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Potassium isotope homeostasis in vertebrates: a feeding experiment

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Potassium (K) is a key nutrient to vertebrates, contributing to vital functions of cells (*e.g.*, membrane polarisation), tissues (*e.g.*, muscle contraction) and circulatory system (*e.g.*, blood pressure). These functions are maintained through homeostatic mechanisms, either acting on the maintenance of the total body K stores or its asymmetric extra-/intracellular distribution in spite of varying environmental and physiological conditions. Such a regulated processing of K by organisms likely induces mass-dependent fractionation of its stable isotopes (^{41}K, ^{39}K). To date, however, the K isotope cycle in vertebrates and its potential as a tool to explore their biology is virtually unexplored.

Here, we present the first results of a systematic study of K isotope distributions in vertebrates (rats, guinea pigs, quails) reared in controlled feeding experiments. All animals were divided in three groups of three individuals each, fed with the same plant-, meat- and insect-based pellets in order to assess trophic and nutritional effects. The K isotope compositions ($\delta^{41/39}K$) were measured in the feed, tissues and fluids (muscle, liver, kidney, bone, blood plasma and cells, urine) using the Thermo Scientific Proteus collision cell MC-ICP-MS/MS and a bespoke purification chemistry.

Our results show that animal intracellular reservoirs are systematically enriched in heavy isotopes when compared to free circulating K such as in plasma and with respect to dietary K (+0.2 to +1.25 ‰). Diet plays a role in determining isotope compositions of animal tissues. However, the variability of tissue $\delta^{41/39}K$ between and within species groups appear to be mainly controlled by differences in K cycling. We observe significant patterns indicative of mechanisms shared between the three species and likely related to the homeostatic regulation of K stores, notably muscle and liver involved in internal homeostasis.

This work paves the way for the development of an interpretive framework for using K isotopes to study key aspects of vertebrate biology, such as energy metabolism or pathological disruptions of K homeostasis.