Heat-Induced Stress Response of *Caenorhabditis elegans*

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Abstract

The bacterivorous, non-parasitic free living terrestrial nematode *Caenorhabditis elegans* is one of the most extensively studied organisms today. The nematodes small body size, compact genomes and exposure to common pathogens has made it an ideal simple model for anatomical, cellular, genetics and neurobiological studies; however little is known of the worm's chemical biology. *C. elegans* like most small organisms utilizes chemical signals, known as pheromones, to communicate with like worms and its environment. Excreted pheromone composition varies according to the environment encountered by the worm, for instance pheromone complexity increases in response to heat induced stress. This hypothesis is currently being tested by initial cultivation of homogenous populations of *C. elegans*, which are then exposed to sudden high temperatures; their exudates are collected, analyzed by NMR and compared to spectra of non-heat shocked worms. In response to hsp1 up-regulation, we expect the heat-shock spectra to contain different peaks compared to non-heat shock and therefore have a more varied ascaroside composition. Comparison of resultant spectra to that of other types of induced stress would help determine if the same additional compounds are produced regardless of the type of stress induced. The complete analysis of the results of this experiment will be influential in the completion of other research endeavors as well as contribute significantly to the understanding of the correlation of genetics and behavior in *C. elegans.*

Background

An ideal simple organism C. elegans exists in predominantly hermaphroditic populations with males comprising 0.01% of the wild-type population.

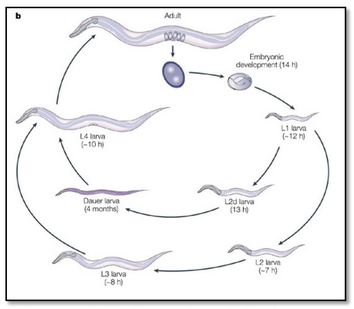


Figure 1. Life-cycle of *C. elegans*

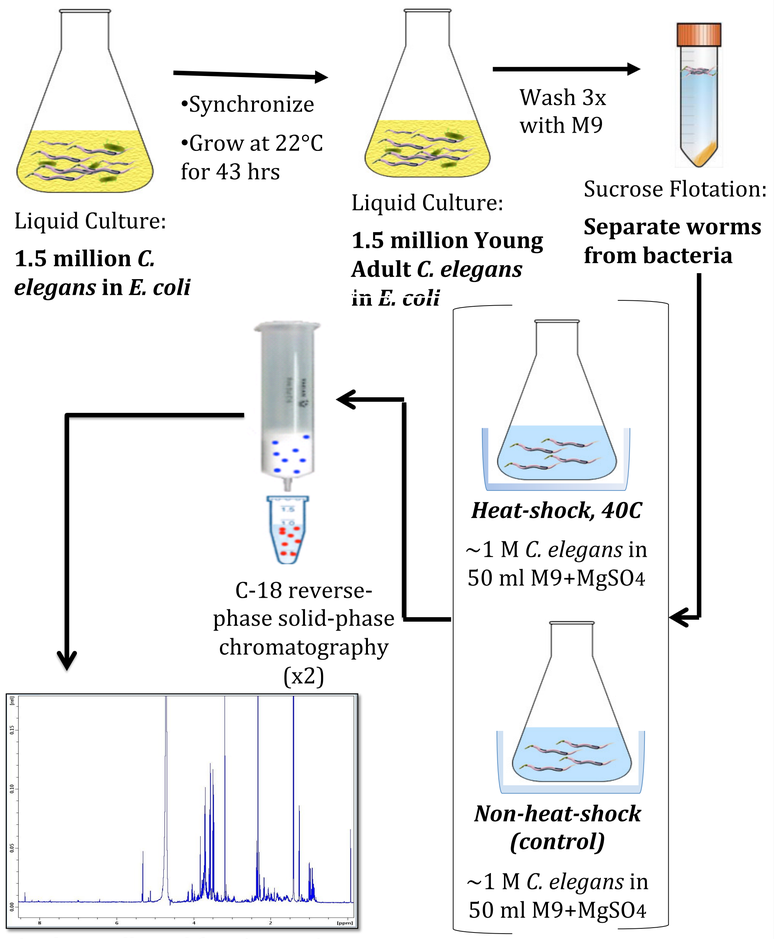
Approximately 300 offspring is produced per generation and each takes approximately 3.5 days to develop from eggs to adults. The life-span of the nematode is 2-3 weeks.

Like plants and bacteria, *C.* elegans uses small molecule chemical signaling to communicate with like worms and its environment. Analysis by NMR and other analytical techniques have revealed worm exudates to contain at least 36 common metabolites, inclusive of organic acids, amino acids and sugars.

Pheromone production is dependent on the age of development of the worm and environmental conditions.

Previous research involving exposure of the worms to above normal cultivation temperatures has revealed *C. elegans* is capable of thermotaxis, mediated by thermosensory neurons and interneurons, forming a neuronal circuit. Detection of above-cultivation temperatures induces up-regulation of a heat shock transcription factor, hsf-1, and down regulation of genes for normal cellular regulation. The hsf-1 defense response requires a system of chaperones including small and 90-kDa inducible hs proteins.

Method



References

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2. Laboratory of Optical and Instrumental Biology. (2011). *Worm Classroom*. Retrieved July 19, 2011, from http://www.wormclassroom.org/short-history-c-elegans-research
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Results

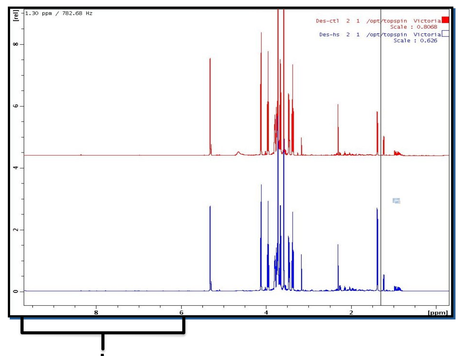

Figure 2. Spectrum compares the control and heat shock samples

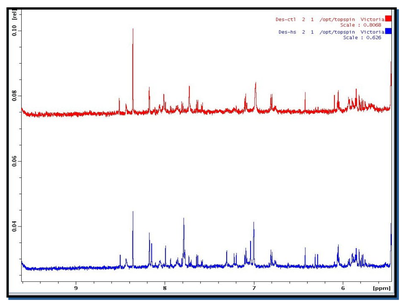

Figure 3. Magnified spectrum between 5.4- 9 .4 ppm showing small differences in peaks generated.

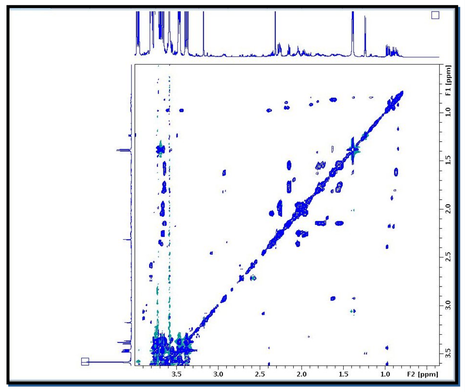

Figure 5. Tocsy of Heat Shock sample

Summary

- Small amount of visual differences
- Large amount of sucrose in both heat shock and control possibly due to skipping of clear gut process in experimental procedures

FUTURE PLANS

- 50 % methanol fraction will be analyzed using NMR
- Repeat experiment including "clear gut step"