RELATIVE BIOAVAILABILITY OF TRACE ELEMENTS AND VITAMINS FOUND IN COMMERCIAL SUPPLEMENTS

J. A. Vinson, P. Bose, L. Lemoine* and K. Hsiao

Chemistry Department
University of Scranton
Scranton, PA 18510 USA

*Faculté de Médecine
Université de Reims
Reims, 50195 France

Commercial supplements of trace elements are available in a wide variety of forms. These include the isolated compounds such as inorganic salts, organic salts, amino acid chelates and a yeast form. The yeast form is made from a brewer's yeast grown in a nutrient media containing the inorganic salt. After several generations of yeast cell division the cell walls are removed by proteolytic enzymes and the yeast is then spray dried.

Vitamins are commercially available in two forms for human supplementation; a synthetic or isolated form and a natural form in which the synthetic vitamin is reacted with a natural yeast or plant extract containing proteins, carbohydrates, lipids and other natural substances.

Bioavailability of vitamins and trace elements has been determined in long-term animal supplementation (3-4 weeks) studies by measuring the vitamin or trace element in liver, blood, serum or plasma and comparing the slope of the dose-concentration plots. A preliminary depletion is usually performed using vitamin or trace element deficient food. In short-term experiments the area under the blood, serum or plasma concentration-time curve is used to compare bioavailabilities after a single dose of the test substance is given to either animals or humans.

Results of the trace element and vitamin studies are shown in Tables 1 and 2 on the following page.(1)

Examination of the blood concentration-time curves for the short-term human experiments involving selenium, zinc and copper revealed that the yeast form was more

Table 1. Relative Bioavailability of Different Forms of Trace Elements.

Element	Animal	Length of Study	Analysis	Relative Bioavailability %[a]
Se	Rat	Long	Blood	100I, 60C, 122Y
Se	Rat	Long	Liver	100I, 146C, 226Y
Se	Human	Short	Auc[b]	100I, 122C
Mn	Rat	Long	Blood	100I, 111C, 156Y
Mn	Rat	Long	Liver	100I, 142C, 163Y
Zn	Rat	Long	Blood	100I, 101C, 172Y
Zn	Rat	Long	Liver	100I, 129C, 187Y
Zn	Human	Short	Auc	100I, 111O, 175Y
Fe	Rat	Long	Blood	100I, 57C, 101Y
Fe	Rat	Long	Liver	100I, 72C, 121Y
Cu	Rat	Long	Blood	100I, 930, 124Y
Cu	Rat	Long	Liver	100I, 1300, 195Y
Cu	Human	Short	Auc	100I, 1010 144Y
Cr	Human	Short	Glucose[c] (2)	100I, 356Y

[a]Relative bioavailability for long-term studies is determined from the slope of the dose-concentration curve. For short-term experiments, it is calculated from the area under the concentration-time curve. For all studies, the Inorganic Salt is defined as 100% bioavailable.
I = Inorganic Salt, C = Amino Acid Chelate, O = Organic Salt, Y = Yeast.
[b]Auc = Area under Blood, Serum or Plasma Concentration-Time Curve.
[c]Percent of Fasting Serum Glucose Decrease.

Table 2. Relative Bioavailability of Synthetic and Natural Vitamins.

Vitamin	Animal	Length of Study	Analysis	$\frac{\text{Natural}}{\text{Synthetic}} \times 100$
A	Rat	Long	Blood	149%
B1	Rat	Short	Auc[a]	138%
B2	Rat	Long	Serum	149%
B6	Rat	Long	Serum	254%
B6	Rat	Long	Liver	156%
B12	Rat	Long	Serum	256%
B12	Rat	Long	Liver	159%
Niacinamide	Rat	Short	Blood	394%
Niacinamide	Rat	Short	Liver	170%
C	Guinea Pig	Short	Auc	148% (3)
C	Human	Short	Auc	135%
E	Rat	Short	Liver	260%
Folic Acid	Rat	Long	Serum	107%
Folic Acid	Rat	Long	Liver	213%

[a]Area under Blood Concentration-Time Curve.