Sample Preparation and Analysis Standardization for Large-Scale Tooth Enamel Carbonate Isotope Databases

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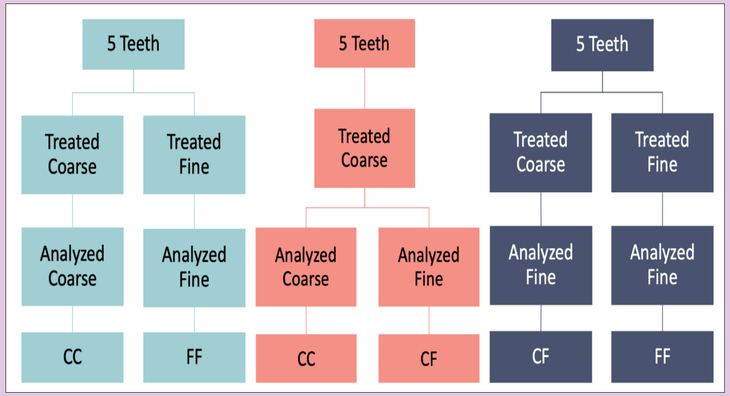
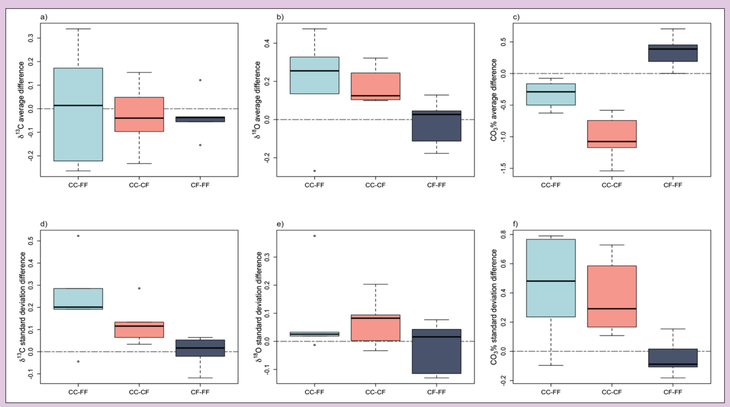
Isotopic analysis is increasingly used to constrain the life history of individuals in forensic human identification. These applications require comparison of data from samples with reference data, creating a need for isotopic databases and demanding comparability of measurements made on evidence and reference samples. Numerous studies have investigated how laboratory methods affect the comparability of measurements made on fossil or archeological samples, but less work has focused on modern forensic materials. Here we conducted a series of experiments on tooth enamel targeting this issue.

1: Particle Size

Q: How does the size of enamel particles during pretreatment and analysis affect IRMS measurements?



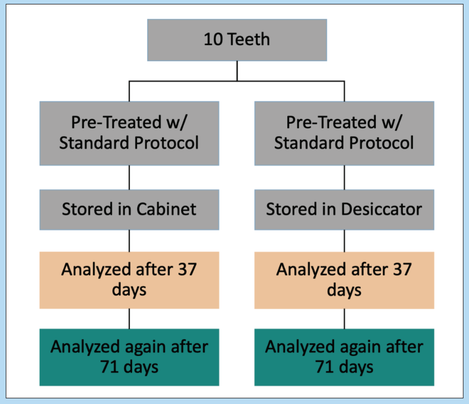
A: Samples analyzed as coarse particles (>250 µm) gave lower CO_2 yields (by 1.02%), more variable yield and $\delta^{13}C$ values (1σ increase of 0.38% and 0.13‰, respectively), and slightly higher $\delta^{18}O$ values relative to fine particles (<125 µm). Pretreatment using different particle sizes only affected CO_2 yield (0.35% lower for fine particles).



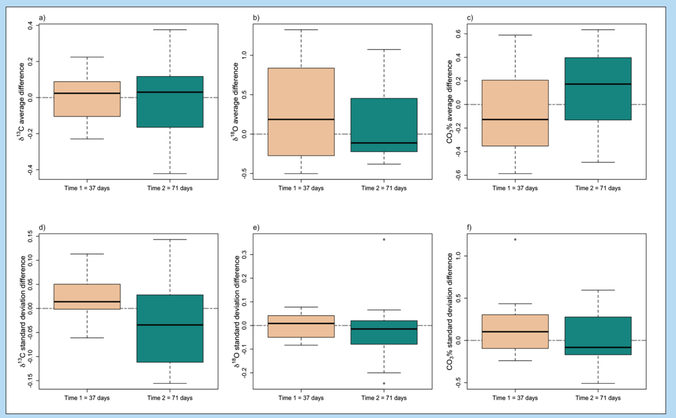
R: Treat samples, then homoginize before analysis

2: Storage Conditions

Q: Do enamel samples stored in ambient conditions exchange O with the atmosphere?



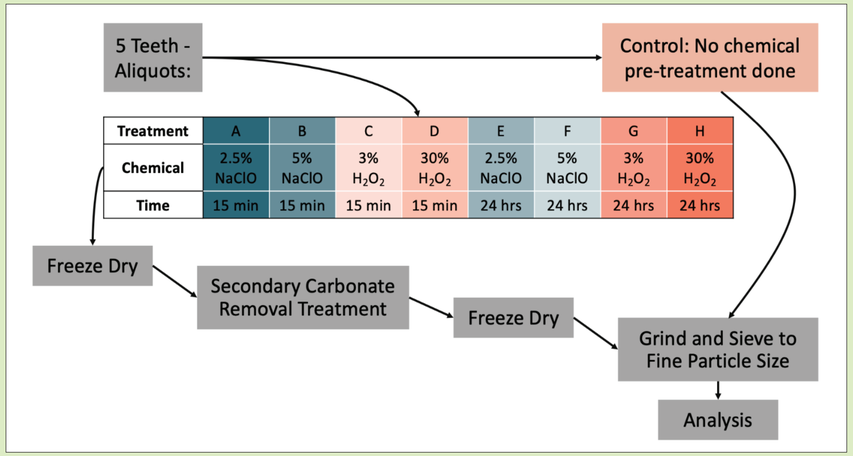
A: No isotopic differences were observed between samples stored in ambient conditions and those stored in a desiccator for up to 71 days.



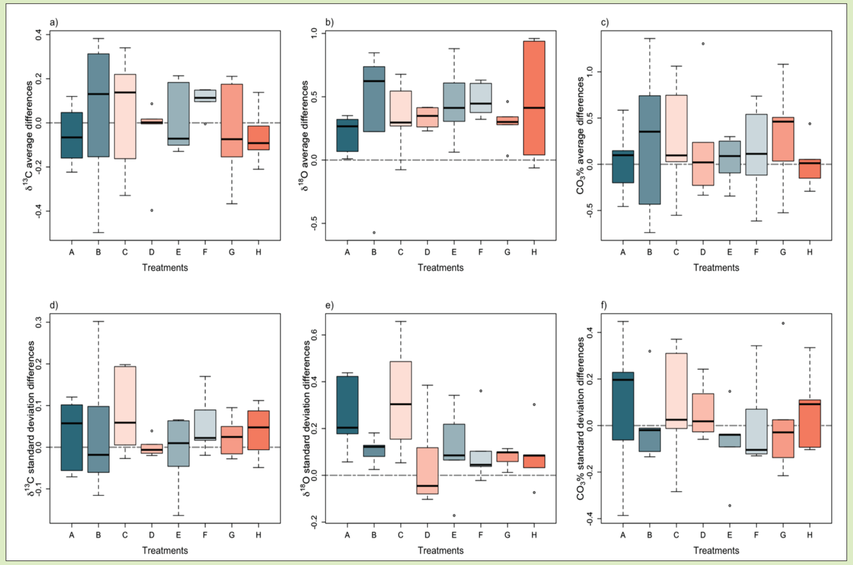
R: Bench-top storage during processing OK

3: Oxidant Treatments

Q: Does treatment with oxidants impact measured isotopic values?



A: Samples treated with different oxidant solutions showed a systematic positive $\delta^{18}O$ shift of ~0.3‰ regardless of the chemical, concentration, or treatment time used. Treatments involving the weakest solutions and shortest times produced more variable $\delta^{18}O$ data.



R: Standardize or eliminate oxidants; avoid short/weak treatments