

PLANTS, WARS & PANDEMICS

Aditi Ghose

DISCOVERED in 1892, yet still revealing its secrets in 2020 – viruses are full of surprises. Not quite living and having no way to multiply on their own, you might even assume them to be harmless. But one look at the graphic headlines of the past few months and you know that we are at a war with them. *‘Battling from the Frontlines’*, *‘Acquiring Ammunition’*, *‘Unknown Enemy’*, *‘Increasing Fatality’*, *‘Unseen Invader’*, *‘Rising Fatality’* – the military metaphors keep pouring in. It’s almost too easy to forget that a similar battle – albeit a fiercer and longer one – has been raging for around 300 million years. That’s the battle between pretty plants and hungry herbivores.

It might seem that there can only be one winner to this war – without the ability to see hear or move, plants have a real disadvantage. So why has the battle been dragging so long? It turns out that thanks to the epic battle with animals, plants have developed vicious poisons, lethal ammunition and even cunning forms of communication. These terrifying tactics have helped



Giant Sequoia - Most massive trees on earth

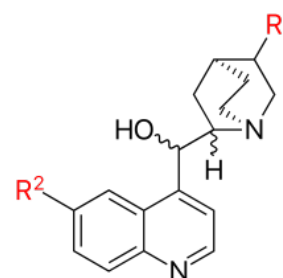
them see-off dinosaurs to caterpillars, making them the oldest, biggest and most abundant ones on earth. What’s more, the weapons in *our* arsenal today – from our foods to medicines – are the products of wars that the plants fought and won. Some of those plant-based medicines are even helping us hold fort against pandemics.

Hitching a ride on a busy travel season and our own ill-preparedness, the novel coronavirus, SARS-CoV-2, has, in a span of months, travelled to 185 countries worldwide – and still counting. A master of disguise and a cunning manipulator of genes, the virus has used our body’s defences against us – afflicting and killing indiscriminately. An effective cure and a reliable vaccine for COVID-19 are months, probably years, away. As the first line of defence, we choose to rely on the defence mechanism of plants. Clinical evaluation of chloroquine phosphate – a structural analogue of quinine, originally extracted from the bark of cinchona trees – has shown to alleviate symptoms for most patients and expedite virus antibody generation. Depending on results from

more than 10 hospitals across several provinces, the Chinese State Council on 17 February 2020 had announced that chloroquine phosphate – the anti-malarial and broad-spectrum antiviral drug, with proven regulatory effects on the immune system – can and will be used for treating COVID-19 patients.



Cinchona Flowers



Cinchona Alkaloids



Bristlecone Pine - Oldest known woody trees in the world, some as old as 4,500 years

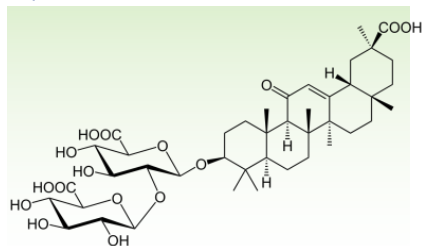


Cinchona Bark

Another plant-origin recruit to contain COVID-19 is an extract of liquorice roots – diammonium glycyrrhizinate. While liquorice has traditionally been employed against coughs, colds and disturbed digestion, its extract has been known to have anti-inflammatory activity and used in the treatment of liver damage by Hepatitis-B. Proposed as a treatment for COVID-19, in combination with Vitamin-C by Prof. Hong Ding of Wuhan University – clinical trials for this therapy have recently been approved. Patent herbal drugs – Lianhua Qingwen capsules and Radix isatidis granula, already proven useful in SARS-CoV outbreak of 2003, along with Huoxiang Zhengpi capsules are extensively being deployed to combat COVID-19. They have been known to improving symptoms such as coughing, weakness and digestive system disorders along with alleviating anxiety.



Liquorice Flowers



Glycyrrhizic Acid



Liquorice Root

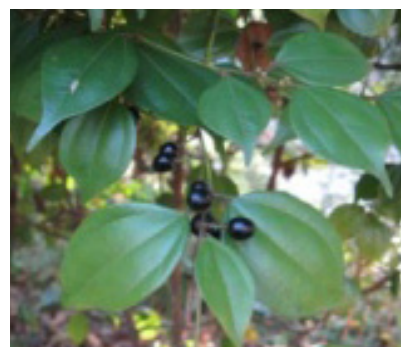
It's not the first time that we are seeking their help. Anti-viral medicines of plant origin have been resorted to during the previous coronavirus outbreaks in 2003 and 2012 and seasonal epidemics of influenza and dengue. *Lycoris radiate*, *Artemisia annua* and *Lindera aggregata* extracts and natural products isolated from *Isatis indigotica*, *Torreya nucifera* and *Houttuynia cordata* have shown anti-Severe Acute Respiratory Syndrome (SARS) effects. To prevent dengue virus entry into the host and inhibit post-entry replication, another plant defense – flavone Baicalein – was employed. Besides, natural products from *Pelargonium sidoides* roots and dandelion inhibit virus entry and key viral enzyme activities and are strong anti-influenza drug candidates. Turns out, we have been thriving on the spoils of the plant-animal million-year war!



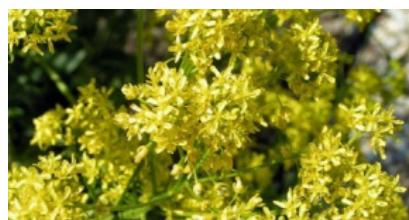
Lycoris radiate



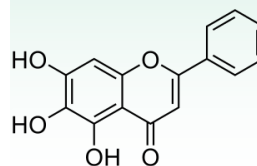
Artemisia annua



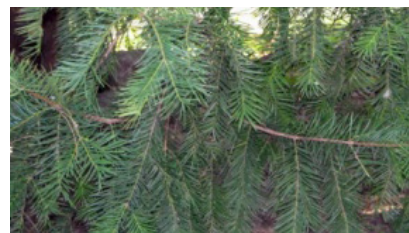
Lindera aggregata



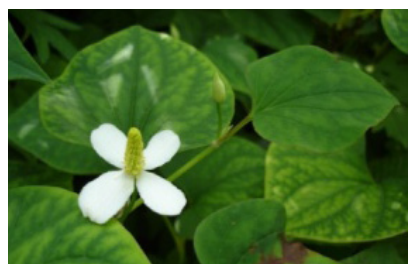
Isatis indigotica



Flavone Baicalein



Torreya nucifera



Houttuynia

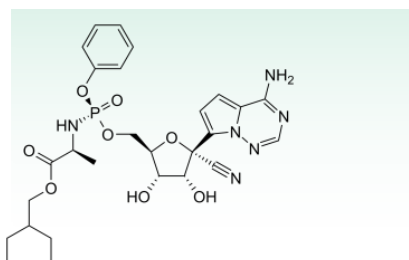


Pelargonium sidoides



Dandelion

Yet ‘war’ is clearly a misnomer for the practice of medicine. As Adina Wise, M.D., neurology resident at Mount Sinai Beth Israel Hospital (Downtown), New York warns in a Scientific American discourse, “To adopt a wartime mentality is fundamentally to allow for an all-bets-are-off, anything-goes approach to emerge victorious. And while there may very well be a time for slapdash tactics in the course of weaponized encounters on the physical battlefield, this is never how one should endeavour to practise medicine.” In medicine, we understand, emergencies – even pandemics – are never an excuse for shortcuts. Routine drug development proceeds with researchers discovering a drug molecule with targeted potential therapeutic activity, optimizing its structure and validating its function using in-vitro experiments, followed by animal and clinical trials. In contrast, plant origin medicines and plant natural products are less clearly understood mechanistically. Yet, they have been used in clinics for hundreds or thousands of years, with well-established safe usage and documented side-effects. Once found effective, its safety already recognized, these plant-based decoctions may be immediately deployed for treating patients. In emergencies like COVID-19, this timeliness is another advantage associated with plant-based drugs.



Structure of Remdesivir - The only drug right now that may have any real efficiency in treating COVID-19

It is for this reason that epidemiologist Nanshan Zhong, credited with discovering the SARS coronavirus in 2003 and advising on the management of COVID-19 outbreak clarifies that chloroquine phosphate is not a highly effective cure

but its effects deserve attention, even though its pharmaceutical mechanism remains unclear. Nevertheless, as a complementary treatment, in combination with other potent treatments, they help to elevate recovery rates. WHO Assistant Director-General Bruce Aylward had upheld Remdesivir, an experimental drug, developed against Ebola as the only “drug right now that we think may have real efficiency”. But such drugs take time to pass clinical trials. In emergencies like COVID-19, readily available *war spoils* – potent plant products with proven efficiency and safety – buy time as the ‘*first line of defense*’.



Large locust swarms such as these can consume over 1,00,000 tonnes of food each day - enough to feed tens of thousands of people for one year.

While COVID-19 is affecting human health worldwide, pests and diseases are threatening plant health too. Food and Agriculture Organisation of the United Nations estimates up to 40% of food crops are lost to plant pests and diseases annually. Climate change and human activities not only lower yields and reduce the nutritional value of crops, they also alter ecosystems. This leads to more plant pests appearing earlier and in places they were never seen before. International travel and trade – having tripled in volume in the last decade – can and does quickly spread pests, like diseases, around the world.

The last 50 years have seen the emergence of a wide variety of coronaviruses. In all probability, they will continue to recombine, mutate and infect multiple species and cell types. Strengthening our defences, understanding its responses and

designing appropriate preventions must go a long way to contain these virions. As with human health, preventive measures – be it against viruses or pests – are far more cost-effective than dealing with full-blown emergencies. After all, plants make 80% of the food we eat, 98% of the oxygen we breathe, provide USD 1.7 trillion worth of trade in agricultural products annually while dealing with hungry pests, rising temperatures, habitat losses and an 80% reduction in beneficial insect population over the last quarter of the century. Protecting plant health is thus of vital importance for our food-security, our medicinal requirements and essentially for our own well-being – as expressed by this year’s International Year of Plant Health slogan – Protecting Plants, Protecting Life. There might never be a better time to choose *our* side in this plant-war than the pressing pandemic.



INTERNATIONAL YEAR OF
PLANT HEALTH
2020

United Nations General Assembly
declared 2020 as the International Year of
Plant Health

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Aditi Ghose is engaged as Education Assistant at the Birla Industrial & Technological Museum, Kolkata, one of the outreach divisions of the National Council of Science Museums (NCSM), Ministry of Culture, Govt. of India. She’s a passionate science communicator and has recently been adjudged as one of the winners of the Nature India Essay Competition 2020, in partnership with the Council of Scientific & Industrial Research, for her take on how socially-impactful science can advance and strengthen the country.