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Factors Affecting Tissue Variation of Iron Stable Isotope Ratios in Marine Fish

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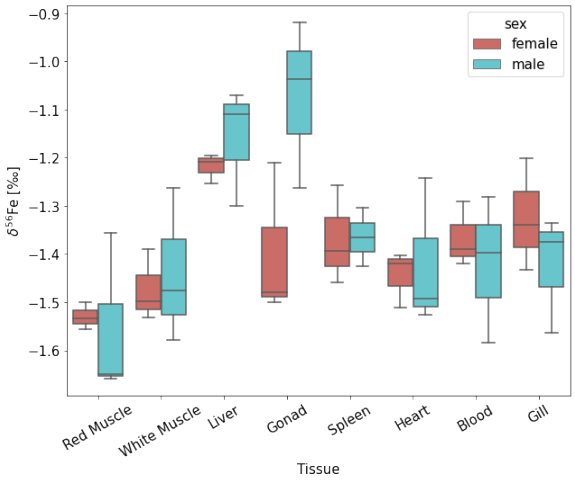

Iron is an essential trace element for life but the bioavailable iron level in marine surface water is limited compared with needs of living organisms. Some studies pointed out that not only primary producers but also large predatory animals such as fish are also affected by Fe limitation[1]. In this presentation, tissue variations of iron stable isotope (δ^{56}Fe) and Fe K-edge X-ray absorption near edge structure (XANES) in chub mackerels (*Scomber japonicus*, 3 females and 3 males) will be shown to assess the mechanism of isotope fractionation via the metabolic process.

The samples were captured around Tsushima-island, Japan. They were frozen at <−20℃ soon after being captured without bleeding. Eight kinds of tissues (red muscle, white muscle, liver, gonad, spleen, heart, gill, and blood) were used for stable isotope and XANES analyses. Accuracy of the isotope measurement was confirmed using two laboratory working standards and four biological CRMs (DOLT-5, DORM-4, ERM-CE464, and BCR-414).

About half of the total body Fe in the chub mackerel was distributed in the blood, followed by the red muscle (ca. 20%), gill (6 – 12%), white muscle (4 – 13%), and the others (1 – 8%). The ranges of δ^{56}Fe were homogeneous among almost all tissues (−1.66 to −1.24‰), while the liver and testis tend to show higher values (−1.30 to −0.92‰). Linear combination fitting of Fe K-edge XANES spectra showed that the contribution of ferritin (main host of ferric Fe in the body) was relatively high in the liver and ovary. Since oxidation of ferrous Fe causes heavy isotope enrichment in ferric Fe, higher δ^{56}Fe values in the livers were plausibly controlled by ferritin level. The difference of δ^{56}Fe values between the muscle and the liver ($\Delta^{56}Fe_{M\text{-}L}$) tended to be larger in the males than females, while the apparent isotopic difference between ferritin and heme Fe estimated using speciation results were 0.28 to 3.53‰ (mean: 1.97‰). Our results indicated that enrichment of heavy Fe in the liver, which is commonly observed in mammals, is likely controlled by ferritin level.

[1]. Galbraith, Le Mézo, Solanes Hernandez, Bianchi & Kroodsma (2019) *Front. Mar. Sci.*, 6. 1-13