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Cheated minerals in animal nutrition

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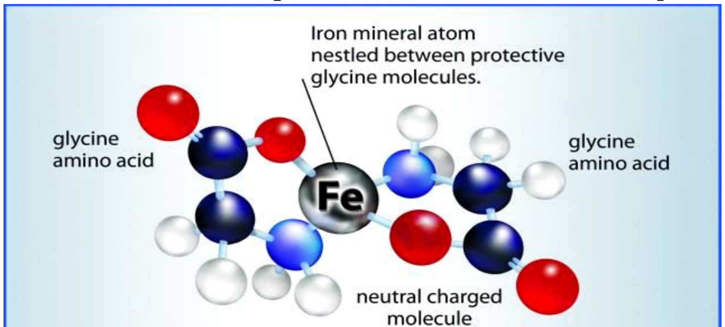
ABSTRACTS

Chelating is the chemical process by which a mineral (iron, cobalt, copper, zinc, and manganese) is combined with a mixture of amino acids and peptides. The resulting substances are known as chelates. Another descriptive term, proteinates, refers to the amino acid bond. These chelated minerals are thought to be more digestible than nonchelated forms. In other words, chelation makes the minerals more bioavailable (able to be absorbed and used for bodily functions), chiefly by shielding them from the effects of other dietary elements in the animal's digestive tract. Proteinates or chelates are described as organic minerals in contrast to inorganic minerals, those that are not bound to amino acids.

Key words: chelate, mineral, nutrition, bioavailability

Overview

In this review, well over half are peer review journal articles describing research in recent years, with abstracts, proceedings and book chapters the balance. As will be seen, in most cases, the experimental results show a benefit, or at least no disadvantage, to feeding chelates. But the exceptions are noteworthy. Giving credit where it is due, much of this work was supported by Zinpro Corporation, but in the same sense of fairness, until recently, it was all too common to use as the control treatment the oxide form of copper or zinc. This unduly favors the chelate in that the oxides are inferior in bioavailability to the sulfates, as several studies show, and furthermore, sulfates are commonplace in animal nutrition. Eloquent investigations utilizing radio labeled chelates, lead by Robert Cousins and his colleagues at the University Florida, have brought us to the beginning of an understanding of the exact mechanism of action of chelates. Various workers underscored the complication of inhibition, such as that due to phytase and excess calcium. It is intriguing to see that the nutritional status of an individual for a given mineral may directly influence the uptake of that mineral. For this reason, Jerry Spears of



Molecules structure of an Iron Bisglycinate Chelate

North Carolina State, a veteran investigator of minerals, always recommends bioavailability evaluations using known suboptimum mineral levels. Site of absorption, it develops, is not a straight forward issue, and some tissues proved to be reliable indicators of nutritional status, while others it would appear are nearly meaningless. An interesting abstract of work in beef cattle (Littledike et al., 1994) that followed dietary treatments for up to five years indicates that body composition alone can alter tissue levels of trace mineral. Montana workers (Patton, 1990) did not observe liver levels of trace minerals paralleled by serum values, and proposed that serum was not a good indicator of mineral status. Stress, especially due to infection, is a common theme in several papers.

Bioavailability

A new method to determine bioavailability of mineral elements was developed at the University of Florida, and described in detail by Holden et al.(1996). With this method, tissue uptake of the mineral element following high-level, short term supplementation is used as the criteria to determine bioavailability. This method appears to offer several advantages over the traditional approach including use of natural diets which are less expensive, and which allow the animals to grow to their maximum genetic potential. Other advantages cited include fewer concerns with respect to mineral contamination of diets and tissues, and the fact that it takes fewer animals to detect statistically significant differences. This new method has proven to be as effective as the traditional method in determining copper and zinc bioavailability from inorganic and organic sources of copper and zinc.

Mode of action in ruminant

Stable in rumen environment & abomasum

↓

Delivered in small intestine as such.

↓

Absorbed through active transport (more blood level)

↓

It act as biological complex (more tissue level)

↓

Enter into different pool

↓

Metabolizable in differently (Neathery et al 1972) (Pharmaco-dyanamics nutrient) (using 65Zn)

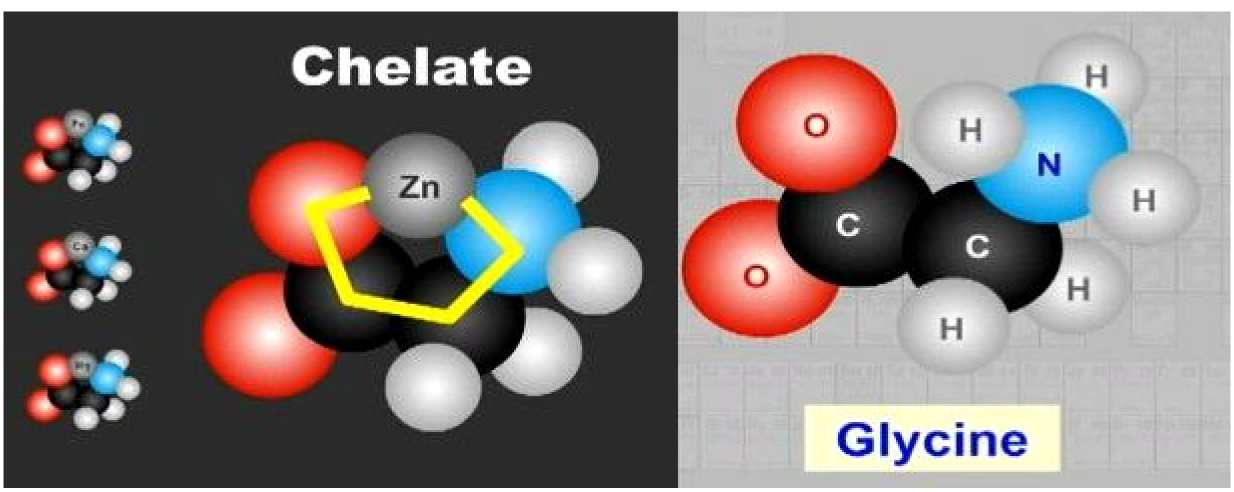
Different chelates

No attempt will be made here to list all manufacturers of chelates. However, some explanation of the difference in approaches is appropriate, allowing for the fact that each product is best described by its own representatives. First of all, a chelate is a mineral bound to nonmetal entity, referred to as the ligand. The nature of the bond is fairly well accepted, inasmuch as it is a function of the laws of physics, but exactly what constitutes the ligand is the source of all the territoriality on the part of the various players. Reiterating the caveat again, that each company is best suited to explain its own products, the matter can be reduced to the following main points. Depending on the product, the ligand is one of three things; 1) a specific amino acid, 2) a small number of amino acids, more than 800 and less than 1200 molecular weight, or 3) an unspecified group of amino acids. As far as this reviewer is concerned, this constitutes the whole of the basic differentiation required of a nutritionist or buyer. There is the one infrequent exception, which of metals in combination with carbohydrates or polysaccharides, but little research presents itself to guide us on this matter (Hussein et al., 1993; Kegley et al., 1994; Kats et al., 1994).

Deficiency sensitizes absorption

Or more correctly, it would appear that nutritional status ofa given mineral can directly alter the uptake of that mineral. To fairly evaluate the evidence that follows, preliminary comments are in order. One needs to keep in mind that in trace mineral metabolism, just as in all biology, variation is the rule, along with mystery. For example, recently Nockels et al. (1993) reported that the major site of Zn absorption in the pig was a function of level of Zn in the diet. At 32 ppm, the colon predominated ($p<.001$) while at 132 ppm, the intestine and stomach absorbed more Zn.

Reproduction It is tempting to invoke chelates as helpful in reproduction, and the Olson et al. (1996) and Hill et al. (1987) studies would appear to supports this, but otherwise, data is rather scarce. A few experiment station reports (Holden et al., 1996) and several field trials certainly lend credence to the idea, but animal numbers are just too few to support their inclusion in this review. Jacques et al. (1993) reported more pups born to bitches fed zinc, manganese and copper chelates, but treatment and control weaned equal live pups. It is not difficult to theorize how chelates could enhance reproduction, given the



intensity of animal production and the proof of efficacy otherwise, but at this time, there is not conclusive evidence to this effect in the refereed literature. While this by no means precludes the possibility of enhanced reproduction due to chelates, more work is needed. Olson et al. (1996) actually reported a decline (P<.0 1) in fertility of heifers, attributed to proteinates.

Advantages of Chelated Mineral Supplements

(1) Better Nutrition

Minerals are catalysts for every enzyme in the human body. Our bodies need several different minerals for essential human nutrition. Deficiencies and imbalances can lead to serious health conditions. Ideally, we should absorb most minerals through our food. However, the modern diet is deficient in mineral nutrition. Food that is highly processed and exposed to contaminants limits nutritional quality. Additional minerals are needed to restore optimal levels of minerals in the body.

(2) Greater Bioavailability

Dietary minerals are often obtained from inorganic sources or mineral salts. Unfortunately, inorganic sources are poorly assimilated and/or ionize easily, yielding low bioavailability. ie. Baker- found manganese sulfate (32.5% elemental Mn) in corn/soy diet had 1-6% bioavailability, providing only 2% of the manganese to be utilized. Minerals found in food are bound to proteins. In a similar fashion, amino acids are protected bythe ring structure in a mineral chelate. This protects the mineral as it passes through the acidity of the digestive system to make the mineral more bioavailable. University of Florida studies indicate that chelated minerals have more bioavailability and absorption than inorganic minerals. Our product’s bioavailability was statistically more significant than seven competitors.

(3) Increased Stability

Chelated minerals, because of their protective ring structure, have the ability to avoid inhibition such as oxidation-reduction reactions when mixed with fat soluble vitamins. The ring structure also enables the mineral to avoid antagonism with other minerals.

(4) Research

Our research is based on published university and industry studies that have analyzed the bioavailability of our original patented chelates (AAFCO definition for chelates in agriculture, Metal Proteinates).

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