

# Population Growth of the Mite *Tyrophagus putrescentiae* on Cheeses and Other Dairy Products



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## Abstract

*Tyrophagus putrescentiae* is a mite that is most commonly found in stored food, like different cheese products. This mite infests high-value dried foods that results in serious economic impact. Human health problems are known from handling, ingestion, or inhaling contaminated materials, and infested foods can cause diarrhea, enteritis, and allergic reactions for some people. Many commercial aged dry cheese susceptible to a infestation by this mite. What type of cheese would make it most vulnerable to infestations? Cubed cheese did not improve the susceptibility, for cheese to grow, and there are some cheese that have a high moisture content, that it prevents the initial adults from being able to survive on a cheese type. Humidity levels can inhibit the life cycles of *T. putrescentiae*, if outside the ideal range adults will stop producing viable eggs. Shredded cheese was proven to not be habitable for mites to grow, even with the increase in surface area present on the cheese. Determining the appropriate conditions that *T. putrescentiae* can help determine futures ways to protect the food products that are more susceptible to this mite and show what are characteristics about products that deter mites from a product, which may be able to be incorporated into susceptible products to lower the incidence of infestations in susceptible products, with stored food products.

## Purpose

The purpose of this research was to observe mite population growth on various cheeses and on a variety of other dairy products in order to determine what types of cheese products are susceptible to *Tyrophagus putrescentiae*.

## Questions, Hypotheses, and Predictions

### Question:

- What type of cheese is most susceptible to mite infestations?
- What characteristics of cheese make it an appropriate source for infestations?

### Hypothesis:

•*T. putrescentiae* should be more attracted to food sources at with a high fat and protein content.

### Prediction:

- Cheese's with a higher protein and fat content will produce larger mite populations.
- Cheese's with a higher moisture content may not yield as large populations as cheeses with lower moisture contents.

## Study System

*Tyrophagus putrescentiae* are referred to by their common names of the mold, cheese, or ham mite. This mite species prefers to reside in durable stored food products, including bacon, flour, peanuts, and various cheese products (Jeon & Lee, 2009). The characteristics of their preferences that have been common across products are that they are attracted to food with high fat and high protein and at 15-40% moisture. This species has also been found commonly in animal feeds and pets foods, in house dust, and also in a laboratories with agar-based culture media (Abbar, Amoah, et al, 2015). Research has found that this mite, eggs make up more than one-half and one-third the immature larval stages, while adults occupy only 10% of the population the most development occurred at 32.2°C, instead of 33.9 °C, however a normal life cycle can occur at around 11.22°C. Mites continued to lay eggs at 36.52°C, although eggs do not hatch (Barker, Philip S.).

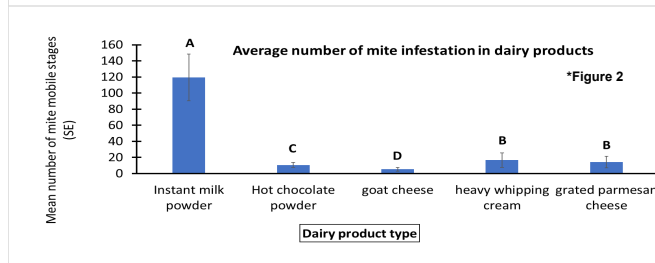
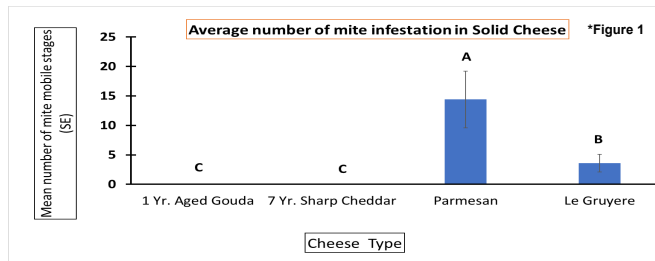


## Methods and Experimental Design

This research was focused on observing the population growth of mites on various cheese products; the differences between shredded and non-shredded cheese, and the effect other types of dairy products have on population growth. Each experiment had replicated treatments, which were different types of product, with one control in each experiment that contained a standard mite diet that is used to maintain the colony. Each treatment had at least 2-5 replications per experiment. Each treatment was then placed in jars, until it was time to identify the population growth, 1-2 weeks later. We selected the larger mites for each treatment from the mite colony maintained in the lab; out of those, 20 adult mites were used for starting an infestation in a jelly jar. The ventilated jars were placed in a cabinet with a relative humidity of ~70%. The 2nd experiment was set up very similarly except with 2 replications for each treatment, the same treatments were used from the 1st experiment, except that cheeses were shredded rather than whole in order, to determine if a greater surface area would increase the survival rate of mites on different cheeses. In experiment 3 we made agar mixtures for each processed dairy product treatment, being powdered instant hot chocolate, goat cheese crumbles, heavy whipping cream, evaporated milk, and 100% grated parmesan cheese. The mixture was comprised of agar, alphacel cooked in water an antifungal solution and the test material of interest. The mixture was cooled after cooking; there were 3 replications for each treatment and the experiment was run for 10 days. All life stages, eggs, larvae, and adults were currently present and alive in each jar were counted. If collecting the final data took more than a day, the mites were placed in a refrigerator where the lower temps would slow the mites down and enter a quiescent stage of the life cycle for counting on another day.

## Results

- There was a significant difference between the solid cheeses for mite population in the first experiment (p-value<.007) (F-value of 3.24) between the groups.
- Based on the data in Figure 1 Parmesan was the cheese with the most mite growth while Gruyere cheese was susceptible under these conditions.
- The second experiment with grated cheese was inconclusive and resulted in no growth of mites. It is possible that shredded cheese is not ideal for mites. There could be environmental factors, such as cheese moisture and RH, that affected the growth of mites on grated cheese.
- The third experiment (figure 2) showed that instant milk powder was the only treatment that was obviously susceptible to mites, with very high numbers produced in just 10 days.
- There was a statistical significance between the groups of experiment 3, of the various dairy products, (p-value<.004) (F-value of 3.48)



## Conclusions

This experience showed mites are sensitive to moisture and humidity; there were many different cheeses, once left in warmer conditions caused a loss of mites due to submersion or desiccation. The second experiment of population growth on shredded cheese did not produce any live mobile stages, which also may have been a result various environmental factors. This population growth is important for stored food products, because *T. putrescentiae* can be found on cheeses and create economic losses in those food products. These results could help further research new methods of removing infestations of mites, knowing the conditions that make an ideal environment for mites. The results also show what cheese products are vulnerable to infestation, but overall the growth seen in figure 1 is not consistent to show a complete susceptibility of mites on certain cheeses. The results in figure 2 show an obvious susceptibility to Instant milk powder, however the other dairy products were not ideal for sustaining population of *T. putrescentiae*. From these results, there could be many different factors as to why mites did not have consistent growth on processed milk products including, moisture, temperature, ingredients, etc. There are many different directions that may be explored to further research the ideal conditions of mites and what specific characteristics of mites cause infestations in dairy products.

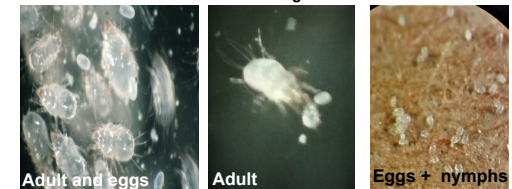
## Discussion

- Differences in mite population may be a result of different environmental factors. Conditions that are too different from an ideal mite environment can affect population growth.
- Parmesan cheese provided the best environment for mites, followed by Gruyere. The differences could be due to the conditions of the cheese and the ingredients in the cheese (Fat, protein, or salt content, etc.)
- Instant milk powder was the best food and conditions for mites in this project, followed by heavy whipping cream.

## Future Directions

- If this research was continued, possible new studies could test different cheeses, to find types that are susceptible to *T. putrescentiae*. This experience showed mites are sensitive to moisture, so expanding research as to what the specific characteristics of conditions that will favor mites could be done. The second experiment could be extended to observe differences in surface areas and spatial arrangement of food products. Continuing to find better ways to control moisture content in dairy products, to simulate similar control environment of mites.
- Future work that controls RH and food moisture could allow us to observe mites in environments that increase or decrease mite population growth. Such work could help protect foods from mites in the future..

## Mite Life Stages



## References

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