

Vinson, J.A., 1991.

ZINC BIOAVAILABILITY

Protocol

Weanling rats were put on an AIN 76A zinc deficient diet for a period of 4 weeks. Then they were divided into 9 groups of 6 rats each for the supplementation study. Each group received an AIN-76A zinc deficient diet which was supplemented at 50, 100 and 250 ppm zinc in the form of either Grow High Zn yeast, Zinc Orotate or Zinc Gluconate. The food was prepared by Dyets, Inc. The supplementation period lasted 5 weeks. Animals were weighed at the beginning of the supplementation and just before sacrifice which was accomplished by halothane asphyxiation.

The blood and liver were removed and the blood converted to plasma. Liver and plasma were frozen until analysis. Samples of plasma and liver were ashed overnight at 450°C in a muffle furnace. The residue was reconstituted in 10% HCl and the zinc analysed by atomic absorption spectroscopy using standards ashed simultaneously with the samples. No loss of zinc was found by ashing. The zinc in the food was analysed and the results are shown below:

High Zn yeast	50 ppm found 36.1, 100 found 68.5, 250 found 132.8
Zn Orotate	50 ppm found 31.7, 100 found 69.0, 250 found 155.5
Zn Gluconate	50 ppm found 50.6, 100 found 103.1, 250 found 300.8

The results are shown in the tables that follow. Statistics were done using a two tailed t-test.

Group	Weight gain during Zinc supplementation			
	Zn in Diet (ppm)			
Group group(g)	50(g)	100(g)	250(g)	Av. weight gain of all animals in group(g)
High Zn yeast	137	187	201	175 ± 74
Zn Orotate	183	137	179	173 ± 56
Zn Gluconate	139	143	124	137 ± 71

The weight gain of the yeast is higher than the other forms of zinc especially at the higher doses of zinc. The Zn gluconate group gained the least weight indicating poorer bioavailability of the trace element zinc which is needed for optimum health. The yeast group had a significantly higher weight gain than the Zn gluconate at the 79% confidence level.

The plasma data is indicative of the current zinc status of the animal at sacrifice. Bioavailabilities are obtained from the slopes of plots of the zinc in food (actual values) on the x-axis vs. zinc in plasma on the y-axis. The slopes are then compared using Zn gluconate as the standard and setting its slope = 1.00. Zn yeast was found to be significantly more bioavailable than either the Zn Orotate (98% confidence level) or the Zn gluconate (96% confidence level). In the plasma, the Zn yeast was over 6 times as bioavailable as the Zn gluconate and over 2 times more bioavailable than the orotate.

Zn Concentration in plasma
Results are the average \pm Standard Deviation

Group	Actual Dose Zn in food (ppm)	Average Plasma Zn (ppm)
High Zn yeast	36.1	1.92 \pm 1.0
High Zn yeast	68.5	5.25 \pm 0.80
High Zn yeast	132.8	10.4 \pm 2.7
Zn Orotate	31.7	3.63 \pm 0.52
Zn Orotate	69.0	4.05 \pm 1.65
Zn Orotate	155.5	7.15 \pm 1.50
Zn Gluconate	50.6	5.15 \pm 1.53
Zn Gluconate	103.1	5.83 \pm 2.12
Zn Gluconate	300.8	8.48 \pm 2.37

Slope of Dose-Response Plot for Plasma Bioavailability

Group	Slope	Relative Slope - Relative Bioavailability
High Zn yeast	0.086	6.46
Zn Orotate	0.027	2.08
Zn Gluconate	0.013	1.00

Zn Concentration in liver
Results are the average \pm Standard Deviation

Group	Dose Zn in Food (ppm)	Average Liver Zn (ppm)
High Zn yeast	36.1	26.3 \pm 2.9
High Zn yeast	68.5	31.6 \pm 4.0
High Zn yeast	132.8	35.8 \pm 6.4
Zn Orotate	31.7	32.1 \pm 3.6
Zn Orotate	69.0	32.8 \pm 2.4
Zn Orotate	155.5	39.3 \pm 2.9
Zn Gluconate	50.6	27.2 \pm 3.6
Zn Gluconate	103.1	33.3 \pm 2.6
Zn Gluconate	300.8	35.0 \pm 3.0

Slope of Dose-Response Plot for Liver Bioavailability

Group	Slope	Relative Slope - Relative Bioavailability
High Zn yeast	0.092	3.68
Zn Orotate	0.061	2.44
Zn Gluconate	0.025	1.00

The liver results were analysed in the same manner as the plasma. Liver zinc represents the principal storage area for zinc. The Zn yeast was found to be significantly more bioavailable than either the Zn orotate (71% confidence level) or the Zn Gluconate (>99.999% confidence level). The Zn yeast was over 3 times more bioavailable than the Zn gluconate and 1.5 times more bioavailable than the Zn orotate.

For both plasma and liver, the Zn gluconate was the least bioavailable form of Zinc. The High Zn yeast was the most bioavailable form of zinc in both the plasma and the liver indicating it was significantly more absorbed and retained than either the Zn orotate or the Zn gluconate. Thus, the High Zn yeast is the best form of zinc for human supplementation.