Endosymbiont Bacteria *Holospora undulata* Confers Oxidative Tolerance in Host *Paramecium caudatum*

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ABSTRACT

Paramecium is a genus of ciliated protozoan that, while unicellular, has a complex intracellular structure, comparable to Metazoan cells, which has made them excellent models for the study of genetics and cellular functions. *Holospora undulata* is a bacterial endosymbiont specific to the species *Paramecium caudatum*; they are unable to grow outside of *P. caudatum*. The presence of this endosymbiont has proven to have an effect on the subsequent gene expression and cellular maintenance of its host cells. Recent studies have demonstrated that infection by *H. obtusa* increases the expression of host heat-shock genes and leads to both resistance at normally-lethal high temperatures and heat resistance in ciliary movement (Fujishima, Kawai, & Yamamoto, 2005; Hori & Fujishima, 2003). Heat-shock resistance occurs because bacterial DNA triggers the upregulation of its *P. caudatum* host's heat-shock genes (i.e., hsp60 and hsp70), although the mechanisms are not known (Hori & Fujishima, 2003). These studies demonstrate that infection of *P. caudatum* by *H. undulata* (a closely-related species to *H. obtusa*) induces heat-shock resistance, but fail to address whether *H. undulata* protects against other common environmental stressors such as oxidative damage. To determine if infection by *H. undulata* has the ability to induce additional tolerances, we examined differences in oxidative tolerance, based on percent survival, between *P. caudatum* with and without *H. undulata* infection. Samples of both lines were treated with increasing concentrations of hydrogen peroxide, the number of surviving cells were counted, and the percent survivability of each sample was calculated. There was an approximate 20% increase in survival when *P. caudatum* was infected with *H. undulata*—thus *H. undulata* infections confer oxidative tolerance. Further studies will be conducted to determine if an increase in survivability occurs in response to other damaging mechanisms. Future work will also investigate if the genes responsible for oxidative damage repair are upregulated, in addition to the already characterized heat-shock genes.

KEYWORDS: *Paramecium caudatum*, oxidative tolerance, endosymbiont, host, heat-shock

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REFERENCES

- Hori, M., & Fujishima, M. (2003). The endosymbiotic bacterium *Holospora obtusa* enhances heat-shock gene expression of the host *Paramecium caudatum*. *The Journal of Eukaryotic Microbiology*, 50(4), 293-298.
- Fujishima, M., Kawai, M., & Yamamoto, R. (2005). *Paramecium caudatum* acquires heat-shock resistance in ciliary movement by infection with the endonuclear symbiotic bacterium *Holospora obtusa*. *FEMS Microbiology Letters*, 243(1), 101-105.