Quantitative Analysis of Angle-Dependent Surface Coloration on Sashimi: Testing Thin-Film Interference, Muscle-Fiber Structural Color, and Optical Activity

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Raw fish (sashimi) consumption is common in Japan, and angle-dependent coloration is regularly observed during meals. Although similar coloration has been reported in meat, few studies have examined the cause of this coloration in fish. Therefore, in this study, I aimed to verify the findings of a previous study on meat, which reported that myofibrils possess different refractive indices depending on their microstructures, leading to multilayer interference that causes this coloration. Pagrus major, a common fish species in Japan, was selected as a representative species, and a scanning electron microscope was used to examine the surface of sashimi samples to determine whether a periodic structure capable of causing structural coloration exists. Dorsal muscle samples were fixed in paraformaldehyde, substituted with t-butyl alcohol, and freeze-dried. Cross-sections both parallel and perpendicular to the muscle fibers were observed. On the cross-section parallel to the muscle fibers, sarcomeres with an average spacing of 1.53 μm were observed. The theoretical reflection spectra were calculated using via the transfer matrix method. The experimental reflection spectra were obtained using a spectrophotometer. The theoretical and experimental peaks matched within a 10% margin of error. This result indicates that the coloration can be attributed to multilayer interference from the myofibrillar microstructure, supporting a unified explanation of its cause across fish and meat tissues. Other experiments, including varying cutting angles and detergent immersion tests, supported this interpretation. This coloration, potentially based on the periodicity of myofibrils, may be useful for evaluating fish sashimi freshness and the pathological condition of muscle.

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