Questing Ticks Drink Water

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Abstract

Survival of questing ticks in the filed depends on uptaking water from environment. With there being little known about the amount of water that ticks consume, we were interested in whether drinking water is a common phenomenon in different species of ticks: *Amblyoma americanum, Rhipicephalus sanguineus, Dermacentor variabilis,* and *Ixodes scapularis.* The question was expanded to whether the ticks drink blood through capillary tubes and which internal organ is responsible for the absorption of the liquid uptake. In capillary feeding of water for an hour, all four species drank water: 0.17☒L in *R. sanguineus*,. 0.35 ☒L in *A. Americanum*, 0.39 ☒L in *D. variabilis. D. variabilis* and *I. scapularis* drank blood, whereas *R. sanguineus* and *A. americanum* did not drink blood in the capillary feeding system. In observations of internal organs using rhodamine 123 as a fluorescent tracer, we found that *A. americanum* and *I. scapularis* drank liquid through type 1 acini of the salivary glands and their midgut, while *R. sanguineus* and *D. variabilis* drank through type 2/3 acini. We found that different species ticks show significantly different ways of obtaining water from environment.

Purpose

The purpose of this experiment is to compare the physiology of water drinking among different species of ticks.

Questions

1.How much water do different species of ticks drink?
2.Are the ticks imbibe blood through capillary tube?
3.Which internal organ is actual site of absorption of water?

Study System

Four different tick species (female) were studied: *Amblyomma americanum, Rhipicephalus sanguineus, Dermacentor variabilis, and Ixodes scapularis.*

Methods and Experimental Design

Equipment used: micro- capillary tube, micropipette, water, dental wax, petri dish, microscope, rhodamine 123, PBS solution and forceps.

First I took the dental wax and placed it firmly in the petri dish. Using forceps I placed the ticks on the wax (Fig. 1). I pushed the legs of the tick into the wax and covered them up with more wax. Next I cut the capillary tubes to about ½ inches. Using the forceps, I separated the the outer mouthparts and slid the capillary tube over the inner mouthparts (Fig. 2. A, B, C). Using a micropipette, I added water to the capillary tube until it reached the mouthparts. I added water to the bottom of the petri dish and covered it with the lid. This made a humid chamber that eliminated some of the evaporation. Using a measurement eyepiece I monitored every 5 minutes checking how much the ticks drank up to an hour.

During he rhodamine feeding experiment, rhodamine pellets were dissolved in ethanol and water. Once dissolved the rhodamine was diluted in water 1000 fold for the feeding. In a small vial 18µL of water and 2µL of rhodamine solution were added for mixing, then inserted into a micropipette. After the tick drank Rhodamine 123, the tick was dissected for exposing the salivary gland and internal organs (Fig. 2D, E, F, G).

Results

Fig. 1. Immobilized ticks on a strip of wax in preparation of ticks for water feeding experiments

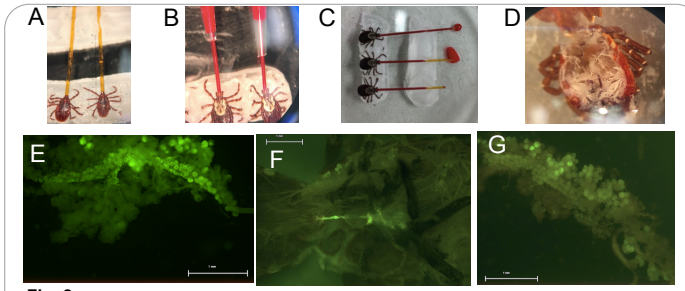

Fig. 2. Different species of ticks feeding on water or blood (A-D) and the salivary glands from the ticks fed on Rhodamine 123 (E-G).
A: *R. sanguinias* with a 12mm long micro capillary tube used for water feeding.
B: *D. variabilis* with a micro capillary tube inside a 10µL pipet tip initially used for long term feeding
C: *D variabilis* initial blood feeding test with bovine blood using a micro capillary tube
D: *A. americanum* dorsal side flipped up viewing ventral side. Salivary glands removed
E: *A. americanum* salivary gland under fluorescent light using Rhodamine 123 as fluorescent compound. Type 1 acini mainly highlighted, but type 2 and type 3 also highlighted.
F: *R. sanguinias* ventral side exposed. Type 2 and type 3 acini hlighted at top of the picture. Peristaltic contractions shown.
G: *D. variabilis* extracted salivary gland. Type 2 and type 3 acini highlighted.

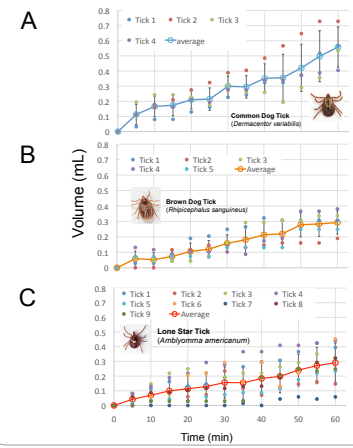

Fig. 3. Water volumes individual tick drank for an hour in each species: common dog tick, brown dog tick, and lone star tick.

Results

1) D. Variabilis drank the most in an hour at ..59mL.
2) A. Americanum drank the second most at .30mL
3) R. sanguineus drank the least at .17mL.
4) The overall water drinking experiment was a success with all species drinking water. However, that was not the case with blood drinking. *D. variabilis* and *I. scapularis* drank blood, whereas *R. sanguineus* and *A. americanum* did not drink blood. Finding that *A. americanum* and *I. scapularis* drank liquid through type 1 acini of the salivary glands and their midgut, while *R. sanguineus* and *D. variabilis* drank through type 2/3 acini is extremely important in understanding feeding patters of Ixodae ticks.

Conclusions

In this study, we found that different species of ticks show different ways of drinking water/blood.

1.All four species drink water in the range of 0.17 to 0.59 mL in one hour.
2.*D. variabilis* and *I. scapularis* drank blood, whereas *R. sanguineus* and *A. americanum* did not drink blood.
3.*A. americanum* and *I. scapularis* drank liquid through type 1 acini of the salivary glands and their midgut, while *R. sanguineus* and *D. variabilis* drank through type 2/3 acini.

Future Directions

Looking toward the future I would like to move toward voluntary drinking in these species. Although it would be difficult to measure how much they were drinking, it would give information about them seeking out water. If they are actively seeking out water, this could give a good indication of possible management techniques for the ticks. I would also like to compare their preferences after a day in a desiccation chamber, as compared to in a humid chamber. From there I would like to test preferences between blood and water.

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