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Stable Potassium Isotopes ($^{41}K/^{39}K$) Track Transcellular and Paracellular Potassium Transport in Biological Systems

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Here we present measurements of the stable isotope ratios of potassium ($^{41}K/^{39}K$) in three biological systems. We show that the ratio of ^{41}K to ^{39}K varies systematically: between the single-celled green alga *Chlamydomonas reinhardtii* and growth medium; between muscles of both euryhaline and stenohaline marine teleosts and seawater; and between blood plasma and red blood cells, muscles, cerebrospinal fluid, brain tissues, and urine in the terrestrial mammal *Rattus norvegicus*. Considered in the context of our current understanding of K^+ transport in these biological systems, our results provide evidence that the fractionation of K isotopes depends on transport pathway and transmembrane transport machinery: K^+ channels and paracellular transport through tight-junctions favor ^{39}K whereas K^+ pumps and co-transporters exhibit less isotopic fractionation. These results indicate that stable K isotopes can provide unique quantitative insights into the machinery and dynamics of K^+ homeostasis in biological systems.