Study on the trace element nutrition and its protective effect on the discoloration of sea laver "nori"

Sunao Yamazaki, Yuji Fujita*, Yuji Takao and Jinghua Zhang

Faculty of Environmental Studies, Nagasaki University, 1-14 Bunkyo-machi, Nagasaki 852-8521, Japan

* *Department of Fishery, Nagasaki University, 1-14 Bunkyo-machi, Nagasaki 852-8521, Japan*

Summary

To understand the cause of discoloration of the sea laver '*nori*,' which was occurred severely in the Ariake Sea in 2001 and 2003, the concentrations of pigments and elements in the normal and discolored laver samples were determined. In the discolored samples, a decrease in all of the pigments, chlorophyll *a* and carotenoids, and proteinous pigments, phycobiliproteins (complex of phycoerythrin, phycocyanin and allophycocyanin), was clearly observed. In addition, it was accompanied by a decrease in the content of trace elements, Fe, Zn, Mn, Cu, and a major element P. Good correlations between these elements and chlorophyll *a*, as well as between these elements and phycobiliproteins, were confirmed, indicating that, in addition to the deficiency of nitrogen and phosphorus, the deficiency of trace elements, Fe, Zn, Mn, and Cu, which are specifically required for biosynthesis of photosynthetic pigments, could be a reason for the discoloration of *nori*. This phenomenon could be the same as "lime-induced chlorosis" of terrestrial plants in calcareous soil where the soil water is heavily alkaline and therefore Fe^{3+} ions turn to insoluble precipitates.

To confirm the relation between the loss of the elements and the discoloration, discolored *nori* obtained at Ariake Sea was cultured in the laboratory under the Fe-deficient and Fe-supplemented conditions. Discoloration was clearly observed in the Fe-deficient condition, in one hand, and an increase in the contents of pigments and Fe was in the Fe-supplemented conditions, on the other.

To look for the source of trace and nutrient elements, the sediments and detritus (floating floc composed of silty clay) were collected from 14 places in Ariake Sea. Both gave the similar elemental composition and contained appreciable amount of C, N, Fe, Zn, Cu, Mn. Since free Fe ion is negligible in sea water, Fe in the detritus could be thought as a good candidate to serve Fe to *nori*, even though it is not yet known how *nori* absorbes trace and nutrient elements from the surface of leaf.

An effective way to supply the deficient micronutrients, especially Fe, is in progress to protect the discoloration of *nori*.