Kudoa

I. Causative Agent and Disease

Kudoa species are metazoans in the class Myxosporea in the phylum Cnidaria (anemones, jellyfish, corals) based on molecular studies and the feature of discharging cells (cnidocytes) known as polar capsules. The genus has over 90 different species among which *K. thyrsites* is most commonly reported in over 30 marine and estuarine fish species worldwide. Many *Kudoa* species infect skeletal muscle tissues producing pseudocysts containing stellate-shaped spores with 4 or more valves and polar capsules. Infections produce inflammation but no significant disease. High intensities of *Kudoa* cause unfit product quality from post-mortem myoliquefaction of fish flesh (soft flesh syndrome) due to release of proteolytic enzymes from the parasite.

II. Host Species

Many species of marine and estuarine fishes from several families are reported hosts of *Kudoa* species worldwide. In Alaska, *Kudoa* has rarely occurred in coho, Chinook and pink salmon, and in Pacific halibut. Sexually mature fish appear to be more susceptible to infection.

III. Clinical Signs

Fish infected with *Kudoa* have white pseudocysts in the skeletal muscle fibers containing hundreds of spores. Muscle tissue may exhibit liquefaction with varying intensities of the parasite that may go visually unnoticed. Heavily infected fish exhibit soft flesh when held on ice for 3-6 d or if cold smoked.

IV. Transmission

Kudoa is likely transmitted by an infectious stage from a marine invertebrate as described for other myxosporeans. After infection, the parasites reach the skeletal muscle by the circulatory system passing through several developmental stages that eventually become spores enclosed in a visible pseudocyst within the host skeletal muscle fiber. When the fish host dies and decomposes, the pseudocysts rupture releasing spores into the water where they likely are ingested by the invertebrate alternate host, probably an oligochaete or polychaete worm. Infectious stages (actinospores) for fish develop in the invertebrate host and are released into the water column.

V. Diagnosis

White pseudocysts or inflammatory foci in the flesh are examined in wet mounts for spores having 4 or more valves with polar capsules characteristic of *Kudoa*. Species is determined by further spore morphology and PCR. Due to its very wide geographic and host distribution, the reports of *K. thyrsites* from around the world may represent several indistinguishable species. Also confounding a diagnosis; post-mortem liquefaction may occur from developing parasite stages, prior to the visual presence of mature pseudocysts and spores.

VI. Prognosis for Host

Kudoa parasitism is well tolerated and fish mortality has not been reported. However, there are species parasitizing the heart muscle which may negatively affect cardiac performance.

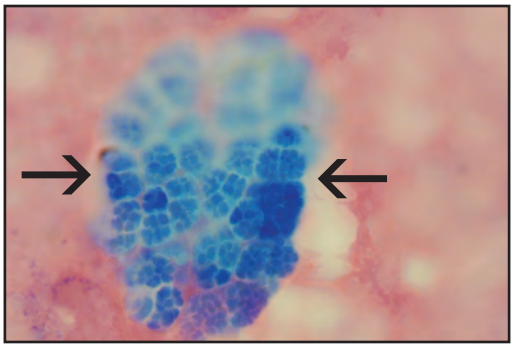
VII. Human Health Significance

Although the pseudocysts and/or the myoliquefaction of the flesh are unacceptable for consumption, there are no human health concerns reported for

most *Kudoa*. A self-limiting foodborne illness can occur in raw olive flounder infected with *K. septempunctata*.

Pseudocyst containing many 4 valved spores (arrow) of *Kudoa* sp. within the muscle of a Pacific halibut.

Wet mount of two 4 valved *Kudoa* spores from red inflammatory foci in the muscle of a pink salmon, X 1000.



Stained smear of a *Kudoa*-like plasmodium (arrows) containing many sporoblasts with dividing sporogonic cells; liquefied fillet muscle of soft-fleshed Chinook salmon, X 400.