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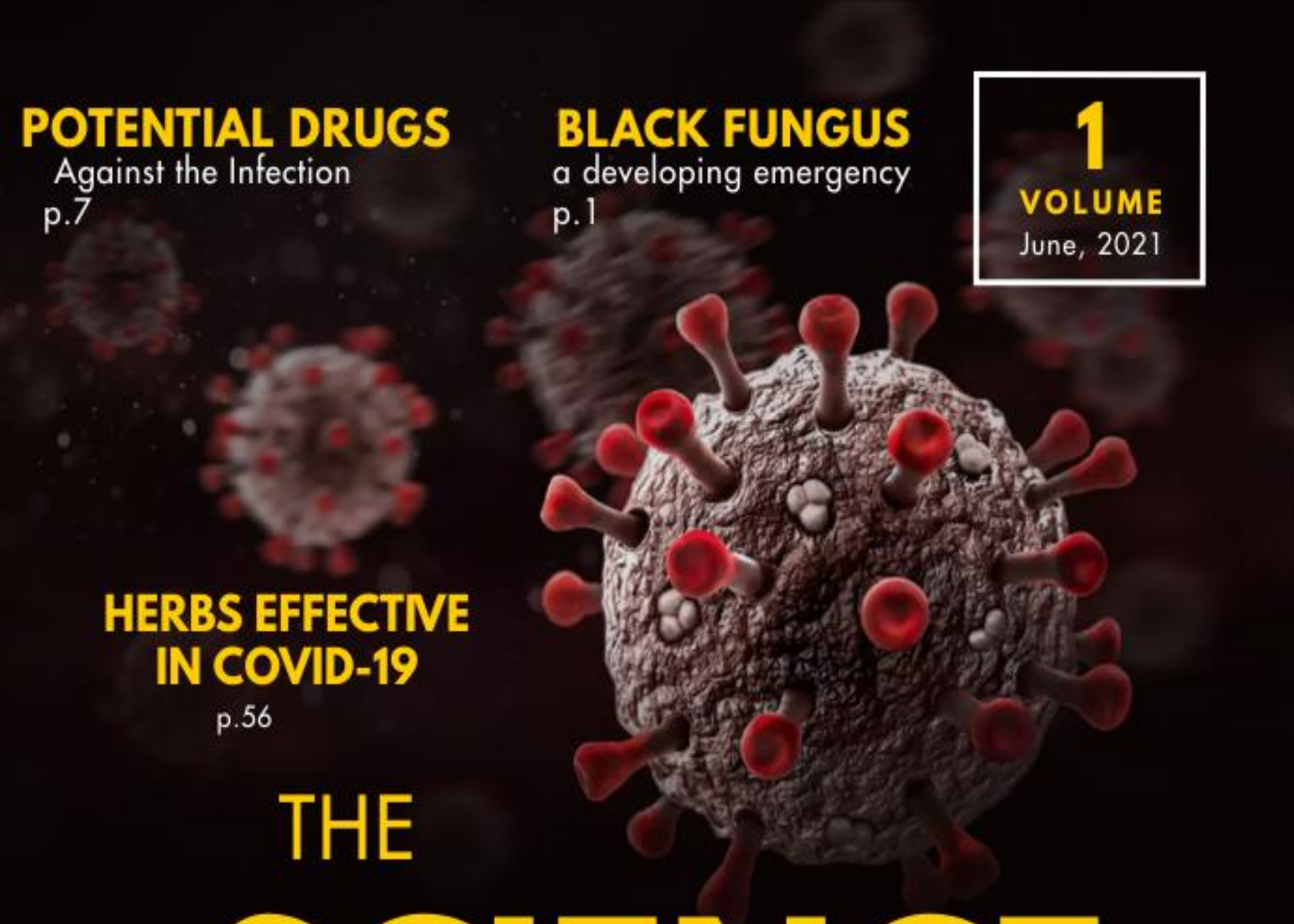

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BLACK FUNGUS- A Developing Emergency

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Abstract

Previously called zygomycosis, mucormycosis is a rare fungal infection caused by a group of molds called mucorymycetes. Black fungal infection, triggered by covid19 leads to blackening or discolouration over the nose, blurred or double vision, chest pain, breathing difficulties mostly in diabetic patients. The infection start from the nose and spread to eyes symptom like fever vomit etc. However mucorymysis is not contagious but those with uncontrolled diabetes and on steroids medication to survive covid-19 complications are worst affected. This review focuses on black fungal infection and its symptoms, causes, treatment and preventive measures.

Introduction

Mucormysis is simply known as black fungus disease or black fungal disease. Group of moulds called mucormycetes that are found throughout the natural environment are the causative agents. It affects the sinuses, lungs, skin and brain frequently. Black fungus or mucormycosis causes disease and death of patients in transplants, ICUs and immunodeficient patients for since long. The people who are on medication for other conditions, especially diabetes, that reduce their ability to fight environmental pathogens are more prone to this disease. It affects the sinuses or lungs of individuals after inhalation of fungal spores are from the air. Fever, headache, coughing, breathlessness, blood vomits and altered mental status are the warning symptoms. Moreover, face, nose, the orbit of the eye, or brain are also affected which can cause even vision loss. Maharashtra has recorded over 2,000 cases, 97 in Karnataka and 40 in Gurugram.

Cause of Mucormysis

It is a complication occur due to fungal infection and affect people who come in contact with fungal spores present in the environment. It can also develop on the skin when fungus enters the skin through a cut, scrape, burn, or other types of skin trauma.It is also reported in the covid-19 patients who are recovering or have recovered as well as diabetic patient with low

immune system.

Why is it affecting covid-19 patients?

Diabetic patients are anyway at high risk of contracting covid-19. For their treatment steroids are used which further compromises immunity. Doctors in India observed that steroids being used as a life-saver treatment for severe and critically ill covid-19 patients, can also proved to be a trigger for mucormycosis. Along with reducing inflammation in lungs steroids can decrease immunity and increase blood sugar levels in both diabetics and non-diabetic covid-19 patients. Whereas, patients with prolonged ICU, cancer, comorbidities, post organ transplant are also at high risk of mucormycosis.

What are the symptoms of mucormycosis?

According to ICMR, sinusitis (nasal blockage or congestion), blackish/bloody nasal discharge and pain on the cheek bone. Along with,one sided pain at the face, numbness or swelling, blackish discolouration over the bridge of nose/palate, teeth loosening, blurred or double vision with pain, fever, skin lesion, blood clot, and chest pain are the other warning symptoms.

What precautions can patients take?

Hyperglycemia should be controlled by regularly monitoring the blood glucose level post discharge of Covid-19 patients. Blood glucose levels of diabetic patients should be monitored. It has been advised by the doctors to use antibiotics, antifungals and steroids judiciously. Sterile water for humidifiers during oxygen therapy should be preferred by the hospitals. Treatment should be initiated as early as possible after observing warning symptoms.

What is the treatment of mucormycosis?

It is important to control diabetes and diabetic ketoacidosis and reduce steroids or immunomodulating drugs in case the patient is still on them and discontinue rapidly. Surgery can be preferred for removing all necrotic (dead) material.Along with this, antifungal therapy has also been advised for at least a period of four to six weeks. Liposomal amphotericin B or LAMB as a medical intervention in patients of mucormycosis

Preventions

1- Using of mask at dusty construction site which are highle prone areas for fungal spores.
2-Wear shoes, long trousers, long sleeve shirts and gloves while handling soil or any other related work.
3- Personal hygiene should be maintained properly.
4- Diabetes should be monitored or controlled timely.

Do's

- Hyperglycemia should be controlled
- It is important to monitor blood glucose level post-COVID-19 discharge and also in diabetes.

- Use steroid judiciously
- Use antibiotics/antifungals judiciously

Don'ts

- Do not avoid warning symptoms
- Do not consider all the cases with blocked nose as cases of bacterial sinusitis especially COVID-19 patients on immunomodulators
- Initiate treatment for mucormycosis timely.

After recovering from coronavirus, it is required to closely monitor and should not miss any warning symptoms mentioned above, as the fungal infection is found to emerge even weeks or months after recovery.

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How does COVID-19 invade the human body

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Abstract

Coronavirus disease (COVID-19), caused by a novel coronavirus, SARS-CoV-2, emerged from Wuhan city of China during late 2019. Due to the rapid spread and associated consequences, it was declared as Global Health Emergency as first pandemic of 21st century by the World Health Organization in March 2021. In this present article the invasive mechanism and transmission stratigies have been discussed. More it has been suggested that people need to take serious precautionary measures to break the transmission chain of the virus in order to defeat it.

Introduction

ARS-Cov-2 is member of family of corona viruses known for crown like spikes (S-Proteins) on their outer surfaces that can cause Covid-19. Corona primarily attacks the throat and lungs of human. It emerged from Wuhan city of China during late 2019 and because of its high rate of transmission it was declared as first pandemic of 21st century by the World Health Organization in March 2021. As of now, it has infected 215 countries claiming lives of million of people. In India, the first case of COVID-19 was recorded On January 27, 2020, when a medical student returned from Wuhan. Since then indian are fighting against this virus.

Composition & Spreading Way in the Human Body

The virus we are talking about, contains RNA as a genetic material material, which enables the virus to make several copies of it, a protein shell to provide a hard protective

enclosure for the genetic material as the virus travels between cells, an outer envelope allows the virus to infect cells by merging with the host cell's membrane.

The Covid affect you when it enters your mouth, nose, or lungs. Inside the body, the S-Protein of the virus attaches to the receptor on one of the cells and utilise that to get inside the cells of body this can trigger the virus to enter the cell in two method:

- As typically happens in case of the flu, the living cell may pull the virus inside by enclosing it in a sac, then the virus releases the RNA
- Virus fuse with the cell surface, then release its genes inside the cells.

After the entry into the cell the virus utilises the ribosome to produce its multiple copies. Ribosomes use genetic information from the virus to make viral proteins such as the spikes on the virus surface. A packaging structure in the cell carries the spikes in vesicles, which merge with the cell membrane. All the parts needed to create a new virus gather beneath the cell membrane. Then a new virus begins to butt off from the cell membrane to the surface of the cell, where they infect more cells. In the meantime, viral s-protein left on the infected cell's surface can cause it to fuse with nearby healthy cells forming a giant viral cell.

How it infects the Lungs

When we breathe, air moves freely through the windpipe, passess the bronchioles, and reach to the alveoli. The trachea and alveoli are fixable respiration; each air sac inflates like a small balloon, and when exhaling, the sac deflates. Inside the alveoli, the cappilaries are present that facilitates the exchange of oxygen and carbon dioxide. In more details, type 1 alveolar cells and type 2 alveolar cells facilitate gas exchange; Type 1 cells are thin enough that the oxygen passes right through, and Type 2 cells secrete surfactant - a substance that lines the alveolus and prevents it from collapsing. The mucus that lines the trachea, bronchi, and bronchioles acts as the first line of defence against the invading germs or microorganism. In a healthy body, the cilia lining the the respiratory tract eliminates the foreign body out of by coughing.

In case of COVID-19 infection, the immune system gets compromised and the virus overwhelms thet immune cells. The bronchioles and alveoli become inflamed and causes the alveoli to fill with fluid, making it difficult for your body to get the oxygen. If one lobe of the lung is infected, then lobar pneumonia or bronchopneumonia affects many parts of the lungs. This can progress to acute respiratory distress that requires treatment with mechanical

ventilation.

Response against the infection

After the infection, Type 2 alveolar cells 2 mediates inflammatory signals that results in recruitment of immune cells such as macrophages that releases cytokines vasodilating, and promoting other immune cells to reach to the site of injury and exit the capillary.

In the starting days of the symptom, the patient suffers from fever along with fatigue, muscle pain, and a dry cough. Few of them may experience nausea and diarrhoea a few days before the arousal of symptoms. Further, patients may suffer from breathing problem especially if they are elderly or have some pre-existing health condition. Within a week, patients (15%, according to the Chi-nese CDC) develop acute respiratory distress syndrome (ARDS), a condition where the fluid fills up in the lungs and this is mostly fatal. This usually happens in severe cases. Patients with milder symptoms probably have more abdominal pain and loss of appetite.

On the other hand symptoms such as gastrointestinal diarrhea, vomiting, abdominal pain, runny nose, discomfort and malaise ,confusion and seizures has also been observed in some Covid-19 patients, particularly in the elderly. These vague and sometimes contradictory symptoms may reflect how the virus interacts with underlying conditions in some patients, like diabetes and high blood pressure, or just differences in susceptibility.

Detection of the virus followed by isolation of the infected person at the earliest possible is the only measure to prevent this disease. Although there are number of methods available for detection of virus to combat this disease in the present pandemic situation, but these available diagnostic methods have their own limitations.

Coronavirus detection approaches are generally based on the travel history of the person from the affected areas as well as the analysis of their clinical symptoms along with some auxiliary examinations. A rapid and sensitive diagnosis of COVID-19 is still under debate, although some diagnosis methods are available presently for virus detection, each having different degree of specificity and based on single or multiple target molecule from the virus. These methods use the pathological changes in the patient's organ by imaging like CT, or viral nucleic acid like RT PCR using one or more gene, or Next Generation Sequencing whole genome, immunological molecules produced by the patient or by the virus in the patient's

body- Antigen–antibody reaction based tests like ELISA . These diagnosis approach has its their own advantages and shortcoming in present scenario

Conclusion

Covid-19 has influenced the life of every individual in one or other way. The virus spread at very fast rate, thats why we require to take serious precautionary measures to break the chain of transmission.

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POTENTIAL DRUGS OF COVID-19

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Abstract

The coronavirus outbreak first came to notice on December 31, 2019 when China informed World Health Organization (WHO) about many cases of pneumonia caused by unknown sources in Wuhan City of Hubei Province. Subsequently, this disease spread to more Provinces in China, and rapidly to the rest of the world. The WHO has declared it as a pandemic. The virus has been named as SARS-CoV-2 and the disease is now called as COVID-19. This disease affects unlike people in different ways. Most of the infected people will recover without hospitalization as their immune system is strong enough to tackle with the virus. Recently, the severity of this virus has grown due to mutation and variation and has resulted in the enhanced mortality. The infection may be symptomatic or asymptomatic. There is no specific for treatment of this disease however, many drugs have been suggested for reducing the severity of the infection and mortality. Many of the drugs are under trial and vaccines are also being developed across the globe.

Introduction

Coronavirus disease 2019 (COVID-19) is an infectious disease caused by a recently discovered novel coronavirus called as severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2; formerly called 2019-nCoV). It was first identified in Wuhan City, Hubei Province, China after an outbreak of a respiratory illness in that area. The WHO declared the COVID-19 outbreak a global health emergency on January 30, 2020. The WHO declared COVID-19 a global pandemic on March 11, 2020. Most people experience mild to moderate respiratory illness infected with the COVID-19 and recover without special treatment. Serious illness is more likely to develop in the older ones and those

with dealing with problems such as diabetes, cancer, chronic respiratory disease and cardiovascular disease. Development of potential therapeutic approaches can be enhanced by the similarities present between SARS-CoV-2, SARS-CoV, MERS-CoV, or human immunodeficiency viruses (HIV). In the current scenario, only one medication has been approved to treat COVID-19. No permanent cure is available till now for the COVID-19. It has been observed that the antibiotics are also not much effective for treating COVID-19, however they may reduce the infection from other bacteria in humans. Several researchers are testing different possible treatments for COVID-19. Currently, all over the world, major efforts are being made by pharmaceutical companies, laboratories, vaccine manufacturers etc. to speed up the discovery and development of therapeutic management against COVID-19. This article collates the main treatments which are being studied across the globe.

1. Hydroxychloroquine sulphate /chloroquine sulphate

These are antimalarial drugs approved for treatment of rheumatoid arthritis and lupus. It has *in vitro* activity to inhibit against different viruses including inhibition of terminal glycosylation of ACE-2 against SARS-Co (Vincent et al., 2005). For treatment of COVID-19 patients, it was used in combination with antibiotic azithromycin. The US Food and Drug Administration has warned against the use of these drugs for treating COVID-19 outside of the hospital setting or a clinical trial because of risk of heart rhythm problems.

2. Antiviral drugs

Remdesivir

It is an adenosine nucleotide analogue, having broad spectrum antiviral activity used treat hepatitis C and Ebola and currently the only drug approved by the FDA for the treatment of COVID-19. It also has *in vitro* activity against SAR-CoV-2 and interferes with the viral RNA-polymerase activity. Remdesivir was found safe in a randomized leads to shortening of time to recovery in adults hospitalized with COVID-19 and had evidence of lower respiratory tract infection (Agostini et al., 2018). In the EU, remdesivir is now licensed for the treatment of COVID-19 in adults and adolescents with pneumonia requiring supplemental oxygen. In India, it was also used for the treatment, however, later it was found infective for the same purpose as per the medical authorities.

Combination of Lopinavir and ritonavir

These are protease inhibitors used for HIV type I infections treatment. It inhibits the HIV protease activity, essential for virus maturation. In mice, both are effective against MERS-CoV (Sheahan et al., 2020). To increase its half-life, ritonavir is combined with lopinavir. It is recommended in several countries for use in treating COVID-19, including Italy and France. In a clinical trial, the combination was stopped early in 13 patients because of adverse effects.

Umifenovir

In vitro studies have reported that, this drug disturbs the angiotensin-converting enzyme 2 (ACE2)/S protein interaction, thus, inhibits entry of SARS in to target cells, further inhibiting the fusion of viral envelope. It is effectively used *in vivo* against H1N5 and influenza-A viruses. Umifenovir in combination with protease inhibitors, is now being considered as a COVID-19 treatment (Kadam and Wilson, 2017).

Favipiravir

It is broad spectrum antiviral drug, a guanine analogue and RNA polymerase inhibitor used for influenza treatment in Japan and China and have antiviral activity against corona virus. It is currently not included in any of the UK trials for COVID-19.

3. Anti-inflammatory agents

Diffuse lung damage is found to be a characteristic of Covid-19 infections. Glucocorticoids may modulate severe inflammation of lung and thus reduce progression to respiratory failure and death. WHO recommended that corticosteroids (i.e. dexamethasone, hydrocortisone or prednisone) can be given orally or intravenously for the treatment of patients with severe and critical COVID-19, and advises not to use against non-severe COVID-19 patients, unless the patient is already taking this medication for another condition. Covid-19 patients who were hospitalized, use of dexamethasone reduced the death of ventilated cases by one-third and resulted in lowering 28-day mortality. Currently there is lack of data on safety and efficacy of use of glucocorticoids in outpatients with COVID-19 and systemic use of it can cause harm in these patients.

4. Ivermectin

It is used as an anti-parasitic agent have antiviral activity against a broad range of viruses. *In vitro* conditions shows it to inhibit the replication of SARS-CoV-2 virus. Ivermectin is suggested to be a promising, effective and safe chemo prophylactic drug in the management of COVID-19.

5. Anti-Coagulant Therapy

Anti-coagulation also called as blood thinner treatments are being given to moderately or severely ill patients who are hospitalized due to COVID-19. In past few months, a recent trend has been observed in COVID-19 patients related to the blood clotting effecting multiple organ, mostly heart and lungs. Blood thinner such as aspirin and clopidogrel are being used extensively in India, on the hospitalized patients so that the risk of use of ventilators can be slowed down.

Conclusion

COVID-19 is a deadly disease and for treatment of this disease no specific drugs or medicines are available till now. Drugs are under trial in laboratories. In future, it might be possible that a specific drug will be available to treat this disease.

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Protocols For Synchronization Of Estrus In Farm Animals

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Introduction

Manipulation of the estrous cycle or induction of estrus to bring a group of females into estrus at a predetermined time is termed as synchronization of estrus. Ideally, an estrus synchronization system should elicit a fertile, tightly synchronized estrus response in a high percentage of treated females. Synchronization of estrus is an advanced managemental method that can reduce human errors and management costs.

Advantages of estrus synchronization

1. Estrous synchronization reduces the cost involved in the hire of AI technicians and semen transport.
2. In estrous synchronized herds there is concentrated calving and uniform weaning so it provides a better opportunity to offer management and observation of herd, results in fewer losses at calving.
3. It is a cheaper method than having individual cows in heat throughout the year.
4. Estrous synchronization protocol shortens the breeding season
5. It reduces calving interval, cows that bred earlier have a better chance of maintaining 365 days calving interval.
6. Calves produced early in the season will wean heavier because they are older.
7. Estrous synchronization is used for the treatment of follicular cyst and repeat breeding.
8. It eliminates estrous detection with timed AI.

9. Estrous synchronization is a prerequisite for embryo transfer.
10. A proper synchronization protocol ensures animals are inseminated until they conceive or are culled.
11. A synchronization protocol will help to decrease the average days in the milk of the herd and decreases the first service.
12. The use of a synchronization protocol can also improve the reproductive performance of the herd.
13. In estrous synchronization, there is planned mating (timed insemination)
14. It enables the shift of the calving season to be coincident with the most favorable season of feeding and marketing.

Principle of estrus synchronization

The pharmacological control of the estrus cycle is based on two approaches; Either shortening the life span of CL by inducing early luteolysis by using Prostaglandins (PGF2α) or by extending the life of CL by administering the Progesterone hormone

By shortening of luteal phase

This induces premature regression of a cyclic corpus luteum (CL) known as luteolysis. Two primary luteolytic agents that are Prostaglandin $F_{2\alpha}$ or its analogs and Estrogen administration result in estrus and ovulation within 2-3 days. In all species, the CL is quick to respond to luteolytic agents during definite stages of its development. Luteolytic agents will not cause regression of the CL during the first 12 or 13 days of the cycle in the pig and first 5-6 days of the cycle in ruminants and horses. Estrus and ovulation can also be synchronized in animals through a combination of progesterone and a luteolytic agent. Luteolytic agents regresses the corpus luteum and the progesterone prevents estrus until its withdrawal.

By extending, luteal phase

This method involves prolong administration of progesterone, therefore; CL regresses naturally during the period of administration of progesterone. This approach results in negative feedback on LH secretion after regression of the CL. Following the withdrawal of progesterone, follicular growth, estrus, and ovulation occur within 2 to 8 days. The interval from the removal of progesterone to the onset of estrus varies among species and the methods of progesterone treatment within species. Generally, long-term progesterone treatment is to be given for 10 days or longer depending on the species.

Table 1: Estrus synchronization protocols used in different farm animals

Species	**Drugs**	**Treatment schedule**	**End of treatment to estrus**	**Breeding / AI time**
Cattle and Buffalo	$PGF_{2\alpha}$	Single Injection, if, CL present	2-4 days	72 and 96 hours
	$PGF_{2\alpha}$	Two injections at 11 to 12 days apart	2-4 days	72 and 96 hours
	Progestogen + $PGF_{2\alpha}$	Progestogen (day 1-7) and $PGF_{2\alpha}$ (day 6)	2-3 days	84 hours
	Progestagen + Estrogen	Estrogen (5mg estradiol valerate) and Progestagen (3mg Norgestomet) injection (day 1) and progestagen implant (day 1-9)	3-5 days	54 hours
	GnRH + $PGF_{2\alpha}$	Inject GnRH (day 0) and $PGF_{2\alpha}$ (day 6)	2-4 days	24-72 hours
	GnRH + $PGF_{2\alpha}$ + GnRH	Inject GnRH (day 0), $PGF_{2\alpha}$ (day 7) and GnRH (day 8 or 9)	2-4 days	24-48 hours timed AI
Goat	Progesterone pessaries + eCG	Progesterone (18-21 days) and eCG (400-800 IU; on day of pessary removal)	2-3 days	30-48 hours
	$PGF_{2\alpha}$	Two injections at 11 or 12 days apart	2-3 days	48 hours
Sheep	$PGF_{2\alpha}$	Two injections at 9 days apart	2-3 days	48 hours
	Progesterone pessary + eCG	Progesterone (12-14 days) and eCG (400-800 IU; on day of pessary removal)	2 days	48-60 hours
Horse	Progestogen in feed	Altrenogest (15 days)	4-7 days	Breed at estrus
	$PGF_{2\alpha}$ + hCG	$PGF_{2\alpha}$ (day 1), hCG (day 7-8), $PGF_{2\alpha}$ (day 15) and hCG (day 21-22)	2-4 days	Breed at estrus
	$PGF_{2\alpha}$	One dose to diestrus mare	3-5 days	Breed at estrus
Swine	Progestagen in feed	Altrenogest (14-18 days)	4-6 days	Breed at estrus

Conclusion

Estrus synchronization is one of the most important and commonly used reproductive biotechnologies available for farm animals. For various protocol approaches, this program is based on numerous hormones, either natural or artificial hormonal agents like Prostaglandins, Progesterone, GnRH, etc. Estrus synchronization can provide major benefits to the farmers in terms of genetic enhancement and reproductive management.

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Lessons Indians Should Learn From Covid-19 Pandemic And How

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Abstract

The war between humanity and novel coronavirus commenced in 2019 and is still going on even after thousands of lives lost nationally and globally. The outbreak posed serious challenges to Indian health care system some of which were met but many failed. This pandemic proved be the much-needed wake-up call to the necessity of long-term changes to India's emergency care and health infrastructure. In this article we have talked about various lessons our nation learnt since the onset of virus outbreak and some that it should learn to avoid this kind of crisis in future.

Keywords: Coronavirus, Covid-19, Pandemic, Indian healthcare, Public health.

Introduction

Since 2019 world is facing a global threat of Coronavirus disease, notoriously named Covid-19 and the war is still going on against this novel virus. At one time or another, it rears its ugly head in one nation or another. As of 12 June 2021, total of 3,782,490 people has succumbed to death globally, out of which 3,67,081 were in India making the nation's covid death rate at an alarming statistic of 1.25% (https://www.mygov.in/covid-19). Despite fatality rates low in percentage, COVID-19 has killed more people than SARS and MERS combined. This outbreak has impacted all the sectors in every nation but it has posed serious challenges to public health, research and medical communities. Finally, statistics are showing decrease in coronavirus infected cases in India but there is no time to rest with the news of approaching third wave and rumours surrounding it.

How Did India Deal With The Entry Of Virus In 2020?

The Government of India recognized the threat of COVID-19 before WHO announced it as a global pandemic officially and hence, introduced a series of steps expeditiously to contain the transmission. Protective measures such as thermal screening, travel history, securing symptoms of the disease, and airport screening began at the end of January 2020 since the first case was reported in the country and face masks, hand sanitizers, social distancing were all healthily encouraged. No country has witnessed such a widespread yet prolonged lockdown and it was praised by WHO as "tough and timely". Some hospitals, as whole were declared as COVID hospitals, attending only the concerned cases. In just few months after the entry of virus in the nation, many research centres were already trying to develop a vaccine. Whole nation became dedicated to deal the pandemic with unity and the efforts were lauded worldwide. India got positive results for its efforts when there was no evident surge in manifest cases overwhelming the health system warranting any such suspicion as compared to many developed nations and it helped flatten the epidemic curve of the country sooner rather than later.

But towards the end of effected year, in rear-view, government's sudden enforcement of the lockdown seemed hastily prepared and immediately disadvantaged already vulnerable populations. Deaths of migrating and starving people in informal economy have not been taken into account. Majority of people with subpar income living in overcrowded and unhygienic conditions combined with non-covid services getting disrupted in hospital and clinics everywhere, exposed the inadequacy of nation's emergency healthcare systems and haphazard planning on root level. Many districts were dealing with capacity issues in civil hospitals and lack of operational feasibility. Worst part was the rising levels of violence against health-care workers and stigmatisation of people with or suspected of having COVID-19 and even in these difficult times when health system was being overburdened, India was busy in usual blame game among different communities, political parties and religions.

2021 Crisis Of Covid 19 Faced By India - The Second Wave

India is battling a second wave of COVID-19, which has rapidly surpassed its first wave in 2020 with more than 300,000 positive tests each day for a week in April 2021 and unfortunately, these stats are said to be vastly undercounted as people in rural area refused to acknowledge the disease due to their mistrust in public healthcare system. People were just thinking of ways to recover from the losses of first wave, soon the nation was seen

tackling and battling with unbeaten new strains of coronavirus with surprisingly high shortage of essential supplies, including beds, oxygen, drugs, vaccines, and COVID-19 tests. Due to India's complacency in that narrow window between both waves, public healthcare collapsed in many states and cities, Maharashtra and New Delhi taking the heaviest brunt. Centre of world's most populous country was painted with horrific picture of burial sites going out of space. The nation is still grieving from the explosive respiratory syndrome and now Black fungus has added to the pile of concerns.

March saw hectic public gatherings, sanctioned and even encouraged by public officials. Only government cannot be blamed because people are responsible for their own health when it comes to visiting such events with negligence and putting other innocents at risk as well by becoming carriers of such a fatal infection. The health infrastructure is important to manage the cases of COVID-19, but the spread of COVID-19 also depends on the interplay of other social determinants. State governments are now scrambling to build up new infrastructure, making announcements about suddenly commencing the construction of new health facilities or oxygen plants but it should have been before the commencement of second wave particularly when India had already realized this requirement during the first wave. Poor management within the healthcare systems has led to grim number of 515 deaths of doctors, according to IMA and there is no doubt that they died soldiers but a person is forced to think if some of those deaths could have been avoided.

Heavier The Darkness, Brighter The Light Surrounding It

With due respect to the effected and deceased, pandemic gave humanity some appreciable moments. From creating a stigma and fear around the patient to providing moral, physical and mental health support, humanity refined and strengthened. Whenever any nation saw a peak in the coronavirus cases, all others were present with a united front to help avert the crisis. Similar was the case with India and its second COVID wave. But surprisingly, brightest light shone over public was not by the administrative authorities but by the work of NGOs. Roughly 3 million non-profits tirelessly working across the country have risen to the occasion and ramped up aid efforts especially where government alone failed to reach the last mile. They are employing their extensive reach with community leaders and a large volunteer base in the community. They all know that a cooperation rooted pandemic response makes everyone safer.

In the face of infrastructural collapse and amidst the confusion and anger caused by lack of vaccines or hiked prices by private sector, civil society groups are stepping forward to meet the needs of the moment.

Conclusion

Nobody can anticipate an upcoming disaster or its impact. There is no doubt that regardless of better healthcare systems in developed countries, every nation suffered at the hands of this lethal virus but in India, better planning and communication could have helped soften the blow of the crisis. Looking back is never helpful unless you have so much to learn by it. The pandemic cases and crisis in India has provided us with many obvious lessons and solutions to avert any similar situations in the future. Infectious disease surveillance and in particular, the timely detection and early warning of disease outbreaks are a function of strength and capacity of the health system along with increasing health expenditure portion from GDP. This is the time to win the trust of people with a thoughtful approach so that people of nation see the public health system as an ally instead of rooting for stereotypes surrounding vaccines and therapeutic approaches. Community intervention with sufficient transparency, trust, and people engagement is the need of the hour.

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Haemonchosis: A Threat to Livestock Production

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Abstract

Haemonchosis is an important parasitic disease of ruminant livestock with worldwide occurance. It causes a huge loss not only in economics but also in production. Sheep and goat may affected by *Haemonchus contortus* and cattle by *Haemonchus placei*. These parasites are widely prevalent in India and commonly found in the abomasum of host. Large numbers of *H. contortus* parasites at necropsy examination and history of anaemia in clincal examination may be regarded as confirmed diagnosis for Haemonchosis. For effective treatment and prevention any broad spectrum anthelmintics may be used unless the resistance against it has been developed. Pasture rotation, alternate grazing of different host species and nutrient supplementation are effective method of prevention and control.

Keywords: Haemonchosis, Anaemia, Barber pole worm, Hypobiosis, Anthelmintic Resistance

Introduction

The parasites are those organisms that reside on or inside the body of other group of organism for their nourishment and causes harmful effect to the host. There are more than 1,000 species of parasites that harbour our domesticated and production animals throughout the world. They can be broadly classified as external or internal, depending on their habitat on their host. Both external and internal parasites affect adversely to host animals and become a potential cause of weaken immunity. Weaken immune conditions makes the animals more suitable and prone to other pathological diseases (Schmid-Hempel P., 2008). These diseases may also be lethal for host. For a long

ago these parasites seems to be culprit for great economic losses ever since humans first undertook the domestication of animals.

Haemonchosis is an important disease of sheep, goat and cattle caused by a blood sucking nematode or round worm. Haemonchosis results in huge losses in economics and production of farmers especially those living in warmer and humid climatic region. Sheep and goat may affected by *Haemonchus contortus* and cattle by *Haemonchus placei*. *Haemonchus contortus* is one of the most important parasites of ruminants with worldwide distribution (*Chunqun et al* 2017). Genus *Haemonchus spp.* was first described by Karl Rudolphi in 1803 (Soulsby, E.J.L. 1968). These parasites are widely prevalent in India and commonly found in the abomasum. Barber pole worm is another name of these parasites as the ovaries of female worm are spirally wrapped around the blood filled intestine giving it's a characteristic appearance of barber pole. Sometimes these are also known as twisted stomach worm, common stomach worm. These parasites are largest of *trichstrongyles*. Warm and moist environment is prerequisite for the development of larvae and this is the reason that most of the infection is seen in rainy season. Too hot or too cold weather is unfavourable for the survival of larvae. Hypobiosis i.e. arrested larval development within the host makes the parasite suitable to cope with unfavourable environmental condition.

Life cycle

The parasite have direct life cycle. Infection is followed by ingestion of infective third stage larvae which reaches to the rumen of the host. After penetration between epithelial cells, the third stage larvae moults to fourth stage and attaches to the mucosa of abomasum. The larvae of *Haemonchus contortus* reaches to sexual maturity in about 2 weeks while *Haemonchus placei* in about 4 weeks. They attach to the mucosa of host with the help of their lancet or buccal teeth and adult nematode parasites start their blood-sucking activity (Vegad and katiyar 2016).

Clinical findings

Anaemia is the first clincal findings due to vigorous bloodsucking by both fourth-stage larvae and adults of *H. contortus*. The average blood loss due to one worm may be approximately 0.05 ml per day and thus if any animal is highly infested with *Haemonchus sp.* e.g. 4000 worms, it may loss 200ml of blood daily, that leads a severe anaemia in very short periods of time (Rodriguez et al 2015). Other common signs like weakness, loss in weight, depression and sometimes accumulation of fluid in submandibular tissue may also

be seen.The severity and duration of disease depends on the number of factors like of numbers of worms present and the ability of the animal to compensate for losses of plasma proteins, haemoglobin and other blood constituents in the host (Constable *et al* 2010).

Diagnosis

The diagnosis may be confirmed by finding of large numbers of the *Haemonchus contortus*, red colour worm in the abomasum. Faecal examination may also be helpful in which large number of worm egg may be seen. The large numbers of *H. contortus* parasites at necropsy examination and history of anaemia in clincal examination may be regarded as confirmed diagnosis for Haemonchosis.

Treatment

Any broad spectrum anthelmintics may be used for treatment and prevention of haemonchosis unless the resistance against it has been developed. Planned approach should be followed in uses of anthelmintics to avoid further development of resistance against it (Arsenopoulos *et. al.*, 2021). Combination of anthelmintics may also be used as per necessity. *H. contortus* populations requires effective treatment at appropriate times. The treatment and selection of anthelmintics should be very efficient and economic. Drugs like closantel, rafoxanide, and nitroxynil has proven its efficacy against treatment of haemochosis when the parasite has developed the resistance against broad spectrum anthelmintics. Fortunately, there are several anthelmintic groups are available for treating haemonchosis despite of this there is no guarantee that all chemicals will be uniformly effective in any one region, due to the widespread occurrence of anthelmintic resistance. As there can be wide variation in the severity of resistance among geographical regions and properties within a region, an awareness of the likely effectiveness of the different groups is necessary for an optimal anthelmintic choice. Drugs like albendazole, fenbendazole, oxfendazole, levamisole, ivermectin, moxidectin and closantel are found very effective in treatment.

Prevention and control

Any parasite control method aimed at minimizing a given parasitic population must consider the basic disease determinants. Generally, nematode control strategies can be directed against the parasite in the host and in the environment. Methods to control *H. contortus* must attempt the break the life cycle of the worm, whether through uses of anthelmintic, animal management or pasture management.

Anthelmintic, drugs that remove the parasite from the intestines are the most common method for managing *H. contortus*. Chemical anthelmintic are often used to combat haemonchosis because they are cheap, simple and cost effective. Ivermectin as well as albendazole and fenbendezole have produced the highest levels of resistance, and resistance with levamisole and moxidectin is increasing. Resistance to these drugs is high because each one uses a specific mechanistic pathway to kill *H. contortus*. Treatment of *H. contortus* using chemical and natural anthelmintic and dewormers is one approach to managing haemonchosis.

Self-cure phenomenon is a relationship between host and parasite which control the worm burden without help of any drug. A challenge dose of larvae may able to initiate the self cure reaction in infected and sensitized sheep. Self-cure of *H. contortus* infections occurs even in the absence of reinfection under natural conditions and is apparently non-immunological in origin (Allonby *et al.,* 2009). An induced self cure reaction results in the elimination of the larvae. Third stage moulting fluid is supposed to be responsible for self cure phenomenon as it is highly antigenic in nature. It is also responsible for antigen-antibody reaction in the body that causes expulsion of larvae from the body which reaches maximum in 48 hours. Self cure reaction may lead to increase antibody titer, alteration of pH in gastrointestinal tract, increase peristalsis, increase histamine concentration and inflammation in the local tissues.

Effective managmental plans, nutritional supplementation and regular monitoring on flock as well as animal basis should be done for controlling the disease. Pasture rotation also helps in the prevention of disease (Besier *et. al.,* 2016). Proper pasture rotation allows time for on-pasture larvae to die out before they can be reconsumed. Alternate grazing of different host species and alternation of grazing and cropping are management techniques that can provide safe pasture and give economic advantage when combined with anthelmintic.

Protein and herb supplements improve the health of the digestive tract, lessening the effects of infection and increasing host resilience. Most animals develop immunity against internal parasites, which keeps the parasites from reproducing but doesn't kill them. The young animals that have not developed immunity and immune-compromised animals are most affected by *H. contortus*.

Conclusion

Haemonchosis is great threat to ruminant livestock production caused by a blood

sucking nematode. The causative organism for haemonchosis in sheep and goat is *Haemonchus contortus* while cattle are affected by *Haemonchus placei*. An animal highly infested with *Haemonchus sp.* may suffer from severe anaemia, weight loss, depression, submandibular oedema in very short periods of time. Planned treatment strategies along with proper management are helpful for prevention and control of haemonchosis.

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Peste des petits ruminant s – A radical threat to small ruminants

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Abstract

Peste des petits ruminants (PPR) is a highly contagious transboundry viral disease of small domestic and wild ruminants caused by *Small ruminant morbillivirus* (SRMV; formerly known as PPRV), a member of *Paramyxoviridae* family. The present article briefly outlines the epidemiology, host range, pathogenesis, clinical presentation and diagnosis of PPR for better understanding of disease dynamics.

Introduction

Peste des petits ruminants (PPR) is an acute or sub-acute febrile, highly contagious and economically unviable disease of domesticated and wild small ruminants with high morbidity and mortality. The disease is widely prevalent and is a significant economic concern in Africa, the Middle East, South Asia and China (Banyard *et al.*, 2010). PPR has a wide host range, including wild animals, making the transmission cycle more complex and difficult to contain. The pathogenesis of SRMV in the natural host is poorly understood and relies mainly on the information derived from other more studied morbilliviruses. PPR is clinically characterized by high fever, serous nasal and ocular discharge, which later become mucopurulent, profuse diarrhoea, erosive stomatitis and pneumonia. Diagnosis of PPR under field conditions rely on the clinical signs, gross pathology, and high mortality rates and needs to be supplemented with molecular techniques for further confirmation. Highly efficacious live attenuated vaccines against different strains of SRMV are available.

History and Epidemiology

Gargadennec and Lalanne first reported the disease in the Ivory Coast, West Africa, in 1942. The first successful isolation of SRMV was achieved in sheep cell culture in Senegal in 1962 (Gilbert and Monnier, 1962), and SRMV was observed under an electron microscope for the first

time in 1967 (Bourdin and Laurent-Vautier, 1967). In 1979, SRMV was classified as a Morbillivirus under the family Paramyxoviridae and the order Mononegavirales (Gibbs *et al.*, 1979). Till the late 1970s, confirmed PPR outbreaks were limited to West African countries (Hamdy *et al.*, 1976; Taylor, 1979). However, during the early 1980s, reports of PPR outbreaks from Eastern Africa and other parts of the world tend to emerge (El Hag Ali and Taylor, 1984; Taylor *et al.*, 1990). Serological based evidence of SRMV in Asian countries as early as 1980 has been reported (Hedger *et al.*, 1980). The first confirmed detection of SRMV in Asia surfaced in 1987, simultaneously in India (Shaila *et al.*, 1989) and the United Arab Emirates (Furley *et al.*, 1987). Soon after, PPR was recognized in Pakistan in 1991 in goats (Pervez *et al.*, 1993). Since then, PPR spread across international borders and is presently endemic in the majority of Africa, the Arabian Peninsula, Middle East, India, Bangladesh, Nepal, Pakistan, Tibet and China, Turkey, Iraq, Iran, Tajikistan and Kazakhstan (Taylor and Barrett, 2007; Wang *et al.*, 2009). Recently, PPR was reported for the first time in Bulgaria (Bataille et al. 2019), Burundi (Niyokwishimira et al. 2019), and Georgia (Donduashvili et al. 2018).

Host range of PPR

PPR is essentially a disease of goats and sheep (Gibbs *et al.*, 1979), where goats are more susceptible to natural infection than sheep. Cattle and pigs are susceptible to experimental infection and are considered dead-end host as they fail to transmit the virus (Gibbs *et al.*, 1979). Both subclinical infection and deaths have been reported in American white-tailed deer (*Odocoileus virginianus*) (Diallo, 2004). SRMV has been isolated from rinderpest like disease in Indian buffaloes (*Bubalus bubalis*) and has been reported in one-humped camels (Govindarajan *et al.*, 1997; Roger *et al.*, 2001). Isolation of SRMV from subclinical infection and deaths in wild animals like gazelles (Gazella dorcas); ibex (Capra ibex nubiana); gemsbok (Oryx gazella) Arabian mountain gazelle (Gazella gazella cora), wild goat (Capra aegagrus) and laristan wild sheep (ovis orientalis laristanica) have been reported (Furley *et al.*, 1987; Kinne *et al.*, 2010; Hoffmann *et al.*, 2012). PPR poses no threat to humans, and no report of SRMV infection in humans has been reported (Diallo, 2004).

Economic impact of PPR

PPR affiliated direct (death, weight loss, reduced milk production and reproductive capacity) and indirect losses (restrictions on sale and movement, expenditure towards veterinary services) are a severe burden on the veterinary resources and livestock economy. The expected monetary losses due to PPR in India alone are in the tunes of US $653 million and $669 million per year (Bardhan *et al.*, 2017). In Kenya, PPR caused economic losses of US $19.1 due to direct

losses (Kihu *et al*., 2015). It is estimated that eradication of PPR from the world would yield a net benefit of US $74.2 billion (Jones *et al*., 2016).

Host-pathogen interaction

The first step in the viral infection includes the attachment of viral H protein with specific host receptors. The SLAM receptor is the principal cellular receptor for morbilliviruses. SLAM is exclusively expressed on immune cells, including lymphocyte, monocytes, macrophages and dendritic cell. Like other morbilliviruses, SRMV also utilizes SLAM as the primary attachment receptor (Adombi *et al.*, 2011). Cell lines, such as B95a, expressing high levels of SLAMs on their cell surface are sensitive to morbilliviruses and serve as a typical cell line for the isolation of morbilliviruses. Levels of SLAM expression in peripheral blood mononuclear cells (PBMCs) have been positively associated with the magnitude of SRMV replication. In 2011, the receptor expressed on the epithelial cells with high affinity for viral H protein was identified as Nectin-4 receptor (Noyce *et al.*, 2011). Nectin-4 is considered an exit receptor and plays a vital role in the virus dissemination throughout the body and subsequent release of the virus via different secretions. CD46 molecule, a receptor that usually binds to the complement component C3b and C4b and protects against complement-mediated damage, has been reported to act as an alternative receptor for the measles virus (Naniche *et al.*, 1993); however, no such information is available for SRMV. Furthermore, the morbillivirus cell entry independent of SLAM, CD46 and Nectin-4 in various cell lines has also been reported (Fujita *et al.*, 2007).

Pathogenesis of SRMV

The information regarding the pathogenesis of PPR remains largely unexplored, and the majority of information is derived from the pathogenesis of related morbilliviruses such as rinderpest virus, canine distemper virus, and particularly measles virus. Pope et al. (2013) suggested that initial uptake of SRMV is regulated by the immune cells, and not by the epithelial cells, of the upper respiratory mucosa, and then SRMV is transported to the tonsils and the regional lymph nodes for primary replication. Once viraemia sets up, SRMV amplification throughout the body and subsequent release through different body secretions are mediated by nectin-4 receptors (Noyce *et al.*, 2011).

Clinical manifestations

The clinical manifestations of PPR may occur in four forms; peracute, acute, subacute or subclinical (Kulkarni *et al.*, 1996). Peracute form of the disease is commonly observed in kids and lambs above four months of age, i.e. soon after depletion of passive protective immunity. Clinically, pyrexia may develop, and animals may die 4–5 days post-pyrexia. The acute form is

the most common and appears after a short incubation period of 2–6 days (Diallo, 2004). The disease is characterized by pyrexia which returns to normal after 3-8 days. A catarrhal discharge around nostrils is a common finding that leads to severe dyspnoea, sneezing and coughing. Crust formation at the medial canthus and congestion of conjunctiva and conjunctival sac may eventually cause complete closure of the eyelids. Mild to severe necrosis on the dental pad, hard palate, inner side of the cheek, and dorsal part of the tongue is a common finding. These oral lesions lead to severe pain, and the animal is reluctant to open its mouth and becomes anorectic. This is followed by severe non-haemorrhagic diarrhoea, leading to severe dehydration, emaciation, sunken eyeballs, hypothermia, and death within 5-10 days (Saliki, 1998). Occasionally, inflammatory and erosive lesions may also develop in the mucous membrane of the vulva and the vagina and may cause abortion in pregnant animals (Abubakar *et al.*, 2008). The lungs are generally affected during late stages, causing dyspnoea and productive cough (Diallo, 2004). Severe pulmonary signs such as noisy respiration, extended head and neck, nostril dilation, protruded tongue and painful cough indicate poor prognosis. The mortality rate ranges from 50-90%, depending on the severity of the outbreak (Diallo, 2004), while survivors recover after weeks of convalescence. The subacute form has a more extended incubation period (> 6 days), and after low-grade pyrexia (39–40°C), animals usually recover in 10–14 days. The subclinical disease is only observed in unusual hosts such as cattle, buffalo, pig and camel.

Figure 1. Goat experimentally infected with SRMV. (A) Severe necrotic lesions on dental pad, gums and tongue. (B) Severe muco-purulent oculo-nasal discharge

Gross pathology

The principal pathological findings of PPR are limited to the alimentary and respiratory tracts (Barker *et al.*, 1993). In general, animals remain emaciated and severely dehydrated (Chowdhury *et al.*, 2014). The perineal and posterior aspects of the hind limbs are soiled with watery, and occasionally, blood-tinged faeces. The lips may be oedematous with progressive accumulation of golden-brown scab material around the commissures. The digestive system usually reveals severe erosions, necrotic stomatitis and enterocolitis (Scott, 1990). In the buccal cavity, erosions could be observed in the mucous membranes of the upper and lower lip, the cheek, the dental pad, hard and soft palate, pharynx, and may extend up to the oesophagus (Truong *et al.*, 2014; Gitao *et al.*, 2016). Gross changes in rumen, reticulum and omasum remain inconspicuous. The small and large intestines are primarily devoid of contents and are filled with foetid fluid. The ileocaecal orifice is commonly affected, and haemorrhagic rings could be observed around the orifice (Gitao *et al.*, 2016). In the small intestine, the ileum is commonly affected due to the presence of Peyer's patches and is characterized by small erosive lesions (Truong *et al.*, 2014). The caecum, colon and rectum often show evidence of linear haemorrhages. Mesenteric lymph nodes are more severely affected and are generally enlarged and edematous (Gitao *et al.*, 2016). Erosive vulvovaginitis could also be observed in a few cases (Gitao *et al.*, 2016).

In the respiratory system, small erosive and petechial changes may be observed on the nasal mucosa, turbinates, larynx and trachea with occasional frothy mucus (Gitao *et al.*, 2016). The lungs, particularly anteroventral areas, become red and consolidated and show evidence of pneumonia and atelectasis. Mucopurulent conjunctivitis and swollen spleen with cysts are significant gross features (Munir *et al.*, 2013).

Diagnosis of PPR

A tentative diagnosis of PPR is made based on clinical signs, epidemiological evidences and post-mortem findings. Confirmatory diagnosis relies on detecting SRMV specific antigen, antibodies, and nucleic acid in the host sample specimen. Antibodies specific to SRMV can be detected using agar gel immunodiffusion test (AGID), counter immune-electeophoresis and indirect enzyme-linked immunosorbent assay (ELISA). Sandwich ELISA is commonly applied for the detection of SRMV antigens in host tissues. Indirect immunofluorescence and immunoperoxidase test are highly sensitive for in-situ demonstration of SRMV in tissue samples and cell culture. Isolation of virus using susceptible cell lines/primary cells is the ‘gold standard’ for PPR diagnosis; however, it is time-consuming and laborious. Molecular techniques such as PCR and RT-PCR with several modifications are highly sensitive and rapid for detecting SRMV genome and are preferred over other diagnostic techniques.

Conclusion

PPR is a significant viral disease of small ruminants that readily spreads across international borders and is prevailing across Asia, Africa and Europe. The disease has severely incapacitated the household economy of rural marginal farmers and is a significant obstacle for the poverty alleviating programs of developing countries. Therefore, disease awareness and regular mass vaccination against PPR at national and international level are essential for an effective eradication program.

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Available on request

Bluetongue: an emerging vector borne disease under climate change influence

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Abstract

Bluetongue virus (BTV), the causative agent of the bluetongue disease belongs to genus *Orbivirus* in the family *Reoviridae*. The midges of *Culicoides spp.* transmit the virus between the susceptible vertebrate hosts. Bluetongue virus affects a wide variety of domestic and wild ruminants. The present article briefly described about epidemiology, host range, pathogenesis, clinical sign, pathology, diagnosis, prevention and control of bluetongue disease.

Introduction

Bluetongue (BT), an arthropod-borne disease of domestic and wild ruminants principally affects sheep (MacLachlan, 2010). As per the *Office International des Epizooties* (OIE), bluetongue has been classified as a multiple species and notifiable disease (www.oie.int). The causative agent , BTV belongs to the *Orbivirus* genus in the *Reoviridae* family (Pringle, 1999). The BTV has a ten-segmented dsRNA genome packed within a three-layered icosahedral capsid. The viral genome codes for seven structural (VP1-VP7) and five non-structural proteins (NS1-NS3/NS3A, NS4 and S10-ORF2) (Belhouchet *et al*., 2011; Stewart *et al.*, 2015). The worldwide distribution and prevalence of BTV coincide with the distribution of the vector which in turn is governed by several ecological factors (MacLachlan, 2010). Bluetongue virus affects a wide variety of domestic and wild ruminants like sheep, goat, cattle, buffalo, bison, antelope, white-tailed deer, sambhar, and other artiodactyles such as camel, and llamas (Meyer *et al*., 2009). Worldwide, 27 serotypes of BTV have been known with the adding up of two new serotypes, BTV-28 from contaminated sheep pox vaccine in Israel and BTV-29 from alpaca in South Africa. The diagnosis of bluetongue can be done by

isolation of virus, antigen detection, nucleic acid detection, and serological assays (Afshar, 1994; Clavijo *et al*., 2000). The effective control strategy includes vaccination of the susceptible animals, management practices and control of the vector.

History and Distribution

Bluetongue was enzootic throughout the entire African continent. Bluetongue was first reported in the late 18th century in South Africa after the import of Merino sheep from Europe (Spreull, 1905). The name "Bluetongue" has been derived from the African "blutong" which describes the cyanotic discolouration of the tongue in clinically affected animals (MacLachlan, 2009). Before 1940s, the occurrence of bluetongue was thought to be restricted to southern Africa. In 1943, the first epidemic was reported outside the African continent in sheep in Cyprus (Gambles, 1949). Bluetongue is enzootic in tropical, subtropical and temperate regions between 40° N and 35° S and may extend up to 50° N (Mellor *et al*., 2008; MacLachlan, 2010). Except for Antarctica, BTV has been circulating in all continents.

Indian Scenario

Bluetongue is endemic in India as the country hosts a remarkable population of susceptible animals. In the Indian subcontinent, BT was first reported from Pakistan in 1958 and later from Maharashtra, India in 1964 (Sarwar, 1962; Sapre, 1964). Thereafter, several outbreaks of bluetongue have been reported from different parts and the virus has become endemic in the subcontinent (Prasad *et al*., 1992; Sreenivasulu *et al*., 1996; Prasad, 2000). In India, 23 BTV serotypes have been reported based on serology and virus isolation (Rao *et al*., 2016). Until now, 13 BTV serotypes have been isolated from India (BTV-1, 2, 3, 4, 6, 9, 10, 12, 16, 17, 18, 21 and 23) (Chand *et al*., 2015; Rao *et al*., 2016; Reddy *et al*., 2018). Bluetongue infections in the country follow the patterns of monsoon. Incidence of the disease is more in the southern part, less in western, northern and north-eastern regions due to short window of monsoons followed by cold winter (Rao *et al*., 2016). In India, seroprevalence of BT was reported in sheep, goat, cattle and buffalo (Walton, 2004). A high prevalence (86%) of BTV in Mithun in the northeast region of the country was also reported through a study (Rajkhowa *et al*., 2004).

Host Range

A wide range of domestic and wild ruminants are susceptible to BTV but the disease is clinically observed in sheep (particularly in the fine wool breeds of Europe and some mutton breeds) and North American white-tailed deer (*Odocoileus virginianus*) (Johnson *et al*., 2006; MacLachlan *et al*., 2009). Merino and Rambouillet sheep are more susceptible to BTV than indigenous breeds (Spreull, 1905; Prasad *et al*., 1992). Cattle are subclinically infected, however, clinical signs exhibited by cattle infected with BTV-8 in Europe has been reported (Darpel *et al*., 2007; Elbers *et al*., 2008). Natural infections are also reported in pronghorn, African antelopes and other wild ruminants, but the virus can also infect camelids, elephants and captive yak (Rivera *et al*., 1987; Ruiz-Fons *et al*., 2008; Meyer *et al*., 2009).

Transmission

Biting midges of the genus *Culicoides* (Diptera: *Ceratopogonidae*) transmit BTV and out of 1300-1400 species only 30 species are known to be the vectors of BTV (Meiswinkel *et al*., 2008). Once acquiring infection by feeding on infected animals, the vectors become persistently infected with virus for the entire lifespan. The viral transmission by *Culicoides* depends on the ambient temperature, total rainfall and humidity (Mullens *et al*., 1995; Wellby *et al*., 1996; Mellor, 2000). The life span of the insect vector is inversely related to temperature as the replication of BTV in the vector increases with rise in temperature. Global warming has been predicted as a cause for the increased competence of *Culicoides* species to transmit BTV and also for the expansion in the global distribution of bluetongue (MacLalchan, 2010).

Pathogenesis

Upon cutaneous inoculation of virus via the bite of Culicoides infected with BTV, the virus first replicates in the local lymph nodes, the site of primary replication (MacLachlan, 2004; Hemati *et al*., 2009). Afterwards, virus is disseminated via blood to the secondary organs like lymph nodes, lungs and spleen, where it replicates in the vascular endothelial cells, lymphocytes and macrophages (Sanchez-Cordon *et al*., 2010; Sperlova and Zendulkova, 2011). BTV causes damage to small blood vessels of the target tissues causing vascular obstruction and tissue infarction. The virus induces the production of vasoactive mediators by endothelial cells, thrombocytes, macrophages and dendritic cells which enhance the damage to the endothelial lining in blood vessels,

increasing permeability of vessels resulting in occurrence of oedema and infarctions (Sperlova and Zendulkova, 2011).

Clinical signs and pathology

Acute, chronic and subclinical forms of bluetongue are manifested in sheep. Fine wool breeds are more susceptible. Viraemia is evident around 3-5 days after infection (Foster *et al*., 1991). Clinical signs in acute condition encompass fever, malaise and anorexia, excessive salivation, respiratory problem, nasal or ocular discharge which may be serous to bloody, petechial haemorrhages in nasal and oral mucous membranes, erosions and ulcers in oral mucosa, stiff gait, hypraemia and haemorrhage in coronary band, oedema in head and neck and congestion of conjunctiva and skin. Cyanosis of tongue is a rare occurrence. Animal suffering from acute BT infection scummb to injuries within two weeks of infection. Emaciation is seen in sheep that survive acute infection as muscle injury and necrosis induced by BTV lead to torticollis, dermatitis and wool break (Elbers *et al*., 2008). The post-mortem lesions include congestion in blood vessels, haemorrhage, erosions and ulcerations of nasal and upper gastrointestinal tract mucosa, haemorrhages in pulmonary artery, excessive froth in trachea, pulmonary oedema, and cardiac and skeletal muscle necrosis with papillary muscles of the left ventricle being the peculiar site (Spreull, 1905; Verwoed and Erasmus, 2004).

BTV infection in goats is less frequent than in sheep and clinical signs are rare in cattle. However, in Central Europe and Western Europe cattle manifested clinical signs after infection with the BTV-8 serotype. Cattle are considered to act as reservoirs and aid in transmission of BTV (Elbers *et al*., 2008).

Diagnosis

A confirmatory laboratory diagnosis of bluetongue is done by isolation of virus, antigen detection, nucleic acid detection and serological assays (Afshar, 1994). Samples for laboratory diagnosis include blood in EDTA or heparin, serum, red bone marrow, liver (adult sheep) and spleen (lamb) biopsy and post-mortem samples include spleen, lymph node, bone marrow, lung, liver, heart and in addition brain of aborted fetuses (Parsonson, 1990; Tweedle and Mellor, 2002). The gold standard method for the diagnosis of bluetongue disease is isolation and identification of the virus. Embryonated chicken egg (ECE), 9-12 days old is used for the intravenous inoculation (I/V) of

sonicated blood and tissue samples. Many cell lines like KC (derived from *Culicoides variipennis* or *sonorensis*), baby hamster kidney (BHK-21), mouse L, Vero and Aedes *albopictus* origin C6/36 (AA) are used for isolation of BTV. Agar gel immunodiffusion (AGID) test was earlier used for the detection of BTV antigen. Identification of BTV serotypes is routinely done using virus neutralisation test (VNT) (Reddington *et al*., 1991). Currently, antigen capture ELISA is also used for detection of BTV antigen in blood and tissue samples (Thevasagayam *et al*., 1996; Chand *et al*., 2009). Indirect-ELISA and c-ELISA are routinely used for the detection of serogroup- specific antibodies against BTV (Afshar *et al*., 1989; Martyn *et al*., 1990;; Chand *et al*., 2017). Serum neutralization test (SNT), a sensitive and specific technique is used for detection and serotyping of BTV (Reddington *et al*., 1991; Hamblin, 2004). NS1 (segment-7) gene-based PCR assays have been recommended as an official test for international trade as per OIE (2012). For quantitative detection of viral RNA and identification of serotype, real-time PCR based assays have been reported (Wilson *et al*., 2009; Leblanc *et al*., 2010; Chand *et al*., 2019a).

Prevention and Control

The effective control strategy includes vaccination of the susceptible animals, management practices and control of the vector. However, a wide range of susceptible hosts and BTV serotypes makes it difficult for its effective control. Vaccination can be used for the prevention of disease or to interrupt the natural cycle of BTV (Savini *et al*., 2008; Caporale and Giovannini, 2010). Live attenuated and inactivated vaccines have shown better results in China, African and other European countries (Stott *et al*., 1985; Bhanuprakash *et al*., 2009). A pentavalent inactivated vaccine comprising of BTV serotypes-1, 2, 10, 16 and 23 is being used in the country (Reddy *et al*., 2010).

Conclusion

Bluetongue is a vector-borne viral disease of domestic and wild ruminants that predominantly affects sheep. The disease has economic impact of country by direct losses due to death of animals, abortions and production loss and indirect losses due to export limitations of live animals and animal products. The midges of *Culicoides spp.* transmit the virus between the susceptible vertebrate hosts. The disease is earlier restricted to specific geographical area between 35° S to 40° N, but due to global warming and environmental condition favorable for vector reproduction the BTV spread beyond this geographical area. The most emphasizing factor for the diagnosis of BTV does not limit

itself to the detection but also involves the differentiation of serotypes as a prime aspect. Vaccination remains the choice as an effective control strategy, along with good management practices and control of insect vector.

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Available on request

A review of pharmacological activities of *Bryophyllum pinnatum*

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Abstract

Bryophyllum pinnatum, popularly known as Panfuti is a medicinal plant used worldwide for various medicinal purposes including treatment of in treatment of hypertension, skin disorders, asthma, cold, insect stings, diarrhea, abscesses, bleeding disorders, renal calculi, jaundice, ulcers etc. It has many phytochemical constituents which are having pharmacological activities such as anti-inflammatory, antilithiatic, antimicrobial etc. In this review various pharmacological properties of *Bryophyllum pinnatum* are discussed.

Introduction

Bryophyllum pinnatum/ *Kalanchoe pinnata* which belongs to the family Crassulaceae is an environmental weed commonly used in folkloric medicine in tropical Africa, India, tropical America, China, and Australia (Khooshbu & Ansari, 2019). It is commonly known as Pathar kuchi, Zakham-e-hayat, Life plant, Air or Maternity plant, Love plant, Canterbury bells, Cathedral bells, Parnabija, Panfuti etc. Traditionally it is used in treatment of hypertension, skin disorders, asthma, cold, insect stings, diarrhea, abscesses, bleeding disorders, renal calculi, ulcers etc. (Nagaratna & Hegde, 2015). It is also known to have pharmacological activities such as antimicrobial (Oliver-Bever, 1983; Mehta *et al*., 1952), antifungal properties (Misra & Dixit,1979), anti-inflammatory, analgesic properties (Pal & Chaudhuri, 1989), antiulcer properties (Pal & Chaudhuri, 1991), antihypertensive (Ojewole,2002), antiallergic activity (Pal *et al*., 1999). The name *Bryophyllum pinnatum* comes from the Greek words bryo, which means sprout, and phyllon, which means leaf, indicating the ability to spread by leaf cutting. Pinnatum

comes from the Latin term pinnatum, which means feathered or winged (Nagaratna & Hegde, 2015). The leaves are most commonly used for its medicinal properties.

Taxonomical classification

Kingdom: Plantae

Division: Magnoliophyta

Class: Magnoliopsida

Order: Saxifragales

Genus: Kalanchoe

Section: Bryophyllum

Species: K. pinnata (Pattewar, 2012)

Phytochemical constituents

Bryophyllum pinnatum contains an abundant amount of phytochemically active constituents such as alkaloids, triterpenes, glycosides, flavonoids, cardienolides, steroids, bufadienolides, and lipids. Bufadienolides, a class of compounds found in the leaves, are extremely active. Bufadienolides, such as bryotoxin A, B, and C, have a structure and activity that is remarkably similar to two other cardiac glycosides, digoxin and digitoxin with antibacterial, anticancer, and insecticidal actions (Gaind & Gupta, 1972, 1974; McKenzie *et al*., 1987; Yamagishi *et al*., 1989).

Pharmacological activities

1) **Antimicrobial activity:** The presence of phenolic compounds in the plant is suggestive of its antimicrobial action. Many studies have been carried out to detect the antimicrobial properties of leaf extract of *Bryophyllum pinnatum*. Ofokansi *et al*. (2005) carried out an *in vitro* study of antibacterial activity of leaf extract of Bryophyllum pinnatem on several bacteria and concluded that the plant is effective against many bacterial species *Staphylococcus aureus, E. coli, Bacillus, Pseudomonas aeruginosa, Klebsiella pneumonia,* and *Salmonella typhi.* Other study revealed that B. pinnatum leaves extracts have varied antibacterial activities against the tested Gram-positive & Gram-negative organisms among which, methanol extract of leaves showed marked antibacterial activities against Staphylococcus aureus, Enterococcus faecalis, Bacillus subtilis and Pseudomonas aeruginosa when compared to the control antibiotic (Akinsulire *et al*., 2017). Two flavonoid compounds were isolated and found to have

antibacterial as well as antifungal activity in another in-vitro research (Akinsulire *et al*., 2007), both flavonoid compounds were found to be active against bacteria (*Escherichia coli, Pseudomonas aeruginosa, Klebsiella pneumoniae, and a gram-positive Staphylococcus aureus*) as well as fungi *Candida albicans* and *Aspergillus Niger*.

2) **Anilithogenic and Nephroprotective activity:** Shukla *et al*. (2014) carried out a study on male wistar rats to determine the effect of leaf extract of *Bryophyllum pinnatum* on ethylene glycol induced urolithiasis. The study revealed that in comparison to the control group, administration of an aqueous extract of *Bryophyllum pinnatum* leaves considerably lowered urine oxalate levels. All groups supplemented with aqueous extract of *Bryophyllum pinnatum* saw significant improvements in serum creatinine and blood urea levels. Animals given ABP had considerably lower relative kidney weight and calcium oxalate depositions than those in Group B. a clinical study was carried out on 23 clinically diagnosed lithiasis patients with stones ranging in diameter from >5mm to 10mm were given a dose of 10ml/day *Bryophyllum pinnatum* leaf extract orally, daily in the morning, with an empty stomach for 30 days. Twenty patients passed stones and three had their size reduced during the research. In 87 percent of patients, there was a significant improvement, and in the remaining 13 percent, there was a modest improvement. There was also a decrease in urinary oxalate and phosphate, as well as an increase in citrate excretion, which was beneficial (Gahlaut *et al*., 2012).

3) **Anti-hypertensive activity:** The effects of aqueous and methanolic leaf extracts of the plant on arterial blood pressures and heart rates in normal (normotensive) and spontaneously hypertensive rats were investigated. Both the aqueous and methanolic leaf extracts of *Bryophyllum pinnatum* (BP, 50-800 mg/kg i.v. or i.p.) reduced arterial blood pressures and heart rates in anaesthetized normotensive and hypertensive rats significantly with more pronounced effect on hypertensive rats (Ojewole, 2002).

4) **Anti-diabetic effect:** Ezeagu *et al*., 2017 conducted an experiment to determine the anti-hyperglycemic effect of *Bryophyllum pinnatum* leaf extract on experimentally induced diabetic rats. Diabetes was induced by injection of alloxan monohydrate intraperitoneally in rats. The results showed that Bryophyllum leaf extract when given at 200 and 400 mg/kg body weight gave an excellent anti-hyperglycemic effect in the

treatment group compared to diabetic control group. In another study on diabetes induced rats, the presence of anti-diabetic action of B. pinnatum aqueous leaf extract in four distinct doses (200, 400, 800mg/kg and 800mg/kg + glibenclamide 2mg/kg) was discovered. When compared to the other dose, the 200mg/kg aqueous extract resulted in a considerable reduction in blood sugar levels with 800mg/kg + glibenclamide 2mg/kg being the most superior (Aransiola *et al*., 2014).

5) **Hepato-protective activity:** Juice of fresh leaves of Bryophyllum pinnate, is used in many regions of India for treatment of jaundice. In a study, protective effect of ethanolic extract of leaves of Bryophyllum was studied on carbon tetrachloride-induced hepatic damage in rats, and it was discovered that the ethanolic extract of the leaves lowers liver enzymes, serum bilirubin, serum cholesterol, and serum total protein. The plant has a clear hepatoprotective effect, according to the findings. Hepatocyte regeneration is increased, and microsomal enzyme inhibition protects the liver from injury (Yadav and Dixit, 2003).

6) **Antileishmanial activity:** Quercetin is a flavonoid in the herb are responsible for the *Bryophyllum pinnatum* plant's anti-leishmanial properties. It was demonstrated in an aqueous extract of leaves by comparing three flavonoids to quercitrin, quercetin, and afzelin against *Leishmania amazonensis* amastigotes. It was also discovered that the oral route was more effective than other routes such as intravenous route or topical. The quercetin aglycones with a rhamnosyl unit connected at C-3 was discovered to be required for the anti-leishmanial activity of the leaf extract (Muzitano *et al*., 2004).

7) **Neuropharmacological activities:** B. pinnatum has been used for many years in traditional medicine and folk medicine as an antipsychotic agent. In a study the antinociceptive peoperty of *Bryophyllum pinnatum* leaf aqueous extract was evaluated using the hot-plate and acetic acid test models of pain in mice. The aqueous extract of the leaves at 25–800 mg/kg i.p. produced significant antinociceptive effects against both thermally- and chemically-induced nociceptive pain stimuli in mice. Yemitan & salahdeen, 2005 carried out an experiment to determine the neurological effects of *Bryophyllum pinnatum* aqueous extract on mice. According to the results, it caused a dose-dependent increase of the onset and duration of pentobarbitone-induced hypnosis in mice, as well as a decrease in exploratory activity in the head-dip and evasion tests. Furthermore, in the inclined screen, traction, and climbing tests, there was a dose-

dependent muscle in-coordination. Salahdeen also conducted an experiment to evaluate the neuropharmacological property of *Bryophyllum pinnatum* aqueous extract in mice, the results suggested that the extract has depressant activity on CNS with significant decrease in locomotor activity in a dose dependent manner.

8) **Antiulcer activity:** In a study male albino rats were used to test the effect of *Bryophyllum pinnatum* leaf extract on indomethacin-induced stomach ulcers. The findings revealed a dose-dependent reduction in the incidence of ulceration and mean basal and histamine-stimulated stomach acid secretion, so validating the use of *Bryophyllum pinnatum* as an antiulcer agent in traditional medicine (Adesanwo *et al*., 2007). Sharma *et al*., 2014 also found similar results in ethanol induced gastric damage with *Bryophyllum pinnatum* aqueous extract having gastroprotective effect.

9) **Anti-inflammatory and Wound healing activity:** In Formaldehyde-induced hind oedema in rats, leaf extracts of B. pinnatum with various fraction were found to have anti-inflammatory activity in doses of 500mg/kg orally once a day for two days, with methanolic extract being the most potent with low significant inhibition in early stage and significant inhibition at a later stage of inflammation when compared to the standard drug Indomethacin (Gupta *et al*., 2010). The high saponin content and tannins in the plant can explain its wound healing properties as saponins have properties like precipitating and coagulating blood, foam forming ability in aqueous solution, cholesterol binding property; tannins have astringent activity which might enhance the wound healing. These properties might explain its use in treating the wounds and burns (Pattewar, 2012). Another study revealed that B. pinnatum leaf extracts (petroleum ether, water & alcohol) has wound healing action of in the dose of each 400 mg/ kg orally on healing of excision wound, re-sutured incision and dead space wound models in Albino rats when given for 10 consecutive days. It also improved the granulation tissue formation and granulation strength (Khan *et al*., 2004).

10) **Anti-cancer activity:** Afzal *et al*., 2012 separated five Bufadienolides from *Bryophyllum pinnatum* leaves which was investigated for its inhibitory effect against EBV (Epstein-Barr virus) early antigen. It showed significant inhibitory action against it. Yamagishi *et al*., 1989 isolated Bryophyllin B, which is a Bufadienolides from leaves of *Bryophyllum pinnatum* which was shown to have potent cytotoxic and antitumor activity. In another study, chloroform extract of *Bryophyllum pinnatum*

leaves was investigated for its inhibitory action on HPV cervical carcinoma cells. The results revealed anti-HPV and anticancer properties of plant extract (Mahata *et al.*, 2012).

Conclusion

Bryophyllum pinnatum has excellent phytochemical constituents which are pharmacologically active. It has potent pharmacological properties as antibacterial, antileishmanial properties, antilithiatic, hepatoprotective activity, nephroprotective activity, anti-inflammatory, analgesic, antiulcer, anticancer, anti-hypertensive and anti-diabetic properties. Various studies have proven its effect and justified its use in traditional medicine worldwide for many years. More studies should be carried out to prove its safety and efficacy.

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Possible solutions to curtail long-term impact of covid-19 pandemic on healthcare scenario in India

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Abstract

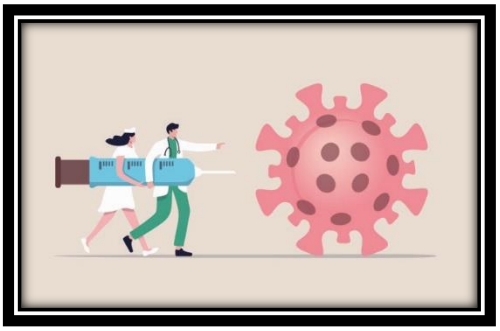
Prevalence of infectious diseases has increased globally as humans have spread across the world. Outbreaks have been occurring frequently, but every outbreak does not reach a global pandemic level as the Novel Coronavirus (COVID-19) has. The COVID-19 pandemic has actually displayed the total health care system all over the world as well as India. Due to this pandemic the demand of health care activities and health care personnel has increased in a supreme level all over the world. This pandemic had major effects on the health care, the pharmaceutical sector, and was associated with considerable impacts; which may appear in short and long-term time-horizon and need identification and appropriate planning to reduce their socio-economic burden.

Introduction

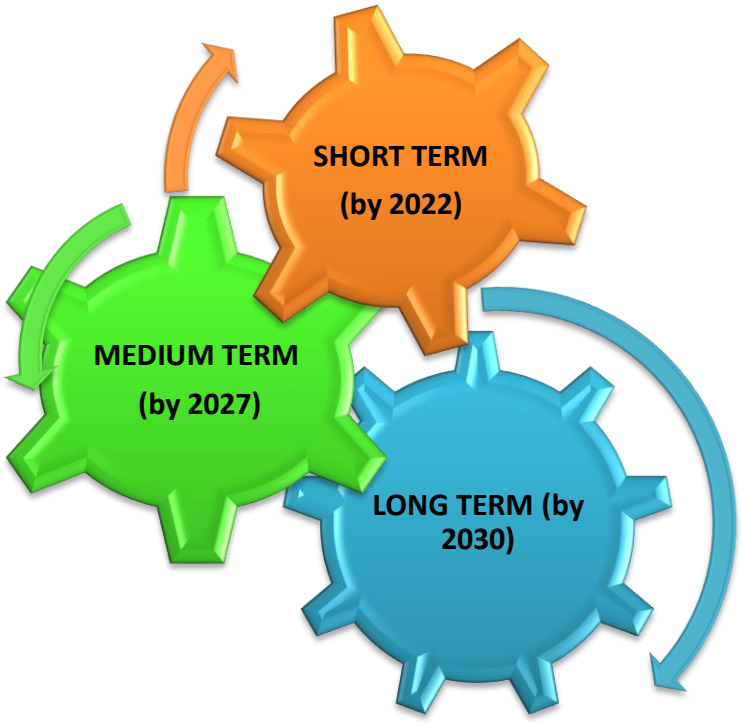
Pandemics are large-scale outbreaks of infectious disease with high burden of morbidity and mortality over a wide geographic area and cause significant economic, social, and political disruption. Healthcare is in a state of flux and there will be financial tough times in the near term for many health systems. In India especially a large amount of health care professionals as well as the health care activity is required on urgent basis. As a consequence of lack of healthcare professionals and facilities a large number of activities are still untouched in our country.

Globalization, with increased global integration and travel, urbanization, and greater exploitation of the natural environment, has led to pandemics spreading quickly, with COVID-19 being deadliest of all witnessed in our lifetimes thus far. While currently all the energies in the country are focused on controlling the transmission and curtailing morbidity and mortality due to the pandemic, here we take a look at how this infection and its fallouts can impact the healthcare scenario in India and some of the possible solutions

for it.



We are in a position to formulate certain plan with objectives and responsibilities for another five to seven years in order to improve the healthcare sector. That can be divided into three phases such as Short, Medium and Long term plans.

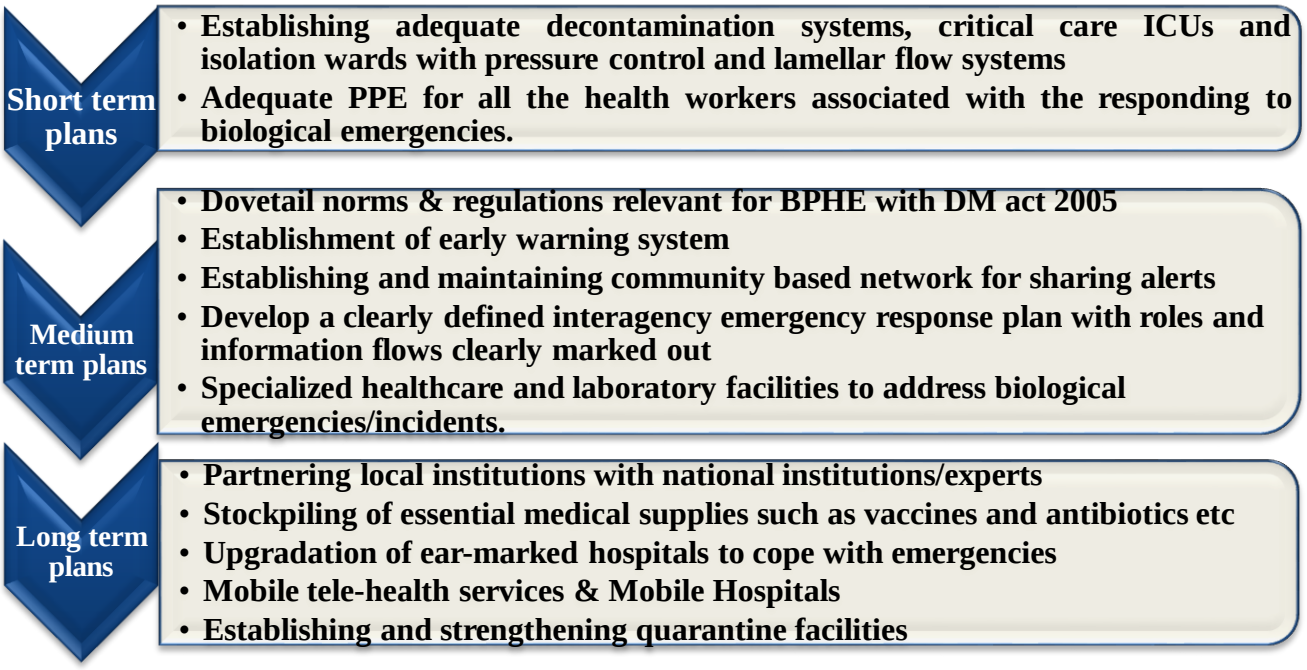


Possible Solutions To Curtail The Long Term Impact

1. Fast-tracking of implementation of targets for public health emergencies within National Disaster Management Plan (NDMP).

2. Community Awareness towards Hygiene will have positive impact in the long-term, though in the short-term likely to increase Primary Health Care (PHC) burden significantly

3. Gaps in Care of patients of other ailments, especially chronic diseases in the short-term can lead to long-term burden on healthcare.



4. Strengthening of Government Infrastructure and Public Private Partnerships (PPP) over next few years, but in the near-term, ongoing plans will see a major realignment.

5. Internalization of Pharma Supply Chain & Make-in-India focus for Medical Equipment

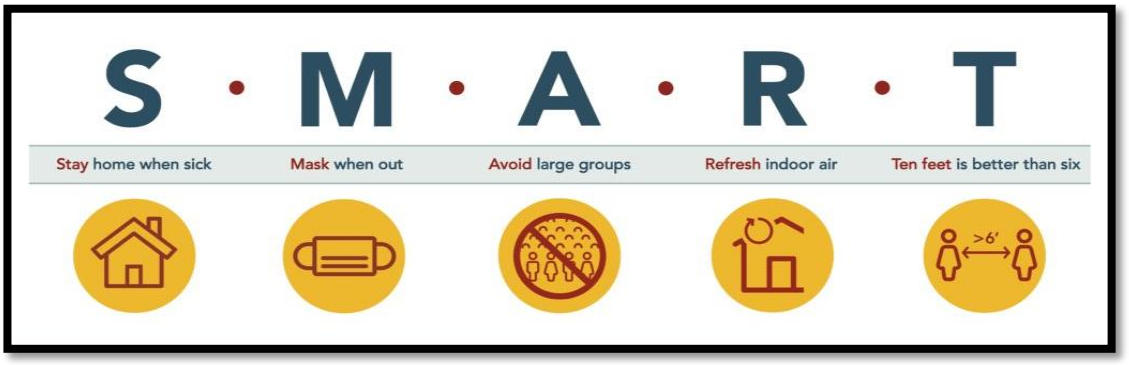
6. Medical Tourism will continue to see a downtrend, at least in the short-term

7. Increased use of Technology, Telemedicine, Training of primary health workers and Mobile hospitals

Conclusion

As we face this humongous challenge and focus on sailing through with minimum damage to human lives, there are opportunities to be unravelled for improvement in the healthcare scenario in the country.

But the only way to tackle any pandemic situation is a good health care system. In India COVID already displayed a fragile health care system and this situation forced India to make difficult choices on how to best meet the needs of their people. Government of India also followed the guideline advised by W. H.O that is to maintain social distancing, using sanitizer with 70 % alcohol, washing hand with soap, etc.



But the scenario is changing and nowadays government has allowed the telemedicine practice with the help of registered medical practitioners. It is already applied in different regions of our countries. But additionally, we need a lot of hospitals and medics also for the treatment of this like pandemics. Health care system should be upgraded but it would involve huge investment in the health care system. So, if we make this facility on an urgent basis, we can save lots and lots of human life.

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IMPACT OF COVID-19 ON LIVESTOCK SECTOR

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Abstract

Covid-19 pandemic has been a global emergency with significant adverse socio-economic impact on the society. Although the mass vaccination program initiated by government which will ensure the protection of public health is going on. However, it is the need of the hour for governments, policy makers and different institutions to make necessary arrangements to identify and attempt to alleviate the downbeat impacts of the covid-19 on the key contributor of food security, nutrition and livelihood. Livestock sector being the key contributor to these areas need utmost care to ensure maintenance of supply chain. Actions should be taken to protect this sector and its activities, services and products upon which the world pin hopes on.

Keywords: Livestock, Nutrition, Covid-19, Pandemic

Introduction

Covid-19 has major impact on the global health and driven back the financial positions by taking lives, destroying livelihood etc. Besides these, it also set off a great loss in our food chain system affecting the livestock sector apprehending its essence and how farmers and livestock industries are struggling. With a population of 536.76 million livestock and 851.81 million poultry, the sector has been the major contributor of animal protein in the country. (DAHD, GOI, 2020) Lesson from the past influenza (1918) and swine (2009) flu pandemic which deranged livestock value chain with socio-economic consequences. In order to stop community transmission of the disease, India was put under national lockdown which affected the vulnerable groups and poverty stricken at great risk. Farmers depending on others resources for such as land, bulk producers, laborers, wage earners etc. were worst affected due to this pandemic. Access of livestock feed in large commercial farms, bulk animal producers (seed farms) were

highly affected due to disruption of transport connectivity. Livestock products being included in the non perishable items, reduction of market access has affected the small scale producers as well as large commercial dairy or livestock farmers as a whole.

Impact On Livestock Industry

Due to Covid-19 pandemic food industries are facing significantly reduced consumption and supply chain disruption challenges. The livestock producers are facing drastic drop in business due to this disruption. The worst part of the countrywide lockdown was that it coincided with the country's peak harvesting time of a variety of crops of the season. Summer vegetables and fruits were ripened, ready to pick; wheat, paddy and barley crops were ready for harvest but the entire farmer's hard work went in vain due to sudden halt of the country. There was a huge demand and supply gap as the food processing companies are running at low manpower. The situation is similar in all affected countries with intensive livestock production industries. Following are some of the major impact of pandemic on animal production:

- Access to Animal feed: Due to shortage of manpower, reduced supply of raw materials has been gravely hit the livestock feed processing industries. Globally for instance certain countries have banned export of livestock produces creating a demand-supply gap in the animal feed industry.

- Diminution of market access: Due to lockdown**,** the disruption of transportation and logistical channels has reduced the sales of live animals as well as livestock products. The pandemic's initial estimated impact on the beef industry is around $13.6 billion, with additional influences that can occur in the future if the covid-19 situation does not come to control. (peel *et al* 2020). Due to shortage of proper cold storage farmers are compelled to dump their non-perishable yields. For instance, milkmen of Palabavi village near Chikkodi in Belagavi district, Karnataka threw around 1,500 litres of milk into an irrigation canal as they had no way to sell it during the COVID-19 lockdown.

- Lockdown halted services: Movement restriction, derange in national and international trade has a major impact upon accessing to breeding stocks, replacement stocks, importing superior germplasm etc. As per the higher officials, the outbreak of African swine fever (ASF) has claimed more than 13,000 pigs in

the last year in different parts of Assam, affecting the livelihood of hundreds of people involved in the animal husbandry in the state. Restrictions on import will have more preponderant impact on certain places which depend on imports to sustain engenderment or rely on meat and dairy imports for consumption.

- Shutdown of services: In order to prevent spread of covid-19, all related services to livestock (except medical aid) around the globe were asked to shutdown their activity which gravely hit the workers/labourers as well as the consumers.
- Fake social media forwards can also reduce the demand and downgrade the livestock industry. For instance, In India during the first covid-19 wave, chicken sales were significantly reduced after a social media storm to create an impression by miscreants that human could contract Covid-19 by consuming chicken.

Measures

Government and policy makers can consider the below mentioned option to mitigate the gravely impact of Covid-19 on the livestock industry while ensuring the public health measures to suppress the transmission.

- Permit specified group of dealers to distribute animal feed in remote areas.
- Waiving the feed transportation cost, farmer's bank loans, tax exemptions, marketing of livestock products in cooperative pattern (bulk collection) will encourage the farmers to ensure proper supply of animal protein.
- Allowing a good no. of shops that serves perishable livestock products to sell in the market with no time frame which will reduce mass gatherings through controlled human movement.
- Allowing agencies to take over trans-boundary animal movements.
- Development of e-commerce platforms will reduce physical contact and help to ease marketing of goods.

Conclusion

Covid-19 pandemic has a huge socio-economic impact. Preparedness and response measures at right time to tackle this pandemic will ensure sustainable livelihood. To ensure uninterrupted supply of meat, milk, egg and other livestock products, it should be included in the emergency goods list. Establishment of bulk collection centers to ensure preservation of perishable items for future use in the high production zones around the country. For rapid sharing of information between the veterinarians/researchers, new emerging technologies should be introduced to the stakeholders/farmers for effectual farm management.

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MALDI-TOF MS: A Rapid Way to Identify Bacteria

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Each testing culture plate has thousands of bacteria and infrequently of various forms. The protein map obtained from bacteriology samples is so complex that using it to diagnose is very difficult, time-consuming and costly. Bacterial identification is mostly based on conventional methods of phenotypic characterization; which include Gram staining, culture and growth characteristics, and biochemical pattern. The traditional strategy of identification using these tests is complex and takes a longer time for identifying bacteria. These procedures affect the diagnosis and hence timely treatment of patients with respect to antibiotic and supportive treatments.

MALDI-TOF MS (**M**atrix- **A**ssisted **L**aser **D**esorption **I**onization-**T**ime of **F**light **M**ass **S**pectrometry) is an innovative tool that's has been recently integrated into the microbiology laboratory workflow as an easy to use, rapid, accurate, and cost-effective technique-with more specificity which has revolutionized bacterial identification in clinical microbiology laboratories. MALDI-TOF-MS identification of bacteria is based on mass signal pattern analysis algorithms and database of bacterial reference. The MALDI-TOF-MS has been used to profile bacterial proteins from cell extracts and has recently been applied to the identification of microorganisms from different genera, different species, and from different strains of the same species. The procedure provides a unique mass spectral fingerprint of the microorganisms. It can identify gram-positive, gram-negative, aerobic and anaerobic bacteria as well as mycobacteria, yeast, and molds, typically at the species level, with accuracy as good and often better than traditional methods when compared to sequencing.

A mass spectrometer is composed of three functional units; (1) an ionizer that converts a portion of the sample into ions, (2) a mass analyzer that separates ions

according to their mass-to-charge ratio (*m*/*z*), and (3) a detection device to monitor separated ions.

MALDI-TOF MS identification is dependent on the ionization of microorganism proteins within the clinical specimen. MALDI ionization mechanism is a type of "soft ionization" that uses transferred energy from a laser to generate protein ions for analysis. The intrinsic property of mass spectrometry is to analyze the mass-to-charge ratio (m/z) of a bioanalyte and providing spectra within minutes. During MALDI-TOF analysis, the m/z ratio of an ion is measured by determining the time required for it to travel the length of the flight tube.

The sample for analysis by MALDI MS is prepared by mixing or coating with a matrix. Matrix is a chemically saturated solution of a low-mass organic compound. The sample within the matrix is ionized in an automated mode with a laser beam. Desorption and ionization with the laser beam generate singly protonated ions from analytes in the sample. The protonated ions are then accelerated at a fixed potential, where these separate from each other on the basis of their mass-to-charge ratio. The charged analytes are then detected and measured by time of flight (TOF) analyzers. Based on the TOF information, a characteristic spectrum called peptide mass fingerprint (PMF) is generated for analytes in the sample.

Identification of microbes by MALDI-TOF MS is done by either comparing the PMF of an unknown organism with the PMFs contained in the database or by matching the masses of biomarkers of an unknown organism with the proteome database.

The identification accuracy of MALDI-TOF MS is dependent on the content of the standard database that the system queries to identify microbial colonies. Mostly used databases and software are Vitek mass spectrometry software and Bruker Biotyper software.

The MALDI-TOF works with much smaller samples, making purification unnecessary. Even if a plate contains multiple different colonies, a diagnostician can focus on one tiny colony without having to isolate and regrow. After one overnight growth, answers come in minutes. While the initial cost of the instrument is high, the cost savings on reagents and labor can offset the expenditure within a few years.

MALDI-TOF MS-based typing may be used as a first-line epidemiological tool. Many researchers have shown that MALDI-TOF MS can be used for early identification of bacteria in blood cultures, urinary tract infections (UTIs), cerebrospinal fluids, respiratory tract infections, stool samples etc. MALDI-TOF MS is useful for the early detection of bacterial hazards which might contaminate drinking water and food. It is also useful in antimicrobial resistance testing and strain typing. As a rapid and accurate microbial identification tool, integration of MALDI TOF MS should change the current standards used in clinical microbiology laboratories. In conclusion MALDI-TOF MS as a microbial identification tool in the routine clinical laboratory provides a powerful and accurate tool to quickly identify microorganisms with subsequent improvement in diagnosis and reduction in the time to appropriate therapy.

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Herbs effective in COVID-19

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Abstract

A new coronavirus illness (COVID-19), spread from person to person, has quickly emerged as the pandemic accountable for the present worldwide healthiness catastrophe. COVID-19 caused by the SARS-CoV-2 (severe acute respiratory syndrome coronavirus 2) is of zoonotic origin. This article will discuss the antiviral and immunomodulatory activities of specific herbs which can be used in dietary therapy and herbal medicine as COVID-19 preventive therapies till discovery or development of specific drugs and vaccines. The foods and plants with antiviral properties against SARS-CoV-2 can help to prevent COVID-19. After being scientifically validated for SARS-CoV-2, these herbs might be used as dietary or supplementary therapy to boost immunity and prevent infection of COVID-19 infections.

Introduction

Towards end of December 2019, a coronavirus epidemic produced by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) began spreading from Wuhan, Hubei, China, resulting in a pandemic worldwide. The fast surge of verified COVID-19 cases and deaths globally sparked widespread alarm due to the higher possibility of catching COVID-19 through its human-to-human aerosol transfer (Boulos and Geraghty 2020). Typical symptoms include fever, coughing, muscular pain, disorientation, headache, shortness of breath and sore throat. Bilateral pneumonia, with or without acute respiratory distress syndrome, was prevalent, as well as rapid mortality

owing to multi-organ failure. Other reliable indications are the loss of taste and smell (Torres & Puig 2020).

There is no effective pharmaceutical therapy for COVID-19. SARS-CoV-2 is an RNA-enveloped single-stranded virus. Understanding the viral lifecycle is required to determine the therapeutic target. The host-entry mechanisms of SARS-CoV-2 and SARS-CoV-1 are identical. Current COVID-19 pharmacological therapies in clinical trials include hydroxychloroquine and remdesivir. In COVID-19 individuals, hydroxychloroquine lowers viral load more effectively when used with azithromycin. Remdesivir has shown clinical improvement against COVID-19. While numerous clinical trials are being conducted to find a possible viable COVID-19 medication, herbal remedies containing well-known antiviral agents are being used for SARS-CoV-2 prevention (Borbone et al., 2021).

Unlike many medicines, herbal and natural substances have minimal toxicity. This is why they may be taken extensively and with appropriate tolerance by individuals all over the world. These natural chemicals also have prophylactic characteristics, which can assist COVID-19 patients not only breathe easier but also prevent acute respiratory distress syndrome (Hoffmann, 2003).

In October 2020, the Indian AYUSH Ministry released an Ayurvedic therapy plan that contains natural substances known to have antiviral characteristics such as ashwagandha, mulethi, and others. Natural chemicals are employed because of their traditional therapeutic functions and abundant availability. These natural products include components that can delay the progression of COVID-19 infection, shorten the length of time of hospitalisation, and may even aid with minor symptoms of the condition.

Many plants, including turmeric, liquorice, alfalfa, red clover contain plant-based estrogens or phytoestrogens that can target SARS-CoV-2 spike proteins and prevent them from attaching to human cells (Cao et al., 2020). The leaves of ashwagandha can suppress the production of an enzyme known as transmembrane protease serine 2 (TMPRSS2), which inhibits SARS-CoV-2 entrance into healthy cells (Kumar et al., 2020).

Certain chemicals in ginger can bind to a bodily enzyme called papain-like protease (PL pro), which is capable of breaking down SARS-CoV-2 proteins (Amin & Jha 2020). Quercetin and gallic acid are phytochemicals found in grapes, strawberries,broccoli, cherries,etc. (King et al., 1999). These drugs can limit the spreading of SARS-CoV-2 in

the body by inhibiting the development of the RNA-dependent RNA polymerase enzyme (Hasan et al., 2021).

Many essential oils have anti-influenza properties like Citrus bergamia (bergamot), Cinnamomum zeylanicum leaf oil (cinnamon), Thymus vulgaris (Red Thyme), Cymbopogon flexuosus (lemongrass), etc. (Vimalanathan & Hudson 2014). The essential oil mix also suppresses influenza virus infectivity by inactivating binding ability of virus. The capture of eucalyptus and tea tree oil on fibre coating materials inactivates influenza virus A (Panyod et al., 2020).

Several common plants, including *Allium sativum, Berberis integerrima* and others, were identified as ACE2 inhibitors and might be explored for COVID-19 prophylaxis following further investigation (Siddiqui et al., 2020).

Application of herbs in COVID-19

Both medication and supplementation of herbs have the potential to be effective antivirals against SARS-CoV-2 as well as COVID-19 preventative medicines. Using foods and herbs as a diet or supplement to prevent infection and strengthen immunity, using as an antiviral agent by coating on masks, as an air-disinfectant (essential oil) to stop aerosol transmission, or as a surface sanitising agent to provide a disinfected environment are effective in preventing COVID-19 (Panyod et al., 2020).

Common herbs may be utilised to stop COVID-19 spread (Table 1). The immunomodulatory impact of these herbs on influenza virus, SARS-CoV-1, and SARS-CoV-2 demonstrates their antiviral activity. Given the current lack of a viable medication and/or vaccination against COVID-19, this will inspire the use of herbs as food therapy and medicine in supplementary COVID-19 preventive strategies. Several clinical studies of herbal remedies against SARS-CoV-2 are under underway. Dietary supplementation and herbal medication can prevent and cure viral infections (Huang et al., 2020).

Table 1 Common Herbs to prevent COVID-19 spread

Sl.no.	Name of the herb	Phytochemicals	Part used	Immunity boosting effect of the herbs	References
1	**Drumstick** *Moringa oleifera Lam.*	Vitamin C, quercetin, kaempferol,	Leaves, fruit	It helps in boosting immunity, fortifying your cells, muscles, and tissues, and assist in healing	Abd Rani et al., 2018

		glucomoringin			
2	**Neem** *Azadirachta indica L.*	nimbolide, azadirachtin	Leaves, fruit, root, stem	It is helpful in protecting the body from dangerous infections, cleanses the blood by emptying out impurities and boost immunity	Susmitha et al, 2013
3	**Tulsi** *Ocimum sanctum Linn*	camphor, eucalyptol, eugenol	Whole plant	It find and eliminate germs, viruses and bacteria as soon as they enter the body	Yamani et al, 2016
4	**Ashwagandha** *Withania Somnifera fam.*	ashwagandha nolide	root, leaves	It reduces stress, which reduces immunological response and renders the body susceptible to viral infections.	Parwe et al, 2020
5	**Ginger** *Zingiber officinale Rosc*	gingerol	Rhizome	It lifts the immune system and destroy viruses to avoid respiratory tract illnesses	Singh et al, 2021
6	**Garlic** *Allium sativum L.*	allicin	Bulb, cloves	It aids the body's ability to resist or eliminate viruses and other germs, as well as combat diseases.	Ryu & Kang 2017.
7	**Turmeric** *Curcuma longa L.*	curcumin	Rhizome	It aids in the removal of toxins from your body as well as the strengthening of your immune system to combat germs and bacteria.	Britto et al., 2020
8	**Black cumin** *Cuminum cyminum L*	Thymol, carvacrol	Seeds	It aids in the removal of free radicals, which decrease your immunity.	Sahak et al., 2016

Daily consumption of kadha, which contains cinnamon, black pepper, ginger, clove and tulsi as major components, is beneficial in the treatment of COVID-19 infection. These culinary spices, which include cinnamon, black pepper, tulsi, and turmeric, have a powerful antiviral effect against SARS-CoV-2 (COVID19) and other viral diseases (Palai et al., 2020)

Surgical masks are effective in preventing viral spread and transmission to people. After removal of the mask, the virus stays on the mask and re-aerosolized, raising human infection risk. So, mask coating with an antiviral agent may be beneficial in disinfection.

In Egypt and India, aromatherapy cures varoisu ailments by utilising essential oils' antibacterial and antiviral properties (Damian & Damian 1995). The usage of essential oil vapours may improve their effectiveness against airborne germs and viruses (Kotan et al., 2013). The anti-influenza viral action of certain essential oil vapours, such as Citrus bergamia (bergamot), Eucalyptus globulus (eucalyptus), is due to the inactivation of the influenza virus's main exterior proteins (Vimalanathan & Hudson 2014). Air sterilisation without endangering human health by utilising essential oils might be an effective method of preventing COVID-19 (Fullick 2019).

Herbal antiviral extracts might be added to cleaning detergents to boost anti-SARS-CoV-2 action. The need for natural medicines, herbal plants, and their formulations must be supplied to this battleground in order to combat the COVID-19 epidemic. Owing to their practicality, cost-effectiveness, environmental friendliness, efficacy, and lack of adverse effects, they must be promoted (Khanna et al., 2020).

Conclusion

There are now just a few allopathic medications that are effective against COVID-19. The mechanism of SARS-CoV-2 infection must be understood in order to design and develop medicines and vaccines. Dietary supplementation and medications of herbs have the potential to act as effective preventative antiviral medicines against SARS-CoV-2/COVID-19. Following experimental validation in SARS-CoV-2 infection models and COVID-19, herbs can be used as a preventative therapy for COVID-19.

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