Effect of zinc supplementation on erythrocyte metallothionein in an elite swimmer: a case study

Koury Josely1,2, Oliveira Cyntia2, Portella Emilson Souza1, Donangelo Carmen 2.

1-Instituto de Nutrição - Universidade do Estado do Rio de Janeiro. Rio de Janeiro. Brasil
2-Instituto de Química Universidade Federal do Rio de Janeiro - Laboratório de Bioquímica Nutricional e de Alimentos. Rio de Janeiro. Brasil.

Introduction
Zinc participates in several antioxidant systems including metalloproteins known to reduce free radicals in erythrocytes, such as the free-radical scavenging protein metallothionein (King et al, 2000; Maret, 2000). However, erythrocyte metallothionein (E-MT) has not been measured in humans in relation to intense exercise. E-MT is considered an index of zinc status more sensitive than other biochemical indices to changes in dietary zinc. Conditions of high zinc demand, such as intense exercise, may have an influence on the response of E-MT levels to dietary zinc. In this study, several biochemical indices of zinc status were evaluated in one anaerobic swimmer elite athlete, before and after 7 months of zinc supplementation (22 mg/d) as zinc gluconate.

Methods
The study was approved by the Ethical Committee of Pedro Ernesto University Hospital, Rio of Janeiro, Brazil. Dietary zinc was assessed during the study by 24h food intake recall and nutrient analysis was done using the CIS/EPM database, modified in agreement with USDA/2000. Blood samples (10 ml) were obtained in the morning (7:30 AM) by venous puncture into heparinized tubes after 16h-period of rest and 12h-period of fast. Precautions were taken to avoid trace mineral contamination during sample collection and preparation. Biochemical analysis included plasma zinc (Zn-P) and erythrocyte zinc (Zn-RBC) by flame atomic absorption spectrometry, and E-MT by the 109Cd-hemoglobin affinity assay of Eaton and Toal (Vargas Zapata et al, 1997) and expressed per hemoglobin weight. The intrassay coefficient of variation for all measurements was lower than 5%. All assays were run at least in duplicate.

Results
The swimmer was a young (23 years), physically active man who underwent rigorous daily physical training (mean, 6h/d) and on the elite category for several years (5 y). Habitual dietary zinc intake was 20 mg/d during all the study. After the zinc supplementation period, all the biochemical indices increased (Table 1).

Table 1: Biochemical indices before (baseline) and after 7 months of zinc supplementation

<table>
<thead>
<tr>
<th>Biochemical indices</th>
<th>Baseline</th>
<th>After supplementation</th>
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<tbody>
<tr>
<td>Hemoglobin (g/dL)</td>
<td>16</td>
<td>16</td>
</tr>
<tr>
<td>Plasma zinc (µmol/L)</td>
<td>120</td>
<td>134</td>
</tr>
<tr>
<td>Erythrocyte zinc (µmol/g hemoglobin)</td>
<td>49</td>
<td>68</td>
</tr>
<tr>
<td>Erythrocyte metallothionein (nmol/g hemoglobin)</td>
<td>1.73</td>
<td>3.45</td>
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Discussion/Conclusion
Our results suggest that the habitual dietary zinc intake may not be sufficient to meet the high zinc demands associated with intense exercise. Zinc supplementation appears effective to increase E-MT levels and it may improve the antioxidant capacity in anaerobic swimmer athletes.

References
Zapata CN, Simões TMR, Donangelo, CM (1997) Biological Trace Element Research Vol 57: 115-123