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¹³C-RETINOL ANALYZED BY GAS CHROMATOGRAPHY-COMBUSTION-ISOTOPE RATIO MASS SPECTROMETRY FOR EVALUATING EFFICACY AND EFFECTIVENESS OF VITAMIN A INTERVENTIONS

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Maize is a staple crop in many parts of the world and has been targeted for biofortification with provitamin A carotenoids to provide more vitamin A (VA) to consumers. VA assessment can be challenging because static serum retinol concentrations do not always reflect total body stores. Maize is a C₄ plant, meaning that it is naturally enriched with ¹³C. For effectiveness studies with provitamin A carotenoids, changes in ¹³C natural enrichment of serum retinol can be determined as a measure of biofortified (orange) maize consumption. To show proof-of-concept, a study in Mongolian gerbils (n=55) investigated changes in the ¹³C/¹²C ($\delta^{13}\text{C}$) of serum retinol from feeding orange maize (C₄) and carrots (C₃) for 62 d. The design was a 2x2x2 maize (orange vs. white) by carrot (orange vs. white) by VA fortificant (VA+ vs. VA-). Liver and serum VA $\delta^{13}\text{C}$ was analyzed by gas chromatography-combustion-isotope ratio mass spectrometry. Serum and liver VA $\delta^{13}\text{C}$ were significantly correlated (R²=0.92, P<0.0001). Serum retinol $\delta^{13}\text{C}$ differentiated controls consuming white maize and white carrots (-27.1±1.2 $\delta^{13}\text{C}\text{‰}$) from groups consuming orange maize and white carrots (-21.6±1.4 $\delta^{13}\text{C}\text{‰}$, P<0.0001) and white maize and orange carrots (-30.6±0.7 $\delta^{13}\text{C}\text{‰}$, P<0.0001). Natural abundance measurements were applied to an efficacy study in Zambian children, in which orange or white maize was fed for 90 days. In these children, ¹³C natural abundance was higher

after two months in the orange maize group compared with the white maize group (P<0.05). Predictions made from equations developed in the gerbil study estimate that maize provided 11% (2-21%, 95% CI) of recent dietary VA in this group. Shifts in serum retinol $\delta^{13}\text{C}$ can be used for maize and other biofortified C₄ crop effectiveness studies. Advantages of this method in effectiveness trials include no extrinsic tracers, one blood sample, and high sensitivity compared with measuring serum retinol alone.

Biography

Sherry A Tanumihardjo studies vitamin A and carotenoid metabolism, serves as Director of the Undergraduate Certificate in Global Health, and teaches at undergraduate and graduate levels including international field experiences. She is on the board of UW Global Health Institute. She has more than 160 publications and chapters published. She has presented at more than 280 domestic and international venues. She has served as a reviewer for many journals and is the recipient of the following awards: WHO's Expert Advisory Panel, G Malcolm Trout Visiting Scholar at Michigan State University, Ruth Pike Lectureship at Pennsylvania State University, Alex Malaspina ILSI Future Leader, Dannon Creative Leadership Institute, Endowed Chair and Vilas Associate at UW.

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