Amino Acid Carbon Stable Isotope Ratios Indicate Sugar Sweetened Beverage and Meat Exposure in a Clinical Feeding Study (P18-125-19)

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Objectives: The aim of this study was to assess the validity and specificity of blood plasma and red blood cell (RBC) amino acid carbon stable isotopes ratios (AA-CIRs) as biomarkers of sugar sweetened beverage (SSB) and meat consumption in a highly-controlled feeding study. Based on previous findings, we hypothesized that SSB intake would increase the AA-CIR of alanine and other nonessential amino acids (NEAA), whereas meat intake would increase the AA-CIRs of essential amino acids (EAA).

Methods: We measured plasma and RBC AA-CIRs in 32 United States adult males who participated in a 12-week, fully in-patient feeding study between 2011 and 2018. Each participant was randomly assigned to one of eight diets, which manipulated the intakes (presence/absence) of SSB, meat, and fish in all possible combinations while maintaining a macronutrient distribution of 50% carbohydrate, 30% fat, and 20% protein at a weight-maintenance level. Fasting blood samples were collected biweekly throughout the study. Plasma and RBC AA-CIRs were measured using n-acetylmethyl ester derivatization and gas chromatography-combustion-isotope ratio mass spectrometry. We examined final week AA-CIRs as a function of the three variable intakes and baseline values from samples collected at the start of the study, and we used a Bonferroni-adjusted $\alpha = 0.0007$ to assess significance.

Results: In general, our results supported our hypothesis that NEAA-CIRs were elevated by SSB intake, whereas EAA-CIRs were elevated by meat intake. In plasma, the CIR of the NEAA alanine was elevated with the intake of SSB but not of meat or fish. In RBC, the CIRs of alanine and glutamine/glutamic acid were elevated specifically with SSB. However, the CIR of alanine in RBC had a smaller effect size than in plasma and was also significantly associated with baseline values. Three EAA-CIRs (leucine, isoleucine, and threonine) increased with meat intake in plasma, but not in RBC, and did not respond to SSB or fish intake. Two EAA-CIRs (valine and phenylalanine) measured in RBC were associated with baseline.

Conclusions: This highly-controlled study suggests that the AA-CIR of plasma alanine is a promising biomarker of SSB intake in United States diets. The CIRs of essential AAs may have potential as biomarkers of meat intake.

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