Spontaneous Necroses in Muscles of Brown Shrimp, *Penaeus aztecus* Ives[1,2]

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ABSTRACT

Brown shrimp (*Penaeus aztecus*) caught in trawls in Galveston Bay and kept in poorly aerated tanks frequently have macroscopic focal, irregular, white areas in the muscles of different segments of the abdomen. When the shrimp are placed in well aerated tanks, some of this discoloration may regress within 24 hours. Similar areas of discoloration are sometimes present in shrimp immediately after being caught in the Bay. These "white areas" histologically are degenerated foci of striated muscle. When the muscular involvment is extensive, the shrimp may die in 18–24 hours. This muscle necrosis may be a metabolic reaction caused by high temperature, anoxia, and stress.

INTRODUCTION

Brown shrimp, *Penaeus aztecus*, caught in trawls in Galveston Bay frequently have focal, light-colored areas in the muscles in different segments of the abdomen (Figure 1). The size and number of such areas vary. A few shrimp have a similar diffuse involvement of the distal segments of the abdomen. Sometimes these distal segments become progressively softer and finally desquamate. We report here our findings in a pathologic study of these shrimp.

METHODS AND MATERIAL

In March 1969 a number of brown shrimp, caught in trawls in Galveston Bay and tagged for identification, were observed to have focal, irregular, white areas in the muscles in different segments of the body. Some of these shrimp were killed and fixed in a 10% solution of formalin. Histologic sections of the muscles were stained with hematoxylin and eosin.

During June and July 1969, 35 brown shrimp (male and female), 60–111 mm total length (tip of rostrum to tip of telson) caught in the Bay were brought alive to the laboratory. In some the typical focal areas were present (Figure 1-B) and in others the posterior 3–4 segments were white and soft (Figure 1-A). Multiple sections were removed from the abdominal muscles and immediately fixed in a 10% solution of formalin. Paraffin sections were prepared and stained routinely with hematoxylin and eosin. Selected sections were also stained with Giemsa's stain and Mallory phosphotungstic acid hematoxylin (PTAH).

MICROPATHOLOGY OF NECROTIC AREAS

The muscles of these shrimp have focal areas of necrosis (Figure 2) of varying size (Figure 3), surrounded by normal muscle tissue. The earliest change observed in the muscles is a variation in the reaction to hematoxylin and eosin, PTAH, and Giemsa's stain. Normal muscle stains blue with phosphotungstic acid hematoxylin, whereas areas showing early degeneration stain pink (Figure 4). The early degenerative changes in the muscle may progress to necrosis, and ultimately the sarcolemma is all that remains in such areas.

Inflammatory cells are absent in the necrotic foci, but occasionally a few large mononuclear cells are present. Regeneration of the focal areas of necrosis in the muscle is characterized by marked proliferation of sarcolemmal nuclei (Figure 5). In only one shrimp have we observed a necrotic area with bacteria, but no inflammatory cells were present.

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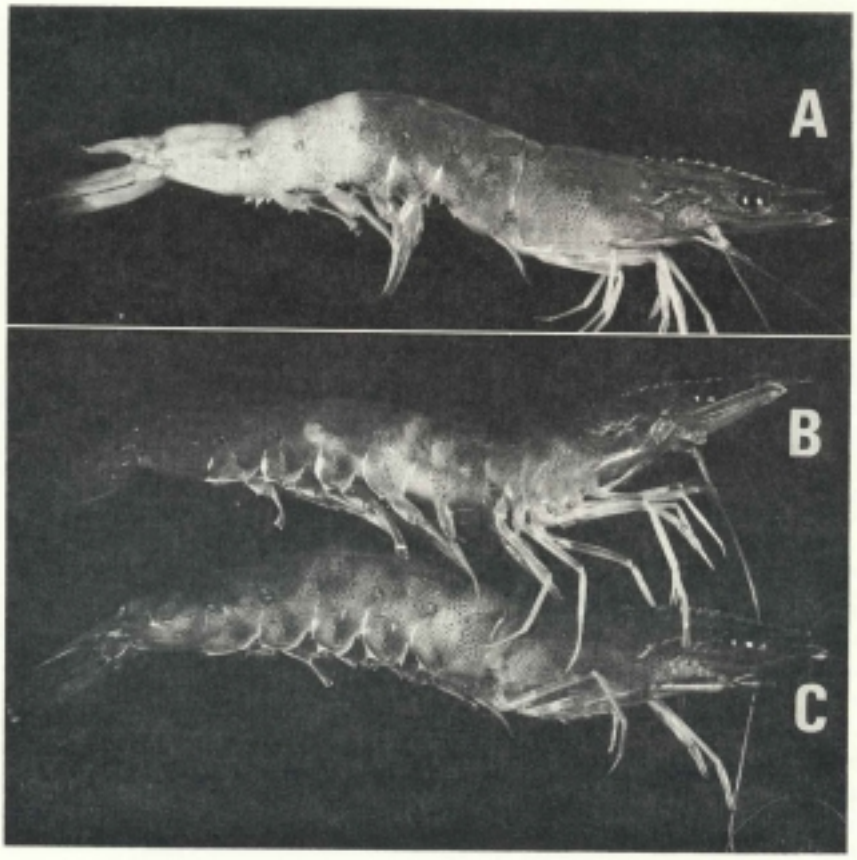

FIGURE 1.—Different degrees of necrosis in brown shrimp. A. Shrimp (91 mm total length) with white discoloration of muscle in the distal third of the body. It was alive when photographed. B. Shrimp (86 mm total length) with several focal white areas visible in the muscle in the 1st, 2nd, and 3rd segment of the body. C. Normal shrimp (93 mm total length).

EFFECTS AND POSSIBLE CAUSES

The lesion is characterized grossly by a white discoloration of the muscle and varies widely in extent. Shrimp with extensive involvement of the muscles have a marked diminution of body movements and may die within 18–24 hours.

Shrimp are likely to show discolored areas when the temperature is high and they are crowded in tanks. On July 2, 1969, the water temperature was near 31.4 C near the Galveston South Jetty where shrimp-marking experiments were conducted. Shrimp caught the preceding day were kept in tanks overnight and tagged the following day. Before they were tagged 85% of these shrimp had focal white areas in the abdominal muscles. When removed from crowded tanks and placed in well aerated tanks, shrimp with few small areas of discoloration showed marked diminution in the number and size of these white foci within 24 hours.

The white discoloration in the abdominal muscles of these brown shrimp is not to be confused with a similar discoloration in

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FIGURE 2.—Focal areas of necrosis, indicated by arrows. This shrimp macroscopically resembled that in Figure 1-A at the time it was killed. Hematoxylin and eosin stain, × 150.

FIGURE 3.—A large area of acute necrosis in the muscle of the same shrimp as shown in Figure 2. Hematoxylin and eosin stain, × 150.

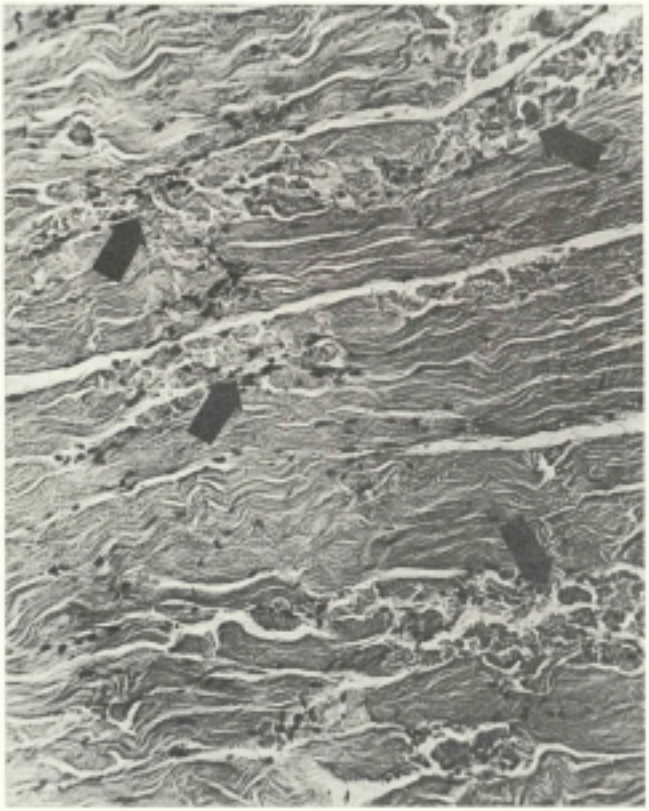


FIG. 2.

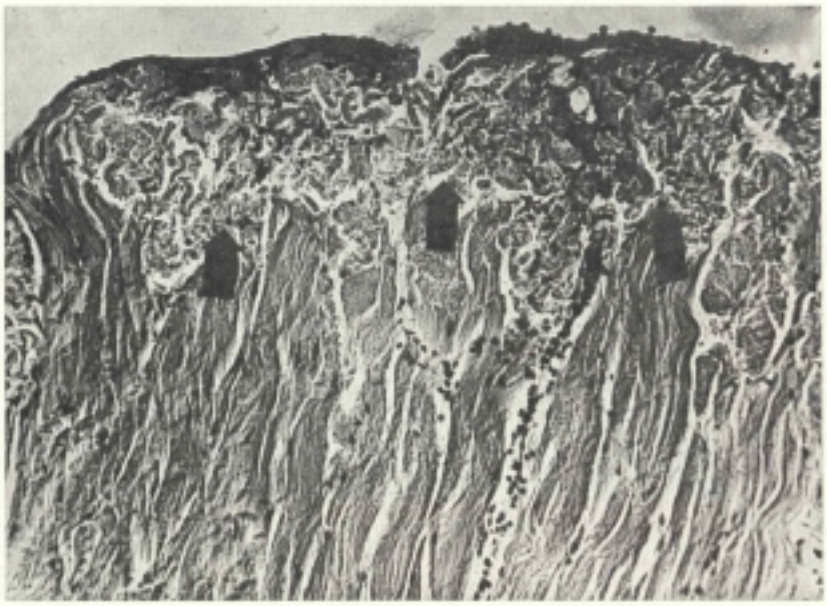
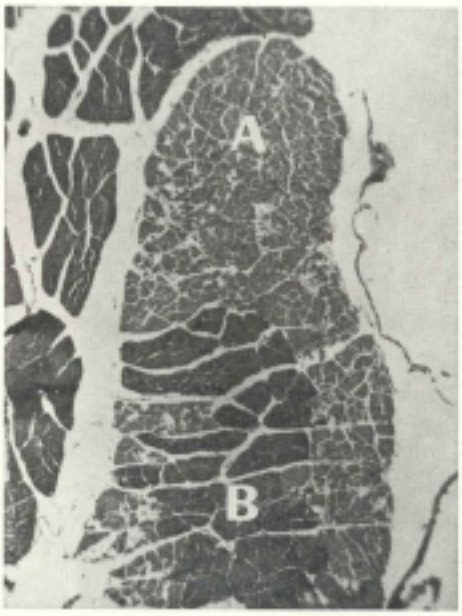


FIG. 3.



shrimp with microsporidiosis (Sprague, 1950). No parasitic organisms have been observed in the muscles of the shrimp used for the present study. Bacteria rarely were found in the degenerated tissue and, when present, appeared to be a secondary factor and not the primary etiologic agent.

It appears from our clinical experience with shrimp that this muscle discoloration is related to water temperature, decreased oxygen content of water in holding tanks, stress, or a combination of these factors although some shrimp have this same discoloration when removed from nets immediately after being caught in the Bay. This lesion may be reversible in the initial stages, but may progress

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FIGURE 4.—Focal white areas in the muscles of a female shrimp 110 mm total length. The degenerating muscle stains lighter (A) than the normal muscle (B). Giemsa's stain, × 27.

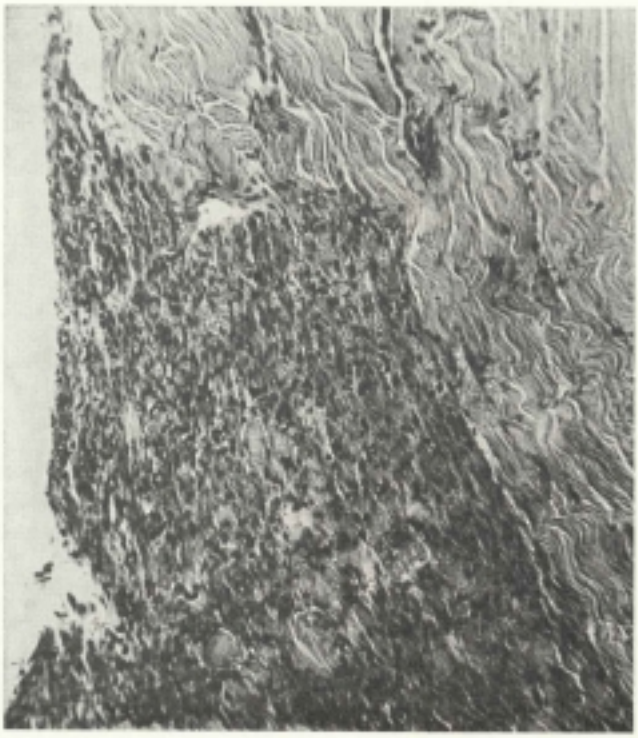

FIGURE 5.—A focal area in the muscle in which a marked proliferation of sarcolemmal nuclei has occurred. Some fragments of degenerating muscle remain in the center of this regenerative process. This female shrimp had focal white areas (like those in Figure 1-B) in the muscle when put into a well aerated tank. Forty-eight hours later this discoloration had decreased significantly. Hematoxylin and eosin stain, × 135.

to necrosis. Studies are in progress to evaluate the possible role of water pollution and toxicity, and the chemical and enzymatic changes in the muscle. This muscle necrosis is of economic importance, since the mortality rate of shrimp kept for bait is high. Furthermore, it is important to establish the pathogenesis of this necrosis; if our hypothesis of a metabolic disturbance is correct, shrimp may be used as a test animal for a variety of experimental studies.

LITERATURE CITED

SPRAGUE, V. 1950. Notes on three microsporidian parasites of decapod crustacea of Louisiana coastal waters. Occasional Papers Marine Laboratory, Louisiana State University 5: 1–8.