Marine lab hunts subtle clues to environmental threats to blue crabs

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The Atlantic blue crab, Callinectes sapidus, long prized as a savory meal at a summer party or seafood restaurant, is a multi-million dollar source of income for those who harvest, process and market the crustacean along the U.S. Atlantic and Gulf coasts. Unfortunately, the blue crab population has been declining in recent years under the assault of viruses, bacteria and man-made contaminants. The signs of the attack often are subtle, so researchers from the National Institute of Standards and Technology (NIST) and the College of Charleston (CofC) are at work trying to identify the clues that will finger specific, yet elusive, culprits.

Pathogens and pollutants impair the blue crab's metabolic processes, the chemical reactions that produce energy for cells. These stresses should cause tell-tale changes in the levels of metabolites, small chemical compounds created during metabolism. Working at the Hollings Marine Laboratory (HML) in Charleston, S.C., the NIST/CofC research team is using a technology similar to magnetic resonance imaging (MRI) to identify and quantify the metabolites that increase in quantity under common environmental stresses to blue crabs—metabolites that could be used as biomarkers to identify the specific sources.

In a recent paper in *Metabolomics*, the HML research team describes how it used nuclear magnetic resonance (NMR) spectroscopy to study challenges to one specific metabolic process in blue crabs: oxygen uptake. First, the researchers simulated an environmentally acquired bacterial infection by injecting crabs with the bacterium Vibrio campbellii. This pathogen impairs the crab's ability to incorporate oxygen during metabolism. Using NMR spectroscopy to observe the impact on metabolite levels, the researchers found that the yield of glucose, considered a reliable indicator of mild oxygen starvation in crustaceans, was raised.

In a second experiment, the HML team mimicked a chemical pollutant challenge by injecting blue crabs with a chemical (2,4-dinitrophenol (DNP)) known to inhibit oxidative phosphorylation, a metabolic process that manufactures energy. This time, the metabolite showing up in response to stress was lactate, the same compound seen when our muscles need energy and must take in oxygen to get more produced. A rise in the amount of lactate proved that the crabs were increasing their oxygen uptake in response to the chemical exposure.

"Having the glucose and lactate biomarkers—and the NMR spectroscopy technique to accurately detect them—is important because the blue crab's responses to mild, non-lethal metabolic stresses are often so subtle that they can be missed by traditional analyses," says Dan Bearden, corresponding author on the HML paper.

More information: T.B. Schock, D.A. Stancyk, L. Thibodeaux, K.G. Burnett, L.E. Burnett, A.F.B. Boroujerdi and D.W. Bearden. Metabolomic analysis of Atlantic blue crab, Callinectes sapidus, hemolymph following oxidative stress. Metabolomics, Published online Jan. 20, 2010, DOI 10.1007/s11306-009-0194-y

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