

Color of Cultivated *Porphyra* and its Fading (Iro-ochi) and Recovery

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Iro-ochi as has been called by Nori (*Porphyra*) farmers is biologically a bleaching phenomenon and has been one of the serious problems in Nori cultivation in Japan. Especially in the last Nori cultivation season, Iro-ochi gave an extremely serious damage to the Nori production in Ariake Bay, Kyushu, Japan, which attracted considerable socio-economic attention in Japan. As early as in late 1960s, we already made fundamental studies on Iro-ochi of *Porphyra*. In this presentation, the summary of the studies will be reported for understanding Iro-ochi and contributing to cope with the problem.

Color and contents of the major photosynthetic pigments (chlorophyll *a*, phycoerythrin and phycocyanin) were compared in faded foliose thalli and normal ones of *Porphyra* with *in vivo* absorption spectra of foliose thalli as well as with quantitative analyses. Nori nets with faded foliose thalli were transplanted from a nutrient-poor waters to a nutrient-rich waters, and the recovery of color (pigment contents) was investigated. Laboratory cultures of faded foliose thalli were also carried out to observe the recovery of color (pigment contents). In addition, normal foliose thalli were cultured with nutrient-poor seawater in laboratory to observe the fading (decrease of pigment contents). During the recovery of fading, micro-structure of the cell was investigated by transmission electron microscopy.

When the faded foliose thalli of *Porphyra* were transplanted to a nutrient-rich waters, the color and pigment contents of thalli recovered considerably within a week and almost completely recovered in about two weeks. Similar recovery of the color was obtained in laboratory cultures with nutrient-enriched seawater. When normal foliose thalli were cultured with nutrient-poor seawater, fading (the decrease of pigment contents) of foliose thalli was clearly recognized. A lot of starch grains were accumulated in the cells of faded *Porphyra* thalli. They quickly disappeared from the cells within a

few days when cultured with nutrient-enriched seawater, whereas they remained in the cells even after two weeks when cultured with nutrient-poor seawater.

It is considered that Iro-ochi or fading (bleaching) of *Porphyra* foliose thalli in Nori farms is mainly due to the lack of available nutrients, leading to unsatisfactory conversion of carbohydrates to such organic matter as proteins including photosynthetic pigments in the cells of faded foliose thalli. The extensive Iro-ochi occurred in Ariake Bay during the last Nori production season is considered to be due to nutrient depletion in seawater caused by a rapid nutrient uptake by the extensive diatom blooms (red-tide) occurred in the bay.