Letter to the Editor

Chromium Picolinate is an Efficacious and Safe Supplement

The recent review by Lefavi et al. (9) omits several pertinent facts and contains misleading information regarding the efficacy and safety of chromium picolinate. Based in part upon a study in which chromium nicotinate was tested and found to be ineffective, the authors conclude that since chromium nicotinate does not alter body composition, no organic complex of chromium will be effective. This is erroneous, because the chemical properties of chromium complexes differ markedly and the chemical variances result in a vast difference in the biological action of the complexes.

In chromium nicotinate (Cr nic), chromium coordinates with four molecules of water and two molecules of nicotinate through the carboxyl carbon. At physiological pH, the water molecules are readily converted to hydroxide which renders Cr nic insoluble in both lipid and aqueous solutions (3, 6, 10, 14). Cr nic enhances insulin activity in isolated adipose tissue (1, 14) and increases glucose uptake by yeast cells (3).

In chromium picolinate (Cr pic), chromium coordinates with three molecules picolinate through both the pyridine nitrogen and the carboxyl carbon (2, 6, 13). Cr pic is lipophilic, which facilitates its entry into and through the plasma membrane of cells (5, 6). In skeletal muscle cells cultured in media that contained Cr pic, the rate of insulin internalization was increased and the uptake of both glucose and leucine were elevated. This effect was specific for Cr pic since zinc picolinate, chromium chloride, and Cr nic were not effective in this assay system (5).

Recently we tested the efficacy of Cr complexes in males and females (ages 25–36) enrolled in a weekly aerobics class (6). Participants were divided into two groups of 6 males and 6 females. The males were given coded bottles that contained 400 µg Cr³⁺ as either Cr pic or Cr nic. The females were given coded bottles that contained 200 µg Cr³⁺ as either Cr pic or Cr nic. The participants were instructed to take one capsule each day at breakfast. Lean body mass was determined prior to beginning the class and exercise regimen, and again after 12 weeks. Lean body mass (LBM) was calculated from total body resistivity measured with a four-terminal portable impedance analyzer. LBM increased 1.8 ±0.3 kg in the females given Cr pic and +0.6 ±0.2 in females given Cr nic. LBM increased 2.1 ±0.3 kg in the males given Cr pic and 0.7 ±0.3 in males given Cr nic.

In one study not cited by the authors, Kaats et al. (8) examined the effect of Cr pic in sedentary volunteers by use of underwater testing displacement. At the completion of the study (69 days), the group given the placebo
showed no significant changes. In contrast, the group given an average of about 200 µg Cr per day lost an average of 1.5 kg body fat and gained 0.7 kg muscle mass. The group given 400 µg Cr per day lost an average of 2.1 kg body fat and gained 0.5 kg muscle mass.

Experiments by Page et al. (11, 12) and C.Y. Hu, Dept. of Animal Sciences, Oregon State University (personal communication) prove that Cr pic also affects body composition in swine. Cr pic added to corn-soybean diet resulted in significantly reduced rib fat thickness and significantly increased loin eye area and percentage of muscling in growing-finishing pigs. No changes were observed when chromium chloride was added to the diets at levels far in excess of those used in the Cr pic trials.

The studies with swine may explain in part the variable results obtained by Evans (4) and Hasten et al. (7). In the swine studies, the most consistent results were obtained when pigs were fed 200 µg Cr/kg diet (1.66 mg Cr pic/kg diet). Near the completion of these experiments, the pigs were consuming an average of 4.2 mg Cr pic/day, which is, using a median mass of 67.2 kg, equivalent to 62 µg Cr pic/kg body mass. Thus, if the efficacy of Cr pic is related to body mass, a 70-kg human requires 521 µg Cr/day (4.34 mg Cr pic/day) in the form of Cr pic.

The discussion of the effects of picolinic acid is extremely misleading because the authors imply that consumption of chromium picolinate will lead to toxic levels of picolinate in the body. The citations listed by the authors contain studies conducted with picolinic acid, not chromium picolinate or any other metal complex of picolinate. Cr pic is absorbed and utilized intact by the cells of the body (5, 6), after which the complex is broken down (probably in the lysosomes). Picolinate is conjugated with glycine and excreted in the urine. Dr. K. Nakajima, Otsuka Group, Japan Immuno Research Laboratories, has studied the chronic toxicity of uncomplexed picolinic acid in rats and found the chronic toxicity level to be 750 mg/kg body weight/day (personal communication). Furthermore, by use of high pressure liquid chromatography (HPLC), we have determined that humans consuming no form of supplemental picolinate excrete approximately 20 mg conjugated picolinate per day. A human ingesting 800 µg Cr/day as Cr pic would absorb less than 7.0 mg picolinate.

We recently completed a study with rats to determine the effect of Cr pic on longevity, and that study has given us some valuable information regarding toxicity. Weanling, male, Long-Evans rats were divided into groups of 10 and fed a purified diet that contained Cr pic in levels from 0 to 42 µg/g diet (0–5 µg Cr/g diet). After 30 months, approximately half of the rats (9/20) in the groups fed 0–2.08 µg Cr pic/g diet (0–0.25 µg Cr) had died, while only one (1/30) rat had died in the groups given 4.2–42 µg Cr pic/g diet (0.5–5 µg Cr/g diet). Growing rats consume about 20 g food per day, which indicates that the chronic toxicity of chromium picolinate is much greater than 8.4 mg/kg body weight/day since this level actually increased longevity.

In conclusion, Cr pic maximizes insulin function in skeletal muscle, the primary target organ of insulin. Rather than categorically dismissing the efficacy of Cr as a means of regulating body composition, investigators should test Cr pic, keeping in mind that the currently observed safe and adequate level for chromium intake (200 µg) may not be adequate to observe an
enhanced anticatabolic action of insulin. Athletes, coaches, and trainers will find that Cr pic is safe and efficacious.

Gary W. Evans  
Department of Chemistry  
Bemidji State University

References

Response

Dear Editor-in-Chief:

Since Dr. Evans is the inventor of chromium picolinate (2), he is undoubtedly very passionate about this compound. Unfortunately, not only is Dr. Evans’ response at odds with findings of researchers not tied to chromium picolinate but, more important, there is very little stated therein that pertains to the salient aspects of our review (4). That is, Dr. Evans seems to have missed the point.

The following addresses the pertinent issues in Dr. Evans’ response and is a reasonable synopsis of the more important issues we presented in our manuscript:

- Although our paper was not a rehashing of the chromium nicotinate versus picolinate controversy or an analysis of their respective structures, Dr. Evans’ unique view on the effectiveness of a picolinic acid compound in insulin potentiation is not supported by the independent research of others. For example, Roginski (6), working under Mertz, reported the strong potentiation of insulin to be dependent upon a nicotinic acid-chromium complex, and that other pyridine carboxylic acid derivatives (such as picolinic acid) were ineffective as ligands, possibly because they bound too tightly to chromium. Consistent with this, Seal (7) found picolinic acid to promote the excretion of trace minerals such that they were unavailable for physiological use. Although most researchers in this field would agree that picolinic acid is a strong chelator of metals, the work above, not included in Dr. Evans’ letter, suggests that it may be too strong a chelator of metals, trapping the nutrients so they can’t be used by the body.

- Dr. Evans feels that we misrepresented chromium supplementation to athletes, labeling it “ineffective.” Of course we stated no such thing. In fact, we clearly made a case for chromium supplementation in athletic populations. However, we did assert that it is highly unlikely that any chromium supplement would produce the anabolic steroid-like muscle mass increases in athletes that chromium picolinate has been touted to produce. This notion, the main point we presented regarding chromium picolinate—that there is no significant body of independent research to substantiate these extraordinary claims of anabolism—has also been espoused by Clarkson (1), Moore and Friedl (5), and Whitmire (9).

- Dr. Evans’ response contains many references as support for his defense of the efficacy and safety of chromium picolinate. Although we have described independent research suggesting there may be reason to question both the efficacy and safety of a chromium-picolinic acid compound, if one eliminates from Dr. Evans’ letter citations that involve Dr. Evans himself (as inventor), other authors involved in the marketing of chromium picolinate products, as well as “personal communication,” there is virtually no rationale for his assertions.

In addition, Dr. Evans points to three key publications as support for his position and suggests we omitted “pertinent facts” contained therein. Of these three publications, two were in press and one is an abstract. I have not found a way to comment on papers that do not yet exist in the scientific literature.
However, since Dr. Evans provides us with some anabolic data from one of his papers, I feel it is appropriate to comment on those data here. It is likely that many reviewers well-read in exercise physiology would find the notion of a 4.6-lb \textit{lean} body mass (LBM) increase in males and a 4.0-lb LBM increase in females resulting from 12 weeks of a weekly aerobics class preposterous. A LBM increase that dramatic is not typically seen in subjects who are weight training three times per week for 12 weeks, no matter what they’re taking.

Importantly, not only does this study have a very small number of subjects (one could only assume there must have been three of each gender receiving one of the two treatments), and no placebo control, but these findings are also inconsistent with the specificity-of-training principle as well as with the results of numerous studies identifying no reduction or a small reduction (at best) in body fat from aerobic dance exercise, with no concurrent increase in LBM, as reviewed by Walberg (8) and by Williford et al. (10). Investigators familiar with this type of research would suggest either (a) that was one great aerobics class, or (b) people in Bemidji, MN, respond in a highly unusual manner to aerobic exercise and/or are extremely chromium deficient, or (c) Dr. Evans’ group is consistently having difficulty accurately measuring LBM.

- Regarding Dr. Evans’ final statement, it is reasonable to state that athletes, coaches, and trainers \textit{may} find chromium picolinate to be safe and efficacious (and they may not). More to our point, however, is that it is unreasonable to state that this compound produces anabolic steroid-like muscle mass changes in athletes, which many companies marketing chromium picolinate, as well as Dr. Evans himself (3), have claimed, though no substantial body of independent research exists to support them.

Moreover, that Dr. Evans has promoted chromium picolinate as an anabolic steroid alternative in health food stores and other locations is not generally appreciated by sport nutritionists who are working hard to teach athletes sound nutrition principles and battling the counterproductive effects of nutrition charlatans.

\textit{Robert G. Lefavi}

\textit{Health and Human Performance Lab}

\textit{Georgia Southern University}

\textbf{References}

2. Evans, G.W. [United States patent number 4,315,927. Issued February 16, 1982].


