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Common Grackle Anting with Lime Fruit and Its Effect on Ectoparasites

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Anting is stereotyped behavior in which birds expose themselves to fluid-secreting ants or other pungent substances. During "active" anting a bird crushes an ant in the bill and rubs it frenetically through its plumage (Rothschild and Clay 1952). During "passive" anting a bird entices ants to crawl through its plumage by crouching or lying on an ant hill with spread wings and tail. Although anting has been recorded for more than 200 avian species, most of them passerines, its adaptive significance remains controversial (Ehrlich et al. 1986, Simmons 1986, Potter 1989). The fact that birds use only ants that secrete acid or other toxic fluids suggests that anting may play a role in defense against arthropod ectoparasites, fungi or bacteria (Ehrlich et al. 1986).

Birds also "ant" with pungent substances, including citrus fruits, aromatic leaves and flowers, mustard, onions, tobacco, vinegar, and mothballs (Whitaker 1957, Simmons 1966, Clark et al. 1990). Simmons (1966) argued that anting with such substitutes is aberrant behavior "resulting from a fault in the individual's learning during the ontogeny of its anting responses." However, other workers feel that anting with substitutes may be adaptive behavior that serves a function similar to anting with ants. Clark et al. (1990) pointed out that most reported ant-substitutes have antimicrobial or insecticidal properties. For example, Common Grackles (*Quiscalus quiscula*) have commonly been observed anting with marigold flowers (Nero and Hatch 1984, Dennis 1985), which contain pyrethrum (Dennis 1985) as well as sitosterol, a chemical known to inhibit oviposition in mites (Clark et al. 1990). In short, anting with substitutes may combat ectoparasites, just as the insertion of green vegetation in nests by birds is known to reduce ectoparasite levels (Clark and Mason 1985, 1988).

On 18 July 1990, D.H.C. observed a male Common Grackle anting with a hemisphere of lime in Wilmington Island Park, Wilmington, Illinois. The condition of the bird's plumage appeared normal. The grackle anted for about 20 min, spending much of its time trying to balance itself on top of the lime. Once balanced, it hammered the fruit repeatedly with downward blows, then preened itself holding bits of lime in the bill. Approximately 20% of the observation period was devoted to such preening. The bird seemed unusually preoccupied and frenzied at times, which is typical of anting behavior (Whitaker 1957, Simmons 1966). After the anting session the piece of lime was examined closely; much of the pulp was missing to a depth of about 1 cm, and there were gouges in the outer surface of the rind. Similar accounts of grackles anting with limes or lemons have been reported by other authors (Gosse 1847, Whitaker 1957, Johnson 1971).

These observations prompted us to test the effect of lime on ectoparasites. We used chewing lice (Insecta: Phthiraptera [formerly Mallophaga]), which are common parasites of passerines (Clayton et al. 1992) including grackles (Kirkpatrick et al. 1991). Instead of conducting the test with lice from grackles, however, we used lice from feral Rock Doves (*Columba livia*) because they are easy to obtain in large numbers. The species tested was *Columbicola columbae*, a feather-feeding louse that impairs host thermoregulatory ability (Booth et al. 1993), leading to reduced survival (Clayton 1989) and mating success (Clayton 1990).

To test for an effect of lime on *C. columbae*, we removed a primary feather from a live bird and placed it in a glass petri dish. We placed the equivalent feather from the opposite wing in a second dish. Each feather had several dozen attached lice, which we were careful not to disturb. To the first "experimental" dish we added a slice of lime (ca. 4-cm diameter) that had been punctured several times with a knife. To the second "control" dish we added an equivalent amount of tissue paper soaked in distilled water. The feathers were not allowed to touch the lime or the paper. Each dish was covered with a glass lid and left undisturbed overnight. After 9 h the lice in each dish were examined carefully under a 10× dissecting scope.

In the experimental dish, 35 of 52 lice (67%) were dead, compared with only 1 of 31 lice (3%) in the control dish. Thus, proximity to lime significantly increased louse mortality ($X^2 = 8.72$, $P < 0.01$). Furthermore, most of the remaining 17 lice in the experimental dish appeared to be dying (many were immobile except for trembling legs). In contrast, only 1 of the remaining 30 lice in the control dish appeared to be dying, whereas the other 29 lice showed normal behavior (Clayton 1991).

To determine which part of the lime was detrimental to lice, we used a fine-tipped (00) brush to dab lime juice on the heads of seven lice on a feather in a petri dish. The juice had no apparent effect on the lice, even after 12 h. We then drenched nine additional lice with juice, which also had no effect. Finally, we dabbed lime peel extract—obtained by scraping the peel with a sharp knife—on the heads of 10 lice. All of these lice died within seconds. Thus, the source of the insecticidal substance was apparently the peel. Because lice in the experimental dish were not in

direct contact with the peel, they were presumably killed by vapor.

The results of our test are not surprising since fruit peels are known to contain insecticidal substances. For example, D-limonene, a monoterpene present at concentrations of 98% in the peel oil of oranges and other citrus fruit, is toxic to a wide variety of arthropods including "unidentified lice on guinea pigs" (Hink and Fee 1986). All developmental stages of the cat flea (*Ctenocephalides felis*) are killed by D-limonene vapor. Fleas exposed to the vapor become uncoordinated, suggesting that the substance is a neuroactive agent (Hink and Fee 1986). Symptoms include trembling of the legs, like that we observed in bird lice exposed to lime-peel vapor. Linalool, another compound found in the oil of citrus fruits and over 200 other herbs, leaves, flowers and wood, is also toxic to cat fleas (Hink et al. 1988).

This work is the first to show that a substance used in anting other than ants can have a detrimental effect on bird parasites. Additional experiments are needed because showing that a substance controls parasites *in vitro* is not equivalent to demonstrating control *in situ* (Clayton and Wolfe 1993). As we did not use an "organically" grown lime in our experiment, it is possible that the lice were killed by a pesticide or color enhancer added to the lime during its production. This possibility should be controlled for in future experiments.

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