Gulf Research Reports

Volume 6 | Issue 4

January 1980

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DOI: 10.18785/grr.0604.10

Gulf Research Reports, Vol. 6, No. 4, 421–422, 1980.

SHORT COMMUNICATIONS

DIATOMS IN THE GILLS OF THE COMMERCIAL WHITE SHRIMP

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ABSTRACT A white shrimp from Galveston, Texas, is the first reported case of a crustacean internally infected by a diatom. Even though more than one species occurred in debris on and between gill filaments, only individuals of *Amphora* sp. occurred within gills. To determine if a related diatom would easily reproduce within the shrimp and cause a host-response similar to that observed, we injected cultured specimens of *A. coffaeformis* into white shrimp. Under the experimental conditions, individuals of that species did not divide, but they elicited an extensive melanistic host-response.

Gills of a single specimen of the white shrimp *Penaeus setiferus* from Galveston, Texas, harbored numerous melanistic regions. This particular specimen, the first crustacean reported to be infected in the hemocoel with algae, had been collected from the natural environment and maintained along with others during a project dealing with shrimp maturation. Soon after death, it was fixed in Carnoy's II solution and sent to us for identification of the agent or agents eliciting the melanistic response. Jorge Leong, who forwarded the specimen, noted no similarly affected shrimp at his laboratory at that time.

Gross examination of a stained preparation (Van Cleave's hematoxylin) of a few gills revealed clusters of diatoms associated with deposits of presumed melanin. These clusters consisted of *Amphora* sp. On the other hand, individuals of *Amphora* sp., *Nitzschia* spp., and *Achanthes* spp. (including *A. exigua*) occurred in debris on and between filaments. Additionally, an apostomatid ciliate occurred within a few filaments.

Sectioned material showed several sites, primarily in the tips of filaments, where hemocytes had apparently encircled diatoms. In the voluminous hemolymph-filled space of the afferent channel of one gill adjacent to its lamellar junctions, *Amphora* sp. occurred in large clusters. Stained internal structures within the diatoms suggest that most were alive at the time of fixation. Apparently *Amphora* sp. grew and reproduced within the shrimp, since individual organisms in the afferent channel ranged from small to large and exhibited a variety of shapes. A heterogeneous debris-like substance surrounded most of the internal clusters of diatoms, possibly resulting from their metabolic wastes. The substance contrasted with the lightly stained hemolymph by staining red and violet with Taylor's technique for bacteria and blue and violet with the Ziehl-Neelsen method for bacteria (Luna 1968). In contrast to that in most shrimp, the hemolymph in this particular shrimp had a fibrinous consistency.

In an effort to determine if diatoms easily reproduce in the white shrimp, we injected saline with cultured *Amphora coffaeformis* into either the hemocoel or abdominal musculature of 50 shrimp. We used *A. coffaeformis* since it closely resembled the unidentified species present in the shrimp from Texas. Within an hour, most injected diatoms concentrated in the gill region. By 24-hour postinoculum (PI), we detected melanization as yellowish-brown foci. These regions acquired a dark color by day 2. By day 4 they became more numerous, larger, and darker. Seldom did more than a few individual diatoms occur together, suggesting their failure to reproduce. Nevertheless, the inoculated shrimp died sooner than saline-injected counterparts used as controls. When only a few individual diatoms were introduced into shrimp in a follow-up experiment, no aggregations became apparent after 7, 14, or 21 days PI.

We conclude that the single infected shrimp from Texas probably represents an abnormal or accidental case. Possibly, recently eaten diatoms passed or were forced through a damaged or filled alimentary tract. In any event, the host apparently encapsulated diatoms at a slower rate than some individuals could multiply. In the experimental shrimp a factor such as the strain of diatom, health or resistance of shrimp, or other influence may have inhibited reproduction of the diatom.

Once certain diatom species gain entrance into a crustacean's hemocoel, hemolymph might provide a good culture medium. *Amphora* spp. are known to be remarkably versatile in their requirements for growth. Cooksey and Chansang (1976) reported different requirements for three different heterotrophic cultures of *Amphora* spp. Moreover, some species withstand harsh environments. *Amphora coffaeformis* adjusts by establishing resting cells which can rapidly reestablish to the logarithmic stage given favorable conditions (Anderson 1975).

Melanization and the cellular inflammatory response in penaeids and other arthropods have already been documented. Lightner and Redman (1977) reported that a variety of pathological conditions, organisms, heavy metals, and

Manuscript received May 12, 1980; accepted July 2, 1980.

unknown agents elicited the response. Babu and Hall (1974) using a variety of histochemical methods demonstrated that the pigment was indeed melanin, and Solangi and Lightner (1976) described the progression of a hemocytic response in shrimp gills.

Another diatom has been observed in an arthropod hemocoel. Laird, et al. (1976) reported that a single larva of *Culex theileri* contained an abundance of *Cocconeis placentula* var. *euglypta*. Algae not in the hemocoel also affect crustaceans, both deleteriously and benignly. As an extreme example of harm, Lightner (1978) described severe acute hemocytic enteritis with secondary bacterial infections in reared blue shrimp. That disease, which greatly affects the production of shrimp, apparently resulted when the shrimp fed on a toxic blue-green alga (D. V. Lightner, personal communication).

ACKNOWLEDGMENT

We wish to thank Jorge K. Leong of the National Marine Fisheries Service in Galveston, Texas, for sending the preserved infected shrimp and O. Roger Anderson of Lamont-Doherty Geological Observatory of Columbia University for sending cultured *Amphora coffaeformis*. Ronnie Palmer and Roswitha Buxton provided technical assistance. The study was conducted in cooperation with the U.S. Department of Commerce, NOAA, National Marine Fisheries Service, under PL 88–309 Project No. 2–325–R.

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