Mechanism of the tunable structural color of neon tetra

S. Yoshioka
Gradate School of Frontier Biosciences, Osaka University

E-mail:syoshi@fbs.osaka-u.ac.jp

Many examples of the structural color can be found in butterfly wings, beetle's elytra and bird feathers. Since the color-producing microstructures of these examples mainly consist of stable materials, for example, dried cuticles in insects and keratin and melanin granules in bird feathers, it is impossible to actively change the microstructure. On the other hand, some fish have the tunability in their structural colors. For example, a small tropical fish, neon tetra, has a longitudinal stripe that looks blue-green in the day time, while it changes into deep violet at night. This fact clearly indicates the variability in the microstructure.

It is known that the iridophore of the stripe part of neon tetra contains two stacks of thin light-reflecting platelets that are made of guanine crystal. Since the arrangement of the platelets is observed periodic, the stack is thought to cause the structural color through the multilayer thin-film interference. Consequently, the variability in the color is thought to originate from the variation in the distance between the platelets.

Two explanations have been proposed so far for the distance variation. Lythoge and Shand considered that the distance is controlled by osmotic pressure that induces the inflow of the water into the iridophore[1]. On the other hand, Nagaishi et al. proposed a different model, called Venetian blind model, in which the inclination angle of the platelets is varied, resulting in the change in the distance[2].

Recently, we have performed detailed optical measurements on the iridophore of neon tetra. We have paid particular attention to the direction of the reflected light, since the Venetian blind model expects that the direction varies with the color change owing to the tilt of the platelets. We present the experimental results and quantitatively discuss the validity of the Venetian blind model.

[1]. J. N. Lythgoe, and J. Shand, J Physiol. 325, 23-34 (1982).
[2]. H. Nagaishi, N. Oshima, and R. Fujii, Comp. Biochem. Physiol. 95A, 337-341 (1990).