nature

[insideview]

medicago

Profile Feature as seen in *Nature* 25 June 2020

THE PROMISE OF PLANT-DERIVED VACCINES AND THERAPEUTICS

A conversation with **DR. BRUCE D. CLARK**, President and CEO of Medicago

A pandemic is a challenging but interesting moment for anyone involved in infectious disease, particularly those developing therapeutics and vaccines. That holds doubly true for Medicago, a Canadian biopharma company. Medicago uses plants to produce vaccine and therapeutic candidates, and the platform has found new purpose in the age of coronavirus. Dr. Bruce D. Clark, who became the company's CEO in March 2017, is overseeing its push to become a fully integrated biotech, with a seasonal flu vaccine close to market and another vaccine against COVID-19 under rapid development.

How did the company come to focus on vaccines?
Our company name comes from the Latin for alfalfa, *Medicago sativa*, and we began in 1999 as nutraceuticals producer. The knowledge we gained on the plant's biological mechanisms and processes allowed us to use them as small bioreactors to produce vaccines and therapeutic antibodies. Today, we can go from genetic sequence to clinical grade material in six to eight weeks.

How can plants serve as a platform for vaccine development?
Our plants produce Virus-Like Particles, or VLPs, in high volume. While non-infectious and non-replicating, VLPs, like a virus without genetic material, present a shell structure studded with the antigen required to trigger immunity.

Producing vaccines in hens' eggs—the process for most seasonal flu vaccines—carries risk of virus mutation during the manufacturing process, potentially rendering the vaccine less effective. Cell-based vaccine manufacturing is another emerging technology, but using cells as bioreactors can make scale-up challenging. Different growing conditions can mean small, but potentially clinically significant differences in the final protein. Our scale-up doesn't require a change in growth medium from bench to commercial manufacturing; it only requires the space to grow more plants.

What is the status of your COVID-19 vaccine?
Because our platform is rapid, we were able to produce a vaccine candidate in just 20 days after receiving the SARS-CoV-2 viral sequence. As of mid-May, we finished initial pre-clinical studies; the next step is non-human primate studies. Our objective is to initiate phase 1 human trials in June or July, and then phase 2 trials by the end of 2020.

In addition to the vaccine, we are developing SARS-CoV-2 therapeutics based on antibodies taken from donors who have recovered from the infection. We have around a hundred candidates and are working on narrowing these down to a few of the most promising.

What progress have you made on your other vaccines?
Our quadrivalent seasonal flu vaccine was accepted for scientific review by Health Canada in October 2019, and we hope a decision will be made for the 2020 Canadian flu season. As a recombinant technology, our plant-based platform has the potential to match selected seasonal influenza strains and allow faster response to emerging viral infections. We are also investigating a next-generation or universal flu vaccine.

WE WERE ABLE TO TAKE A TARGETED SARS-COV-2 SEQUENCE AND PRODUCE A VACCINE CANDIDATE IN JUST 20 DAYS.

In addition to flu vaccines, we are working on a vaccine against rotavirus, a highly contagious and potentially fatal childhood infection. This development is in collaboration with the Japanese company, Mitsubishi Tanabe Pharma, and is currently in phase 1 trials. We have a vaccine candidate against norovirus, also known as the winter vomiting virus, which is a real burden for children, older adults and people living in close quarters, like cruise ships or military bases. This candidate is ready to enter phase 1 trials.

If the COVID-19 and seasonal flu vaccines receive approval, could you scale up production?
Our vaccines would be the first plant-derived ones for human use to reach the market, and we are the only plant-based manufacturing company that has been able to produce vaccines on a commercial scale. We have the capacity to produce millions of doses in our facilities in Durham, U.S. and Quebec City, Canada, where we are also building a new manufacturing facility. This is expected to open by 2023 and to expand our annual production capacity to 50 million doses of a quadrivalent seasonal flu vaccine or up to a billion doses of the COVID-19 vaccine. We plan to market the seasonal flu vaccine in North America first, but we will seek partnerships for this and other projects to expand our global reach.

How has COVID-19 influenced the company, or not?
Overall, the outbreak hasn't altered our long-term plans. It is problematic, as for most companies, but as we already have many employees who work remotely, we have been able to adapt to this new reality. Moreover, we have strong relationships with our long-term investors. If anything, we view this pandemic as an opportunity to showcase the usefulness of our platform help in global preparedness for current and future disease attacks, and to seek new investment that will match our growth ambitions.

To learn more about plant-derived vaccines and therapeutics, visit medicago.com.

medicago

SPRINGER NATURE