ARS technology makes studying tick-borne diseases less expensive and less dependent on live animals

U.S. Department of Agriculture, **Agricultural Research Service, Pacific West Area**

An artificial tick feeding system designed by the U.S. Department of Agriculture (USDA) Agricultural Research Service (ARS) offers a less expensive way to study tick-borne diseases that also minimizes the number of live animals required for research.

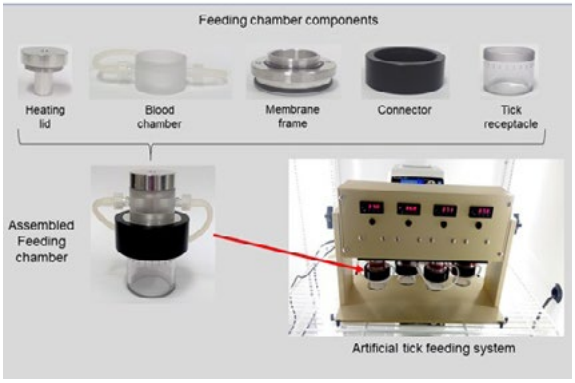
Scientists from around the world have been focused on addressing the problem of tick infestation and tick-borne diseases. Tick infestations have expanded into areas that were once considered tick-free and are comingling with wildlife, livestock, and humans resulting in the spread of tick-borne pathogens (microorganisms that cause disease). Lyme disease in humans is the best-known tick-borne disease, but similar diseases in cattle and other animals can be costly for the livestock industry.

Ticks feed off the blood of live "host" animals, which can be mammals, birds, reptiles, or amphibians. When a tick feeds off an infected host animal, it too can become infected with a pathogen and then pass on the infection to its next host.

Research involving ticks typically requires the use of live animals. However, animal experiments are costly, as large numbers of animals are required to generate enough data to reliably test scientific hypotheses. In addition, the variation between individual animals prevents standardized research.

The artificial tick feeding system designed by ARS scientists at the Animal Disease Research Unit (ADRU) in Pullman, Washington, simulates the process by which ticks feed off the blood of a live animal. In the artificial system (also called an *in vitro* system), the blood is contained in a temperature-controlled chamber, and ticks access the blood through a synthetic membrane instead of animal skin.

In a study published in January 2020 by *Scientific Reports*, ARS researchers and colleagues from Washington State University demonstrated that the artificial feeding system could be used to simulate the tick-borne disease transmission process. Uninfected ticks used the system to feed on infected blood, then



Above: The artificial tick feeding system.

on uninfected blood; the previously uninfected blood showed evidence of bacterial infection after tick exposure.

This system can help reduce the number of animals required for detailed studies of tick-pathogen interactions. In addition, the *in vitro* tick feeding system allows for the testing of various strategies for preventing tick attachment, such as the use of essential oils and tick-specific chemical treatments.

A variety of design attributes make the *in vitro* tick feeding system an elegant solution for the study of tick-borne diseases in the laboratory. The simple assembly and disassembly of the feeding chambers allows cleaning and blood changing without interruption of tick feeding, which improves experiment consistency and reproducibility. Individual chambers provide identical biological conditions for testing. The use of synthetic membranes eliminates the need for animal skin.

Several national and international institutes working on tick and tick-borne disease research established collaborative agreements with USDA to improve their research by using the ARS artificial tick feeding system. In addition to cattle pathogens, some collaborators are using the system to study tick-borne pathogens that affect humans, such as *Borrelia burgdorferi,* the causative agent of Lyme disease.