

Title: Flies as a vector for bacterial pathogens

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Abstract: The capability of flies to transfer pathogens to food was determined over 100 years ago. The relationship between the presence of flies in close proximity to food and the spread of typhoidal diarrheal disease during the Boer and Spanish-American Wars was first made in 1904 (Nash, 1904). Many species of flies live in close association with humans (synanthropic); including flesh flies, house flies, vinegar/fruit flies and blowflies among others (Olsen, 1998). Families of these flies are sometimes collectively called filth flies, feeding and breeding in animal feces, garbage and other decaying organic matter including food. Synanthropic flies that land near humans have been long recognized as vectors for numerous viruses, bacteria and protozoans causing human disease and are more prevalent where poor sanitation conditions exist, particularly in urban areas (Greenberg, 1971). Pepler (1944) found that houseflies transported *Salmonella* Enteritidis 3 miles from a sewage pond to a kitchen and flies carried *Salmonella* from processing plants to markets and homes in Mexico (Greenberg et al., 1963). Greenberg (1964) reported that when house flies were exposed to dog feces containing 10^5 *S. Typhimurium* cells/g for 2 hours, 5 out of 20 flies became infected with *Salmonella* containing between 43 and 635 bacteria. The infected flies were exposed to a Mexican milk drink (Atole) for 100.5 hours which were then (surprisingly) consumed by volunteers. While none of the volunteers showed signs of illness, 8 of 10 milk samples contained between 5,000 and 640,000 *S. Typhimurium* cells/ml. Other examples of flies contaminating food or food production facilities include Fukushima et al. (1979) detecting *Yersinia enterocolitica* from flies collected at a swine production facility and Rosef & Kapperud (1983) isolating *Campylobacter jejuni* from flies at both a poultry and swine farm.

Phase 1 of this research involved controlled laboratory experiments to determine the short time exposure effects on bacterial transfer by flies from and to food. Two separate experiments were conducted to determine the transfer of *E. coli* by fruit flies during short term exposure to apple slices and bologna. Short time exposure (1, 5 and 15 min) of flies to inoculated apple slices were tested in the first experiment to determine the transfer of *E. coli* to flies. No difference ($P \leq 0.05$) in the number of bacteria transferred to flies were found due to these exposure times. In the second experiment the transfer of *E. coli* from inoculated apple or bologna slices (5 min exposure) to un-inoculated slices (1, 5 and 15 min exposure) were tested. More bacteria were transferred to bologna at 1 and 5 min compared to apple while the number transferred did not differ at 15 min exposure. The percentage of *E. coli* transferred from inoculated food to flies was low (<0.5%) while the percentage transferred from flies to un-inoculated food was relatively high (>50%). This study found that flies can pick up and transfer bacteria to food in short exposure times.

Phase 2 research is examining on farm migration of pathogens such as *Salmonella* and *Campylobacter* via flying insects. Fly traps were placed at the center of a poultry farm and in quadrants 50 and 100 meters from the center. These data are still being analyzed however *Salmonella* has been isolated from flies caught in traps 50 and 100 meters from the poultry farm.

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