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Beneficial Effects of Chromium Supplementation

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Insulin, a peptide hormone secreted by the b-cells of the pancreatic islets, has an essential role in the uptake of glucose by liver and skeletal muscle cells. In addition to its role in carbohydrate metabolism, insulin promotes a leaner physique, aids monoaminergic activity, supports brain steroid receptor binding, and exerts a trophic effect on neurons (1). More recent studies suggest that insulin has a dramatic impact on life span (2,3). In view of all these functions, any factor affecting the production, secretion, or mechanism of action of insulin should have adverse effects on normal body physiology. Conversely, factors that enhance or potentiate the activity of insulin should promote the positive effects caused by this hormone. A very-low-fat diet and exercise training are two known factors that increase insulin sensitivity (4), but a drastic change in diet may be difficult to follow and rigorous exercise training may not be compatible with the patient's life style. Numerous studies have explored the role of chromium picolinate in modulating symptoms of diabetes, which have led to investigate the role of chromium picolinate in insulin sensitivity.

The rural and urban populations in Iraq use bread made from barley flour for the management of diabetes mellitus (5). This observation led Ghanin and Naismith to investigate the effects of barley on diabetic rats. They found that rats fed with barley had considerably lower glucose concentrations than those rats which did not receive barley. Analysis of the various constituents of barley revealed its high content of chromium containing 10 times as much brewer's yeast, formerly believed to be the richest natural source of chromium picolinate (6). Ghanin and Naismith concluded that the beneficial properties of Iraqi barley must reside in its high content of chromium. Experimental chromium deficiency in rats leads to diminished glucose tolerance and eventually to a state resembling diabetes mellitus (7).

In diabetes, microangiopathy affects the capillaries throughout the body, and is characterized by hypertrophy of basement membranes (8). Since basement membranes are composed of collagenous (type IV) and non-collagenous proteins (9) an abnormal deposition may arise from excessive synthesis or from reduced break down of those proteins (10). Plasma fragments of these proteins have been found to be elevated in diabetic rats (11). Mahdi and colleagues (12) conducted a study in which they found that treatment with barley in diabetic rats led to a significant lowering of plasma fragments of collagen proteins, which restores basement membrane metabolism. Since glomerular filtration is dependent in part by its basement membrane, renal failure in hyperglycemic patients may be prevented by chromium picolinate supplements. Although, the authors of the study do not speculate on this, their findings indicate positive changes in the constituents of basement membrane in the kidney and liver in the animals treated with chromium (12).

Recent studies conducted by Evans and Meyer have reported a dramatic increase in both the median and maximal lifespan in Long-Evans rats receiving food supplemented with chromium picolinate (2,3). This has led McCarty to postulate that aging is associated with a reduction of insulin activity in the brain, and this contributes to age-related alterations of hypothalamic functions that result in an older neurohormonal milieu (1). He suggests that chromium contributes to a significant retardation of the aging process.

Effective insulin activity in the brain declines in the aging process, concurrent with the systemic decrease of insulin sensitivity and glucose tolerance, and this reduced central insulin activity contributes to certain age-related alterations of hypothalamic and brain function that play a crucial role in the aging process. These alterations include reduced hypothalamic catecholamine activity, impaired function of insulin-dependent glucoreceptors, and increase neuropeptide Y activity. The reduction of in the thermic response to carbohydrate (13) and the gain of body fat typically seen with aging could reflect, at least in part, this decreased brain responsiveness to insulin.

Conversely, promoting greater central insulin activity with chromium may maintain the hypothalamus in a more youthful functional state and thereby retard various aspects of the aging process. Sensitizing of glucoreceptors and neuropeptide Y suppression should promote a more negative caloric balance and a leaner physique, while enhanced monoaminergic function may lead to a more youthful hormonal milieu. If insulin's neurotrophic effects are significant in the mature brain, a deceleration of neuron or synapse loss may also play a role. Improved function and delayed atrophy of the pineal gland and/or thymus may conceivably contribute to chromium picolinate's longevity effect of the improved insulin action on these glands. Improved pineal and thymic functions, in turn, should help to keep the hypothalamus and pituitary functionally youthful (1). McCarty postulates that if a youthful hypothalamus is maintained by potentiating the activity of insulin, the opposite effect should be observed in diabetic-induced animals, which he found to be the case. In streptozotocin-diabetic rats, production of growth hormone, TRH, TSH and pituitary gonadotropin declines (14).

The dramatic effects of chromium picolinate are intimately associated with its role in potentiating the activity of insulin. The role of chromium in tissues to insulin is poorly understood (15). However, two speculations can be offered from the data available. First, the effect of chromium in sensitizing tissue to insulin must be intracellular rather than acting on the exoplasmic surface of the membrane. This hypothesis arises as a result of the fact that plasma membranes are essentially impermeable to the hydrated form of the trivalent ion (4). Therefore, if chromium is to be effective it must be in a form that enables it to cross the lipid bilayer, one of which is chromium picolinate. If this is true other forms of chromium which are unable to cross the lipid bilayer should not produce the effects of observed by chromium picolinate. This is in fact the case. Abraham and colleagues failed to reproduce previous findings of the effect of chromium. This was due to the fact that they used chromium supplements in the form of chromium chloride ($\text{CrCl}_3 \cdot 6\text{H}_2\text{O}$). Interestingly, their study demonstrated an increase in serum HDL cholesterol with a decrease in VLDL cholesterol as a result of chromium supplementation (16). Secondly, chromium must be involved in the secretion of insulin because insulin sensitizing action is accompanied by down-regulated insulin secretion.

In light of the numerous essential functions of insulin, chromium picolinate supplements may have special significance. This supplement is effective in tiny doses (one capsule daily providing 1.6 mg, corresponding to 200 mcg of chromium) (16). Furthermore, no side effects or toxicities have been reported in clinical studies with this compound, and it is estimated that over a million Americans are now using it as a nutritional supplement

(17). This supplement costs as little as 5 cents per day (retail) in the U.S. Moreover, chromium supplementation, on strictly nutritional grounds, is commendable in light of evidence that the typical American diet is a poor source of chromium. Even though, more clinical trials and mechanisms of action of chromium are required, the information available suggest that chromium supplementation may be a promising avenue to maintenance of optimal insulin sensitivity promoting health and longevity.

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