



## A REVIEW TO SUMMARIZE THE AVAILABLE EVIDENCES ON TURMERIC'S (CURCUMA LONGA) MEDICINAL PROPERTIES TO UNDERSTAND THE SCOPE OF ITS EFFICACY IN THE TREATMENT AND PREVENTION OF COVID19 DISEASES.

### Ayurveda

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### ABSTRACT

The massive outbreak of coronavirus disease (COVID-19) across the world, has affected more than 200 countries and territories which was originated in bats and transmitted to humans through unknown intermediate hosts in the Wuhan seafood market, China, in December of 2019. Most people infected with the COVID-19 virus experience mild to moderate respiratory illness and recover without requiring special treatment. Older people and those with underlying medical problems like cardiovascular disease, diabetes, chronic respiratory disease, and cancer are more likely to develop serious illness. However, few broad-spectrum antiviral drugs have been evaluated against COVID-19 in clinical trials, resulted in clinical recovery. There is no system of medicine has any evidence-based treatment for COVID-19 yet and vaccine is recommended. WHO is helping to accelerate drug research. In India, Ministry of Ayush has issued guidelines which contain preventive and remedial information and advisories for the management of COVID19 symptoms. This review has assembled evidences of Turmeric/Curcuma longa which is one of the ingredient of the ayurvedic preventive majors issued by Ministry of Ayush and revealed various routes of administration of Turmeric /Curcuma longa asserted in Ayurvedic Texts as a remedy and additional preventive majors for COVID 19 symptoms.

### KEYWORDS

Turmeric, Curcuma longa, Covid19 prevention, Herbal Respiratory Masks, Herbal Fumigation for Viral Infection, Herbal Gargling for Viral Infection, Golden Milk, Turmeric Milk, Nasal Spray for Viral Infection, Covid 19 Protective measures, Herbal Smoking in Viral Infection, Nasya, Pratisaran, Gandush, Kaval, Swedan,

### INTRODUCTION:

Ayurved and Turmeric: Some 5000 years back Ayurved, age old system of medicines has revealed many remedies for health promotion, prevention of many ailments and for alleviation of diseases too. Now it is the time to implement them in such an obscure global fatal condition of COVID 19 pandemic. Ministry of Ayush has dictated preventive majors to shun the infection as well as medication code for different stages of covid19 symptoms. As prevention is better than cure, these preventive measures based on age old texts of ayurved will help to boost the immunity in this covid times. Golden Milk is one of the preventive majors and is prepared with half tea spoon of Haldi (turmeric) powder in 150 ml hot milk once or twice a day. In the current review, traditional features and modern properties of Turmeric - Curcuma longa have been summarized and analyzed its relevance and scope in regard with COVID-19 infection. Effective forms and administration routes of Turmeric for preventive and curative stages of covid19 infection have been recapped of which virtue can be proved by conducting clinical studies further.

#### 1) About Covid 19 Disease:

According to WHO, COVID-19 affects different people in different ways. Most infected people develop mild to moderate illness and recover without hospitalization.

Type	Symptoms
<b>Most Common</b>	Fever, Dry cough, Tiredness
<b>Less Common</b>	Aches and pains, Sore throat, Diarrhoea, Conjunctivitis, Headache, Loss of taste or smell, A rash on skin, or discolouration of fingers or toes
<b>Serious</b>	Difficulty breathing or shortness of breath, Chest pain or pressure, Loss of speech or movement

For serious symptoms immediate medical attention is required. People with mild symptoms manage their symptoms at home.

On average it takes 5–6 days from when someone is infected with the virus for symptoms to show, however it can take up to 14 days.

#### WHO Classification of Signs of COVID-19 patients:

Severity	Symptoms and Signs
<b>Asymptomatic</b>	COVID nucleic acid test positive. Without any clinical symptoms and signs and the chest imaging is normal
<b>Mild</b>	Symptoms of acute upper respiratory tract infection (fever, fatigue, myalgia, cough, sore throat, runny nose, sneezing) or digestive symptoms (nausea, vomiting, abdominal pain, diarrhea)

<b>Moderate</b>	Pneumonia (frequent fever, cough) with no obvious hypoxemia, chest CT with lesions
<b>Severe</b>	Pneumonia with hypoxemia (SpO <sub>2</sub> < 92%)
<b>Critical</b>	Acute respiratory distress syndrome (ARDS), may have shock, encephalopathy, myocardial injury, heart failure, coagulation dysfunction and acute kidney injury.

#### 2) Properties of Turmeric according to Ayurved:

Ministry of Ayush has suggested Turmeric Milk or Golden Milk as a preventive major for covid19 and is prepared by adding half teaspoon of Turmeric powder to 150 ml of hot milk. Turmeric (Curcuma longa) has an old vedic history and was used as Medhya rasayana (brain tonic), antidote for snake venom and for Shvitra, Palita diseases in vedic period. It is an **entity** in Ayurved and is being most commonly practiced herb.

The aim of this review is to summarize the available evidence on medicinal properties of Turmeric (Curcuma longa) to understand its scope in the treatment and prevention of covid19 diseases.

हरिद्रा कटुका तिक्ता रुक्षोष्णा कफपित्तनुत्  
वर्ण्या त्वन्दोष मेहास्रशोथपाण्डुराणपहा ॥ भा. प्र.  
खदिराभयामलकहरिद्रारुक्कर सप्तपर्णारुबध करवीर  
विडंग जातीप्रवाला ति देशोनि कुष्ठघ्नानि भवन्ति ॥ १३ ॥  
हरिद्रामन्त्रिष्ठासुवहासूक्ष्मैला पालिन्दी चदन कतक  
शिरीष सिधुवार श्लेष्मातका इति देशोनि विषघ्नानि भवन्ति ॥ १६ ॥ च.सू. ४ [1]

Haridra is not only an extremely popular dietary flavouring ingredient from the kitchen but also an aromatic herb that has been used for thousands of years as a medicinal herb to treat a variety of ailments.

The rhizome is part of use and formulations are prepared for different diseases conditions. In Bhavprakash its properties have been mentioned as Katu (pungent), Tikta (bitter) in rasa (taste) and Ushna in virya (potency of the drug). It balances kapha and pitta dosha.

It is indicated in Varnya herbs and helps in establishing original complexion, Kushthghna – herbs effective in Tvaka vikara (skin diseases) and Vishghna – herbs having soothing, chelating or demulcent effect with potency to pacify the toxic effects of the drugs and food.

#### 3) Turmeric Or Haridra Benefits in Specific Diseases:

हरिद्रा स्वस्से तिक्ता रुक्षोष्णा विषमेहनुत् |  
कंडू कुष्ठ व्रणान् हन्ति देहवर्ण विधायिनी ॥  
विशोधनी कृमिहरा पीनसा रुचि नाशिनी ॥ घ. नि. [2]

According to ayurvedic texts Turmeric or Haridra helps in prameha (diabetes), shotha (oedema), pandu (anaemia) vrana (wound), visha (poisoning), kandu (itching), kushtha (skin diseases), kantidayaka (luster), samshodhana (cleansing of the body), krimi (worm infestation), pinasa (chronic rhinitis), aruchi (anorexia) etc. conditions.

#### Haridra in Jwar Vikar (Fever): Saannipatik Jwara:

सन्निपातज्वरे व्याघ्री देवदारुनिशाधनां पटोलपत्रनिंबत्वक् त्रिफलाकटुकायुतम् ॥ ६५॥ अ.ह.चि.ज्वर १ [3]  
In Ayurveda, COVID-19 can be considered as Janapadaudhwans, Vata-Kaphaja Sannipatika Jwara, Aupasargika Vyadhi and Dhatupaka Awastha. In Ashtanghruday chikitsasthan chapter one a list of plants for Sannipaatik Jwara in kwath form is mentioned. Kwath contains haridra, vyaghri, devdaru, patol, nimb, triphala etc medicines can be consumed in Sannipatik Jwara.

#### Sudarshana Churna:

त्रिफला रजनीयुग्मम् कंटकारीयुगं वटी ।  
तद्रज्ज्वरानां सर्वेषामिदं चूर्णं प्रगाशनम् ॥ २६-३६॥ शा.सं. मध्यमखंड चूर्णकल्पना [4]  
Sudarshanchurna which is mixer of herbs is a medicine used for fever contains Haridra.

#### Kaphaja Jwara and Haridra:

हरिद्रां धित्रकं निम्बमुशीरा .....  
पिबेन् मरिच संयुक्तं सशौद्रं कफजे ज्वरे ॥ ग.नि.ज्वर [5]  
In Gagnigraha formulation made up of haridra, chitrak, neem, vala, black pepper and honey is consumed in Kaphaj Jwar.

#### Haridra in Kasa vikar:

अथ वशिष्ठोक्तं रसायनम् ।  
दशमूलं बलां मूलां हरिद्रे पिप्पलीद्वयम् ॥ १३१- १३१॥ अ.ह.चि. कास ३ [6]  
Ashtang hruday chikitsa sthanam mentions Vashisthokt Rasayan. It consists of dashmul, bala, murva, haridra, pippali etc. medicines. This rasayana is prescribed for cough in every season and can be used for covid 19 infection too for cough.

उभे हरिद्रे सुरदारुशुण्ठीं गायत्रिसारं च पिबेत् समांशम् ॥ १९॥  
बस्तस्य मूत्रेण सुखाम्बुना वा ॥ सु.उ. कास ५२ [7]  
Acharya Sushruta mentions a remedy in which two kinds of Haridra, Deva-daru, Shunthi and the pith of a Gayatri- tree pounded and are mixed in equal parts, can be taken with the urine of a goat in cough and also in covid positive patients for cough.

#### Haridra in Shwas vikar:

हरिद्रां मरिचं द्राक्षां गुडं रास्नां कणां शटीम् ॥ ४१॥  
लिह्यात्तैलेन तुल्यानि श्वासात्तो हितभोजनः । सु.उ. श्वास ५१ [8]  
According to Acharya Sushruta mixer of turmeric, black pepper, black raisin, rasna, pimpali, kachora and jaggary blended with sesame oil should be consumed for breathlessness in asthma patients and shwas regimen should be followed.

भार्गीत्वक् त्र्यूषणं तैलं हरिद्रां कटुरोहिणीम् ॥ ४४॥  
पिप्पलीं मरिचं चण्डां गोशुकुद्रसमेव च ।  
तलकोटस्य बीजेषु पचेदुत्कारिकां शुभाम् च ॥ ४५॥ सु.उ. श्वास ५१ [9]  
A compound made of Bharangi, Tvak, Tryushana, Oil, Haridra, Katurohini, Pippali, Maricha, Chanda and the expressed liquid of cow-dung should be consumed for breathlessness by asthma patients and can be beneficial for covid patients in symptom like breathlessness.

हरिद्रा मरिचं द्राक्षा गुडो रास्ना कणा शटी ।  
कटुतेले लिहन्त्याच्छासान् प्राणहरानपि ॥ २॥ यो. र. श्वास चिकित्सा हरिद्रादि अवलेह [10]  
Haridradi avaleha is described in Yogratanakar's Shwas chikitsa chapter. Ingredients of this avaleha are turmeric, black pepper, raisins, jaggary, rasna, pimpali, bitter oil and is useful in asthma - breathlessness.

In this way many formulations useful for fever, cough and asthma containing Haridra are also written in Bhaishjya Ratnavali. Bhaishjya Ratnavali mentions about Vasadi kwath indicated in Shwas disease which contains Haridra too and can be instrumental in covid patients. Shwas, kasa, pratishyay are the common symptoms exhibited by covid 19 positive patients. Hence, Clinical study/ Research can be conducted to determine the efficacy of all above formulations in covid positive patients.

#### 4) Different Administration Routes of Haridra illustrated in

#### Ayurvedic Texts

##### Haridra through Nasya:

धवत्वक् त्रिफला श्यामातित्वकैर्मधुकेन वा  
श्रीपर्णीरजनीमिश्रैः क्षीरेदशगुणे पचेत्ता। सु.उ.प्रतिश्याय नस्य २४ [11]  
Acharya Sushruta has mentioned medicated milk is prepared from arjun bark, triphala, madhuk, haridra etc. herbs for Nasya treatment beneficial in common cold and can be administered in covid patients with mild symptoms.

##### Haridra through (skin) Lep Kalpna

Shwas lepa V.S.Vol-1.18/47  
In Vangsen samhita Lep/application formula for shwas patient is mentioned which might prove beneficial for breathlessness in covid 19 positive patients.

##### Haridra through nasal path:

घ्रेयनस्योपचाराश्च कषयाः स्वादुशीतलाः ॥ १४७ पीनसनासारोगचिकित्सा च.चि. त्रिमर्षीय २६ [12]  
Acharya Charaka has explained Ghreya chikitsa in Pinas vikar. Ghreya treatment means inhalation of aromatic volatile herbs and their parts. Charak samhita has mentioned various drugs for ghreya chikitsa. Just like that Turmeric in powder form can be inhaled as a Ghreya Treatment in specific dose as it shows antiviral, anti bacterial properties. As SARS-CoV-2 entry factors are highly expressed in nasal epithelial cells, Turmeric inhalation might directly impact nasal epithelial cells to reduce the load of microbes, infectious agents like virus. [13] Ghreya treatment of Haridra / Turmeric might also help to reduce the inflammation locally and thus reduce the nasal obstruction too. Efficacy of Haridra/ Turmeric inhalation to reduce nasal viral load in covid positive patients should be reviewed.

However, few studies have used liquid-based vehicles in the preparation of curcumin formulations. Yuosef AL Ayoub **et al** in their study proposed the use of nano-emulsion and micro-suspension formulations to prepare nebulised curcuminoid for lung delivery. The performance and genotoxicity results of the formulations suggest the suitability of these preparations for further inhalation studies in animals. The nano-emulsion formulations prepared with limonene oil and oleic acid were found to be nontoxic at the curcuminoid doses that were used in the genotoxicity study. Therefore, the study indicated safety and suitability of the nano-emulsion formulation which could be extended to further investigations for both animals and humans. [14] [15].

##### Haridra through Nasa Paridhavan:

सर्जाजुनोदुग्धर वसकानां त्वचाकषायः परिधावनेना योगरत्नाकर उत्तरखण्ड नासारोग [16]  
Yogratanakar has specified Nasa paridhavanam/ prakshalana or nasal douching which means irrigation or flushing of nostrils with herbal decoctions. In Nasa Paridhavan one can wash nose internally for different conditions or on daily basis to expel pollutants, microbes, viruses, secretions from nasal passage with the help of simple water, herbal decoctions etc.

It is very important to keep nasal hygiene maintained to avoid cold, cough, fever, respiratory diseases and covid19 infection always for which nasal irrigation /wash is the useful method. It washes out nasal viral, bacterial load and so it might prove beneficial in patients with COVID-19 infection. Especially in this pandemic turmeric or turmeric oil added warm water nasal wash might prove more potent in viral infections like covid 19 and inquest can be conducted to validate the same.

Several studies have demonstrated high viral titers within the nasopharynx and oral cavity which is the primary source of infection and viral replication. This irrigation might reduce a high nasal/ nasopharyngeal viral load and symptom severity too. Interestingly, there have been a number of studies recently conducting trials in the same subject, the effect of nasal saline irrigations in the setting of Viral Upper Respiratory Tract Infections, including common coronaviruses (not including SARS-CoV-2). One of the major takeaways from these studies was decreased viral shedding in patients treated with saline irrigations compared to the control group. Nasal saline irrigations are available over the counter and widely viewed as safe and affordable. [17] Hence, Nasal irrigation with Turmeric (essential oil) might show a similar effect for the novel SARS-CoV-2 and other viral respiratory infections too.

##### Haridra through Steam Inhalation:

For steam inhalation Turmeric essential oil or turmeric powder or

aqueous extracts of turmeric can be added to the water and inhaled through the steam. Essential oils are strong and one should use (one or two drops) them sparingly. Using too much of essential oils or herbs for steam inhalation can burn your skin, sensitive respiratory tract mucous membranes and can harm your eyes too.

Mohd Saleem et al conducted study to reveal efficacy of turmeric mixed steam inhalation in cold. They concluded that although steam inhalation with plain water is helpful but steam inhalation with Tulsi and turmeric is more effective in relieving symptoms of common cold and may be practiced for clients in hospital, home as well as community settings.[18]

Turmeric volatile oil is effective against disorders of the respiratory tract. The volatile oil is active in removing sputum, relieving cough, and preventing asthma. Thus, turmeric volatile oil may evidence an efficacious drug in the treatment of respiratory diseases. [19] Along these lines, Swedan /steam inhalation treatment with the addition of turmeric essential oil to the water might help to expel sputum, relieving cough, subside the breathlessness in any respiratory tract infection and in covid-19 infection too.

#### Aqueous extracts and Turmeric oil through Air Diffuser:

Turmeric aqueous extracts or Turmeric essential oil can be used in an air diffuser to release the essential oil into the air which might help in relieving cough and expelling sputum. Thus study can be headed to prove disinfectant property against SARS-CoV-2 present in covid 19 positive patient's rooms or in air.

#### Turmeric oil massage for Cough and Cold :

Turmeric essential oil can be diluted with a carrier oil, such as coconut oil or sesame oil. (5-6 drops of turmeric essential oil to around 30 ml of carrier oil) and gentle massage could be given for cold, cough and breathlessness across the neck glands, at the pressure points of temples and around chest area. Topical treatment is helpful to loosen the congestion, to soothe the muscles that may ache from coughing and to make breathing easier.

#### Haridra through Dhupana:

लाक्षाहरिद्रातिविषामयाब्दहरणकेलादलवक्रकुंठं

प्रियंगुकां चाच्यनले निधाय धूमनिलौ चापि विशोधयेत् ॥ १७॥ सु. कल्प. ३ [20]

Dhupana is a method by which blended drug formulations of herbal, herbo-mineral or animal origin are used for fumigation so as to heal vana, yonivyapada, kama rogas, nasa rogas, udar rogas, gatradaurgandhya to disinfect bsheshajagara, vranagara, sutikagara, shastrakarmagruha, kumaragara and also to sterilise asavas and aristas. In above verse Acharya Sushruta has introduced Dhupana formula for the purification of air which includes Haridra.

Dhupana is an integral part of Rakshavidhi (Sterilization, Fumigation), which ensures protection against microbes. The various drugs mentioned in dhupana karma have antiseptic and antimicrobial properties and being used for disinfection of rooms and environment especially during rainy and winter seasons. It also helps in control of pests, rodents and insects and thus prevents outbreak of epidemics.

Dhupana is a procedure in which fumes or smoke produced from burning defined drug formulations are inhaled by patients for the therapeutic relief or are exposed externally as a cleanser to the environment. It is preventive as well as curative treatment procedure. Smoke can be facilitated to expose or inhale in various diseases such as cough, coryza, piles, epilepsy, insanity, asthma and wounds. Since time immemorial, sages used to clean the environment by Homa-havanadi rituals. However, due to the lack of scientific validation, its safety and efficacy to prevent airborne infections was not proved. [21] Sushma Bagde Bhatwalkar et al in their research study evaluated environmental disinfection efficiency of traditional fumigation practice by using natural plant products such as garlic (*Allium sativum*) peel, turmeric (*Curcuma longa*) powder, Carom (*Trachyspermum ammi*) seeds (Ajwain) and Loban (resin of *Styrax benzoin* and *Boswellia* species). The effect of traditional fumigation on the microbiological quality of air was revealed by active air sampling. The study comprehensively conclude that fumigation with garlic peel, turmeric powder, ajwain seed powder and loban significantly reduces air borne bacteria. In addition, garlic peel is effective in disinfecting surfaces of drug resistant MRSA bacteria which is one of the main bacteria responsible for nosocomial infections. The ease of availability and acceptance of these plant products could be utilized as a cheap and

effective alternative in treating throat or respiratory tract infections. [22] As Dhupana method is safe, economical and Turmeric/Haridra is antiviral and antibacterial in nature, Turmeric Dhupana /fumigation might strike effective for covid-19 infection and study could be lead to evaluate the efficacy.

#### Haridra through Dhupan (medicated smoking):

तीक्ष्णे ज्योतिष्मती निशा ॥ 17 ॥

दशमूल मनोव्हालं लाक्षा श्वेता फलत्रयम् ।

गन्धद्रव्याणि तीक्ष्णानि गणो मूर्धविरेचनः ॥ 18 ॥ अ. ह. धूमपानविधि 21/17-18 [23]

हरिद्रां पत्रमेरुण्डमूलं लाक्षां मनःशिलां

सदेवदार्वलं मांसीं पिष्ट्वा वर्तिं प्रकल्पयेत् ।

तां घृताकां पिबेद्भूमं यदेवैर्वा घृतसयुतेः ॥ १७ ॥ च. चि. हिककाशास १७ [24]

Dhupana is inhaling medicated smoke or herbal smoking is one of the important treatment procedures in diseases of the nose and respiratory pathway which is also a part of dinacharya-daily regimen for healthy persons for the maintenance of health in ayurved.

In Ashtang Hruday Sutasthanam, Haridra is referred as murdhvirechan or head cleansing medicines in dhupana vidhi chapter. Haridradi Dhumvarti (herbal smoking sticks) is noted in Charak Samhita as well as in Ashtang Hruday shwas chikitsa chapters. It is very useful in shwas and hikka for expelling out the kapha from different channels and to make the channels clear for easy breathing. Dhupana consists of the inhalation of medicated smoke through mouth and/or nose and releasing it only through the mouth and never be exhaled by nostril as a protocol of Ayurvedic Dhupana. Though Dhupana is remedial in many conditions, one should use it limited to avoid accumulation of black tar in lungs.

Animal study conducted at Al Azhar University by Mona G.E et al suggested that curcumin and/or quercetin exerts protective effects by modulating the extent of lipid peroxidation, improving the antioxidant system, inhibiting the oxidative stress, abrogating DNA fragmentation in lung and liver tissues induced by nicotine. Combined therapy with both curcumin and quercetin was much better than each one alone. Turmeric reduces nicotine induced toxicity in albino rat which supports the health benefits of haridra in dhupana / herbal smoking. [25] Research can be conducted on smoking sticks which are made up of Turmeric to reduce or eliminate the COVID 19 viral load and bearthlessness.

#### Haridra through Kaval, Gandush

In Ayurveda, Kaval (swishing medicinal liquids in mouth) and Gandush (holding medicinal liquids in mouth) are the morning procedures described in the Dinacharya /daily regimen and are useful in prevention of the diseases of the mouth, teeth and the gums.

Thusly, Haridra decoction can be used for both the kaval and gandush treatments in covid positive patients too which might reduce the viral load and possibly the risk of coronavirus transmission over the short term. It might be not suitable for treating Covid-19 infections or protecting yourself against catching the virus.

Nasal mucosa represents a vulnerable area for coronavirus to colonize due to presence of abundant blood vessels, mucinous glands and serous glands which create a humid environment.

Evidences supported the efficacy role of antimicrobial rinses against the enveloped viruses including the human coronavirus recently identified. Carrouel et al found the use of a mouth rinses with local nasal applications that contain  $\beta$ -cyclodextrins combined with flavonoids agents reduce the viral load of saliva and nasopharyngeal microbiota, including potential SARS-CoV-2 carriage. [26]

#### Haridra Kwath Kaval for Sore Throat:

It is concluded from the study that treatment with Haridra Kwath Kaval on acute Tonsillitis relieves majority of symptoms and recovery of disease is fast. It is simplest method of treatment with minimal or no side effects. Herbal material used in this treatment Haridra (*Curcuma longa* Linn.) is easily available. Due to its antibacterial and anti-inflammatory property symptoms of acute Tonsillitis relives without side effect. **Kawal** proved important procedure for treatment of Tonsillitis in Mukhroga and can be implemented and analysed for covid 19 patients. [27]

Toni Luise Meister et al conducted study at Bochum, Germany on commercial mouthwashes demonstrated in cell culture experiments by virologists which could reduce the risk of coronavirus transmission. They provided evidence that SARS-CoV-2 can be efficiently inactivated by commercially available oral rinses within short exposure times of 30 seconds. The main route of transmission of SARS-CoV-2 is suspected to involve direct contact with respiratory aerosols or droplets of infected individuals, produced during sneezing, coughing, or talking, and subsequent contact to nasal, oral, or ocular mucosal membranes. SARS-CoV-2 initially colonizes the upper respiratory tract of infected individuals.

High viral loads in the oral cavity provide a rich source of potentially infectious virus as well as an entry route for new infections. Hence, if assuming that the throat functions as a major site of viral replication during early stages (even before symptom onset), oral antiseptics could lower the number of infectious aerosolized virus particles and consequently the risk of transmission or infection. The in vivo effects of the oral solutions require further analysis during clinical studies. In particular, they observed that 3 formulations Listerine Cool Mint, Dequonal, Iso-Betadine mouthwash 1.0% containing different active compounds significantly reduced viral infectivity. [28]

Turmeric added hot water or turmeric decoction might show potency to reduce viral and microbe infectivity and could be verified through in vivo trials in quarantined patients for covid 19.

#### Haridra through Pratisaran:

कल्को रसक्रिया चूर्णस्त्रिंविधं प्रतिसारणम् ॥ १३ ॥

युञ्ज्यान्तत् कफरोगेषु गण्डुषविहितौषधैः । अ. ह. सू. २२ गण्डुषादिविधि

Pratisaran means coating body parts like oral cavity, teeth, gums, tongue, skin, scalp, cervix etc with herbs. Herbs in powder, paste and solidified decoction form can be applied with fingers to the specific body parts. Asgtang Hruday notes that the herbs used in Gandush vidhi can be employed in Prasarana treatment. Considering virucidal property of Turmeric/ Haridra powder or paste in milk or haridra raskriya it can be applied in oral cavity to reduce the viral load of covid19 infection and can be verified by exploring it through research.

#### Haridra Mukhchaadi (Facemask):

Variety of herbal facemasks are available in the market to prevent the covid 19 infection.

The defence Institute of Advanced Technology, India has developed cotton mask using herbal extracts of neem oil, turmeric, tulsi, ajwain, black pepper, gum Arabic, clove, sandalwood and saffron. Herbal extracts have been used in the non woven fibers of the three layered biodegradable masks named Pavitrapati a patented invention. These masks are made available on online platforms such as Amazon, Flipkart etc.

Like so Turmeric masks can be manufactured and evaluated by conducting in vivo study for its virucidal role considering covid 19 infection.

**Uma Prajapati** from Upasana Design Studio is making reusable eco-friendly herbal masks at Auroville, Puducherry, India. These masks are available on specific website.

Dr Balachandar Vellingiri and others have made effort to develop easy to use, universal virus covid19 negation systems through masks. They have developed an efficient viral inactivation system by exploiting active compounds from naturally occurring medicinal plants nirgundi, amala, pomegranate, dugdhika, garlic, aavartaki, bhunimba, hathichuk, gorakhmundi, karpur tulsi, aparajita, khurasani ajwain, vidandg, jambu, gudmar and infusing them into nanofiber-based respiratory masks to develop fibrous filtration with three-layered masks using the compounds from medicinal plants. In the absence of vaccination, covid 19 protective masks can be worn to prevent transmission of airborne pathogenic aerosols to control the diseases. [29]

**An effort has been accomplished in order to summarize the ayurvedic properties of Turmeric / Curcuma longa / Haridra / Haldi with its various administration modes and several significant formulations in various disease conditions relevant to covid 19 symptoms explained in several texts to correlate its applicability in different stages and symptoms of COVID-19 infection.**

#### 5) Milk as Anupana:

Now the role of Milk will be acknowledged, as Golden Milk is

prepared by adding half tea spoon Haldi (turmeric) powder in hot milk. In Golden milk, milk is added as an Anupana.

अनुसह पश्चात् वा पियते इति अनुपान ।

Those substances which are drunk along with or after medicine and food intake are known as Anupana.

तत्तद् रोगघ्न वैषज्यम् भेषजस्यानुपीयते

यच्च सहायकारी स्याद् अनुपानम् तद् उच्यते । रसरंगिणि

Whatever reduces the ailments by augmenting action of medicine, when taken along with it is known as Anupana. In Ayurveda, Anupana is a media or a classical vehical for drug administration that can be taken either before or after or along with drugs or diet. Anupana is the best way to reduce dose, toxicity, increase bioavailability and lowers the adverse effects. The recommendation of medicine and aahara (diet) is incomplete in Ayurveda without the practice of Anupana. Anupana acts as adjuvant, vehicle, digestant, appetizer and synergism too.

अथानुपानकर्मगुणान् प्रवक्ष्यामः - अनुपानं तर्पयति, प्रीणयति, ऊर्जयति, बृंहयति, पर्यामिभिर्निर्वर्तयति, भुक्तमवसादयति, अन्नसंघातं भिनत्ति, मार्दवमापादयति, क्लेदयति, जरयति, सुखपरिणामितामाशुव्यवयितां चाहारस्योपजनयतीति ॥ ३२५ ॥

अनुपानं हितं युक्तं तर्पयत्याशु मानवम् ।

सुखं प्रति चाहारमायुषे च बलाय च ॥ ३२६ ॥ च. सू. २७ अन्नपानविधिम् [30]

Anupana enforces refreshment, pleasure, energy, nourishment, adequacy, digestion, food breakdown, softness, moisture, quick diffusion of food and drug in human body due to the presence of the yogavahi and vyavahi properties in it. Anupana saturates body with quick saturation of food and drug, delightment towards food, longevity and strength.

#### Selection of Anupana:

यदाहारसुगौः पानं विपरीतं तदधिष्यते ।

अन्नानुपानं धातूनां दृष्टं यन्न विरोधि च ॥ ३१९ ॥ च. सू. २७ अन्नपानविधिम् [30]

उपवासाद्यध्वभास्त्रीमारुतातपकर्मभिः

क्लान्तानामनुपानार्थं पयः प्रयत्न यथाऽनुत्तम् ॥ ३२२ ॥ च. सू. २७ अन्नपानविधिम् [30]

Aacharya Charaka says, particular Anupana combined with particular food should dominate the properties contrary to the food and should maintain its features favourable to seven dhatus or seven fundamental body tissues. Anupana like milk is amrut or healthful for persons who are fasting, travelling, walking and talking excessively, after intercourse, wind and sun exposure and fatigued.

यथा तैलं जले शिषं शणैश्च प्रसर्पति ।

अनुपान बलादङ्गे तथा सर्पति भेषजम् ॥ ५ ॥ शा. सं. मध्यमखंड ६ [31]

Sharangdhar samhita claims that with the help of Anupana, medicine diffuses quickly, circulates well and administers adequate amount of release of active ingredients of the medicine throughout the body due to the presence of the yogavahi and vyavahi properties in it.

#### 6) Concept of Bio enhancer and Turmeric

Phytomedicine has been playing an important role in pharmacotherapy. However, there are numerous reports of poor bioavailability resulting in reduced in vivo activities of several medicinal plant extracts and phytoconstituents.

There are several reports of herbal medicinal products (HMPs) that require large doses to be therapeutically effective and some studies have identified that the active compounds in such products have poor bioavailability. It is essential to understand the reason behind the poor bioavailability of bioactive moieties before selecting an appropriate technique or bio enhancer and different strategies. Several medicinal plants need boosters or appropriate bio enhancers to prove their in vivo efficiency. Ayurvedic texts have indicated combinations of drugs, combinations of drug and food (like Anupana which work as bio enhancer for drugs) for better bioavailability. More attention is expected on bio enhancers for the plants which are proved in vitro active. [32]

Sidney J. Stohs says in his article that Curcumin is the major biologically active polyphenolic constituent in turmeric, also called diferuloylmethane. Curcumin is found primarily in roots and rhizomes of the turmeric plant (Curcuma longa). In addition to curcumin, two other curcuminoids occur in lesser amounts in turmeric, namely, demethoxycurcumin (DMC) and bis-demethoxycurcumin (BDMC). Curcumin exhibits a wide range of beneficial effects including anti-inflammatory, antioxidant, chemoprotective, tissue protective, antibacterial, anti-fungal, antiviral, metabolism regulating, immunomodulating, antineoplastic and anti-depressant properties. Issues

which greatly limit the effectiveness and usefulness of curcumin are its low oral bioavailability attributed to water insolubility, and rapid metabolism to inactive metabolites. Curcumin is an oil-soluble compound, practically insoluble at room temperature in water at acidic and neutral pH. While it is soluble in alkali, it is very susceptible to auto-degradation. The water solubility of curcumin is estimated to be 11 ng/mL. However, its poor solubility and poor absorption in the free form in the gastrointestinal tract and its rapid biotransformation to inactive metabolites greatly limit its utility as a health-promoting agent and dietary supplement. [33]

**Milk a VEHICLE to enhance the permeability of Turmeric**

In a study conducted by Shishu Goindi et al the oral bioavailability of curcumin from turmeric, Biocurcumax™ and of plain curcumin was investigated using conventional vehicles by a non-everted rat intestinal model. Results of ex vivo intestinal permeability studies showed an enhancement in the permeability of curcumin with increase in lipophilicity of the vehicle used. Maximum permeability of curcumin was obtained from corn oil (13.4%) followed by clarified butter (9.82%), milk (4.24%) and aqueous suspension (1.66%) in 8 hours. Another very interesting and important observation was that the permeation/saturation of curcumin was more from turmeric and Biocurcumax™ than from plain curcumin. These studies strongly suggest that curcumin may be consumed as turmeric/Biocurcumax™ in lipophilic vehicles instead of plain curcumin for maximum beneficial effects. [34] Hence, the combination of Turmeric with Milk in golden milk has better oral bioavailability and its benefits are precisely indisputable.

**Heat increases solubility of Turmeric**

Lower serum and tissue levels of curcumin irrespective of the route of administration, rapid metabolism and elimination are major factors curtailing curcumin bioavailability which makes it necessary to use adjuvants or curcumin nanoparticles or liposomes. Preetha Anand et al say in an article Bioavailability of Curcumin: Problems and Promises that nanoparticles, liposomes and defined phospholipid complexes propose significant promise and are worthy of further exploration in attempts to enhance the medicinal value of Turmeric. [35]

Biji T. Kurien and R. Hal Scofield have shown in animal study the increased solubility of curcumin (12-fold) and turmeric (3-fold) by the use of heat on rat intestinal model.

The treatment with heat did not destroy curcumin's biological activity. For the delivery of drugs *in vivo* or topically, water is indisputably the simplest and the most non-toxic vehicle, provided the drug is soluble in aqueous medium. They demonstrated a significant increase in solubility of curcumin in water and suggested the possibility of considering heat-solubilized curcumin for future *in vivo* and *in vitro* studies. [36]

Hong-Hao Jin et al claim that liposomes made up from milk fat globule demonstrate better stability. Hence milk added to the Turmeric powder to prepare golden milk proves gainful for the enhancement of therapeutic ability and availability of the Turmeric. [37] Above research articles ascertain that turmeric needs bio enhancer to play the role of an active drug for different disease conditions. According to Biji T. Kurien and R. Hal Scofield heat increases the solubility and bioavailability of active principles of Turmeric undoubtedly. The fact of heating the golden milk to make Turmeric more active and bioavailable (orally) can be implemented while consuming it.

**7) Phytochemicals and medicinal properties of Turmeric:**

Abundant literature linked with medicinal properties of Turmeric is available. Out of these Covid 19 related medicinal properties detected in the articles have been summarised below.

Turmeric is a product of *Curcuma longa*, a rhizomatous herbaceous perennial plant belonging to the ginger family Zingiberaceae, which is native to tropical South Asia.

**Composition Of Turmeric: [38]**

No	Component Name	Medicinal Property
1	Curcumin	Anti-HIV, anti-EBV, antiadenoma – carcinogenic, anti-aflatoxin, antiatherosclerotic, antiaggregant, antiangiogenic, antiarachidonate, anticancer, antiedemic, anti-ischemic,

		antiinflammatory, antileukemic, antileukotrene, antilymphomic, antimelanomic, antimetastatic, antimutagenic, antinitrososaminic, antioxidant, antiperoxidant, antiprostaglandin, antisarcomic, apoptotic, Cox-2inhibitor, fibrinolytic, hepatoprotective, immunostimulant, ornithine decarboxylase inhibitor, protease inhibitor, protein kinase inhibitor
2	Desmethoxy Curcumin	Antiangiogenic, anti-inflammatory, anticancer
3	Tetrahydro Curcumin	Antioxidant, anti-nflamatory
4	Alpha Curcumene	Antitumor and anti-inflammatory
5	Ar- turmerone	Antitumor, anti-inflammatory cox-2 inhibitor, choleric, hepatotonic
6	Curcumol	Anticancer, antitumor(cervix) and anti-sarcomic
7	Curdione	Anti-leukopenic, antisarcomic, antitumour, anti X-radiation.
8	Dehydro Curdione	Analgesic, antiarthritic, antiedemic, anti-inflammatory, Anti-oxidant, antipyretic and calcium channel blocker
9	Zingiberene	Antirhinoviral, antiulcer and carminative

Turmeric has been in use for thousands of years as a dye, flavouring and a medicinal herb. Turmeric contains nine main phytonutrients and has antimicrobial, antioxidant, astringents and other useful properties. Curcumin is the most active polyphenolic constituent of the spice turmeric. In gel form it is a component in local drugs delivery system. [39]

**Anti-inflammatory properties of Turmeric**

Turmeric constituents include the three curcuminoids: curcumin (diferuloylmethane; the primary constituent and the one responsible for its vibrant yellow color), demethoxycurcumin, and bisdemethoxycurcumin, as well as volatile oils (tumerone, atlantone, and zingiberone), sugars, proteins, and resins.

Julie S Jurenka states in her article that numerous pharmacological activities, including antioxidant and antimicrobial properties, have been attributed to curcumin. Based on early cell culture and animal research, clinical trials indicate curcumin may have potential as a therapeutic agent in diseases such as inflammatory bowel disease, pancreatitis, arthritis, and chronic anterior uveitis, as well as certain types of cancer. [40]

**Role of Immunomodulator in treatment of covid 19 infection.**

Tessa S. Schoot et al. stated in study that coronavirus disease 2019 (COVID-19) is caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). It is currently unknown whether immunosuppressive drugs are advantageous or detrimental in patients with COVID-19. Immunosuppressive drugs could be harmful in the initial phase of COVID-19. In this phase, the host immune response is necessary to inhibit viral replication. However, immunosuppressive drugs might have a beneficial effect in the later, more severe phase of COVID-19. In this phase, an overshoot of the host immune response (the “cytokine storm”) can cause ARDS, multi organ failure and mortality. [41]

**Turmeric as an Immunomodulator**

Curcumin exerts proimmune activity in several autoimmune disorders including Alzheimer's disease, multiple sclerosis, cardiovascular disease, diabetes, allergy, asthma, inflammatory bowel disease, rheumatoid arthritis, renal ischemia, psoriasis, and scleroderma. Overall, these findings suggest that curcumin warrants further consideration as a potential immune-regulatory treatment in various immune disorders. [42]

Immunomodulatory properties of curcumin are mostly immunosuppressive, but in some cases immunostimulative effects have been reported. Although studies with inflammatory disease might direct the investigators towards the exploration of only immunosuppressive properties of curcumin, caution shall be exercised regarding the immunostimulative effect of curcumin. Due to the potent neoplastic, anti-inflammatory and immunoactivating properties,

studying the mechanism of the action of curcumin is an intriguing challenge. Defining the basis of the appropriate concentration in the host for the effective therapeutic response, synthesis of curcumin analogues with improved properties and the effect of curcumin on the cross-talk among activated lymphocytes are some of the direct questions that remain to be answered. [43] Study targeted on covid19 specific immunomodulator role of turmeric /curcumin might help to understand at what stage of covid19 turmeric is most beneficial and the role of Turmeric Milk or Golden Milk should be rated out in relation with prevention of COVID 19 infection.

#### Can turmeric help fight viruses?

Curcumin strongly down-regulates levels of extracellular infectious virus. Study data demonstrated that curcumin binds to and inhibits kinase activity of the IKK- $\beta$ 2 complex in infected cells. Curcumin partially exerts its inhibitory influence on RVFV replication. Curcumin also demonstrated efficacy against ZH501, the fully virulent version of RVFV. Curcumin treatment down-regulated viral replication in the liver of infected animals and might prove effective by restraining multiplication of virus in covid19 patients. [44]

Various study results proved antiviral activity of turmeric. Some of the study showed turmeric effectively inhibits haemagglutination in influenza virus, HIV-1 LTR-directed gene expression, decreases of HCV replication.

Many previous investigations have shown the extensive antimicrobial activity of curcumin, although *in vivo* studies in some cases reported the less effective results of curcumin inhibitory effect. Curcumin is most effective against *Helicobacter pylori*. The extensive antiviral effects of curcumin against different viral pathogens nominate this compound as an antiviral drug candidate to develop new antivirals from natural resources against sensitive viruses especially by developing different curcumin derivatives effective in Covid19 infection which needs further investigations. [45]

#### Can Turmeric/Curcumin help airway inflammation?

World health organisation in their second document related to Covid 19 have defined various stages of lung infection like Pneumonia, Severe pneumonia, Acute respiratory distress syndrome (ARDS) etc. There is no such drug proved effective in covid 19 infection and their various stages based on severity. Animal study conducted for detecting an effect of turmeric on airway inflammation by S.J. Moghaddam et al demonstrated dietary administration of curcumin effectively suppresses NTHi-induced COPD-like airway inflammation and lung cancer progression in mice. Similarly study could be planned to prove efficacy of Turmeric / curcumin as an anti inflammatory medicine in the symptoms of covid19 infection. [46]

Tao Zhu et al from Chongqing Medical University, China concluded the results of animal study says the asthmatic airway inflammation and airway mucus hyper secretion were notably blocked in mice by curcumin indicating that it may be considered an effective therapy for the potential treatment of asthma in the future. [47] Curcumin's diverse array of molecular targets affords it great potential as a therapeutic agent for a variety of inflammatory conditions and cancer types.

In every published clinical trial, curcumin appears to be extremely safe, even at doses up to 8 g daily. Of less importance are *in vitro* and animal trials that in select settings have demonstrated potentially adverse effects. *In vitro*, in the presence of copper and cytochrome p450 isoenzymes, curcumin induced DNA fragmentation and base damage. In a rat model of liver cancer curcumin did not prevent spontaneous hepatic tumour formation and in fact, shortened life span from 88.7 to 78.1 weeks ( $p=0.002$ ).66 [40]

#### Acute respiratory distress syndrome (ARDS) and Turmeric

Acute respiratory distress syndrome (ARDS) is the most grave ailment of covid19 infection, the most severe form of acute lung injury, is associated with reduced lung compliance and hypoxemia. Curcumin exhibits potent anti-inflammatory properties but has poor solubility and rapid plasma clearance. To overcome these physiochemical limitations and uncover the full therapeutic potential of curcumin in lung inflammation, in this study investigator has utilized a novel water-soluble curcumin formulation (CDC) and delivered it directly into the lungs of C57BL/6 mice inoculated with a lethal dose of *Klebsiella pneumoniae* (KP). Study says survival enhanced and bacterial burden reduced by CDC administration in animal study on mice. WHO has

asserted acute respiratory distress syndrome (ARDS) as a severe condition in covid19 positive patients. Considering the promising results of the animal study conducted by Boya Zhang et al research for oral as well as pulmonary mode of Turmeric formulation it can be studied in covid positive patients with ARDS too. [48]

#### Curcumin as an Add-on therapy in Patients of Bronchial Asthma

Modern science as well as ayurveda has mentioned significant role of Turmeric in Shwas / Bronchial Asthma. Abidi A et al. say in their study that Curcumin capsules improved the lung function safely due to the anti-inflammatory effect of curcumin though there was no visible clinical efficacy in patients of mild to moderate asthma. Therefore a further clinical evaluation is needed with more number of subjects, a higher tolerated dose and for a longer duration. Absence of any clinically significant adverse events indicates dependable safety profile of curcumin. Study thus concluded that curcumin is effective and safe as an add-on therapy for the treatment of bronchial asthma which indicates its applicability in covid positive patients which needs further investigation. [49]

#### Pulmonary fibrosis in Covid19 infection and Turmeric

Covid 19 ailment has a distinct course or advancement. Patients may range from asymptomatic to those with respiratory failure, complicated by acute respiratory distress syndrome (ARDS). One possible complication of pulmonary involvement in COVID-19 is pulmonary fibrosis, which leads to chronic breathing difficulties, long-term disability and affects patient's quality of life. There are no known specific mechanisms that leads to this phenomenon in COVID-19 patients, but some information arises from previous severe acute respiratory syndrome (SARS) or Middle East respiratory syndrome (MERS) epidemics. [50]

#### Anticoagulant treatment in COVID-19

Besides the respiratory involvement, COVID 19 patients frequently develop a pro-coagulative state caused by virus-induced endothelial dysfunction, cytokine storm and complement cascade hyperactivation. It is common to observe diffuse microvascular thrombi in multiple organs, mostly in pulmonary micro vessels. Thrombotic risk seems to be directly related to disease severity and worsens patient's prognosis. Low-molecular-weight heparin (LMWH) is widely used in COVID-19 patients to prevent thrombi formation, but further studies are needed to assess the optimal anticoagulant regimen. [51]

#### Curcumin modulates the Inflammatory Response and inhibits Subsequent Fibrosis

A study was conducted in a mouse model of infection (reovirus 1/L)-induced *acute viral pneumonia*, which leads to ARDS. Mice demonstrated severely damaged lungs as evidenced by diffuse alveolar damage followed by infiltration of the interstitium and alveolar spaces with fibroblasts with excessive collagen deposition. However, in reovirus 1/L-ALI/ARDS undergoing treatment with curcumin in a pre-clinical model, these inflammatory and fibrotic changes were significantly reduced. [52]

In one more animal study Dongwei Zhang et al proved the subsidence of collagen deposition in lungs by 17-28% after curcumin treatment which was accompanied by increased expression levels of cathepsins L (25%-39%) and K (41%-76%) and a 30% decrease in TGF- $\beta$ 1 expression. Remarkably definite modes and formulations of Turmeric might help in covid19 pulmonary fibrosis treatment and before time employment of the treatment might prevent the same. [53]

#### Anticoagulant activities of curcumin and its derivative

Dong-Chan Kim et al. conducted study to know the anticoagulant properties of curcumin and its derivative (bisdemethoxycurcumin, BDMC). They were determined by monitoring activated partial thromboplastin time (aPTT), prothrombin time (PT) as well as cell-based thrombin and activated factor X (FXa) generation activities. Study was conducted on Primary Human Umbilical Vein Endothelial Cells. Data showed that curcumin and derivative of curcumin - BDMC prolonged aPTT and PT significantly and inhibited thrombin and FXa activities. In accordance with these anticoagulant activities, curcumin and BDMC showed anticoagulant effect *in vivo*. Therefore, these results suggest that curcumin and BDMC possess antithrombotic activities and daily consumption of the curry spice turmeric might help maintain anticoagulant status.

Bioavailable form of Turmeric through appropriate route might help to

prevent and to cure pro-coagulative state in covid19 patients which needs more inspection. [54]

## CONCLUSION:

According to Ayurvedic texts Turmeric / Haridra / Curcuma Longa is beneficial in ailments like Pratishyay (Cold), Kanthshul (Sore Throat), Jwar (Fever), Kasa (Cough), Pinas (Sinusitis), Shwas (Asthma) which are also a part of covid 19 manifestation. Ayurvedic Texts have stated several formulations and distinct drug administration modes for above symptoms and conditions. Other than these quotes several cellular studies has been conducted to evaluate Turmeric/ Curcumin's concern regarding anti inflammatory, anti viral, anti asthmatic, anti coagulant, anti fibrotic properties. Some of the studies having positive and conclusive results are mentioned in this review. Though Turmeric/ Curcumin exhibits various medicinal properties in cell culture, human trials doesn't show cheered results due to its weak bioavailability. Curcumin shows limitations related to its poor pharmacokinetic/ pharmacodynamic properties, its chemical instability, and its PAINS (pan-assay interference compounds) character. To overcome these critical pharmaceutical issues, new formulations, the direct delivery to the specific tissue taking advantage from the hybridization approach and the development of nanotechnology-based delivery systems have been developed mainly for curcumin. The use of nanoparticles, in particular, can ensure controlled release of drugs and reduce their toxicity. [55] **Turmeric Milk is an age old remedy for cold and cough. Clinical study for the evaluation of its exact role in prevention of Covid19 infection should be conducted and its efficacy in various stages of covid 19 infection should be validated. Also numerous forms of Turmeric formulations –Swaras (Fresh Juice), Churn (powder), Kalka (Paste), Kashaya (Decoction or Tea), Kshir (Milk), Ghan, Satva, Arka, Ghurut, Tail, Asav, Arishta through various routes of human body parts like nose, mouth, skin, lungs, breath should be studied in-vitro, in-vivo and in-silico for better safety, potency and bioavailability in covid 19 patients.**

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