

What do ants think of our spices?

Experiment testing what common household spices and seasonings attract or repel ants.

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Abstract: Ants are one of the most abundant individual organisms in the world. They are scavengers that find their food through olfaction. Ants are decomposers and are essential for our ecosystems; however, they can be frustrating to humans when they find a human's food. This experiment focuses on determining if vinegar, cinnamon, and garlic powder are effective ant-repellents or if they attract ants. To investigate this, four treatments were set up: a control (no treatment), a vinegar treatment, a cinnamon treatment, and a garlic powder treatment. Crushed chocolate graham crackers were placed in the center of each of the spices or seasoning treatments. The number of ants at each treatment site was counted every 15 minutes for 1.5 hours. It was determined that cinnamon and vinegar are effective ant-repellents, while garlic powder attracted the ants. The control setup responded to the experiment as predicted. This information may be valuable for future research and exploration of natural ways to prevent the attraction of ants.

Keywords: *Solenopsis, Monomorium pharaonic, cinnamon, vinegar, garlic*

Interactions with ants occur everywhere; they are in the outdoors where we picnic and play, and they enter our homes and living facilities. Exact counts of the number of ants in the world are not available, however the conservative estimate of the total abundance of ground-dwelling ants is 3×10^{15} and almost 20×10^{15} of all individual ants in the world (Schultheiss et al. 2022). Ants live in colonies. The most common type of ant we encounter in our lives are worker ants (Brundage 2020). Ants are one of the world's primary decomposers (Dong et al. 2023). Ants use olfaction to find their food. They are able to remember at least 14 different food

orders (Huber and Knaden 2018). This ability to remember and recognize the odors of food is what allows ants to pinpoint where food is and explains why ants are strongly attracted to odors they have experienced before. When managing ants, the best form of protection would be exclusion. Exclusion involves preventing the ants from entering the home or structure (Ants n.d.). Using sealants to close gaps where ants could enter is a good way to implement this strategy. Another strategy that can be used against ants is sanitation; this includes keeping vegetation, and places ants may live, away from your home or structures. Combinations of these preventative measures

are the best practices for keeping ants out of your home. Studies have been conducted to test non-toxic household products, such as lemon juice, cinnamon, chalk, to see their repulsive nature on ants. This study found that lemon juice and cinnamon were the most effective repellents (Ambati and Duvvuri 2019). Another study tested spices such as nutmeg, cinnamon, and turmeric for their repellent activity against foraging ants (Vu et al. 2022). This brings up the question about the common spices used: what do ants think of their flavor? What common household spices or seasonings repel or attract ants? The purpose of this experiment is to identify which of the three household spices tested contain ant-repelling properties. The answer to this question could help the average person repel ants from their food.

Materials and Methods

To begin the experiment, all the materials were gathered. The ingredients for the three treatments were 3 tbsp of granulated garlic powder (Member's Mark™, Bentonville, AR), 3 tbsp of organic ground Saigon cinnamon (McCormick®, Hunt Valley, MD), 6 tbsp apple cider vinegar (Great Value™, Bentonville, AR), and 4 sets of 7g crushed chocolate graham cracker snacks (Kellogg's®, Battle Creek, MI); these ingredients were measured and collected. Four pieces of paper were used as settings for the graham crackers and treatments. The paper served as the location for the treatment and control groups, as well as a boundary to count and observe how the ants interacted with the crackers and treatments. The four pieces of white printer paper (Papermill®)

were taped to the sidewalk using masking tape. In the center of each piece of paper, 7g of crushed chocolate graham crackers were placed. On the setting labeled no treatment, nothing was added to the setting. On the setting labeled garlic powder, the 3 tbsp of granulated garlic powder were sprinkled in a circle surrounding the graham crackers. On the setting labeled cinnamon, the 3 tbsp of ground Saigon cinnamon were sprinkled in a circle surrounding the graham crackers. On the setting labeled vinegar, the 6 tbsp of apple cider vinegar were applied in a circle surrounding the graham crackers. Once the four test groups were prepared (see Figure 1), the initial measurement of no ants being present was recorded.



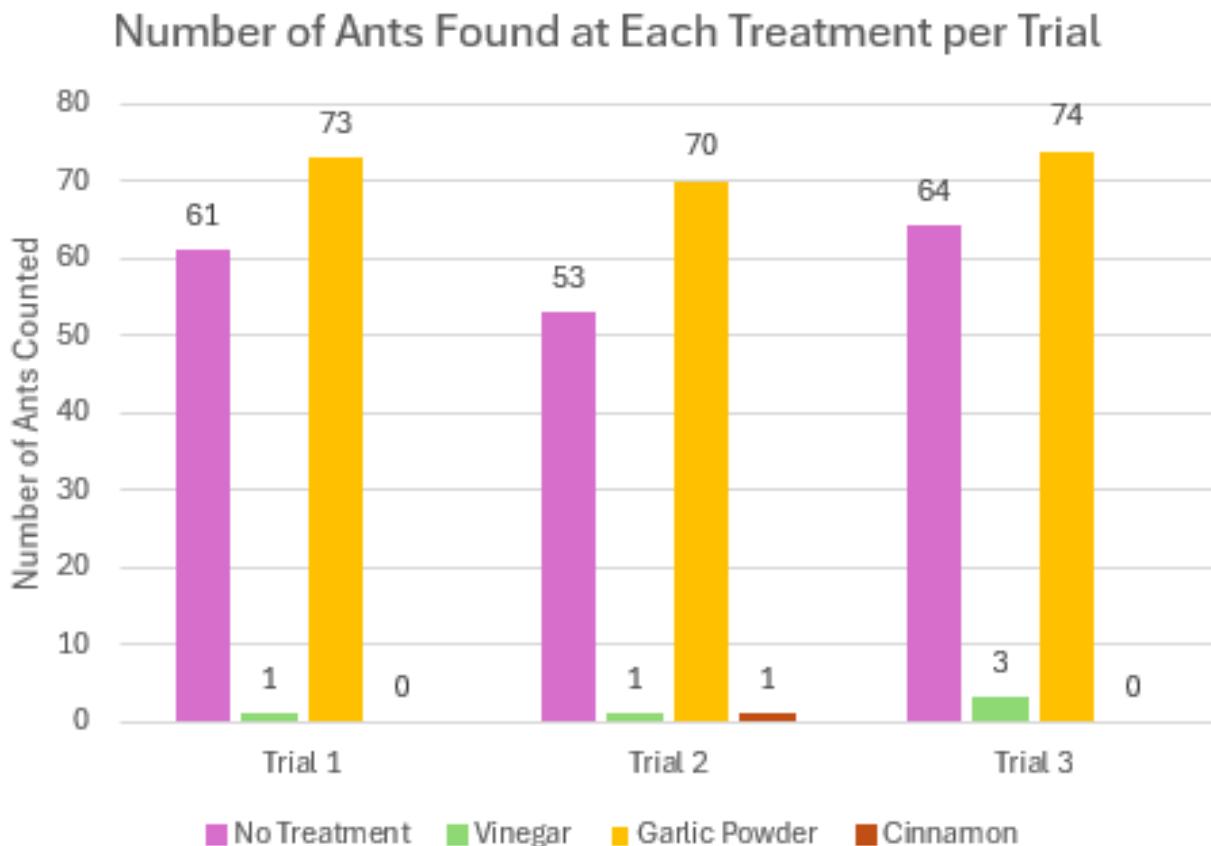
Fig. 1 The chocolate graham crackers treated with control group (top left), cinnamon (top right), garlic powder (bottom left), and vinegar (bottom right).

Every 15 minutes for 1.5 hours, the number of ants present on each setting was counted and recorded. The types of ants and other insects that were observed interacting with the treatment and/or graham crackers was

recorded. During the experiment at the one-hour mark, the vinegar treatment was reapplied; due to the experiment's high sun exposure location, the liquid treatment (vinegar) evaporated quickly and needed to be reapplied. When the 1.5 hours were completed, the four settings were collected and disposed of properly. This experiment was repeated three separate times over the course of a week. The setting for the experiment was a sidewalk in front of a house. The sidewalk has easy access to the grass for the ants and is easily visible for experiment measurement purposes.

Results

In this experiment, the greatest number of ants were always found on the control group (no treatment) or the garlic powder treatment. The least number of ants were found on the vinegar and cinnamon treatments. In all three trials, the garlic powder treatment had the most ants, with the control group having the second most ants. In two of the three trials, no ants were observed on the cinnamon treatment. The data collected can be seen in Figure 2.



The majority of insects observed on the treatment site were ants, however there were several flies and spiders seen. The flies were identified as *Musca domestica* and the spiders are members of the class Arachnida. Two types of ants that were observed in the treatment sites were the *Solenopsis*, commonly known as fire ants, and the *Monomorium pharaonic*, commonly known as the Pharaoh ant. The *Monomorium*

pharaonic ants were seen more often than the *Solenopsis*. The number of ants at each treatment site was recorded every 15 minutes during the experiment. The ants interacted with the food most often with the food when it had been outside 15 to 30 minutes. The ants interacted the least with the food when it had been outside for over 70 minutes. The data discussed can be found in Figure 3, Figure 4, and Figure 5.

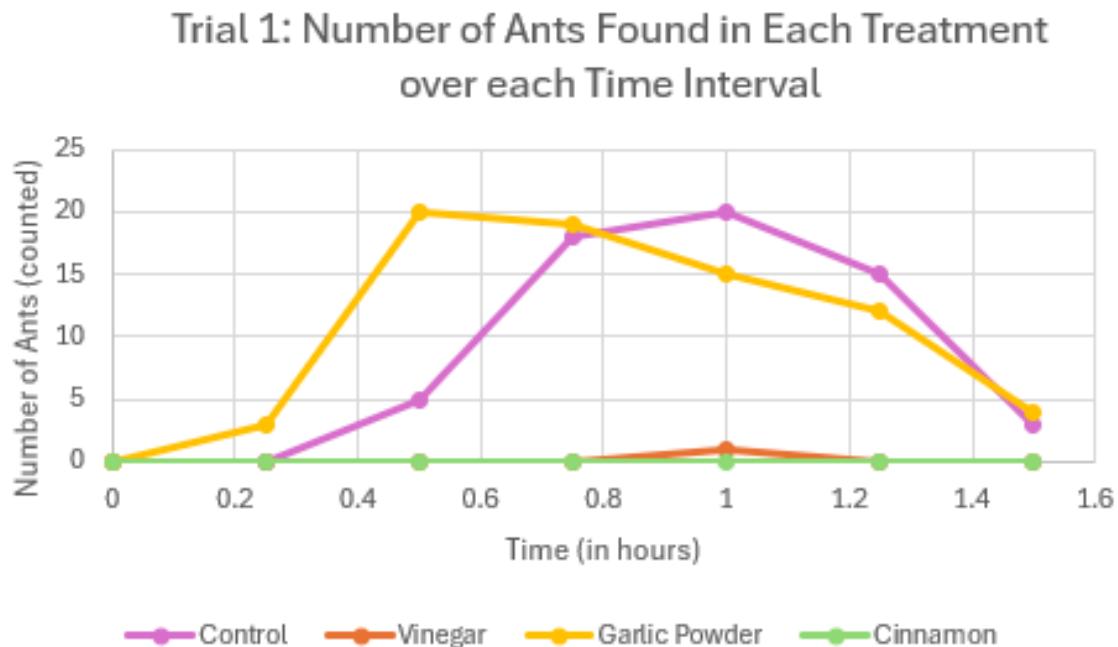


Fig. 3 Line chart depicting Trial 1: Number of Ants Found in Each Treatment over each Time Interval.

Trial 2: Number of Ants Found in Each Treatment over each Time Interval

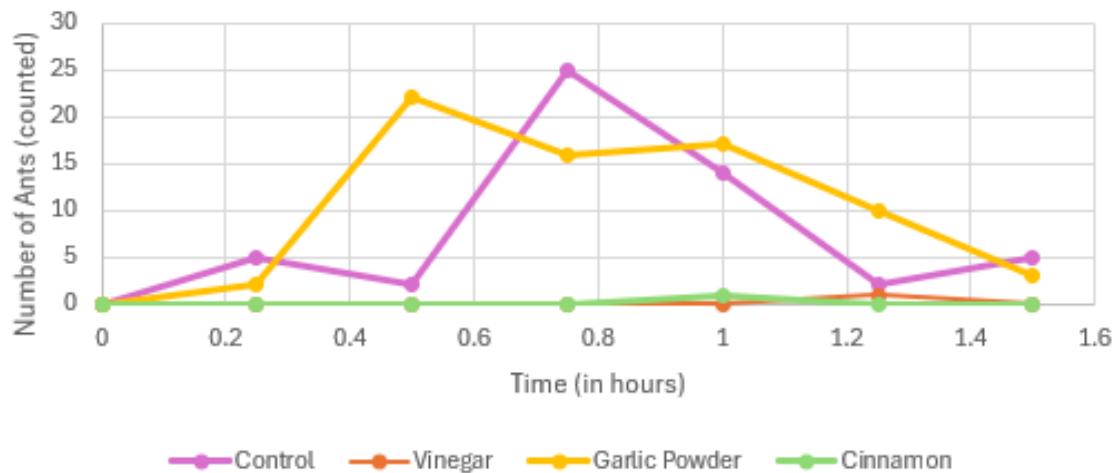


Fig. 4 Line chart depicting Trial 2: Number of Ants Found in Each Treatment over each Time Interval.

Trial 3: Number of Ants Found in Each Treatment over each Time Interval

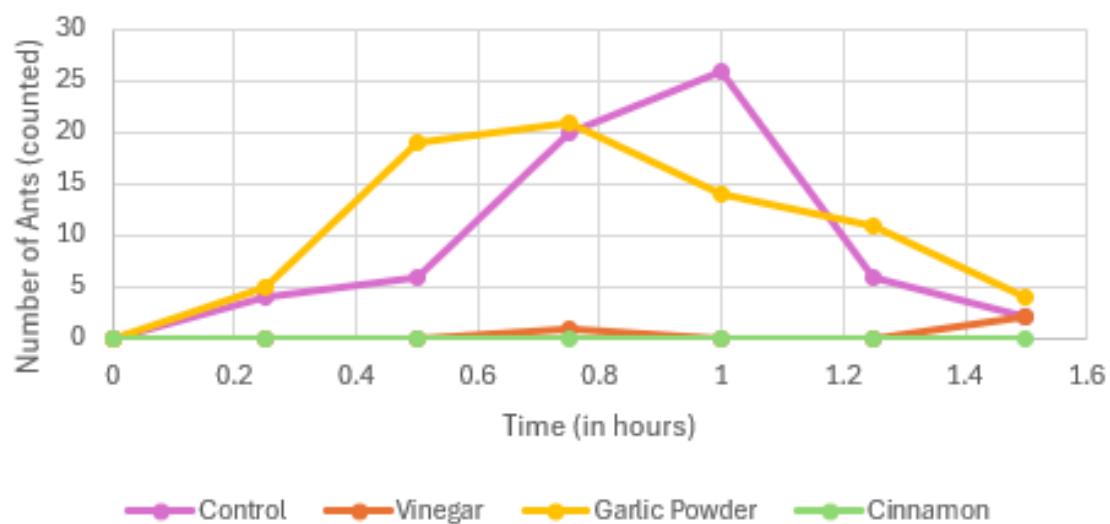


Fig. 5 Line chart depicting Trial 3: Number of Ants Found in Each Treatment over each Time Interval.

Discussion

The goal of this experiment was to determine which household spices work well in repelling ants and which attract ants. The garlic powder treatment appeared to attract the ants, the vinegar treatment and cinnamon treatment repelled the ants, and the control treatment appeared to have no impact on the ants' behavior. Many ants were observed interacting with the granulated garlic power, almost as much as they interacted with the crushed graham crackers. Several ants were observed carrying pieces of garlic powder away from the treatment site. The vinegar treatment strongly repelled the ants. Several ants were observed approaching the graham crackers, interacting with the vinegar treatment, and then leaving that treatment site immediately. The vinegar treatment did seem to weaken overtime due to the vinegar evaporating in the intense sun. The reapplication of the vinegar treatment at the one-hour interval resolved this issue; however, it does suggest that an ant repellent that uses vinegar would have to be reapplied more often. The cinnamon treatment was a very good repellent of the ants. No ants ever interacted with the cinnamon or the graham crackers on that treatment platform. The control group (no treatment) was observed as expected; many ants interacted with and carried pieces of graham cracker away. Ants find their food using odor receptors located

on their antennae. Ants have four to five more odor receptors than most insect; this exceptional sense of smell is what makes ants so good at finding food. Ants prefer foods containing fats and sugars. In a study conducted, researchers found that the spice cinnamon, along with black pepper and chili pepper, have a repelling effect on the house ant, *Tapinoma sessile* (Mutalib et al. 2017). The findings of this experiment support the claim that cinnamon has ant-repellent properties. It is interesting the ants were observed choosing to interact with the garlic so much. In other studies, garlic has been researched as a natural insecticide (Afifi et al. 2021). The ants responded to the vinegar as expected. They avoided the vinegar as much as they could; this makes sense as vinegar has been shown to be an effective natural insecticide against ants (Harlan et al. 2021). More information about how these spices impact the attraction or repulsion of ants could lead to new developments in how food is protected from ants.

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References Cited

Afifi, A., Ruddin, N. I. S., and Zainudin, M. H. M. 2021. The effect of garlic, black pepper, and clove as natural insecticide toward ants.
<https://publisher.uthm.edu.my/periodicals/index.php/mari/article/view/337>

Ants. (n.d.). <https://dph.illinois.gov/topics-services/environmental-health-protection/structural-pest-control/ants.html>

Ambati, M., and Duvvuri, K. 2019. Repulsion of ants using non-toxic household products. Journal of Emerging Investigators, 2. <https://emerginginvestigators.org/articles/19-057/pdf>

Brundage, Adrienne. 2020. Veterinary Entomology It's all Fun & Games until Someone gets Lyme Disease. Dubuque, IA, Great River Learning.

Dong, H., Huang, X., Gao, Q., Li, S., Yang, S., and Chen, F. 2023. Research Progress on the Species and Diversity of Ants and Their Three Tropisms. Insects, 14(11), 892.
<https://doi.org/10.3390/insects14110892>

Harlan, J. C., Conner, M., Dinh, K., Stevens, C., Marx, B., Salinas, F., and Macias, A. 2021. An analysis of household products as ant repellents. <https://instars-ojs-tamu.tdl.org/instars/article/view/359>

Huber, R., and Knaden, M. 2018. Desert ants possess distinct memories for food and nest odors. Proceedings of the National Academy of Sciences of the United States of America, 115(41), 10470–10474. <https://doi.org/10.1073/pnas.1809433115>

Mutalib, N.A., Azis, T.M.F., Sarina Mohamad, Azizan, N.I., Sidek, H.J., Roziana, M. H. and Z. Razali. 2017. The repellent and lethal effects of black pepper (*Piper nigrum*), chilli pepper (*Capsicum annuum*) and cinnamon (*Cinnamomum zeylanicum*) extracts towards the odorous house ant (*Tapinoma sessile*). Journal of Engineering and Applied Sciences 12(8): 2710-2714.

Schultheiss, P., Nooten, S. S., Wang, R., Wong, M. K. L., Brassard, F., and Guénard, B. 2022. The abundance, biomass, and distribution of ants on Earth. Proceedings of the National Academy of Sciences of the United States of America, 119(40).
<https://doi.org/10.1073/pnas.2201550119>

Vu, J., Mitra, H., Hardy, J. S., and Chauhan, N. 2022. Ants and spices: The potential of spices to repel pest ants (Formicidae). ODU Digital Commons. <https://digitalcommons.odu.edu/reyes-2022/1/>