Permeability of the stomatogastric ganglion sheath to RPCH in the stomatogastric nervous system of *Homarus americanus*

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Central pattern generators are mechanisms that function to produce and regulate the fixed outputs of a nervous system that generate rhythmic movement. In order to respond to differing environment conditions, neuromodulators, which can alter membrane properties or synaptic connections, enable pattern generators to elicit a variety of rhythmic patterns. These neuromodulators can either be released locally within the nervous system or released hormonally, circulating in the hemolymph of the lobster. In *Homarus americanus*, the American lobster, the stomatogastric ganglion (STG) is one of the four ganglia in the stomatogastric nervous system that generate these rhythmic patterns; all of these ganglia are encased in connective tissue sheaths. It has been found that this sheath can serve as a differential barrier to certain hormonal modulators of the lobster, as the sheath is only permeable to some modulators. To discover the extent to which this sheath can serve as a differential barrier, known modulators need to be tested when the sheath is present or absent, and by comparing the modulatory effects of the given modulator, it can be ascertained whether the modulator could serve as a hormonal modulator or only be released within the nervous system, and the threshold level in which significant effects are elicited can be determined.

In my research, I am looking at red pigment-concentrating hormone (RPCH)—a hydrophobic compound that has been found to excite neuronal activity in many crustaceans—and the threshold level at which RPCH can serve as an activator when the STG is sheathed and desheathed. First, I compared the activity levels of several neurons involved in two different rhythmic stomatogastric patterns, LG in the gastric mill pattern and LP and PD in the pyloric pattern, via extracellular recordings on various motor nerves in the stomatogastric nervous system. In higher concentrations, like $10^{-6}$ M, there are similar levels of excitation whether the STG is sheathed or not, suggesting that the sheath is permeable to RPCH and thus RPCH can serve as a hormonal modulator. However, RPCH is most likely found in lower concentrations naturally in the hemolymph of lobsters, so I looked at $10^{-7}$, $10^{-8}$, and $10^{-9}$ M concentrations. I found the same effects repeated in the $10^{-7}$ M concentration and preliminarily in the $10^{-8}$ M concentration; however, there was not a noticeable activation of either the gastric mill or pyloric patterns at the $10^{-9}$ M concentration in the desheathed condition, which suggests that the threshold for RPCH is between a $10^{-8}$ and $10^{-9}$ M concentration.

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References:
Figure 1.

RPCH 10^-7M- sheathed

RPCH 10^-8M- sheathed

RPCH 10^-8M- desheathed

RPCH 10^-9M- desheathed

References:
Dennison, B. 2008. Regulation of central pattern generators by the ganglionic sheath in the American lobster, *Homarus americanus*.