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HUMAN NUTRITION

RESEARCH NOTES

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Industry Moves to Regulate the Term "Metal Amino Acid Chelate"

Over the years, the term "metal amino acid chelate" has been used to describe a certain class of mineral compounds: calcium amino acid chelate, magnesium amino acid chelate, etc. Based on pioneering research, Albion Laboratories developed mineral forms that mimicked chelates in food and was the first to introduce them to the natural food industry. These ultimate mineral forms gained notoriety because of their superior bioavailability and significantly lower toxicity.

Subsequently, the use of the term "amino acid chelate" became widely abused. A few unscrupulous companies began to sell inorganic minerals that were dry blended with vegetable protein as if they were amino acid chelates. A true metal amino acid chelate must be formed in a liquid environment, because only in solution will the ingredients react and form the special claw-like chelate bonded structure. These dry-blended "chelates" are cheap because they do not have to be dried or the protein digested into amino acids, but they do not possess the advantages of true amino acid chelates.

Unfortunately, the unsuspecting public, who had put their faith in the word "chelation," fell victim to these unscrupulous few. The Government's lack of interest in this issue allowed this abuse to grow and become commonplace. For example, one manufacturer who is still in business and claims to make amino acid chelates (research has shown that he does not), wrote the following in response to questions about his product: "We do not provide information on bioavailability, absorption, stability, etc. We only manufacture the products and do not develop any technical information."

Now, thanks to a movement by the National Nutritional Foods Association (NNFA) for industry self-regulation, the issue surrounding the use of the term amino acid chelate is being given proper attention. Over the last year or so, members of special committees to the NNFA have been working to develop proper definitions to certify metal amino acid chelates, as well as other mineral forms. The NNFA is to be commended for its desire to address this issue and protect the public interest.

Ashmead, H., et al., "Chelation does not guarantee mineral metabolism," J. Appl. Nutr. 26:5, Summer, 1974.

Ashmead, H.D., Conversations on Chelation and Mineral Nutrition, (New Canaan: Keats Publishing) 37-46, 1989.

Metal Amino Acid Chelate – What Is It?

A Metal Amino Acid Chelate is the product resulting from the reaction of a metal ion with amino acids having a mole ratio of one mole of metal to one to three (preferably two) moles of amino acids to form coordinate covalent bonds, as seen in Figure 1. The resulting molecule, known as an amino acid chelate, has two or three five-member heterocyclic ring structures (see Figure 1)[1] containing a metal ion (as the closing member of

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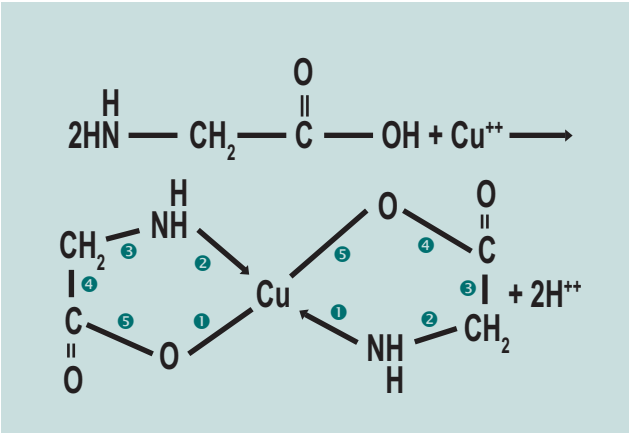
Figure 1.
The formation of a dipeptide-like chelate of copper. Coordinate covalent bonds come from the amino group and ionic bonds from the carboxyl group. The numbers in circles indicate the s member bonds which form the two heterocyclic rings of the amino acid ligands.



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the ring). The metal ion is attached by coordinate covalent bonds to two or more nonmetals in the same molecule.

The average weight of the amino acids must be approximately 150 daltons (or AMU), and the resulting molecular weight of the chelate must not exceed 800 daltons. The molecular weight of this chelate is very important because the molecular weights of the molecules composing the chelating agents, known as ligands, will determine whether or not chelation can even occur and how bioavailable the resulting molecule is. The molecular weight of the chelate is found by totaling the atomic weights of every atom composing the ligands plus the atomic weight of the metal being chelate.[2] Certain laboratory instrument can also "weigh" a single amino acid chelate molecule and compute its molecular weight.

1. Ashmead, H.D., et al., Intestinal Absorption on Metal Ions and Chelates (Springfield: Charles C. Thomas) 1989.

2. Taylor, Maddie D., First Principles of Chemistry (Princeton: D. Van Nostrand) 98-114, 1960.

Nutritionally Functional Chelates

To be utilized, a chelate must be nutritionally functional as well as being a true chelate. Research at Albion has clearly demonstrated that different chelates have different absorption rates and bioavailability. For example, absorption studies with ^{54}Cr have shown that the Albion chelate was significantly more bioavailable than chelated chromium picolinate.[1] In order for a metal amino acid chelate to be nutritionally functional, it must meet all the parameters in the above definition, plus:

1. **It must have electrical neutrality (non-ionized).**
2. **The chelate must have an appropriate stability constant.**
3. **The chelate must contain an easily metabolized ligand.**

The last requirement – easily metabolized ligand – is usually well met by any of the recognized amino acids. It allows the chelate to have 100 percent nutrient density. All of the chelate – both the metal and the ligand – has biological usefulness. To use amino acids as chelating agents removes the potential for problems that might arise from using ligands that are of no biological value, and make the body perform additional needless work to eliminate them from the body. Some chelating agents, such as picolinic acid and EDTA, are typical examples of ligands that have no biological usefulness, and have been seen to facilitate loss of a broad spectrum of minerals, causing mineral deficiencies.[2,3]

1. Graff, D., et al., Absorption of chromium from various sources, "Publication pending. Also see Albion Research Notes V.2, N. 5, October 1993.

2. Seal, C., "Influence of dietary picolinic acid on mineral metabolism in the rat," Ann. Nutr Metalo 32:186, 1988.

3. Cook, J.D. and Monson, E.R. "Food Fortification in Man II. The effect of EDTA absorption of dietary non-heme iron," Ann J Clin Nutr. 29:614, 1976.

All the metal amino acid chelates produced by Albion Laboratories, Inc. are nutritionally functional – the most superior form of metal amino acid chelate.

Why Stipulate a Maximum Molecular Weight?

If an amino acid chelate weighs more than 800 daltons (or AMU) it is probably not an amino acid chelate because the molecular weights of the individual amino acids range from 75.07 daltons for glycine to 204.23 daltons for tryptophan as seen in Table 1 (see page 3).[1] The heaviest normally supplemented mineral that can be chelated is molybdenum, which has a molecular weight of 95.94 daltons.[2] Therefore, one mole of molybdenum chelated to three moles of tryptophan would be the largest amino acid chelate possible under the definition, and its molecular weight would be between 700 and 800 daltons. A low molecular weight chelate is required for that chelate to be nutritionally functional.[3,4]

If the molecular weight of a chelate is too great, it must be digested in order for absorption to take place. This would effectively eliminate large chelates' nutritional advantages. For this reason, Professors Kratzer and Vohra rule out proteins or partially hydrolyzed proteins as effective chelating agents.[5] Furthermore, it is doubtful that intact proteins can truly chelate metals. A metal protein complex (metal proteinate) would generally have a molecular weight far too large.

Even before Kratzer and Vohra stated that small molecular weight chelates were essential for intact absorption, Albion had previously determined that if the ligand were not digested to the amino acid state, the resulting chelate absorption would be reduced. Subsequently, Tiffin published data stating that if an amino acid chelate did not have a small molecular weight, it would not be absorbed intact in either plants or animals.

Several amino acid chelates, and so-called chelates, from different

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manufacturers were assayed for their molecular weights. It was determined that only Albion Laboratories was making amino acid chelates that weighed less than 800 daltons as seen in Table 2.[7] These data demonstrate that even though the other companies whose products were assayed were calling their products amino acid chelates, they were not true amino acid chelates. Their molecule weights were too great. They may have been metal proteinates, but they were not amino acid chelates because the amino acid chelate definition limits the molecular weight to 800 daltons (AMU).

1. Budavari, S., ed., Merck Index (Rahway; Merch & Co.) 1989.

2. Hampel and Lawlry, Encyclopedia of Chemistry, (NY: Van Nostrand Riegold), 1972.

3. Ashmead, H.D., The Roles of Amino Acid Chelates in Animal Nutrition, (Park Ridge: Noyes) 457-469, 1993.

4. Ashmead, D. and Graff, D., "Placental transport of chelated iron," Proc. Int. Pig Vet Soc Congress, Mexico 207, 1982.

5. Kratzer, F. and Vohra, P. Chelates in Nutrition, (Boca Raton: CRC Press) 1988.

6. Tiffin, L., "Translocation of Micronutrients" in Dinaner, R., ed., Micronutrients in Agriculture (Madison: Soil Science Society) 207, 1972.

7. Johnson, B., "Molecular Weight Study" Unpublished, 1978.

Table 1. ►
Amino Acids Found in Nature that can Chelate Cations.

Amino Acid	Weight	Amino Acid	Weight
Glycine	75.07	Glutamine	146.15
Alanine	89.09	Asparagine	132.12
Valine	117.15	Lysine	146.19
Leucine	131.17	Arginine	174.20
Isoleucine	131.17	Histidine	155.16
Serine	105.09	Hydroxlysine	162.20
Threonine	119.12	Cycteine	121.16
Tyrosine	181.19	Cystine	240.30
Phenylalanine	165.19	Methionine	149.21
Tryptophan	204.23	Proline (Imino Acid)	240.30
Aspartic Acid	133.10	Hydroxyproline (Imino Acid)	131.13
Glutamic Acid	147.13		

Table 2. ►
Average Molecular Weights of Iron Amino Acid Chelate.

Albion	**274.7 daltons (AMU)**
Company A	**9,174.6 daltons (AMU)**
Company B	**1,569.8 daltons (AMU)**
Company C	**91,746.7 daltons (AMU)**
Company D	**2,038.0 daltons (AMU)**

Table 3. ▼
Absorption of Amino Acid Chelates *in Vitro* (ppm)

	Albion	Technique A	Technique B
Magnesium	87 ppm (100%)	50 ppm (58%)	45 ppm (52%)
Iron	275 ppm (100%)	107ppm (39%)	57 ppm (21%)

Albion's Patented Metal Amino Acid Chelates

As stated above, stabilized true amino acid chelates are absorbed intact, in part because of their low molecular weights. If the proteinaceous ligand is not digested to the amino acid state, the resulting compound must be modified in the stomach and intestines before absorption. When this occurs, the benefit associated with the chelate is largely lost. For example, in a study, proteinaceous chelates were produced using a variety of manufacturing techniques, including Albion's patented techniques for making true amino acid chelates. These different chelates were then tested for absorption in vitro by putting the chelates in simulated gastric solution and then exposing them to intestinal tissue were assayed for mineral absorption. As can be seen in table 3, when the chelate had a low molecular weight, its absorption was much greater. Presumably, the other chelates had to be modified in the gastric solution before they could be absorbed, whereas the Albion chelates did not.

1. Graff, D., et al., "Absorption of minerals compared with chelates made from various protein sources into rat jejunal slices in vitro. Address at Utah Academy of Arts Letters Sciences, April 1970.

Albion's Patented Metal Amino Acid Chelates

In this issue of the Albion Research Notes, some of the basic characteristics of true metal amino acid chelate, as well as what other practical and chemical considerations are required for chelation, have been given a brief overview. Entire textbooks have been written about the unique chemistry of these molecules, including those by Dr. H. DeWayne Ashmead, President of Albion Laboratories. Albion's involvement in the research behind mineral chelate nutrition, chemistry, and product development, along with over 45 patents relating to mineral chelates, make it obvious that Albion is the leading expert in the production of the highest quality metal amino acid chelates. If you're looking for a true reacted mineral chelate, Albion is the only company with proven results.

Albion Human Nutrition
100 Maple Park Blvd., Suite 110
St. Clair Shores, Michigan 48081 USA
[P] 586•774•9055 | [TF] 800•222•0733
[F] 586•774•8838
[e] info@AlbionMinerals.com