Microbiome-Mediated Stress Resistance: Effects of *JUb134* and *JUb19* in *Caenorhabditis elegans*

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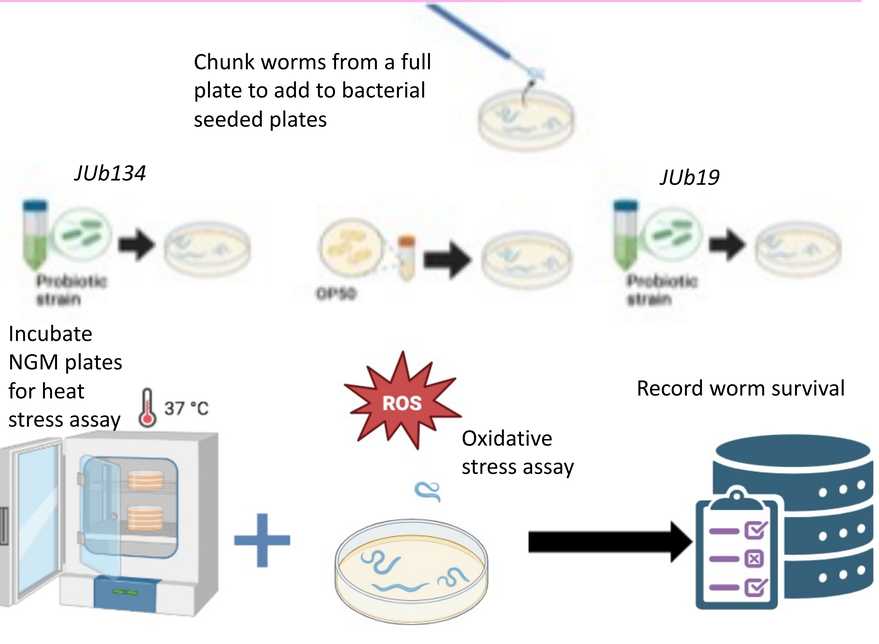
Abstract

The microbiome is very important in regulating host physiology, metabolism, and immune function. In *C. elegans*, the microbiome influences phenotypic traits of the host by regulating signaling pathways and stress resistance. In this study, we analyzed how the colonization of the microbiome by two bacterial strains, *JUb134* and *JUb19*, impacted stress resistance in *C. elegans*. To assess strain-specific effects and phenotypic changes, oxidative and heat stress assays were conducted. The results of this study show that *JUb134* fed worms had the highest survival compared to *JUb19* fed worms in both stress conditions. These findings indicate that a bacterial diet can influence stress resistance in *C. elegans*. Also, it is possible that the presence of one strain can activate stress response pathways differently in *C. elegans*. Future studies could analyze how the stress response pathways are activated differently when faced with environmental stressors. Understanding these interactions can help clarify how bacterial colonization of the microbiome contributes to stress resistance.

Intro

- Probiotics are used in promoting gut health and modulating immune responses.
- The gut microbiome plays a key role in metabolism, immunity, and overall health.
- *C. elegans* serve as a model for identifying functional probiotics due to their similar biological pathways with humans and conserved stress pathways [1].
- Key mechanisms include the activation of the insulin/IGF-1 and p38 MAPK pathways, which are crucial for both stress response and lifespan extension [2].
- Stress resistance is regulated by DAF-16, HSF-1, and SKN-1 [3].
- Use of an artificial microbiome is beneficial as it offers an effective approach to understand the cause-and-effect relationships in host-microbiome systems.

Assessing impact of heat and oxidative stress on *C. elegans*



Do *C. elegans* colonized with *JUb134* and *JUb19* have better survival under heat stress?

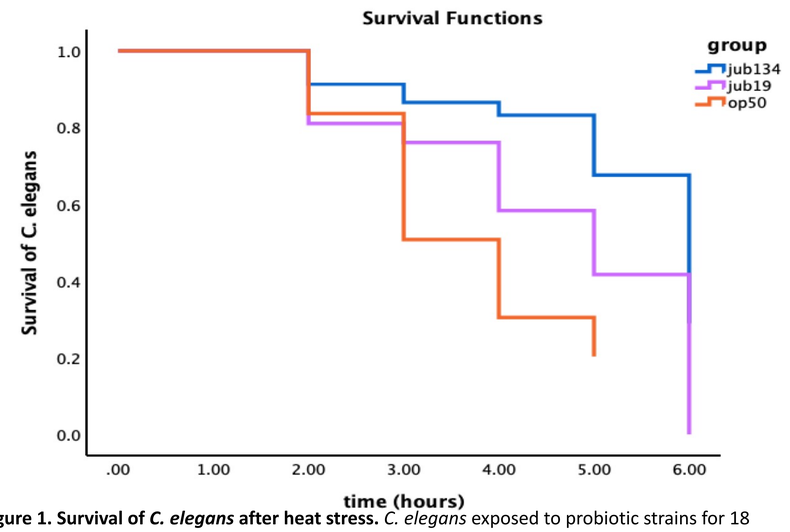


Figure 1. Survival of *C. elegans* after heat stress. *C. elegans* exposed to probiotic strains for 18 hours prior to heat stress. The assay was conducted for six hours at 37 degrees Celsius. *JUb134* fed (64 worms) and *JUb19* fed (55 worms) promoted better survival compared to OP50 fed (59 worms). A one-way ANOVA showed a significant effect of the bacterial strains after the heat stress assay, df (2,6), p <0.001. Levene's test showed homogeneity of variance (p=0.55).

- *JUb134* fed worms showed the highest survival in heat stress assays.
- *JUb19* fed worms showed the lowest survival, suggesting weaker resistance to stress assay.

Do *JUb134* and *JUb19* enhance oxidative stress survival in *C. elegans*?

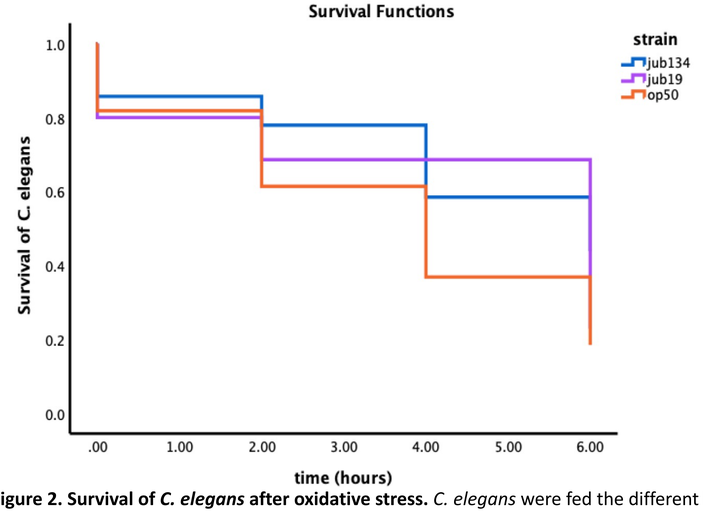


Figure 2. Survival of *C. elegans* after oxidative stress. *C. elegans* were fed the different bacterial strains for 18 hours prior to being exposed to hydrogen peroxide. Survival was monitored every hour for six hours. *JUb134* (54 worms) showed the highest survival, *OP50* (51 worms) showed intermediate survival, and *JUb19* (49 worms) had the lowest survival. A one-way ANOVA showed a significance in the data, df (2,6), p < 0.001. Levene's test confirmed homogeneity (p = 0.61).

- Quick mortality in *JUb19* fed worms can indicate a weaker defense against ROS and potentially no activation of signaling pathways.
- Different doses of ROS-generating chemicals can have different effects on *C. elegans*, and cellular homeostasis is affected.

Discussion

- The data presents strain specific differences and how survival and physiology can vary due to microbiome health in *C. elegans.*
- Both assays support the idea that microbiome influences general stress resistance.
- *JUb134* showed that its resistance and protection may be due to strain-specific interactions with *C. elegans'* stress pathways.
- *JUb19* may result in lower pathway activation leading to quicker mortality.
- Stress response pathways in *C. elegans* are conserved in humans so it can give information on how the human microbiome can be influenced by the same environmental stressors.

Future Work

- Use age synchronized worms to reduce variability and have controlled results.
- Measure gene expression of DAF-16, SKN-1, and HSF-1 to confirm pathway activation.
- Test multiple concentrations of hydrogen peroxide to evaluate dose-dependent oxidative stress responses.

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References

[1] Bouasker, S., Nodland, S., Millette, M. (2024). The Probiotic Strain Lactobacillus acidophilus CL1285 Reduces Fat Deposition and Oxidative Stress and Increases Lifespan in Caenorhabditis elegans. Microorganisms, 12(6), 1036.
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