

Impact of chromium supplementation on human health and body composition

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ABSTRACT

Chromium(III) has been proposed to have a dietary or pharmacological position in changing frame composition and enhancing signs and symptoms of insulin resistance, kind II diabetes, and related conditions even though the mode of action of Cr(III) at a molecular degree has didn't be elucidated. This assessment info the cutting-edge reputation of research into Cr(III) supplementation. Clinical trials, meta-analyses and systematic critiques have didn't show clinically widespread results from Cr(III) supplementation on frame composition or symptoms of insulin resistance and related conditions in people and livestock. despite the fact that new Cr(III) supplements hold to appear inside the clinical literature, research have did not elucidate the mechanism of chromium action at a molecular level. Conflicting results on a position of transferrin in Cr(III) transport and detoxing have appeared. Cr(III) supplementation cannot presently be endorsed in people or livestock. further studies are required to probe the mechanism of Cr(III) movement in growing insulin sensitivity and glucose uptake in rodent fashions of insulin resistance and diabetes, with unique attention being became to a ability position of transferrin in Cr(III) transport

and cleansing.

Keywords: *Chromium, diabetes, insulin signalling, transferrin.*

INTRODUCTION:

In organic environments, two distinct forms of chromium (Cr) are typically established. The first is Cr(VI), typically encountered in chromate or dichromate forms, while the second is Cr(III). Chromium(VI) complexes are widely recognized as toxic substances, mutagens, and carcinogenic agents, particularly when ingested. They exhibit thermodynamic instability, readily converting to chromium(III) compounds, which represent the stable form of chromium in the presence of water and air. Chromium in its trivalent form is present in an extensive array of food items, yet it remains largely unrecognized by the general populace. It is posited that optimal nutritive Cr(III) is derived from the utilization of a chrome sword device in food processing; this suggests that individuals adhering to a weight loss regimen consume considerably lower levels of Cr(III) compared to the cutting-edge diets prevalent in developed nations. Despite the presence of toxicity in certain shops and the positive aspects of various cultures, Cr(III) is evidently not harmful to organisms under any reasonable treatment. No advanced tolerable restriction for humans has been established due to the absence of compelling evidence regarding the toxicity of any examined substances thus far. This does not imply that there are no potentially harmful consequences associated with elevated levels of Cr(III). In the 1950s, Cr emerged as a significant trace element for mammals. However, the essence of chromium has been the subject of considerable debate, primarily due to foundational concepts, and recent research indicates that beneficial effects in rodents regarding insulin sensitivity and potentially lipid profiles, including LDL cholesterol and triglyceride levels, necessitate supranutritional, pharmacologically relevant doses of Cr(III) [Vincent JB, et.al 2019, Vincent JB, et.al 2017, Vincent JB, et.al 2018]. In human existence, no consistent remedy exists – correlations between chromium and beneficial health

outcomes have been established. In 2014, the European Food Protection Authority (EFSA) found no compelling evidence to support the notion that chromium is a significant element. They concluded that there is no evidence of health concerns related to chromium intake in healthy individuals and that the recommended intake levels for chromium are no longer deemed appropriate. The historical examination of beneficial and pharmacological investigations involving Cr(III) has recently been thoroughly reviewed.

DISCUSSION:

Body composition:

In the late 1980s, assertions emerged that Cr(III) supplementation, especially as Cr(III) picolinate, could result in reductions in body mass and enhancements in lean body mass. Despite swift challenges to these assertions, Cr(III) picolinate became a widely used nutritional supplement, with product sales surpassing half a billion dollars (US). In 1997, the Federal Trade Commission (FTC) of the United States mandated that companies cease marketing claims, such as that Cr(III) diminishes body fat, induces weight reduction without exercise, or enhances muscle mass, due to insufficient 'competent and reliable scientific evidence.' [Federal Trade Commission, 2019] Lukaski [Lukaski HC, 2019] recently reviewed the effects of Cr(III) on body composition, concluding that 'the preeminence of experimental findings underscores that Cr(III) supplementation... is neither a substantial contributor to body mass reduction nor a promoter of body fat loss or muscle gain in adults.' A 2019 systematic review of trace element supplementation in exercise and athletic performance concluded that Cr(III) supplementation, in the majority of research, demonstrated no correlation with measures of anthropometric or body composition changes. In 2019, the inaugural meta-analysis of studies regarding the benefits of Cr(III) on body composition was published, exceeding five times the previous research. The variables analyzed included body mass, body fat percentage, BMI, and waist circumference. No statistically significant influence was detected regarding fat or fat characteristics on midriff

circumference. Despite the majority of studies indicating no effect from Cr(III) supplementation for each variable, the meta-analyses revealed statistically significant improvements in body mass loss (0.75 ± 0.30 kg), reduction in body fat (0.68 ± 0.64), and decrease in BMI (0.40 ± 0.26). Group analysis indicated that the effects on body mass reduction and body fat alteration were especially pronounced for participants undergoing supplementation for 12 weeks or less and receiving 400 mg of creatine per day or less; specifically, the minimal dosages for the briefest time. Despite being statistically significant, these results lack clinical significance and are constrained by the restricted number of trials, of which few were of high quality. Another weakness of the meta-analysis is that the errors in two of the major studies were not adequately assessed. Supplementation of Cr(III) in boluses of up to 1000 mg daily does not seem to exert any clinically significant impact on body mass and composition in healthy, overweight, or obese individuals, assuming such effect exists, and cannot be endorsed.

Human health and disease:

For several decades, Cr(III) has been suggested as an adjunct treatment for insulin resistance, type II diabetes, and related conditions. Rodent studies indicate that large, supranutritional doses of Cr(III) can enhance insulin sensitivity and may lead to beneficial alterations in LDL cholesterol, total cholesterol, and triglyceride levels in both healthy and disease model animals [Vincent JB, et.al 2019]. In humans, the results remain unclear, possibly due to the fact that the doses of Cr(III) administered have not matched those utilized in the most rigorous rodent studies. From 2001 to 2004, the US National Institutes of Health (NIH) conducted a program advertisement focused on 'Chromium as an adjuvant treatment for type II diabetes and blood glucose management.' Clinical trials funded under this advertisement did not replicate the results of earlier trials typically financed by nutraceutical companies that reported beneficial effects in humans. In 2005, the US Food and Drug Administration (FDA) issued a letter of enforcement discretion regarding a request for eight health claims related to Cr(III) from a nutraceutical company. The FDA permitted

a single health claim, which noted that ‘the actuality of such a relationship between chromium picolinate and either insulin resistance or type II diabetes is largely uncertain’ [Costello RB, et.al 2016]. Consequently, due to these factors and the increasing evidence indicating that chromium (Cr) is not an essential element for organisms, governmental support for Cr(III) nutritional or pharmacological research has largely been absent in the United States and Western Europe in recent years. Recent exploration of the effects of Cr(III) on human health has focused on meta-analyses (e.g., [Huang H et.al 2018, Heshmati J, et.al 2018]), although several clinical trials have also been conducted (e.g., [Jamilian M, et.al 2019, Farrokhian A, et.al 2019]). The quantity of meta-analyses examining the effects of Cr(III) on the symptoms of polycystic ovarian syndrome is approximately equal to the number of clinical trials conducted. The findings from these meta-analyses and trials are inconsistent [Costello RB et.al 2019 & Costello RB, et.al 2016]. The outcomes of the meta-analyses are contingent upon the inclusion criteria, especially regarding the quality of the clinical trials incorporated, as higher quality studies generally report no beneficial effects from Cr(III) supplementation. The situation has been effectively summarized by Costello and colleagues: ‘Until adequately powered trials that control for issues of nutrient phrasings, bioavailability, background diets, and drug use provide further conclusive evidence of the efficacy of Cr(III) supplements, the current support for health professionals to recommend Cr(III) supplements for glycemic control in diabetes cases is insufficient.’ [Costello RB, et.al 2016] In contrast to clinical trials that have administered 1 mg or less of Cr daily, findings from rodent studies suggest that adult humans should consume a minimum of 10 mg of Cr daily, potentially allowing for larger doses of Cr(III) in similar trials. The American Diabetes Association asserts that there is insufficient evidence to endorse the routine use of herbals and micronutrients, such as chromium, for improving glycemia in individuals with diabetes.

Chromium supplements:

Alongside the Cr(III) supplements that have predominantly been utilized in research over the past two decades—such

as Cr chloride, Cr picolinate, Cr nicotinate, Cr propionate, Cr-amended incentive, and Cr methionine – there remains a growing body of literature documenting the use of alternative Cr(III) compounds as nutritional supplements [Berenjian A, et.al 2018, Feng W, et.al 2018, Feng W, et.al 2018, Feng W, et.al 2019, Krol E, et.al 2019, Guo W-L, et.al 2019, Cui J-F, et.al 2019, Ye H, et.al 2019]. A multitude of these accoutrements remain insufficiently defined. Indeed, the compound that has garnered the most attention in recent publications, Cr malate, has been inaccurately characterized, leading to a plethora of inquiries regarding the studies conducted with it [Smart M, et.al 2018]. Notwithstanding certain assertions, none of these accessories seem to offer any advantages linked to their use beyond those initially reported for the more thoroughly examined composites. For illustration, CrCl₃, Cr nicotinate, and Cr picolinate, the three most prevalent Cr(III) supplements for human consumption, seem to be absorbed to similar extents, resulting in comparable Cr(III) levels in bodily fluids [Vincent JB, et.al 2019]. There has been some debate in the field regarding the implicit toxicity of Cr picolinate [Vincent JB, et.al 2019]. Nevertheless, there seems to be a consensus that the supplement poses no danger when ingested orally, as it is likely to degrade within the gastrointestinal tract, thus functioning solely as a source of Cr(III). Nevertheless, the emulsion has been suggested to possess toxic and mutagenic properties towards cultured cells and potentially to organisms if it enters the bloodstream entirely [Vincent JB, et.al 2019]. A recent study has confirmed that Cr picolinate exhibits clastogenic and cytotoxic properties in a cure-dependent manner towards Chinese Hamster Ovary (CHO) cells, while Cr propionate does not demonstrate such effects [Jiang L, et.al 2018].

CONCLUSION:

Recent studies have reinforced determinations. In humans, chromium is likely not an essential element. Cr(III) supplementation does not have beneficial effects on body composition, and the boluses used to date show no positive impact on the symptoms of insulin resistance, type II diabetes, or related conditions in humans. Furthermore, the use of

Cr(III) supplementation cannot be recommended for ranch animals due to insufficient data on treatment and response relationships, despite the absence of a clear response being demonstrated. The molecular mechanism for the enhancement of insulin resistance in rodents due to pharmacological boluses of Cr(III) remains unresolved. Transferrin is implicated in the detoxification of Cr(III) and may play a role in its transport related to the pharmacological properties of Cr(III); however, further studies are required.

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