Proceedings of the Nutrition Society (2008), **67 (OCE)**, E77 doi:10.1017/S0029665108006861

1st International Immunonutrition Workshop, Valencia, 3–5 October 2007, Valencia, Spain

Changes in nutritional status and their effects on serum and thymus zinc levels and serum copper:zinc

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Previous studies have shown that the intake of low-quality dietary protein causes a decrease in plasma Zn levels and an uptake by other organs[1,2]. It is known that nutritional disorders affect the immune system and that Cu and Zn play a critical role in its integrity. Moreover, an increase in Cu:Zn is associated with a higher risk of morbidity and mortality in patients who are immunodeficient[3,4]. In the present work the effect of feeding a cereal-based diet and a recovery diet on serum Cu and Zn levels, Cu:Zn and thymus Zn concentration was investigated in weaning rats.

Wistar rats at weaning (21–23 d) were fed a diet containing 65 g precooked maize protein (M) or casein (Cas)/kg for18 d. Group M was refed with a 200 g casein/kg diet (MC) for 20 d. Age-matched control groups received stock diet (C_1 (40 d) and C_2 (60 d)). Body weight (BW; g) and body-weight gain (BWG; g/d per 100 g BW) were determined. Serum Cu (μg/ml) and Zn (μg/ml) concentrations were determined by atomic absorption spectrophotometry and Cu:Zn was calculated. Thymuses were removed and weighed (TW; mg) and the Zn content (νg/ g organ) was determined by atomic absorption spectrophotometry.

Serum Zn was decreased in M and Cas groups compare with the age-matched controls (group C_1); thus, Cu:Zn was higher in these experimental groups. This ratio, as well as serum Zn level, returned to normal in group MC. Thymus Zn level in group M was higher compared with groups Cas and C_1, which had similar values. Thymus Zn was normal in group MC and no significant differences were found between groups MC and C_2.

	Serum Zn (μg/ml)		Serum Cu (μg/ml)		Cu:Zn		Thymus Zn (μg/g organ)	
Group (*n* 6–10)	Mean	SD	Mean	SD	Mean	SD	Mean	SD
M (40 d)	1.22[a]	0.4	1.32[a]	0.3	1.25[b]	0.4	65.7[a]	18.8
Cas (40 d)	1.32[a]	0.3	1.37[a]	0.1	1.07[b]	0.2	21.4[b]	1.3
C_1 (40 d)	2.18[b]	0.7	1.30[a]	0.1	0.65[a]	0.2	30.1[b]	4.3
C_2 (60 d)	2.18[b]	0.6	1.57[b]	0.2	0.75[a]	0.2	25.6[b]	2.0
MC (60 d)	1.94[b]	0.3	1.16[a]	0.2	0.61[a]	0.1	26.3[b]	4.9

[a,b]Mean values within columns with unlike superscript letters were significantly different ($0.05 > P > 0.001$).

The increase in serum Zn level and the reduction in Cu:Zn during recovery was concomitant with a higher BWG (MC 5.48 (SD 0.66) *v.* M −0.15 (SD 0.37); $P<0.001$) and TW (MC 625.4 (SD 157.2) *v.* M 88.6 (SD 26.2); $P<0.001$).

These results indicate that serum Zn and Cu:Zn are dependent on the quantity and/or quality of dietary protein. The reduced serum Zn concentration could be caused by a higher uptake of this mineral by the thymus, which was observed to have an increased Zn content. This outcome may represent a compensatory mechanism to overcome the low concentration and/or activity of thymic hormones described in malnourished status, as it is known that Zn could be an immunomodulator of thymocyte proliferation and maturation[4]. These data suggest that it would be not necessary to determine the Cu:Zn, since data for serum Zn and for Cu:Zn lead to the same conclusion.

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