that this summarization is not the complete description of *Canna indica* but is definitely an optimum effort to create awareness and broaden the knowledge horizon of this subject.

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