

**Title** A microbiological hazard analysis of California Walnut production and handling  
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### **Abstract**

Indigenous microbiota (aerobic plate count (APC), Enterobacteriaceae, yeasts/ molds, coliforms, and *Escherichia coli*) were enumerated on California walnuts collected from key points including directly from trees, the orchard floor, points after harvesting, during mechanical hull removal, and before and after dehydration. Walnuts were also inoculated with *Salmonella* spp., *E. coli* O157:H7, and *Listeria monocytogenes* and held under laboratory conditions that simulated commercial conditions. Indigenous microbiota enumerated from fruit collected from the tree canopy or the orchard floor increased as walnut fruit matured. At relative humidities (RH) less than 40%, inoculated bacteria declined during storage while at RH greater than 40% inoculated bacteria survived or grew on walnut hulls. After harvest, walnuts are transported to hulling facilities, where the hull is removed both mechanically and with the aid of water, producing a slurry of crushed hulls and orchard debris. In hulling facilities, populations of indigenous microbiota increased in the water after exposure to harvested materials while removing the hull had little impact on reducing the microbiota on the walnut fruit. Indigenous microbiota and inoculated *S. Enteritidis* declined in freshly crushed/blended green hulls, while mature, brown hulls supported both the survival and growth of indigenous microbiota and *S. Enteritidis*. After hulling, walnuts are dehydrated at temperatures less than 43°C, stored at ambient or cool temperatures, and sold either in-the-shell or as kernels after cracking. Microbial declines of < 1 log CFU/nut in APC were observed during commercial dehydration. In laboratory dehydration studies, *S. Enteritidis* declined by <1 - 2 log CFU/nut. Inoculated bacterial pathogens survived for extended periods on in-shell walnuts and kernels; decline rates were generally slower at colder temperatures; greater declines were observed on in-shell walnuts and with *E. coli* O157:H7, and *L. monocytogenes*. The data provided in this dissertation may be applied to the development of walnut-specific Good Agricultural Practices and Good Manufacturing Practices.