The journey to a tick vaccine

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Ticks (*garapata* in Tagalog) are small arachnids that attach to larger animals—such as humans, cats, dogs, and birds—and feed on their blood. Though usually not as prevalent as flies, mosquitoes, or spiders, these tiny creatures can be just as difficult and potentially dangerous to handle.

Ticks feeding on host animals can cause anemia and can infect the host with a number of harmful diseases. Most notably, in humans ticks can cause Lyme disease, which results in a wide variety of symptoms for months after the initial infection. And while Lyme disease is not found in Philippine ticks, local species can still transmit diseases to animals, including pets such as cats and dogs.

Because of the harm that ticks can cause their hosts, and the diseases that they can spread, ways to treat or prevent tick infections are valuable. When a tick initially attaches to a host, it secretes a variety of chemicals into the host's blood, and some of these can suppress the host's immune response, making the body more susceptible to tick-borne diseases and the tick itself. Because of this, vaccines for tick infections are important, as they can counteract this effect, give the host's immune response a boost, and make it easier to fight the tick and the infections that can come with it.

A team of Japanese researchers, working with Filipino researchers from Cavite State University and the University of the Philippines Los Baños, is working to create more effective tick vaccines by targeting certain molecular components found in ticks.

Their work—published in Experimental and Applied Acarology—examines one species of tick, *Heamaphysalis longicornis*, or the longhorned tick. The researchers looked at one type of molecule called peroxiredoxins (Prxs).

A tick feeds on a host's blood, which is usually rich in iron. Inside the tick's body, the iron reacts with the oxygen in the tick's system. This reaction forms a type of chemical called reactive oxygen species (ROS), which—if unchecked—can interfere with many basic cellular components such as nucleic acids and proteins. Many organisms, including humans, have antioxidant defenses to mitigate the effects of ROS. Ticks make use of Prxs, which are powerful and essential detoxifying agents used by a number of tick species. This allows them to ingest large amounts of host blood, without ROS damaging their own bodies.

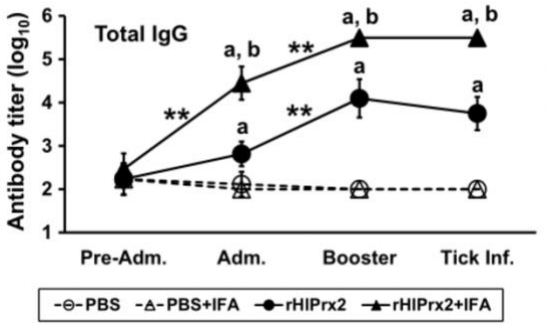
Because Prxs play such a central role in the *H. longicornis*' feeding, the researchers hypothesized that creating a vaccine that uses this molecule as a way to target ticks would be an effective way to alert the immune system of an infection.

To test the hypothesis, the researchers vaccinated mice by injecting them with rHlPrx2 (a Prxs variant specific to *H. longicornis*). This would allow their immune systems to recognize this molecule, and the threats associated with it, allowing for a faster immune response. Weeks after the immunization process, the team tested the mice's immune response to ticks by allowing 20 ticks to feed on each mouse.

The effectiveness of the vaccine was measured by looking at how many ticks were able to feed on the mice, how many ticks were able to molt into adults, and how many adult ticks were able to survive. The team also took blood samples from the mice, and analyzed them to see if their immune responses were heightened at all. All of these metrics were compared to those of control mice, which were not immunized but also subject to tick feeding.

The results of the study were very promising. Considering the number of ticks that were able to feed on the mice, the number of ticks that were able to mature, and the number of adult ticks that were able to survive, the vaccine seemed to have had no effect, as these numbers were very similar to the control, unvaccinated mice.

However, analyzing the blood samples of the immunized mice showed increased levels of IgG1, a type of antibody involved in the immune response, meaning that the immune responses of the vaccinated mice were made stronger. And while this vaccine was not enough to deter ticks from feeding on the mice, the increased immune response also confirms the importance of rHlPrx2 to *H. longicornis*' feeding behavior and gives evidence that the molecule not only remains in the tick's body but also is secreted into the host's blood.



The researchers found that the vaccine was able to increase levels of IgG in mice being fed on by ticks (represented by the black triangles and circles)

So while the results showed that Prxs cannot serve as the main basis of a vaccine, it is probably an important piece of the puzzle. Further research can then build on this result, either refining the vaccine created by these researchers, examining its effects in different animals or different species of tick, or even combining the effects shown here with vaccines leveraging other important molecules.

REFERENCE

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Luis Wilfrido Atienza graduated from the Ateneo de Manila University, with a BS in Biology, and a minor in poetry. He currently works as a writer for a medical communications agency, and spends some of his free time writing about science.