Goldschmidt 2026 Abstract
https://doi.org/10.46427/gold2026.37966

What Controls the Water Isotope Signatures in Coconut Water? Implications for Tropical Hydrology

CHRISTIN MÜLLER[1,2,3,4], JANIE MASSE-DUFRESNE[2,3,4,5], GEORGE MATARIKI[6], JONAH TAVITI[6], BROOKS RAKAU[6], SAMMY ERICKSON[6], MELISSANDE LOYER[7,8], LUCIEN BERTONE[1,2,4] AND FLORENT BARBECOT[3,4,9]

[1]Université du Québec à Montréal (UQAM)
[2]Geotop - Research Centre in Earth System Dynamics
[3]CentrEau - Quebec Water Management Research Center
[4]UNESCO Chair in Global Environmental Change, Université du Québec à Montréal (UQAM)
[5]École de Technologie Supérieure
[6]Department of Water Resources, Ministry of Lands and Natural Resources
[7]Polytech Paris-Saclay, Université Paris-Saclay
[8]Commissariat à l'énergie atomique et aux énergies alternatives (CEA)
[9]Departement des Sciences de la Terre et de l'atmosphère, Université du Québec à Montréal (UQAM), Montréal, QC Canada

Coconut water is widely consumed in tropical regions, but its stable isotopic composition and influencing factors are not well understood. This study investigates the hydrogen (δ^2H-H_2O) and oxygen ($\delta^{18}O$-H_2O) isotopic composition of coconut water collected across multiple tropical islands in the Caribbean and Pacific to assess the combined influence of fruit development, palm physiology, and environmental conditions. Coconut water samples were taken from nuts of different filling stages, fruit size, maturity, and tree type, including multiple nuts from individual trees. [1]

Across all sites, coconut water isotopic compositions plot systematically below the Global Meteoric Water Line, indicating a consistent offset relative to local meteoric water. There are clear differences between full and unfilled coconuts. The water from partially filled fruits is closer to GMWL. Tree height differentially affects δ^2H-H_2O and $\delta^{18}O$-H_2O in coconut water, with δ^2H-H_2O showing a more pronounced response. However, the results of this study suggest that tree height is not a dominant control on the isotopic composition of coconut water. It indicates that coconut palms may access relatively similar water sources across height classes or that the coconut root system does not reach very deep soil layers.

Coconut size represents a primary control on isotopic composition, particularly for $\delta^{18}O$-H_2O. Larger coconuts exhibit more enriched isotopic values compared to medium and small fruits. This pattern indicates that larger coconuts remain on the tree longer, increasing exposure to evaporative processes within the fruit. An influence of altitude on the isotopic composition of coconut water can be inferred from the dataset, although further investigations are required to confirm and understand this pattern. Notably, coconut water does not exhibit the typical isotopic depletion with altitude that is commonly observed in precipitation along windward slopes, where $\delta^{18}O$-H_2O and δ^2H-H_2O decrease with increasing elevation.

The results identify coconut water as a distinct and previously underexplored plant water pool that reflects local precipitation signals and integrates fruit-scale fractionation processes, highlighting its potential as an emerging proxy for tropical environmental and hydrological conditions.

[1] Mueller et al. (2026): Isotopic Signatures of Coconut Water as Indicators of Tropical Hydrological Processes; *Ecohydrology* – submitted