Potential for Chemical Repellents Against the Mite *Tyrophagus putrescentiae* to Prevent Infestation of Country Hams

Cadence Ciesielski[1,2] Naomi Manu[1], and Thomas Phillips[1]

[1]Department of Entomology, College of Agriculture, Kansas State University
[2]Department of Philosophy, College of Arts and Sciences, Kansas State University

Undergraduate Research Experience in Entomology

K-State 2025 K-STATE Research and Extension

Abstract

Tyrophagus putrescentiae (Shrank), commonly known as the ham mite, is a cosmopolitan pest found of various stored food commodities, including aged hams and cheeses (Amoah et al. 2017; Campbell et al. 2017). Recent research suggested methods to deter *T. putrescentiae* from infestation of country hams using different types of food-safe chemicals (Abbar et al. 2016). In this experiment, four chemicals were tested to ascertain their effectiveness in deterring *T. putrescentiae* from ham infestation. Repellency tests used a piece of ham and a group of mites placed on opposite sides of a Petri dish with a black construction paper floor. A test barrier of a test compound or solvent control was deposited on a white filter paper strip bisecting the dish at its center. The chemicals Nootkatone, Propylene Glycol, Glycerol and a fatty acid blend called "C8910" prevented more mites from contacting the ham compared to strips with solvent. These results suggest the potential for using one or more of these food-safe compounds to prevent ham mites form infesting hams in aging rooms.

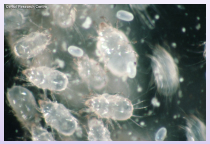

Figure 1 (left). Mite-infested ham hanging in a typical aging net. Figure 2 (right). Storage of dry-cured country hams on wooden racks in a commercial aging facility.

Questions, Hypotheses, and Predictions

The objective was to determine the repellency potential of selected chemicals known to repel other arthropod pests could be used to keep *T. putrescentiae* away from dry cured hams. We hypothesized that the chemicals C8910, Nootkatone, Propylene Glycol and Glycerol would prevent mites from entering a treated space. We predicted that chemicals in higher concentrations would prevent proportionally fewer mites cross over a treated space to infest a sample of ham.

Study System

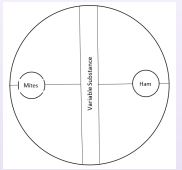
Tyrophagus putrescentiae, the ham mite, is an arachnid that is similar to other small arthropods. Ham mites can live in many different environments, but thrive in spaces at 30°C with RH of 85%, at which they complete their life cycles in two weeks. Ham mites prefer high protein and fat foods, such as aging country hams (Figs. 1-4) as well as fungi growing on such foods. Ham mites are known to commonly occur in human habitats (Campbell et al. 2017).

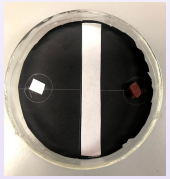



Figures 3 (left). Life stages of *T. putrescentiae.* Figure 4 (right). Infestation of *T. putrescentiae* on a semi-moist pet treat.

Methods and Experimental Design

Four chemicals and a control were tested to examine how they affect ham mites in regard to orientation to and contact of country ham pieces. Glass Petri dishes served as test arenas into which about 25 large mites were released on one side, and a small block of ham (125 mm^3) was placed 7 cm away on the other side (Figs. 5 and 6). A 1 cm-wide x 8 cm long strip of white filter paper, treated with either a test chemical or a given solvent, was placed across each dish at its mid-point. The chemicals C8910 or Nootkatone in acetone, or Propylene Glycol or Glycerol in water, were applied as 50 uL solutions to the white paper strip. A grease-pencil line was drawn along the outside edge of the treated paper strip to confine the test material from spreading outside the treated strip in to the general arena floor. The treated strip was allowed to dry for 30 min before adding mites to the arena. A thin layer of petroleum jelly was spread around the inner wall of the Petri dish to contain the mites for the 60-min observation period. Then, in 20 minute intervals, the numbers of *T. putrescentiae* on or within the ham circle were counted at three 20-min intervals after introduction.





Figures 5 (left). Diagram of experimental arena to evaluate traversal of mites across a barrier containing a chemical repellent. Figure 6 (right). Mites from the lab colony were on a small square of paper placed opposite the ham piece.

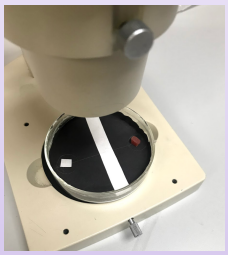
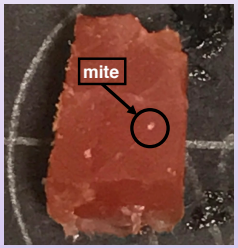



Figure 7 (left). *T. putrescentiae* were counted with a dissecting microscope under red light for accuracy as mites will hide when exposed to white light. Figure 8 (right). *T. putrescentiae* on country ham piece used in a trial.

Results

Results showed higher numbers of *T. putrescentiae* crossed to the piece of ham in control dishes (solvent only on barrier), compared to fewer crossing over to the ham piece treated with repellents. There was a clear pattern of fewer mites crossing the dishes in trials with higher concentrations of chemicals (Figs. 9-11). For this analysis, we report only the data points from the 60 minute interval, although mite numbers increased with increasing time from 20 to 40 minutes. With C8910 an average of 10.3 mites were found on the ham. For Nootkatone, the average was 4.7 mites. The 10%, 50%, and 100% concentrations of Propylene Glycol allowed on average 3.9, 2.2 and 2.1 mites to contact the ham, respectively. The 10%, 50%, and 100% concentrations of Glycerol allowed on average 6.0, 1.3 and 2.3 mites to contact the ham, respectively.

Figure 9. Low concentrations of C8910 (left) and Nootkatone (right) to prevent *T. putrescentiae* from contacting ham pieces.

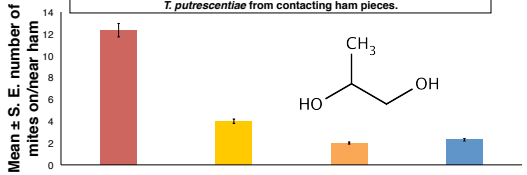


Figure 10. Varied concentrations of Propylene Glycol to prevent *T. putrescentiae* from contacting ham pieces.

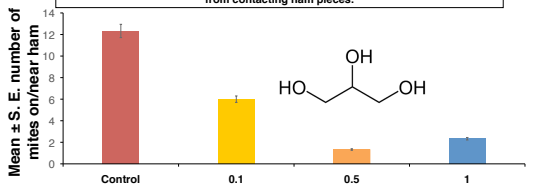


Figure 11. Varied concentrations (mg/cm^3) of Glycerol to prevent *T. putrescentiae* from contacting ham pieces.

Conclusions

Overall, each chemical produced a substantial rate of deterrence, with the most successful being Glycerol at an application rate of 0.5 mg/cm^3 concentrations and Nootkatone at 0.1 mg/cm^3.

Future Directions

Ham producers and other members of the food industry may find a solution to *T. putrescentiae* infestation from this research. Future work could study additional repellents and develop methods to repel or deter mites using barriers or protective surfaces on a larger scale to better manage mites with safe chemicals.

References

Abbar, S, B. Amoah, M.W. Schilling, T.W. Phillips. 2016. Efficacy of selected food-safe compounds to prevent infestation of the ham mite, Tyrophagus putrescentiae (Schrank) (Acarina: Acaridae), on southern dry-cured hams. *Pest Manag. Sci. 72: 1604-1612.*

Amoah, B, M.W. Schilling, T.W. Phillips. 2017. Physical Factors Influencing Orientation of Tyrophagus putrescentiae (Schrank) (Sarcoptiformes: Acaridae) to Food-Baited Traps. *Journal of Insect Behavior,* 30: 544.

Campbell, Y.L., Y. Zhao, S. Abbar, T.W. Phillips, M.W. Schilling. 2017. Mite control and sensory evaluations of dry-cured hams with food-grade coatings. *Meat Muscle Biol.,* 1: 100-108

Acknowledgement

Work was partially funded by USDA Methyl Bromide Transition Program.