

Tapinoma sessile and its Preference for Sour, Sweet, Bitter, and Salty Solutions

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ABSTRACT

Tapinoma sessile is a common ant species that often nests in close proximity to human structures and food sources which often leads to conflict. This study investigated if ants exhibited preferential forage selection for sweet (sugary) foods when compared to bitter, sour, and salty solutions. Ants were placed in terrariums and induced to choose food sources. Selection was indicated by the mass harvested. Ants showed a high preference for sweet foods when compared to the other foods and the control (water). These findings are significant as they showed that ant preference for sugary foods is high enough to perhaps use sugar to lure ants away from crops.

INTRODUCTION

Selecting forage is a crucial choice facing an individual in its quest for survival.

Individuals choose between foods that vary in abundance, accessibility, palatability, and nutritional value. Selecting optimal forage, can lead to high energy intake, a healthier individual, higher fitness, and increased reproductive fitness (Pyke *et al* 1977). Suboptimal selection can lead to low energy intake, poor health, low reproductive fitness and death. These consequences are severe enough that forage selection is not random and represents an evolutionary derived survival strategy (Pyke *et al.* 1977).

This study determines the foraging preference of a common, native species of ant, the odorous ant (*Tapinoma sessile*), by measuring its preference between sweet, salty, sour, and bitter solutions. *T. sessile* is commonly seen nesting in various locations from sandy beaches, to swamps, bogs and houses. The common name is derived from the fluid smelling of rotten coconut produced in their anal glands (Ricks and Vinson PP 329-334 Journal of Ecology). *T. sessile* has been observed to prefer sugary foods such as honeydew. The odorous ant protects species of insects that produce honeydew in an effort to increase production and consumption

(Barbani 2003; Buczkowski and Bennett 2006). *T. sessile* has also been observed foraging on sugary plant secretions such as phloem and nectar (Barbani 2003; Buczkowski and Bennett 2006). Sugar is detected chemically by a pair of antennae located on the ants head (Ricks and Vinson 2004). Preference may be due to the fact that this species of ant is unable to digest solid food. Digestion occurs when digestive enzymes are excreted onto food sources and the liquid is ingested (Ricks and Vinson 2004). Sugar's high energy content, ease of digestion, and near liquid nature (honeydew) makes it an optimal choice for a species with a digestive system unable to ingest solid foods.

This study will test the hypothesis that ants will prefer sweet solutions, matching their observed *in situ* preference (Barbani 2003; Buczkowski and Bennett 2006). Practical applications of these results will include strategies to limit the degree of damage ants inflict on crops world wide (Cherrett and Peregrine 1976; Morrison *et al.* 1997; Agrawal 1998; Dyer *et al.* 2001).

METHODS

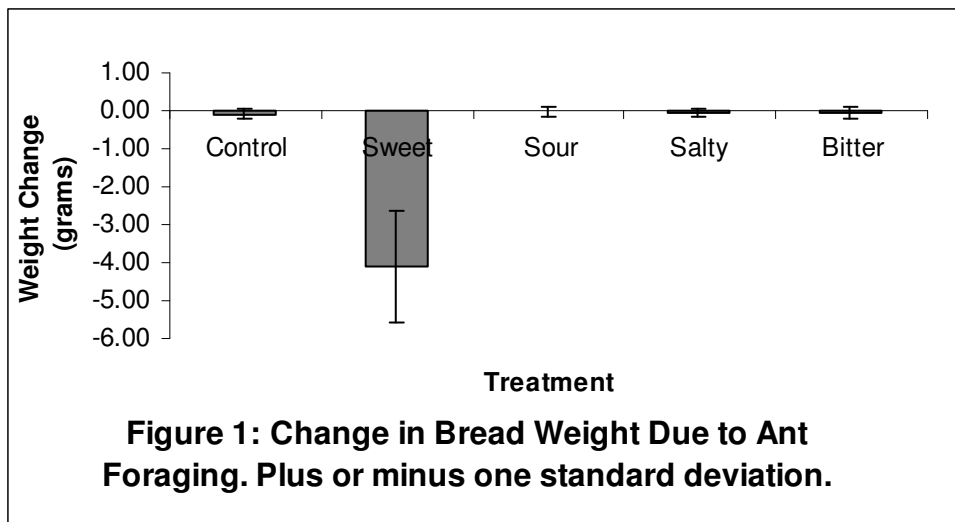
Four solutions were prepared for this study: Bitter (0.15g of ground Nabob Coffee beans in 99.85 ml of deionized water), sour (0.15 grams of citric acid in 99.85 ml of deionized water), salty (1.0 grams of sodium chloride in 99.0 ml of deionized water), and sweet (5.0 grams of sucrose in 95.0 ml of deionized water). The fifth (control) solution was 100ml of deionized water (Migabo 2007).

Five 2cm³ squares of bread were cut from a single piece of white bread. 13 drops or 0.5ml of the bitter solution was placed on each side of the five bread squares. These squares were weighed and the initial mass recorded at room temperature. The squares were then placed in a corner of a covered pre-made terrarium to reduce evaporative water loss. This procedure was then repeated for the other solutions until each terrarium had five bread squares present. Each

terrarium had a single colony with approximately 100 ants. The ants were given free access to the squares for 12 hours. At this time, the location of the bread was switched to ensure no side bias existed (Migabo 2007). After 24 hours the bread squares were weighed and the final weight was subtracted by the initial weight. This experiment was repeated ten times and means and standard deviations were calculated for this experiment (Migabo 2007).

RESULTS

Overall the ants only showed a preference for the sweet solution. In fact the only solution that initiated any real foraging activity was the sweet solution (Figure 1). Compared to the control the sweet solution lost 4g more, bitter lost 0.02g more, sour lost 0.02 more, and salty lost 0.03g less than the control.



The standard deviations for all the solutions, except sweet, were small and overlapping. Sweet's standard deviations were large but did not overlap with any other solution.

DISCUSSION

The results of this study supported the hypothesis as ants appeared to prefer sweet foods over other options and the control. Ant's preference for sugar comes as no surprise as studies have shown this species' preference for sugar (Barbani 2003; Buczkowski and Bennett 2006).

Ants prefer sugar as it is abundant, easy to store, provides high levels of energy, and is easy to digest (Went *et al.* 1972). Ease of digestion may be crucially important for ants, as they are unable to digest solid bits of food. They excrete digestive enzymes onto foods and consume the semi-liquid food particles (Ricks and Vinson 2004). Sugar's ease of digestion and often liquid nature (nectar, honey due, plant fluids) makes it an optimal choice for a species unable to digest solid food.

It is unclear why the other sources of food were avoided. Ants can sense these types of odors as they follow pheromone trails and locate food sources containing these odors (Fielde 1905; Galen 1999). Ant preference for sugary foods may have resulted in avoidance of other food sources until sugar was completely consumed. Future studies could test this by extending the duration of the experiment to determine what is selected after sugar is depleted.

Culver and Beattie (1978) and Fellers (1989) reported that ant forage preference is variable temporally. Repeating this study at other temporal scales would determine if sugar preference is consistent. Another variable not controlled for was colony structure. A new, rapidly growing colony will have different nutritional needs when compared to a static colony more concerned with maintenance and repair. The age of the ant colonies was unknown and not uniform amongst all repetitions. Klotz and Reid (1992) reported that ants use both structural and light cues to navigate to food sources. As not all terrariums were the same and each one was exposed to slightly different light conditions some terrariums may have presented easier to navigate landscapes. Failure to control these variables may have attributed to the large standard deviation observed in the sweet data.

Ants have been reported to steal nectar and pollen from numerous species of plants and not transfer pollen between individuals reducing pollination, reproduction and fruit production

(Galen 1999; Galen and Cuba 2001). Ants also consume plant material and cause extensive crop damage valued at billions of dollars world wide (Cherrett and Peregrine 1976; Morrison *et al.* 1997; Agrawal 1998; Dyer *et al.* 2001). The results of this study could be used to design sugar based lures to attract ants away from valuable crops and resources.

This study aimed to discover if ants exhibited differential preference for sweet, bitter, salty, or sour tasting foods. The hypothesis tested was that ants would prefer sweet foods and the findings of this study confirmed that. The simplistic nature of the ant digestive system limits it to liquid food and the ease of digestion and often liquid nature of sugar makes this a valuable food source. A high preference for sugar in ant food can be used to lure ants away from valuable crops. This study could be improved by controlling for terrarium structure, colony age, and lighting conditions to improve the accuracy of this study. Investigation into if foraging preference is similar for colonies of different age, and if preference is similar during different times of the day and year would greatly add to the growing literature on ant forage preference.

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