Mechanisms underlying variable responses to isoforms of the neuropeptide C-type allatostatin (AST-C) in the American lobster, *Homarus americanus*

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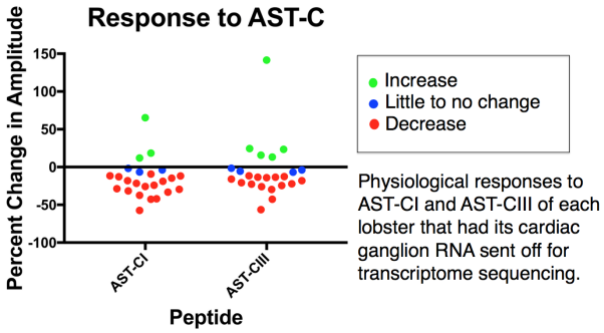
The crustacean heart is unique, in that its pacemaking and central pattern generation are solely dependent on the cardiac ganglion. The crustacean cardiac ganglion is a branch-like trunk in the heart. This cardiac ganglion is made up of 9 neurons that provide extremely rhythmic and patterned, reoccurring action potentials (Cooke, 2002). Central pattern generators (CPGs) produce patterned and predictable outputs that generate behaviors such as walking, chewing, and breathing. These CPGs can be influenced by neuromodulators that ultimately alter their output in response to environmental stressors. Many neuromodulators belong to specific families of peptides which contain different isoforms. One specific neuropeptide that modulates the crustacean cardiac system is C-type allatostatin (AST-C). There are three functional isoforms of this neuropeptide that have been identified in the American lobster, *Homarus americanus*, AST-C I, II, and III. AST-C I and III have shown to provoke differing responses in the crustacean heart. Individual responses to perfusion of AST-C I and III are characterized by either increases or decreases in contraction amplitude (Dickinson et al., 2018).

This summer I have been investigating the possible mechanism behind the variable responses to the isoforms AST-C I and III in the American lobster. It has been hypothesized that the mechanism behind this variation is due to the differing levels of expression of four putative AST-C receptors. To investigate this hypothesis, physiological responses of the cardiac system to AST-C I and III were recorded. RNA was also extracted and isolated from the cardiac ganglion, the eyestalk ganglion, the brain, the hypodermis, and the cardiac muscle. This research focuses specifically on the cardiac ganglia samples because of their importance in determining cardiac output. These cardiac ganglia samples were then bioanalyzed and the concentration of RNA was recorded. Cardiac ganglia RNA samples from 24 lobsters that showed varying responses to AST-C I and III have been sent off to Georgia Genomics for transcriptome sequencing using Illumina RNAseq (Figure 1). These receptor transcripts will then be mapped onto a preexisting cardiac ganglion transcriptome. This will allow us to determine if differing receptor expression levels between lobsters is responsible for their varying physiological responses to AST-C I and III.

Figure 1.



Physiological responses to AST-CI and AST-CIII of each lobster that had its cardiac ganglion RNA sent off for transcriptome sequencing.

Faculty Mentor: Patsy Dickinson

Funded by the Student Faculty Research Grant Fellowship supported by NSF

References:

Cooke, I. M. (2002). Reliable, responsive pacemaking and pattern generation with minimal cell numbers: the crustacean cardiac ganglion. *The Biological Bulletin*, *202*(2), 108-136.

Dickinson, P. S., Armstrong, M. K., Dickinson, E. S., Fernandez, R., Miller, A., Pong, S., ... & Wiwatpanit, T. (2018). Three members of a peptide family are differentially distributed and elicit differential state-dependent responses in a pattern generator-effector system. *Journal of neurophysiology*.