Some Interesting Isotopic Studies of Diet

ANIMAL STUDIES: *Diet Discrimination, Tissue Differences, and Diet Changes Over Time*

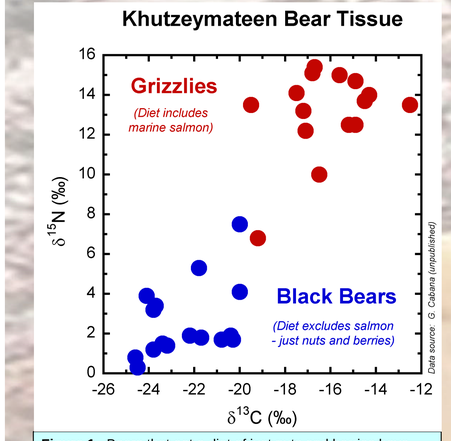

Figure 1. Bears that eat a diet of just nuts and berries have tissue $\delta^{15}N$ and $\delta^{13}C$ values lower than those of bears that also eat salmon (which is higher up the food chain).

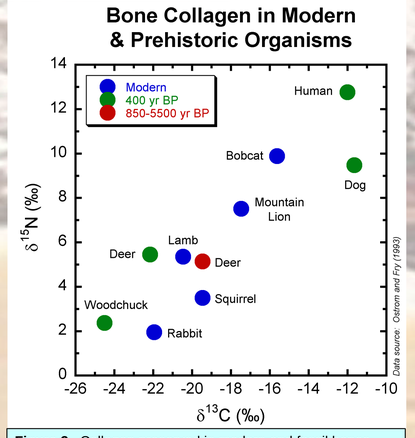

Figure 2. Collagen preserved in modern and fossil bones records an organism's relative diet. Carnivores have higher $\delta^{15}N$ and $\delta^{13}C$ values than herbivores.

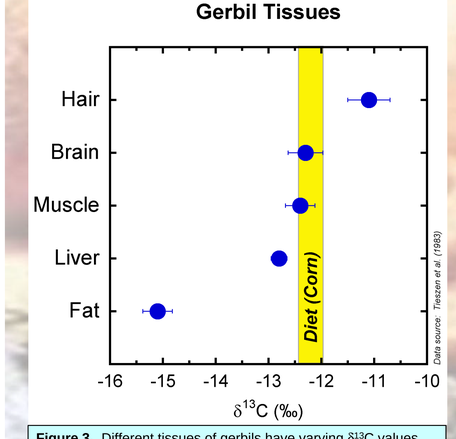

Figure 3. Different tissues of gerbils have varying $\delta^{13}C$ values. Brain, muscle, and liver tissue best reflect the $\delta^{13}C$ signature of a gerbil's diet. Note the large offset between diet and fat! Fat typically has lower $\delta^{13}C$ values than other tissues.

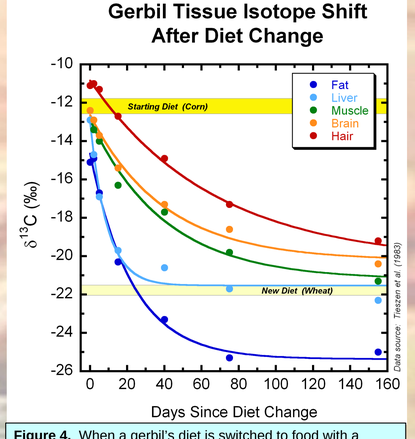

Figure 4. When a gerbil's diet is switched to food with a different $\delta^{13}C$ value, its tissues change over time to reflect this. This happens as carbon in the tissues is replaced. Some tissues show this change more rapidly than others. For example, liver tissue achieves the $\delta^{13}C$ value of the new diet in less than 80 days, whereas hair takes well over twice as long.

HUMAN STUDIES: *Animal Protein Consumption, International Differences, Organ Differences, and Paleodiet Changes Over Time*

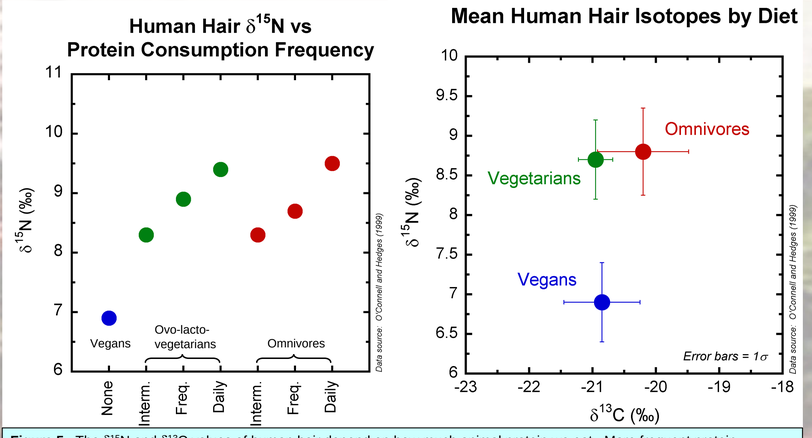

Figure 5. The $\delta^{15}N$ and $\delta^{13}C$ values of human hair depend on how much animal protein we eat. More frequent protein consumption results in higher $\delta^{15}N$ and $\delta^{13}C$. Note the very low $\delta^{15}N$ values of vegans, who eat no animal protein.

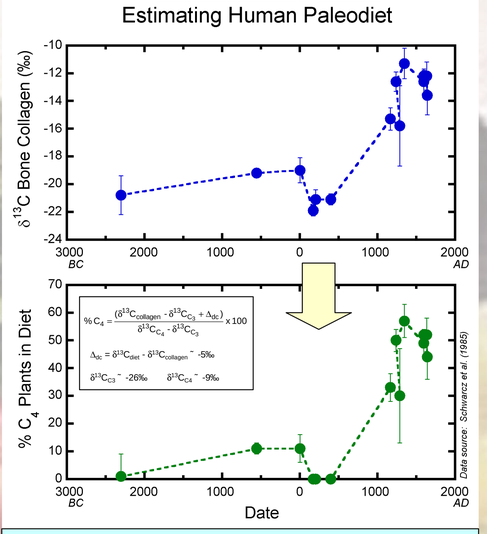

Figure 8. The $\delta^{13}C$ values of collagen from human bones (both fossil and modern) can be used to estimate the amount of C_4 plants (e.g., maize) versus C_3 plants (e.g., wheat) in the diet of native populations. The study above calculated this percentage over the last 4000 years using a "mass balance" formula with average values for C_3 and C_4 plants and the known isotopic offset between a person's diet and their bone collagen. The importance of C_4 plants in human diets has increased dramatically, from less than ~10% before 500 AD to ~30-60% between 1000 AD and 1600 AD.

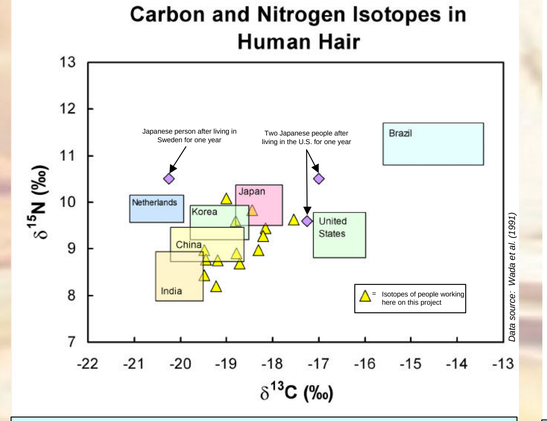

Figure 6. Average diets vary among people living in different countries, and these differences are recorded in the isotopic composition of our hair. Note the isotopic shifts (particularly $\delta^{13}C$) of the Japanese people who lived in other countries for one year. With a hair sample, one could reasonably guess where they had lived!

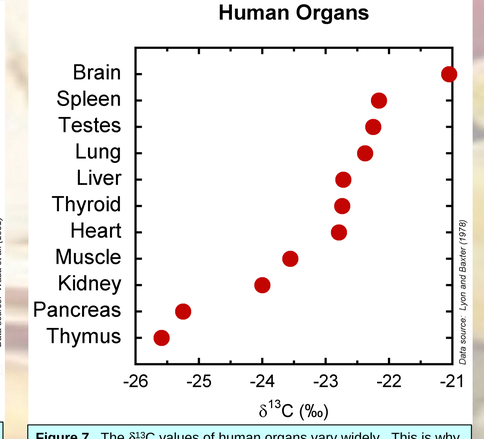

Figure 7. The $\delta^{13}C$ values of human organs vary widely. This is why isotope-related diet studies need to compare similar organs and tissues among individuals.

References

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