Oxygen isotope fractionations across individual leaf carbohydrates in grass and tree species

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Almost no δ(18) O data are available for leaf carbohydrates, leaving a gap in the understanding of the δ(18) O relationship between leaf water and cellulose. We measured δ(18) O values of bulk leaf water (δ(18) OLW) and individual leaf carbohydrates (e.g. fructose, glucose and sucrose) in grass and tree species and δ(18) O of leaf cellulose in grasses. The grasses were grown under two relative humidity (rH) conditions. Sucrose was generally (18) O-enriched compared with hexoses across all species with an apparent biosynthetic fractionation factor (εbio) of more than 27%■relative to δ(18) OLW , which might be explained by isotopic leaf water and sucrose synthesis gradients. δ(18) OLW and δ(18) O values of carbohydrates and cellulose in grasses were strongly related, indicating that the leaf water signal in carbohydrates was transferred to cellulose (εbio =ă25.1%■). Interestingly, damping factor pex px , which reflects oxygen isotope exchange with less enriched water during cellulose synthesis, responded to rH conditions if modelled from δ(18) OLW but not if modelled directly from δ(18) O of individual carbohydrates. We conclude that δ(18) OLW is not always a good substitute for δ(18) O of synthesis water due to isotopic leaf water gradients. Thus, compound-specific δ(18) O analyses of individual carbohydrates are helpful to better constrain (post-)photosynthetic isotope fractionation processes in plants.
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