

# COMMON MINERALS USED IN NUTRITIONAL SUPPLEMENT FORMULATIONS

THE FUNCTION AND BENEFITS OF MINERALS IN NUTRITIONAL SUPPLEMENTS





## **Minerals are commonly used in nutritional supplement products, in sachet, liquid, tablet and capsule form.**

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This paper details the use, function and benefits of different minerals commonly found nutritional supplement products.



## An Overview

Minerals are inorganic substances found in rock, soil and in water, they are elements found on the periodic table. Elements are the fundamental components of all matter; they cannot be broken down or changed into anything else except by combination with other elements to form more complex substances. In terms of biology, minerals are inorganic, that is, not biological in origin. Nutritional minerals are essential constituents of all body cells and are needed by the body in varying, often tiny amounts. They have a role as catalysts for many vital body system processes such as the production of cell energy, synthesis of protein and the formation of membranes and structures of the body.

The nutritionally important minerals are usually divided into two groups depending on the quantity found in or needed by the body, those needed in larger quantities such as calcium and magnesium are known as macro minerals. Calcium is the most abundant mineral in the body and is mostly found in the skeleton. An adult skeleton contains around 1kg of calcium in a crystallised form called hydroxyapatite.

Magnesium, the second most abundant mineral comes in at an average of 25g, 60% is found in the skeleton the rest is distributed in the soft tissues. The other macro minerals include phosphorus, potassium, sodium, chloride and sulphur. The rest are known as trace minerals and are only needed in minute amounts, these include zinc, selenium, iron, chromium, copper, boron, iodine, manganese and molybdenum.

The level of minerals in food has declined significantly over the past 60 years.<sup>1</sup> Iron levels in meat products have dropped by nearly 50% while dairy products show a fall in magnesium and calcium levels.

## Quest's Synergistic Mineral Range

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Quest mineral formulas are designed to account for the natural synergies and competition between minerals providing complementary and synergistic nutrients to help maintain nutritional balance [See "Synergy and Competition"](#). They are formulated to provide bioavailable minerals in a gentle and effective form. [See "Bioavailability"](#).



## Functions and Health Relationships

Key Minerals	Function	Health Relationship
<b>Calcium</b>	The most abundant mineral in the human body; the majority is stored in the bones and teeth giving strength and structural support to the body. The remaining calcium is found in blood, muscle, and intracellular fluid and a constant level is maintained to allow the processes in which calcium is involved to function efficiently.	Contributes to normal growth and development of bone in children and for the maintenance of bones and teeth in general. Inadequate calcium levels increase the risk of fractures and osteoporosis, supplementation has been shown to reduce this risk particularly for postmenopausal women. <sup>2</sup> It is also involved in normal muscle function, blood clotting, the normal function of digestive enzymes, energy metabolism, neurotransmission and the process of cell division and specialisation.
<b>Magnesium</b>	The second most abundant mineral in the human body. It is involved in more than 300 enzymatic reactions and is needed for a wide range of body processes.	Contributes to normal muscle function and contraction including of the heart muscle tissue. It is needed for the maintenance of normal bones and teeth, electrolyte balance, the functioning of the nervous system and neurotransmission, protein synthesis, cell division, normal psychological function and energy metabolism. It helps to reduce tiredness and fatigue and muscle cramps, particularly in pregnancy.
<b>Iron</b>	Contributes to the normal formation of red blood cells and haemoglobin. It is needed for the transport of oxygen and energy-yielding metabolism and for the reduction of tiredness and fatigue. It is involved in normal cognitive function and supports the immune system and the process of cell division.	Roughly 50% of cases of anaemia worldwide are attributed to iron deficiency and this is considered to be the largest international nutritional disorder by the World Health Organization. <sup>3</sup> Menstruating women, vegetarians and vegans may be at a higher risk of iron deficiency. Iron supplementation is recommended during pregnancy as it may improve birth weight and gestational length. <sup>4</sup>
<b>Selenium</b>	Contributes to the normal function of the immune system and the protection of cells from oxidative stress. It is involved in spermatogenesis and normal thyroid function and is needed for the maintenance of normal hair and nails.	Selenium is an essential trace mineral. It has antioxidant properties meaning it may help protect organisms from oxidative damage. Research suggests an association between low selenium levels and an increased risk of cardiovascular disease and some cancers. <sup>5</sup> It is recommended to support fertility and the quality of sperm.
<b>Zinc</b>	Contributes to the function of the immune system and protection of cells from oxidative stress. It is involved in normal fertility and reproduction, DNA synthesis, process of cell division and the maintenance of normal levels of testosterone in the blood. It is needed for healthy bones, hair, skin and nails, the maintenance of normal vision and cognitive function. It also contributes to protein synthesis and the metabolism of nutrients including vitamin A, fatty acids and carbohydrates.	Severe zinc deficiency is unusual in developed countries; however, less severe cases may be observed in elderly and pregnant individuals. Symptoms of mild deficiency may include white spots on the nails, loss of hair, appetite, weight, and the sense of taste and smell. Zinc supplementation may be helpful for conditions such as acne vulgaris, peptic ulcers, diarrhoea in children, ADHD, herpes simplex virus (cold sores), infertility in men, and for boosting immunity.



Key Minerals	Function	Health Relationship
<b>Chromium</b>	Contributes to macronutrient metabolism and the maintenance of normal blood glucose levels.	May be helpful to control fluctuations in blood sugar levels, research has shown it may reduce insulin resistance and symptoms of hypoglycaemia. <sup>6</sup>
<b>Copper</b>	Occurs naturally in many foods and is also abundant in the earth's crust and most of the world's surface water, so deficiency is uncommon, however it can be depleted by zinc and iron supplementation.	Contributes to the maintenance of connective tissues, hair and skin pigmentation. It plays a role in the functioning of the immune and nervous systems and in the transport of iron in the body. It also contributes to the protection of cells from oxidative stress.
<b>Iodine</b>	Contributes to production of the thyroid hormones T3 and T4 and normal thyroid function.	It is needed for normal growth, cognitive function, energy-yielding metabolism, normal functioning of the thyroid, nervous system and for skin health.
<b>Manganese</b>	An essential trace nutrient found in minute quantities in the body mainly in the liver, kidneys, pancreas, and bones.	Contributes to energy metabolism, the maintenance of normal bones, formation of connective tissue and to the protection of cells from oxidative stress.
<b>Phosphorus</b>	Found in many foods, such as milk, cheese, grains, dried beans, peas, colas, nuts, and peanut butter. It is an important co-factor for calcium in the maintenance of bone.	Contributes to the normal growth and development of bone in children and the maintenance of normal bones and teeth in general.







## Synergy and Competition

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Minerals can be highly competitive battling for nutritional dominance in the body and displacing other minerals in the process, for instance a high intake of zinc or iron may deplete the body of copper and vice versa. In addition minerals require adequate levels of certain vitamins in order for the body to absorb and utilise them effectively. A healthy diet and food supplement regime should aim to ensure a balance of minerals is maintained in the body.

Quest mineral formulas are designed to account for the natural synergies and competition that exist between minerals and provide complementary and synergistic nutrients to help maintain nutritional balance. Anyone looking to supplement their diet with minerals should ensure they maintain a balance of minerals by choosing synergistic formulas containing these complementary nutrients.

**Table 1: Examples of Bio-Balance formulation strategies**

Primary Nutrient	Synergistic Effect	Synergistic Nutrient
Iron + Zinc	▲ <b>Absorption and utilisation enhanced by copper</b> <sup>16,17</sup> Copper is essential to iron and zinc transport in the body. <sup>12</sup>	Copper
Iron	▲ <b>Absorption enhanced by vitamins C &amp; B</b> <sup>12,13,14</sup> Vitamin C and B vitamins promote the absorption of iron in the intestine.	Vitamin C & B
Iron	▲ <b>Utilisation in the body increased by molybdenum</b> <sup>11</sup> Molybdenum plays an important role in iron utilisation in the body.	Molybdenum
Calcium	▲ <b>Absorption and effectiveness increased by vitamin D</b> <sup>20</sup> Vitamin D increases absorption of calcium. Clinical studies show calcium and vitamin D combination is more effective in preventing bone loss.	Vitamin D
Zinc	▲ <b>Absorption increased by vitamin B6</b> <sup>15</sup> Clinical trials show an increase in zinc absorption as the level of dietary vitamin B6 increases.	Vitamin B6
Magnesium	▲ <b>Assimilation and utilisation increased by vitamin B6</b> Vitamin B6 increases the cellular assimilation of magnesium.	Vitamin B6
Selenium	▲ <b>Antioxidant activity increased by vitamin E</b> <sup>18,19</sup> A combination of selenium and vitamin E has greater protective antioxidant properties.	Vitamin E
Iron or Zinc	▼ <b>Causes deficiency in copper</b> <sup>7,8,9,10</sup> High and prolonged intakes of iron and/or zinc produce a copper deficiency in the body.vzzz	Copper

## Bioavailability

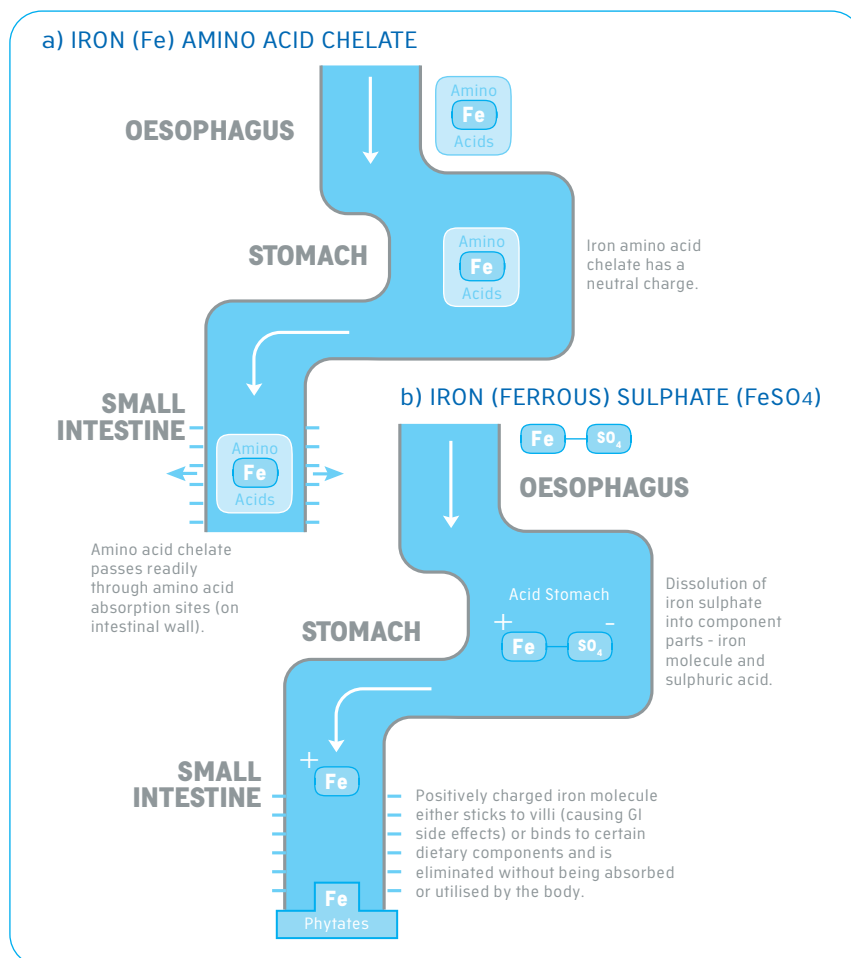
Minerals cannot be absorbed or utilised by the body in their natural state, they have to be combined or chelated to a carrier substance for transport into the body. Once inside the mineral is extracted from the carrier ready for utilisation by the body. Not all carriers are as effective or gentle on the digestive system, as others, for instance many people experience constipation when taking iron in the sulphate form (ferrous sulphate). Combining or chelating the mineral molecule with a blend of amino acids has been shown to maximise absorption and reduce gastrointestinal adverse effects.

This is because amino acid chelated minerals form a stable compound that delivers the mineral to the amino acid absorption sites in the intestinal walls allowing the mineral to readily pass through the intestinal wall. **See Figure 1.**

In contrast mineral salt compounds such as sulphates, fumarates etc. contain a more unstable bond causing the mineral and carrier compound to separate too soon in the gastrointestinal tract. The resulting loose mineral molecule is poorly absorbed and has a greater chance of being eliminated from the body without properly utilised. This can potentially cause adverse gastrointestinal effects such as constipation. **See Figure 1.**



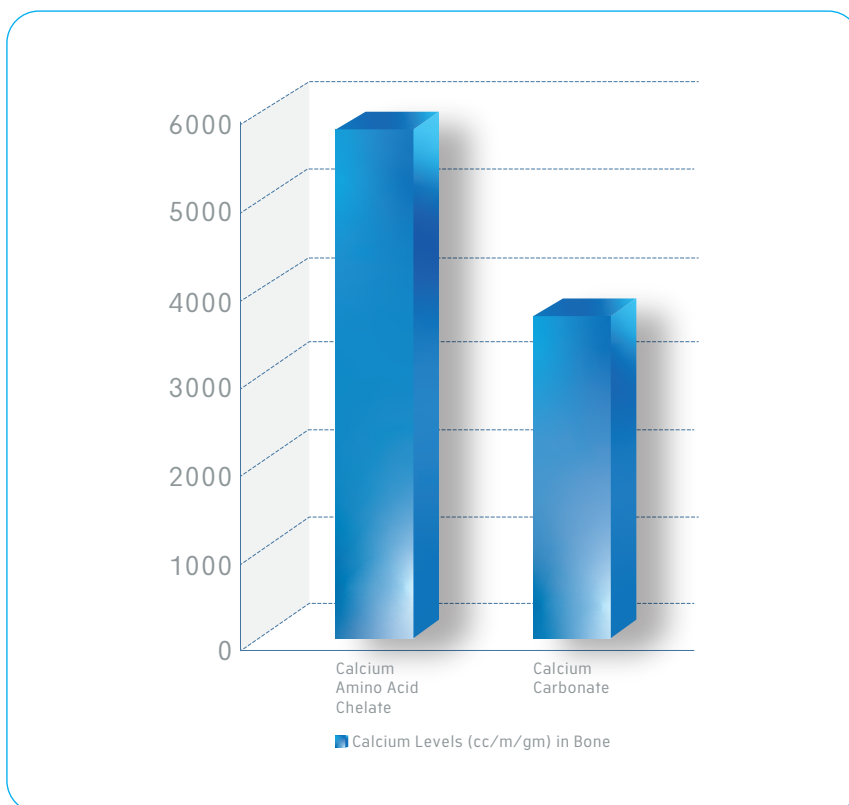
**Figure 1: Comparison of intestinal absorption of mineral chelates versus other mineral forms**



Amino acid chelated forms have shown to be more effectively absorbed than other chelating agents such as sulphates, fumarates, carbonates or oxides.



**Figure 2: Comparison of absorption of calcium amino acid chelate with calcium carbonate<sup>25</sup>**



Clinical trials comparing iron sulphate and calcium carbonate with mineral molecules chelated with amino acids have shown the amino acids compounds are between 4-3 times better absorbed meaning they are more effective even at lower doses. See Table 2 and Figure 2.

**Table 2: Clinical and scientific advantages of amino acid chelated minerals**

Key Minerals	Health Relationship
▲ 3-4 times greater bioavailability <sup>21</sup>	Amino acid chelated iron has a 90.9% iron bioavailability compared to a 26.7% iron bioavailability of iron in iron sulphate.
▲ 4 times greater absorption <sup>22</sup>	Amino acid chelated iron has a 6.0% mean geometric absorption value compared to 1.7% in iron sulphate.
▲ 57% greater mineral retention <sup>25</sup>	57% more calcium retained in bone from amino acid chelated calcium, compared to calcium carbonate.
▲ More effective at lower doses <sup>23</sup>	15mg of iron in amino acid chelated form reduced iron depletion in pregnant women more effectively than a higher dose of 40mg of iron from iron sulphate. 30.8% iron depletion (15mg iron amino acid chelate) versus 54.5% iron depletion (40mg iron sulphate).
▲ Twice the absorption <sup>26</sup>	44% calcium absorption from amino acid chelated calcium compared to 24% from calcium carbonate or calcium citrate.
▲ 2 – 3 times greater protection from absorption inhibitors <sup>24</sup>	SUSTAIN task force report concluded that amino acid chelates (iron) are 2-3 times better absorbed in the intestine due to the amino acid chelate protecting minerals from absorption inhibitors in the diet.

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