

New study identifies immune response biomarkers, novel pathways to support Mollusca aquaculture

January 12 2021, by Margaret Nagle



Credit: Tim Bowden

Understanding the immune systems of oysters and clams is important in monitoring the effects of pollution and climate change on the health of molluscan species and the potential impacts on the aquaculture industry. Their immune responses also can serve as indicators of changes in ocean

environments.

A new study involving the University of Maine assessed immune responses in four economically important marine mollusc species—the blue mussel, soft-shell clam, Eastern oyster, and Atlantic jackknife clam—and identified new biomarkers relating to changes in [protein function](#) involved in novel regulatory mechanisms of important metabolic and immunological pathways.

The discovery will aid further biomarker identification to benefit the [aquaculture industry](#) and provides new understanding of how these pathways function in diverse ways in different animal species.

"These biomarkers reveal how several different physiological functions can be generated from a single protein sequence. This gives added value to an organism's physiology," says Tim Bowden, UMaine associate professor of [aquaculture](#) and co-author of the study published as the cover article in the December 2020 issue of the journal *Biology*.

Bowden, a researcher in UMaine's School of Food and Agriculture and Aquaculture Research Institute, conducted the study with United Kingdom colleagues Igor Kraev of the Open University and Sigrun Lange of the University of Westminster.

Oysters and clams play a critical role in the food chain, representing more than 7% of global marine capture fisheries products in 2018, according to the Food and Agriculture Organization of the United Nations. In the U.S., more than 82% of the 2018 total value for marine aquaculture was derived from clams, mussels and oysters. Understanding molluscan metabolism is a priority based on the role of marine mollusks in global ecosystems and their burgeoning commercial value.

In their study of post-translational protein modification, the researchers

found that deimination, or conversion of the amino acid arginine into the nonstandard amino acid citrulline, affects multiple pathways involved in immunity, metabolism and gene regulation.

Deimination is known to play a role in human diseases such as Alzheimer's and Parkinson's.

Study findings suggest that the enzymes that regulate deimination in mammals, birds and reptiles, and bacteria, parasites and fungi also are active in molluscan pathways. Peptidylarginine deiminases, or PADs, which had not previously been reported in Mollusca, may in fact serve as a control switch for varied immune and metabolic pathways in Mollusca and across the phylogenetic tree, according to the research team.

The researchers documented species-specific variations in the size and distribution of extracellular vesicles (EVs) in the bivalves studied. EVs have multiple functions including transporting proteins, genetic cargoes and biomarkers into cells and mediating host-pathogen interactions, among others.

Further investigation of the physiological and immune-related roles of EVs and characterization of the biomarkers they transport is warranted to enhance understanding of regulatory mechanisms and pathways in Mollusca and to support the global aquaculture industry.

More information: Timothy J. Bowden et al. Extracellular Vesicles and Post-Translational Protein Deimination Signatures in Mollusca—The Blue Mussel (*Mytilus edulis*), Soft Shell Clam (*Mya arenaria*), Eastern Oyster (*Crassostrea virginica*) and Atlantic Jackknife Clam (*Ensis leei*), *Biology* (2020). [DOI: 10.3390/biology9120416](https://doi.org/10.3390/biology9120416)

Provided by University of Maine

Citation: New study identifies immune response biomarkers, novel pathways to support Mollusca aquaculture (2021, January 12) retrieved 2 May 2024 from

<https://phys.org/news/2021-01-immune-response-biomarkers-pathways-mollusca.html>

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