ALBION®
HUMAN NUTRITION

# RESEARCH NOTES

A COMPILATION OF VITAL RESEARCH UPDATES ON HUMAN NUTRITION

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# Chromium – An Often Controversial, But Very Essential Trace Mineral

Schwartz and Mertz found chromium was essential in animals in 1959. In 1977, Jeejeebhoy, et al., documented chromium deficiency in humans receiving long term parenteral nutrition. Chromium deficiency in animals and man appeared to be characterized by glucose intolerance, as well as elevations in cholesterol and triglycerides. From early on, chromium has been considered to be part of the still not totally defined glucose tolerance factor (GTF) – a water soluble constituent of liver, blood plasma, brewer's yeast, and some other biologic extracts and cells. Various analyses have suggested that GTF was a chromium containing complex, along with nicotinic acid, glycine, glutamic acid, cysteine, and glutathione.

Once absorbed, non-chelated chromium may be transported via the iron carrier protein – transferrin. When transferrin is saturated with iron or other minerals, chromium binding is reduced, and absorbed chromium is easily lost in the urine, possibly explaining the elevated blood levels and urinary losses of chromium associated with strenuous exercise. Some chromium may bind to albumin, or be complexed to lactate (as well as bicarbonate and citrate). Once absorbed, most of the chromium is transported to the liver, where it may be incorporated into GTF. When blood glucose rises, or insulin is secreted, GTF is secreted into the plasma. The GTF enhances the effect of insulin, and chromium is lost in the urine. The average urinary loss of chromium is about 0.2 µg/day. Some have suggested that the quantity of GTF (or chromium) secreted in response to a glucose load may reflect the nutritional status of chromium. Many diabetics, as well as individuals with marginal glucose intolerances, have been observed to exhibit a reduced or absent release of chromium in response to glucose loads.

*Mertz, W. and Schwartz, K. Am J Phyliol. 196:614, 1959.*

*Jeejeebhoy, et al., JACN Vol. 30:531-538, 1977.*

## Chromium in Human Nutrition: A Review

Dr. Walter Mertz, a leader in chromium research, has summarized the current state of chromium studies. There are fifteen studies on chromium and impaired glucose tolerance discussed. Only human studies were considered which used chemically defined chromium compounds and proper controls. In 12 of the 15 studies, chromium supplementation showed positive effects on glucose metabolism. Dr. Mertz's evaluation of the results of the 15 studies is as follows.

1. Impaired glucose tolerance can be improved or normalized by chromium supplementation, or can be maintained in spite of a reduced insulin output. Chromium will only improve impaired glucose tolerance when the impairment develops because of chromium deficiency. In this way, chromium is an essential nutrient, not a drug. Chromium will not improve normal glucose tolerance. Unfortunately, there is no acceptable means to assess chromium status. Thus, the response to chromium supplementation usually cannot be predicted. It is still trial and error to determine appropriate response.

2. The studies used chromium dosages of from 52 to 2080

μg/day. The supplementation of 1563 μg or more per day was usually effective. Dosages of 624-2080 μg/day may be needed for diabetics.

3. In vitro and in vivo animal studies have indicated that chromium must be complexed to specific ligands to be fully active. Nicotinic acid is one, amino acids may be another. A recent human study showed that nicotinic acid may be found to be a limiting factor and produces similar effects as chromium deficiencies in certain conditions.

4. Response to chromium supplements varies with geography. Areas of greater chromium deficiency have shown the strongest response to chromium supplementation.

5. The magnitude of chromium's effect on glucose tolerance increases with the degree of impairment and deficiency.

Mertz also stated that based on proper studies, to date, chromium deficiency has not been shown to be a direct contributor to the risk of cardiovascular disease, as once thought. Rather, the impact of low chromium status, through impaired glucose tolerance, may lead to the disturbances in lipid metabolism which in turn could contribute to cardiovascular disease.

*Mertz, W., J Nut. 123:626-633, 1993.*

# Absorption of Chromium from Various Sources

Absolute daily requirements range between 50 and 200 μg/day, but dietary intakes may still be deficient. In view of the published reports suggesting that the typical American diet generally provides only 50% of the suggested dietary intake for chromium, chromium supplementation may be a sensible alternative. The chromium salts found in most supplements are poorly absorbed. Several organic chromium complexes have been developed using a variety of ligands: amino acids, yeast, picolinic acid, and nicotinic acid. All of these organic complexes have been reported to have superior bioavailability. Picolinic acid, while a strong chelators, will not release the chromium to the cells without forcing body cells to give up other essential minerals in exchange. Furthermore, picolinic acid has been shown to interfere with the metabolism of nicotinic acid in the GTF. It has been suggested that a nicotinate and chromium complex may be the biologically active form of chromium in the body. However, this complex is very unstable in the stomach and intestines due to its pH level. Mertz proposed the complexing of the amino acids to the nicotinate chromium complex to stabilize it in the gut. Albion, through a patent pending process, has developed this chromium amino acid niacin chelate. The chelate contains one mole of chromium, two moles of nicotinic acid, and two moles of amino acid.

**TABLE 1**

**$^{51}$CHROMIUM* IN THE BLOOD**

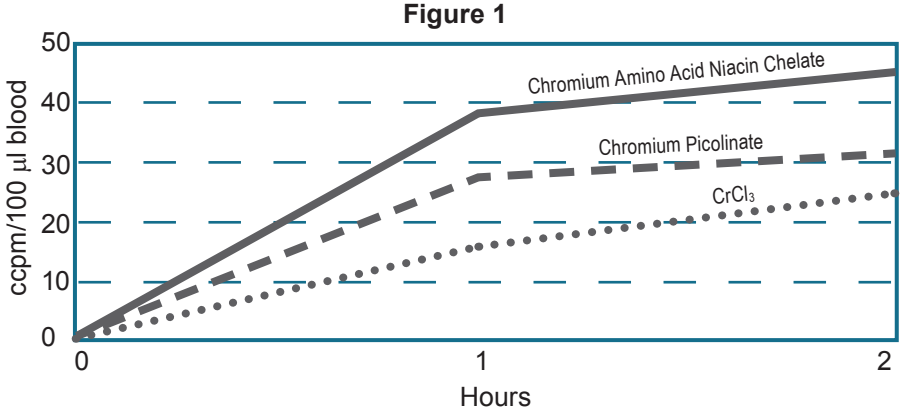
| | 1 Hour | 2 Hours |
|---|---|---|
| $CrCl_3$ | 17.0 ± 4.3 | 23.8 ± 4.3 |
| Cr Picolinate | 29.1 ± 9.8 | 31.2 ± 12.8 |
| Cr Chelate | 37.4 ± 11.4 | 45.6 ± 25.0 |

* Corrected counts per minute/100 lg

In animal studies at a university, the researchers compared the bioavailability of chromium Picolinate, chromium chloride, and this patent pending chromium amino acid niacin chelate (Chromium Chelavite). The results can be seen in Table 1 above and Figure 1 below.

*Graff, D., et al., Submitted for publication, publication pending.*

**Figure 1**



## Efficacy of Chromium Supplementation in Athletes: Emphasis on Anabolism

Chromium is the key component of the biologically active GTF being marketed to athletes. GTF involvement in normal insulin function has been seen to potentiate insulin activity. The maintenance of adequate chromium stores is critical to insulin's effects of the metabolism of fats, carbohydrates, and proteins. Due to excessive chromium turnover and often times marginal chromium intake, athletes may have a larger need for chromium. In view of this, the use of biologically available chromium supplementation may be beneficial. Supplementation with chromium to restore and maintain sufficient chromium stores may help promote optimal insulin efficiency – a necessity to high level athletic performance. Lefavi, et al., felt, however, that the potential for anabolic benefits, resulting from optimal insulin performance, would likely be marginal. In addition, they felt that the reports of short term anabolic increases from supplementation with organic chromium compounds, particularly chromium Picolinate, need to be further substantiated, suggesting the original test may have been flawed.

*Lefavi, R.G., et al., Int J of Sports Nutrition 2(2):111-122, 1992.*

## Chelated Chromium for Stress

In several trials, researchers at a university evaluated the effect of supplemental chromium on the immune status of stressed growing steers. Albion's chromium-niacin chelate was found to decrease serum cortisol. An increase in cortisol is associated with a compromised immune function. Cortisol is a natural inhibitor of a wide array of immune system functions. The animals also showed a greater decrease in serum glucose while receiving the Albion chromium chelate than observed in an earlier study using high chromium yeast (Chang, et al., 1993).

The second study compared the effectiveness of high chromium containing yeast to Albion's chromium-niacin chelate, and a non-supplemented control group of stressed animals had reduced morbidity. However, the steers receiving Albion's chromium chelate had half the morbidity of that seen with the high chromium yeast group, and less than one-third of that seen with the control group suggesting an improvement in immunity.

*Mowat, D.N., Chang, X., and Yang, W.Z. Can J Animal Science, 1993, Vol 73:49-55.*

## Effects of Supplemental Chromium on the Immune Response

The objective of this study, also conducted at a university, was to determine the effects of Albion's chromium-niacin chelate on the immune response of dairy cows subjected to physical and metabolic stresses associated with late pregnancy, calving, early lactation, and peak milk yield.

Like all mammals, including humans, periparturient cows are subject to acute physical stress when giving birth and chronic metabolic stress associated with lactogenesis, galactopoiesis, negative or low energy balance, and peak milk yield. Lymphocytic and neutrophilic functions are impaired in the peripartum period, and may play a role in the increased incidence of clinical mastitis seen at this time.

This study measured the cell-mediated and humoral immune response of periparturient cows supplemented with Albion's chromium-niacin chelate, versus non-supplemented control cows. Humoral immune response was assessed through immunization with ovalbumin and human erythrocytes, coupled with weekly blood sample assays for antigen specific antibodies. Cell-mediated immunity was assessed in vitro using mitogen and antigen stimulated peripheral

*(Continued on next page)*

blood mononuclear cell blastogenesis assay of cells. The results showed that the cattle supplemented with Albion's chromium-niacin chelate had significant improvements in both cell-mediated and humoral immune responses. The researchers concluded that this supplemental chromium may help offset stress-associated immunosuppression.

*Burton, J.L., Mallard, B.A., and Mowat, D.N., Journal of Animal Science, 1993, Vol 71:232-238.*

## Choice of Chromium

As one can see from the information reviewed in this newsletter, chromium supplementation may be a good idea for a number of people. Its dietary scarcity and the low bioavailability of many of the typical chromium forms found in foods, combined with the important biochemical roles of this trace metal make it so. In the studies reviewed, Albion's Chromium Chelavite was found to be much more bioavailable than yeast sources of chromium, chromium picolinate and chromium chloride. Animal studies have found Albion's chromium chelates to have greater biological activity than chromium from yeast. Albion's patents pending chromium-niacin amino acid chelate was seen to have a greater impact on glucose metabolism, as well as a superior effect on the immune status of the animals studied. If higher bioavailability and superior biochemical impact are important in the selection of a chromium supplement, Albion's Chromium Chelavite is the intelligent choice.

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