Dietary Zinc Deficiency affects Blood Linoleic Acid: Dihomo-γ-linolenic Acid (LA:DGLA) Ratio; A Sensitive Physiological Marker of Zinc Status In vivo (Gallus gallus)

Spenser Reed¹, Raymond Glahn¹, Thomas Brenna¹ and Elad Tako²*

¹Division of Nutritional Sciences, Cornell University, Ithaca, NY, USA.
²USDA-ARS, Robert W. Holley Center for Agriculture and Health, Cornell University, Ithaca, NY, USA.

ABSTRACT

Objectives: Zinc (Zn) is a vital micronutrient used for over 300 enzymatic reactions and multiple biochemical and structural processes in the body. To date, sensitive and specific biological markers of Zn status are still needed. The aim of this study was to evaluate the sensitivity of a previously unexplored potential zinc biomarker, erythrocyte linoleic acid: dihomo-γ-linolenic acid (LA:DGLA) ratio in vivo (Gallus gallus).

Methods: Diets identical in composition (except Zn concentration) were formulated and two groups of birds (n=12) were randomly separated upon hatching into two diets, Zn(+) (Zn-adequate control, 42 µg/g Zn), and Zn(-) (Zn-deficient, 2.5 µg/g Zn). Dietary Zn intake, body weight, and serum Zn were measured weekly. Additional blood was collected each week for erythrocyte fatty acid analysis. At the conclusion of the study, tissues were collected for gene expression analysis.

Results: As expected, body weight, feed consumption, Zn intake, and serum Zn were significantly higher in the Zn(+) versus Zn(-) group (P<0.05). Hepatic TNF-α, IL-1β, and IL-6 gene expression were higher in the Zn(+) group (P<0.05). Hepatic Δ6-desaturase was significantly higher in the Zn(+) group (P<0.001). The LA:DGLA ratio was significantly elevated in the Zn(-) group compared to the Zn(+) group (22.6±0.5 and 18.5 0.5), % w/w, respectively, P<0.001).

Conclusions: This study suggests erythrocyte LA:DGLA is able to differentiate Zn status.
between Zn adequate and Zn deficient birds, and may be a biomarker to assess dietary Zn manipulation in vivo. This justifies further feeding trials, especially those in which a diet more representative of the target Zn-deficient population is used.

© 2015 Reed et al.; This is an Open Access article distributed under the terms of the Creative Commons Attribution License (http://creativecommons.org/licenses/by/4.0), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.