Zinc isotope composition of hard and soft tissues of rats fed animal- and plant-based diets

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Zinc isotope composition of animal tissues reflects the $^{66}Zn/^{64}Zn$ (expressed as $\delta^{66}Zn$) of food and water and can be used to distinguish trophic differences in dietary behavior. Thus, "non-traditional" Zn isotope analyses hold great potential for dietary reconstruction where "traditional" isotopic approaches such as $\delta^{15}N_{collagen}$ are unavailable. However, few studies have systematically explored Zn isotope fractionation and thus variation in $\delta^{66}Zn$ between different tissue types remains poorly understood for most taxa. Moreover, previous studies have not focused on trophic differences in an experimental setting.

Here we present results from controlled feeding experiments in which rats were fed different diets (plant-, insect-, animal-, and bone-meal containing pellets), meant to approximate trophic level differences for a total of 59 days.

Zinc concentration and $\delta^{66}Zn$ values of bulk fodders were analyzed to characterize dietary Zn intake. $\delta^{15}N$ and $\delta^{13}C$ were also measured on the same samples. Soft tissues (liver, kidney, muscle, red blood cells, plasma, hair), hard tissue (bone) and excreta (feces, urine) were analyzed to determine: 1) if diet to tissue Zn isotopic fractionation is similar to that documented in previous studies, 2) if $\delta^{66}Zn$ differences are detectable between dietary ("trophic") groups and 3) if Zn isotope fractionation patterns between diet and tissues are consistent across different dietary ("trophic") groups.

Our results indicate that diet-tissue fractionation patterns in rats are similar to those of previously studied large mammals. Measured $\delta^{66}Zn$ variation of food (i.e. between diets) is 0.52‰ while within-diet variability between different tissues exceeds 1‰ for all diets revealing clear biological fractionation between tissues. Bone is consistently enriched in ^{66}Zn relative to diet, while most other tissues are depleted to different degrees. Experimental diets differ from one another in $\delta^{66}Zn$, $\delta^{15}N$ and $\delta^{13}C$ and the patterning of these differences is reflected in the tissues of the animals consuming them. Implications for reconstructing diet and trophic relations in food webs using $\delta^{66}Zn$ values in vertebrates will be discussed.