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Zinc Bioavailability from a Faba Bean Diet to Rats

The increased utilization of legume protein in human and animal diets has attracted great attention over the effects of vegetable protein sources on animal growth and nutrient bioavailability (5). Thus, a number of reports have established that the inclusion of faba bean protein in diets of growing animals brings about some undesirable physiological and biochemical effects: impairment of growth, reduction in the intestinal absorption of sugars, aminoacids, etc. (6, 7). The present investigation was initiated to elucidate if the presence of protein from *Vicia faba* in the diet increases zinc requirements of growing animals and to study the excretory pattern of zinc under different conditions of zinc and protein supply.

Male Wistar rats, weighing about 180 g were divided into three dietary groups of five animals each and placed in metabolic cages. Dietary zinc supplies varied between dietary groups: Control (71 ppm), *Vicia faba* (28 ppm) and zinc supplemented *Vicia faba* (108 ppm). Animals were fed *ad libitum* over 10 days with diets containing about 18 % protein, which has been previously described (7). Also free drinking water was provided

(Zn content < 0.65 ppm/100 ml). Body weights and food intake were recorded daily. Feces and urine were collected separately from each rat between days 5 to 9. The zinc content in diet, feces and urine was determined by using a Perkin-Elmer atomic absorption spectrophotometer.

The results of this experiment showed that supplementing the legume protein diet with zinc significantly improved growth rate and food efficiency. In both groups, these values were in turn, significantly lower than those obtained in rats fed on the control diet.

On the other hand, it has been repeatedly reported that inadequately low levels of dietary zinc are accompanied by changes in food intake (4), which are corrected by additional supply of zinc to the diet (2). Therefore, it is interesting to note that zinc supplementation slightly but significantly increased appetite, despite the fact that changes in food intake would only account partially on the observed growth retardation, since other factors are known to be implicit in this phenomenon: sulphur amino acid deficiency, antinutritive substances, etc. (1, 6).

Table 1. Body weight gain, food intake, food efficiency and zinc balance in rats fed over a period of 10 days on the experimental diets.

The results (Mean $\pm$ S.E.M.) were statistically evaluated by the analysis of variance.

	Diet			Anova
	V. faba	V. faba + Zn	Control	
Initial Body Weight (g)	177.8 $\pm$ 2.13	178.0 $\pm$ 3.55	180.6 $\pm$ 3.55	N.S.
Final Body Weight (g)	208.6 $\pm$ 1.67	219.8 $\pm$ 4.09	242.1 $\pm$ 9.63	***
Food Intake (g)	159.8 $\pm$ 2.58	173.1 $\pm$ 3.42	186.3 $\pm$ 5.64	**
Daily Gain (g/day)	3.1 $\pm$ 0.14	4.2 $\pm$ 0.32	5.8 $\pm$ 0.24	***
Food Efficiency (g food/g gain)	5.2 $\pm$ 0.20	4.2 $\pm$ 0.29	3.2 $\pm$ 0.14	**
Zn Intake (mg/4 days)	1.9 $\pm$ 0.08	8.1 $\pm$ 0.44	5.6 $\pm$ 0.55	—
Fecal Zn (% intake)	50.2 $\pm$ 1.52	79.8 $\pm$ 1.96	61.0 $\pm$ 2.47	***
Urinary Zn (% intake)	9.2 $\pm$ 0.58	4.3 $\pm$ 0.22	6.3 $\pm$ 0.27	**
Zn Balance (mg/4 days)	0.8 $\pm$ 0.05	1.3 $\pm$ 0.17	1.9 $\pm$ 0.29	*
Plasma Zn (μ g/100 ml)	88.0 $\pm$ 6.50	114.2 $\pm$ 6.10	108.0 $\pm$ 8.30	*

N.S. = not significant; * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Differences in zinc bioavailability among plant sources seem to be attributable primarily to variations in protein, phytate, fiber, calcium and zinc of the diet fed (3). Our measurements of plasma zinc support the suggestion of a reduced zinc availability to rats from the *Vicia faba* diet, which has been repeatedly reported with other legumes (2, 3, 9).

Thus, animals consuming diets of field bean either supplemented or unsupplemented with zinc showed differential fecal and urinary patterns, which appears to suggest that not only absorptive but also the metabolic efficiency contributed to zinc homeostasis and utilization (8). Finally, it can be concluded that zinc bioavailability and growth performance in faba bean fed rats can be improved by fortifying the diet with zinc, keeping in mind that since growth rats in both legume groups were lower than the control ones, some other factors are involved.

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