Demystifying Isotope Dilution

for Mass Spectrometry

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Agenda

- Concept
- History and Applications
- Advantages and Disadvantages
- Calculations

Isotope Dilution History

- de Hevesy and Paneth, 1913
- Metals Speciation, 1930s
- Biomedical Reactions, 1940s
- Nuclear Applications, 1950s
- PCBs, chlorinated dioxins, and furans, 1980s
- New Methods

Isotope Dilution Process

- Counting Fish and Isotope Dilution
- Labeled Standard: n_B Added
- Let them Infiltrate
- Collect Subsample
- Count Labeled vs. Unlabeled
- Calculate number of fish: n_A
- $n_A = n_B$ x SAMPLE SIZE / LABELED

Isotope Dilution for GC/MS

- Labeled Standard for Each Analyte
- Both Labeled and “Native” Treated Alike
- “Natives” Calibrated vs. Labeled
- Labeled Calibrated vs. Recovery Standards

Isotope Dilution Advantages

- Chemical Unity
- Better Accuracy and Precision
- Compensates for Losses
- Few Known Interferences

Isotope Dilution Disadvantages

- Cost
- Reaching True Equilibrium in Spiking Solids
- Isotopic Effects

ISTD vs ID Calibration

Internal Standard Concentration ug/Kg =

$$\frac{(A_x)\,(I_s)\,(V_t)\,(Df)\,(GPC)}{(A_{IS})\,(RRF)\,(V_i)\,(W_s)\,(S)}$$

Isotope Dilution Concentration ug/Kg =

$$\frac{(A_x)\,(I_L)\,(V_{EX})(Df)(GPC)}{(A_L)\,(RR)\,(W_s)\,(S)}$$

Thank you!

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