Short Paper

Occurrence of Nitrite-induced Methemoglobinemia in Cultured Eels*1

In February 1980, there occurred an accident in a commercial culture pond equipped with a water recirculating system in Mie Prefecture: many of the eels *Anguilla japonica* suffered from a disease, the symptoms of which were less activity, discoloration at the gills, *etc.*, and some of those diseased fish were killed finally.

Twelve specimens of 2-year-old eel were arbitrarily taken up from the pond when many diseased eels occurred. Nine of the specimens were easily judged to be diseased from brown coloration of the gills. Blood was individually collected by a heparinized syringe from the heart. The erythrocytes were separated as usual and the hemolyzate prepared therefrom.

As shown in Fig. 1, the hemolyzate from the diseased eel exhibited a mixed absorption spectrum composed of that of methemoglobin (MHb; maxima at 500 and 630 nm) and that of oxyHb (maxima at 540 and 575 nm)[1]. Hence the disease was diagnosed as methemoglobinemia. The proportions of MHb to total Hb in the nine blood samples, as determined by the method of SANO *et al.*[2], were 33–70% (av. 53%). In this respect, no essential differences were found between F and S components of Hb, which were separated from each other by starch block electrophoresis[1].

The water quality analyses showed that the nitrite nitrogen (NO_2–N) content of the pond water was 10.5 ppm, which was much higher than the "normal" range, 0.05 to 0.5 ppm[3]. In this connection, nitrite is known to induce methemoglobinemia in some fish[4]. Such a high level of nitrite, therefore, seemed responsible for the methemoglobinemia in the present case.

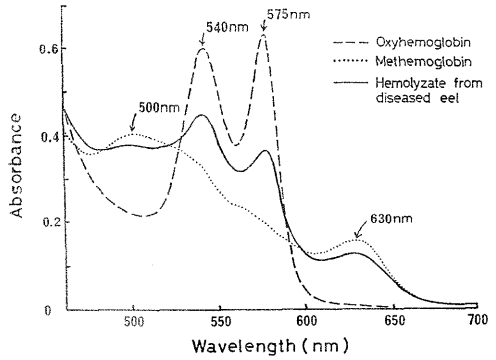

Fig. 1. Absorption spectra of the diseased eel hemolyzate, oxy- and methemoglobin of eel. Solvent: 0.1 M phosphate buffer pH 7.0.

To make it sure, several groups of four eels each were reared for one month at various levels of NO_2–N. At 20 ppm NO_2–N, half of the eels developed methemoglobinemia, the MHb proportions being 3–55% (av. 24%). At 30 and 40 ppm levels, all eels tested developed methemoglobinemia, exhibiting the MHb proportions of 15–68% (av. 38%) and 15–65% (av. 40%), respectively. Incidentally, YAMAGATA *et al.*[5] also have observed that the blood of eels turned into chocolate-brown, when they were exposed to 30 ppm NO_2–N for nine weeks.

As far as the water recirculating system of the type used here is concerned, the upper limit of the cultured fish is said to be less than 1/30 of the weight of filter gravel[6]. According to the culture pond owner, the pond had accommodated the eels five times more the upper limit when the accident occurred. Such mass culture of eels could have resulted in an unusual accumulation of nitrite in the pond water, which in turn could have caused the accident.

The authors wish to thank Prof. K. HASHIMOTO, Laboratory of Marine Biochemistry, The University of Tokyo, who kindly read the manuscript.

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(Received January 12, 1981)

*1 亜硝酸塩によるウナギのメトヘモグロビン血症の発生.

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