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Potential Applications of Plant Biotechnology against SARS-CoV-2

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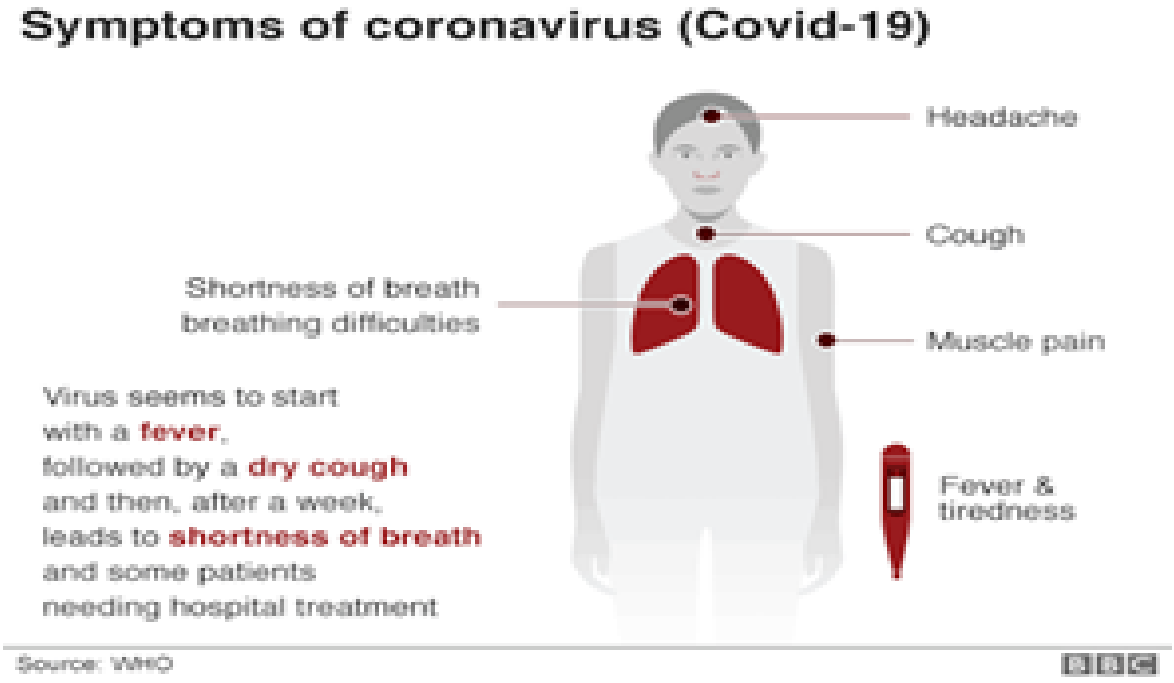
SUMMARY

Severe acute respiratory syndrome corona virus 2 (SARS-CoV-2) is a novel corona virus responsible for an ongoing human pandemic (COVID-19). There is a massive international effort underway to develop diagnostic reagents, vaccines, and antiviral drugs in a bid to slow down the spread of the disease and save lives. One part of that international effort involves the research community working with plants, bringing researchers from all over the world together with commercial enterprises to achieve the rapid supply of protein antigens and antibodies for diagnostic kits, and scalable production systems for the emergency manufacturing of vaccines and antiviral drugs. Here, we look at some of the ways in which plants can and are being used in the fight against COVID-19.This article is associated with COVID-19 outbreak. The first human cases of COVID-19, the disease caused by the novel corona virus causing COVID-19, subsequently named SARS-CoV-2 were first reported by officials in Wuhan City, China, in December 2019. In India first case of the novel Corona virus (COVID-19) was found on 30th January 2020 at Kerala.

INTRODUCTION

A corona virus is a group of viruses known to infect both humans and animals. This virus causes respiratory disease in humans, ranging from the common cold to more serious infections. Signs and symptoms include respiratory symptoms and include fever, cough and shortness of breath. In more severe cases, infection can cause pneumonia, severe acute respiratory syndrome and sometimes death. Standard recommendations to prevent the spread of COVID-19 include frequent cleaning of hands using alcohol-based hand rub or soap and water; covering the nose and mouth with a flexed elbow or disposable tissue when coughing and sneezing; and avoiding close contact with anyone that has a fever and cough. The positive cases of the COVID-19 had increased almost exponentially in India. The most affected Indian state is Maharashtra where the maximum positive cases were found. At initial stages it was very difficult to manage the COVID-19 positive cases in India but later on as per the government safety guidelines against COVID-19 and effortless work from health care worker, situation got under control. In India vaccine development is in progress and soon the Indian people will get vaccinated against COVID-19.



How to prevent the community spread of COVID-19 disease

- Wash hands regularly using alcohol-based hand rub or soap and water and avoid touching your face with your hands.
- Keep social distancing for all people to decrease the spread of virus. Social distance measures work by reducing contact between sick and healthy individuals
- Cover the mouth and nose by face mask to avoid the infection.

COVID-19: How Can Plant Biotechnology Help?

An outbreak of potentially lethal corona virus (SARS-CoV-2) in Wuhan, China, in December 2019, has created a pandemic (COVID-19) that has provoked governments across the world to introduce emergency containment and control measures. The aim of these measures is to delay the spread of infection, thus reducing the acute pressure on hospital beds, frontline medical staff, and resources. Slowing down the rate of infection and thereby reducing the total number of acute cases at any one time can help to prevent the collapse of national healthcare systems. These tactics also give researchers more time to develop effective testing assays to identify carriers, treatments that reduce the severity of symptoms and resolve infections more quickly, and vaccine candidates to protect the unexposed segment of the population.

Why Plants?

Plants have been used as a platform for the production of diagnostic reagents and pharmaceutical proteins for more than 30 years, an approach often described as 'molecular farming'. Several molecular farming companies specialize in the development of plant-derived proteins as diagnostic re agents, for example Agrenvec (Madrid, Spain), Diamante (Verona, Italy), ORF Genetics(Kópavogur, Iceland), and Ventria Bioscience In vitria (Fort Collins, CO, USA). Furthermore, multiple products have been tested in clinical trials, with a small number reaching the market as medical devices and, more recently, pharmaceuticals For example, a chimeric secretory IgA/G produced in transgenic tobacco plants was marketed as a medical device (CaroRX) for topical use to prevent dental caries whereas a recombinant form of the human enzyme glucocerebrosidases produced in plant cell suspension cultures is marketed as a pharmaceutical (taliglucerase alfa,Elelyso) for patients with Gaucher's disease The pioneers of molecular farming originally considered the main advantages of plants to be economy, scalability, and safety, because plants can be cultivated inexpensively on a large scale and do not support the growth of human pathogens However, these advantages have generally not been persuasive enough to displace the major production platforms used in the biologics manufacturing industry.

Diagnostic Reagents

The rapid spread of COVID-19 has generated a sudden and huge demand for diagnostic kits, revealinga critical shortage in the corresponding reagents and the means to produce them. Two major diagnostic assays are required: one to detect the virus itself and, thus, identify the infectedpopulation and potential spreaders of the disease, and one to detect antibodies against the virus and, thus, identify the currently infected as well as convalescent and (potentially) immune population. The publication of the SARS-CoV-2 sequence also provided the information required to generate recombinant viral proteins as diagnostic reagents. The availability of such proteins allows the immediate development of assays to detect serum antibodies in convalescent patients, particularly antibodies against the S protein. Plants provide the means to produce these proteins within a few weeks on a massive scale so that the kits can be manufactured and stockpiled for distribution to testing centres. By contrast, it would take months to establish cell lines expressing the same reagents, and possibly years to ramp up production capacity to the necessary levels. Therefore, we envisage a scenario in which transient expression systems are used to address the pressing need for large quantities of this reagent in the short term (2–6 months), complemented by transgenic plants to achieve even larger-scale production on a longer-term basis. As an example of the former approach, the Italian biotechnology company Diamante is using tobacco to express antigens based on the SARS-CoV-2 RBD for use in ELISA tests for the detection of serum antibodies.

Vaccine Candidates

A conventional approach to vaccine development would be based on inactivated or attenuated strains of SARS-CoV-2, but these approaches take a long time to produce sufficient material and the vaccines have many disadvantages and adverse effects, including the risk of reacquired virulence. A quicker and safer alternative is the production of subunit vaccines based on individual proteins, which could be presented either as individual SARS-CoV-2 antigens in a prime–boost schedule with a suitable adjuvant, or as VLPs with multiple copies of SARS-CoV-2 antigens arrayed on the surface. Both strategies are currently being developed as a means to address theCOVID-19 pandemic.

Antivirals

Antiviral drugs inhibit the viral replication cycle and, therefore, slow down the infection, giving the immune system more time to respond. Many antiviral drugs are small chemical entities produced eficiently using synthetic or semi synthetic processes, and it is unlikely a switch to plant-based production would be beneficial or even practical. However, some proteins can also be used asantivirals, including carbohydrate-binding proteins (lectins) from plants. Lectins are known to bind and inactivate a broad range of viruses by blocking the glycan structures present on the virus surface

Current status of vaccine in India

Vaccines greatly reduce the risk of infection by training the immune system to recognize and fight pathogens such as viruses or bacteria. Vaccine development for disease COVID-19 is already initiated in India and other countries. Indian based three biotech companies are involved in development of vaccine; Serum Institute of India (SII) in collaboration with Astra Zeneca & Oxford university, Zydus cadila and Bharat Biotech. Vaccine developed by all the three companies are in the third phase of human trial and post successful of trials, soon it will be available for Indian public.

Vaccine Developed	Organization	Location
Covishield	Serum Institute of India	Pune
Covaxin	Bharat Biotech	Hyderabad
ZyCov-d	Zydus cadila	Ahmedabad

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