Researchers unlock the secrets of fungal viruses: Why it matters

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Credit: AI-generated image (disclaimer)

In the past year the world has been overwhelmed with rapidly emerging, important and fascinating information regarding SARS CoV-2, the virus that causes COVID-19. The pace of learning has been astounding, not just for the general public but for virus experts.

There are millions of viruses out there, including many that don't directly infect animals or humans. Some are better understood than others. Among the least studied are viruses that infect fungi. But it's becoming increasingly important to address this gap: fungal viruses can cause tremendous damage, for instance by hitting agricultural outputs. Researchers estimate that such viruses destroy up to 30% of crop products. This has huge implications for food security.

In the past few decades the technology needed to sequence and study fungal viruses has improved in leaps and bounds. This, coupled with a rising understanding among scientists that fungal viruses have very real and frequently negative consequences, hopefully means we're at the dawn of a new era when it comes to understanding fungal viruses.

Until recently there were only a few types of viruses easily detected in fungi. But this has begun to change. In a recent paper with colleagues we used the latest RNA sequencing technology to identify a whole host of single stranded RNA viruses in the notorious plant pathogenic genus *Armillaria*. We also confirmed previous studies which had showed that species in this genus did not contain double stranded RNA viruses. Knowing this is important because the first step in managing any disease is identifying and understanding the causal agent.

This illustrates how technology is allowing researchers to better understand fungal viruses, and come up with ways to manage them.

Varied viruses

The first fungal viruses were discovered in the 1940s in Agaricus bisporus, the most common commercially cultivated mushroom. This viral infection causes a malady known as "La France disease" and results in malformed fruiting bodies (mushrooms) and yield loss.

Certain fungal viruses, when properly understood and harnessed, can become helpful and useful. Some, for instance, make the fungi they infect less aggressive, a phenomenon called hypovirulence. One example is the hypovirus CHV1, which reduces virulence in the tree pathogen *Cryphonectria parasitica*, one of the most devastating of all plant-killing fungi. It decimated natural populations of the American chestnut tree, beginning in the early 1900s. CHV1 was first discovered in Europe in the 1960s after people noticed that European chestnut trees affected by *C. parasitica* had begun to recover. They did not suffer the same devastation that befell the American species.

Hypovirulent viruses have been of great interest to researchers because of their potential as biocontrol agents of fungi that cause serious plant diseases. But to work out which fungal viruses are uniformly harmful and which might be harnessed for biocontrol, scientists first have to study the viruses' genetic makeup.

New DNA sequencing technologies have heightened the ease with which fungal viruses can be studied. This has led to a huge increase in the number of fungal viruses that are being characterized. Researchers have recently used the latest technology to focus on the earlier-diverging lineages of the fungal kingdom. They found that just over 20% of the microorganisms they studied contained RNA viruses. These viruses also included novel lineages not previously recorded.

All of this deepens our understanding of how these viruses emerge and function—which makes combating them potentially easier in future.

Scientists are also starting to better understand how fungal viruses move between species. Some recently discovered fungal viruses are most closely related to viruses that were thought to infect plants only. It is speculated that these viruses may have been acquired from plants in a manner similar to the way bat viruses have in some cases adapted to become human pathogens. It is also possible that fungal viruses might infect plants, although little is as yet known regarding this possibility.

Much more to learn

As fungal viruses are increasingly studied, the great breadth of their diversity is becoming clear. And their role in the biology of fungi will likewise become more evident.

I have been studying fungal viruses for decades. My Ph.D., completed nearly 30 years ago, focused on fungal viruses, specifically those of the common brewer's yeast, *Saccharomyces cerevisiae*, which is used in brewing and baking. I am convinced that many new opportunities, especially associated with the biological control of plant and human diseases caused by fungi, will emerge from the study of fungal viruses.

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