# NUTRITIONAL ELEMENTAL MINERAL-BASED COMPOUNDS

Description of the TBA test kit from HCMI

**Primary Use:** identifying the underlying mineral elements needed to activate gene potential, which activates the building blocks responsible for cellular detoxification and regeneration.

<table>
<thead>
<tr>
<th><strong>Bismuth</strong></th>
<th>40. Chromium polynicotinate</th>
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<tbody>
<tr>
<td>1. Bismuth citrate: Bismuth subcitrate</td>
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<tr>
<td>2. Bismuth subsalicylate</td>
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<tr>
<td><strong>Boron</strong></td>
<td>41. Chromium trichloride</td>
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<tr>
<td>3. Calcium fructoborate</td>
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<td>4. Borate salts</td>
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<td>5. Boric acid</td>
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<td>6. Boromycin</td>
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<td>7. Boron (elemental)</td>
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<td>8. Boron aspartate</td>
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<td>9. Boron citrate</td>
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<td>10. Boron oxide</td>
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<tr>
<td><strong>Calcium</strong></td>
<td>42. Adenosylocobalamin or cobamamide</td>
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<td>11. Calcium apatite</td>
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<td>12. Calcium ascorbate</td>
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<td>13. Calcium bisglycinate</td>
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<td>14. Calcium carbonate</td>
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<td>15. Calcium chloride</td>
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<td>16. Calcium citrate</td>
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<td>17. Calcium citrate malate</td>
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<td>18. Calcium fluoride</td>
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<td>19. Calcium L-5-methyltetrahydrofolate</td>
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<td>20. Calcium lactate</td>
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<td>21. Calcium malate</td>
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<td>22. Calcium metaphosphate</td>
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<td>23. Calcium orthophosphate</td>
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<td>24. Calcium phosphate or monocalcium phosphate</td>
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<td>25. Calcium sulfate</td>
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<td>26. D-calcium pantothenate</td>
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<td>27. Dicalcium malate</td>
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<td>28. Dicalcium phosphate</td>
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<td>29. Dicalcium triphtohosphate</td>
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<tr>
<td>30. Microcrystalline hydroxylapatite</td>
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<td>31. Octacalcium phosphate</td>
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<td>32. Tricalcium phosphate</td>
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<tr>
<td><strong>Chromium</strong></td>
<td>43. Hydroxocobalamin or hydroxycobalamin</td>
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<tr>
<td>33. Chromium bitartrate</td>
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<td>34. Chromium chelavite,</td>
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<td>35. Chromium citrate or chromium(III) citrate</td>
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<td>36. Chromium glycinate or amino acid chelate</td>
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<td>37. Chromium nicotinate</td>
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<td>38. Chromium nicotinate glycinate</td>
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<td>39. Chromium picolinate</td>
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<tr>
<td><strong>Cobalt</strong></td>
<td>44. Methylcobalamin</td>
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<tr>
<td>42. Adenosylocobalamin or cobamamide</td>
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<tr>
<td>43. Hydroxocobalamin or hydroxycobalamin</td>
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<tr>
<td><strong>Copper</strong></td>
<td>45. Copper bicarbonate</td>
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<tr>
<td>46. Copper citrate, copper(II) citrate or cupric citrate</td>
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<tr>
<td>47. Copper hydroxides</td>
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<td>48. Copper lysinate HCl</td>
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<td>49. Copper superoxide dismutase</td>
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<td>50. Copper zinc superoxide dismutase</td>
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<tr>
<td>51. Sodium copper chlorophyllin</td>
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<tr>
<td><strong>Gold</strong></td>
<td>52. Gold chloride</td>
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<td>53. Gold colloid</td>
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<td>54. Gold hydrosol (2ppm - 5ppm)</td>
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<tr>
<td><strong>Iodine</strong></td>
<td>55. Lugol’s elemental iodine</td>
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<td>56. Potassium iodide</td>
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<td>57. Sodium iodate</td>
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<tr>
<td>58. Sodium iodide</td>
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<tr>
<td><strong>Iridium</strong></td>
<td>59. Iridium dioxide</td>
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<td>60. Iridosmium or iridian osmium</td>
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<td>61. Organoiridium compounds</td>
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<tr>
<td><strong>Iron</strong></td>
<td>62. Catalase</td>
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<tr>
<td>63. IRE-BP = iron-responsive element-binding proteins</td>
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<tr>
<td>64. Iron amino acid chelate, iron glycinate</td>
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<tr>
<td>65. Iron(II) chloride or ferrous chloride</td>
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<tr>
<td>66. Iron(III) chloride or ferric chloride</td>
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<tr>
<td>67. Iron elemental or reduced iron</td>
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<tr>
<td>68. Iron (II) fumarate or ferrous fumarate</td>
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<tr>
<td>69. Iron(II) gluconate or ferrous gluconate</td>
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<td>70. Iron(III)-hydroxide polymaltose complex (IPC)</td>
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<td>71. Iron(II) sulfate</td>
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<tr>
<td>72. Iron sulfide</td>
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<tr>
<td>73. Lactoferrin aka lactotransferrin</td>
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<tr>
<td>74. Lactoferricin</td>
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</tbody>
</table>

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75. Proteins: heme, myoglobin, cytochrome P450
76. Protein cofactors (ferritin, rubredoxin)

Lithium
77. Lithium aspartate
78. Lithium carbonate / Dilithium carbonate
79. Lithium chloride
80. Lithium citrate / Trilithium citrate
81. Lithium orotate

Magnesium
82. Magnesium amino acid chelate,
83. Magnesium aspartate
84. Magnesium chloride
85. Magnesium citrate
86. Magnesium fluoride
87. Magnesium gluconate
88. Magnesium glycinate
89. Magnesium hydroxide
90. Magnesium lysinate
91. Magnesium malate
92. Magnesium orotate
93. Magnesium phosphate
94. Magnesium stearate
95. Magnesium sulfate or magnesium(II) sulfate
96. Magnesium taurate

Manganese
97. Manganese ascorbate
98. Manganese aspartate
99. Manganese chloride tetrahydrate
100. Manganese citrate
101. Manganese gluconate
102. Manganese glycerophosphate
103. Manganese sulfate monohydrate

Molybdenum
104. Molybdenum aspartate
105. Molybdenum citrate

Phosphorus
106. Tetrasodium pyrophosphate

Potassium
107. Potassium alpha-ketoglutarate
108. Potassium aspartate
109. Potassium aspartate HCl
110. Potassium and magnesium aspartate
111. Potassium asporotate
112. Potassium bisulfate
113. Potassium bromated
114. Potassium chloride
115. Potassium citrate
116. Potassium fumarate
117. Potassium gluconate
118. Potassium glycinate
119. Potassium-Magnesium taurate
120. Potassium malate or dipotassium malate
121. Potassium orotate
122. Potassium phosphate
123. Potassium sodium tartrate aka Rochelle salt
124. Potassium succinate
125. Potassium sulfate

Selenium
126. Selenium aspartate
127. Selenocysteine
128. Selenomethionine
129. Methyl-selenocysteine

Silicon
130. Orthosilicic acid – choline stabilized
131. Silica

Silver
132. Silver hydrosol
133. Silver lactate aka Aragentum lacticum
134. Silver oxide

Sodium
135. Sodium chloride or Natrum Muriate
136. Sodium phosphate or Phosphasoda
137. Sodium sulfate aka sodium sulphate

Vanadium
138. Vanadium citrate
139. Vanadium glutarate
140. Vanadium glycinate
141. Vanadium nicotinate glycinate chelate
142. Vanadyl sulfate

Zinc
143. Zinc(II) acetate or zinc diacetate
144. Zinc aspartate
145. Zinc bisaspartate
146. Zinc citrate or trizinc dicitrate
147. Zinc gluconate or zinc di(D-gluconate)
148. Zinc glycinate or zinc bis(aminoacetate)
149. Zinc picolinate
150. Zinc sulfate
Bismuth
1. Bismuth citrate aka Bismuth subcitrate is used to smother bacteria in the stomach.
2. Bismuth subsalicylate is used as an antidiarrheal; it is the active ingredient in such "Pink Bismuth" preparations as Pepto-Bismol, as well as the 2004 reformulation of Kaopectate. It is also used to treat other gastro-intestinal diseases.

Boron
3. Calcium fructoborate (borate salt) is very water soluble and easily absorbed by bone tissue; since there are two boron atoms per compound, this form of Boron is a rich source of boron.
4. Borate salts e.g. 1) sodium borate 2) potassium borate 3) sodium tetraborate, aka Borax; 4) sodium tetraborate pentahydrate aka Borax pentahydrate. Borates are the name for a large number of boron-containing oxyanions. The term "borates" may also more loosely refer to chemical compounds which contain borate anions react readily with fluorine and fluoride compounds, therefore such salts act as fluoride toxicity modulators and detoxifiers. Since the thyroid gland is the most sensitive endocrine gland to fluorine toxicity, this is an effective way to save the thyroid and support its recovery. Borax is also used as a beetle repellant in agriculture.
5. Boric acid has antiviral, antiseptic and antifungal properties, particularly for the eyes.
6. Boromycin is a bacteriocidal polyether-macrolide antibiotic; effective against most Gram-positive bacteria, but ineffective against Gram-negative bacteria. Boromycin kills bacteria by negatively affecting the cytoplasmic membrane, resulting in the loss of potassium ions from the cell. Recent studies reveal potent anti-HIV activity. It was found to strongly inhibit the replication of the clinically isolated HIV-1 strain as well as the cultured strain in vitro.
7. Boron (elemental)
8. Boron aspartate (an amino acid chelate).
9. Boron citrate is best for women as it reduces excretion of calcium by 44%, and activates estrogen and vitamin D.
10. Boron oxide has much less bioavailable but also less potential for toxicity.

Calcium
11. Calcium apatite one of the two primary components of bone structure; see calcium hydroxylapatite.
12. Calcium ascorbate or L-ascorbate or diascorbate is a form of Vitamin C which is predisposed to support muscles and structural elements in the body. This form would be counter-productive if a patient is taking Rx calcium channel blockers to control blood pressure.
13. Calcium bisglycinate (amino acid chelate salt) easily absorbed by muscle and used to form, build and control the geometric patterns of cell membrane surfaces.
14. Calcium carbonate is a good antacid although calcium also stimulate the stomach to produce gastrin. Poorly absorbed without the simultaneous presence of cholecalciferol (Vitamin D3). There is no calcium carbonate in human bone.
15. Calcium chloride, water soluble, very stimulating to the stomach feedback loop which causes gastrin to be released which in turn stimulates production of hydrochloric acid. Used extensively in food as a supplement and to keep fruits and vegetables firm whether frozen or canned.
16. Calcium citrate, rich source of water soluble calcium; used primarily by the blood.
17. Calcium citrate malate, water soluble very bioavailable mixture of organic calcium used by the blood, bone and muscle tissues.
18. Calcium fluoride, trace component of human bone, major component of dentine; trace component of elastin protein. Homeopathic dose has been used in Cell Salt form to treat sagging skin; fine creaking of the joints of the hands and feet; poor tooth enamel; and cracks in the palms of the hands and lips. With magnesium, it is helpful with hemorrhoids; can also be used in conjunction with caffeine-based enema to clear the blood vessels of the rectum.
19. Calcium L-5-methyltetrahydrofolate very bioavailable form of folate which easily merges into the Kreb’s Cycle or TCA Cycle.
20. Calcium lactate. In medicine, calcium lactate is very water soluble and is most commonly used as an antacid and also to treat calcium deficiencies. Calcium lactate can be absorbed at various degrees of pH and does not need to
be taken with food for absorption. It is added to many Rx formulations as a base or filler. Calcium lactate is added
to sugar-free foods to prevent tooth decay. When added to chewing gum containing xylitol, it increases the
remineralization of tooth enamel; for this reason it is also added to OTC mouthwash products. It is also added to
fresh-cut fruits such as cantaloupe to keep them firm and extend their shelf life, without the bitter taste caused by
calcium chloride.

21. **Calcium malate**, food additive; absorbed by bone and muscle; modest source of calcium for cell membrane
surface geometry.
22. **Calcium metaphosphate or pyrophosphate or dicalcium diphosphate** component of human bone and
the liver.
23. **Calcium orthophosphate** component of human bone.
24. **Calcium phosphate or monocalcium phosphate** component of human bone.
25. **Calcium sulfate** as a trace mineral species, it is concentrated at the physis of a growing bone. Once the
bone is capped, content of this calcium decreases over time. It is used topically to treat cracked skin of the
heels of the feet. Homeopathic dose treats skin lesions which heal slowly or poorly including acne and
herpetic blisters; used to treat forehead pain, and vertigo.
26. **D-calcium pantothenate or calpanate (Vitamin B-5 variant)**, very water soluble essential vitamin. It is
required to synthesize coenzyme-A (CoA), as well as to synthesize and metabolize proteins, carbohydrates,
and fats. It helps prevent skin ulcerations, aids with wound healing and it lowers blood lipid levels. Lipoic
acid is known to help with conditions of peripheral neuropathy. A recent study of patients with diabetic
polyneuropathy who did not respond solely to lipoic acid supplements, when lipoates were given in
combination with pantothenic acid, 84.8% improved. Poor metabolism and/or conversion of pantothenic
acid into bioactive forms are associated with skin issues and hair loss. Only the D-isomer has biologic
activity. The L-isomer in synthetic mixtures actually antagonizes the ability of the D-form to carry out work.
Coenzyme A may act as an acyl group carrier to form acetyl-CoA and other related compounds; this is a way
to transport carbon atoms within the cell. CoA is important in energy metabolism for pyruvate to enter the
tricarboxylic acid cycle (TCA cycle) as acetyl-CoA, and for α-ketoglutarate to be transformed to succinyl-
CoA in the cycle. CoA is also important in the biosynthesis of many important compounds such as fatty
acids, cholesterol, and acetylcholine. CoA is incidentally also required in the formation of ACP, which is also
required for fatty acid synthesis in addition to CoA. Pantothenic acid in the form of CoA is also required for
acylation and acetylation, which, for example, are involved in signal transduction and enzyme activation
and deactivation, respectively.
27. **Dicalcium malate** does not release gas in the stomach like calcium carbonate; does not stimulate release of
gastrin or increase HCl production; absorbed by bone and muscle tissue; supports the Krebs and glyoxalate
energy producing cycles.
28. **Dicalcium phosphate** a component of human bone.
29. **Dicalcium triphosphate** a component of human bone.
30. **Microcrystalline hydroxylapatite or calcium hydroxyapatite** the largest quantity of the primary
structural form of calcium in human bone.
31. **Octacalcium phosphate**
32. **Tricalcium phosphate** a component of human bone.

**Chromium**
33. **Chromium (III) 25µg - 35µg / day** cinnamon increases efficacy of chromium’s effect on insulin resistance;
has a synergistic effect with vanadium and molybdenum on glucose metabolism.
34. **Chromium bitartrate** water soluble bioavailable chromium organic salt.
35. **Chromium chelavite, chromium-niacin amino acid chelate or glucose tolerance factor (GTF) chromiuum chelavite** consistently effective at decreasing insulin resistance; inhibits synthesis of new fat
from carbohydrates; highest bioavailability (57%); absorbs primarily in the lower small intestine as an
amino acid rather than as a chromium salt in the upper small intestine.
36. **Chromium citrate or chromium(III) citrate** water soluble bioavailable chromium organic salt.
37. **Chromium glycinate or amino acid chelate** water soluble bioavailable chromium amino acid chelate;
do not compete for absorption in the upper small intestine as it is absorbed as an amino acid in the lower
small intestine; easily absorbed by muscle tissue.
38. **Chromium nicotinate**, water soluble bioavailable organic salt which has a positive absorption at the level of the capillaries.

39. **Chromium nicotinate glycinate**, superior absorption compared to chromium nicotinate.

40. **Chromium picolinate** > 200µg / day can damage DNA in sensitive liver and kidney cells moderately decreases insulin resistance; 37% bioavailable.

41. **Chromium poly nicotinate or chromium trinicotate** decreases insulin resistance and decreases essential hypertension due to availability of niacin released in the capillary bed; lessens free radical formation and DNA damage in the liver and kidneys. 30% bioavailable.

**Cobalt**

42. **Adenosylcobalamine or cobamamide**, natural form of Vitamin B12 in the human body; not available in an injectable form.

43. **Hydroxocobalamine or hydroxycobalamine** produced by bacteria which are used to produce the vitamin commercially. It is not a form normally found in the human body, but is easily converted in the body to usable coenzyme forms of vitamin B12. Because of its affinity for the cyanide ion it is a treatment for cyanide poisoning; it is also a nitric oxide scavenger. This is the most water soluble form of Vitamin B12; readily absorbed in the distal half of the ileum. Vitamin B12 has a key role in the normal functioning of the brain and nervous system, and for the formation of blood. It is involved in the metabolism of every cell of the human body, especially affecting DNA synthesis and regulation, but also fatty acid synthesis (especially odd chain fatty acids) and energy production. Fungi, plants and animals are incapable of producing vitamin B12. Only bacteria and archaea have the enzymes required for its synthesis; many foods are a natural source of B12 because of bacterial symbiosis. Herbivorous animals store this vitamin in fat tissue as B12 is the most fat soluble of the B Vitamins.

44. **Methylcobalamine or mecobalamine**, natural or normal bioactive form for humans. This is the most fat soluble form of Vitamin B12. Vitamin B12 refers to a group of compounds called cobalamins which are available in the human body in a variety of mostly interconvertible forms. Together with folic acid, cobalamins are essential cofactors required for DNA synthesis in cells where chromosomal replication and division are occurring—most notably the bone marrow and myeloid cells. As a cofactor, cobalamins are essential for two cellular reactions: 1) the mitochondrial methylmalonyl-CoA mutase conversion of methylmalonic acid (MMA) to succinate, which links lipid and carbohydrate metabolism, and 2) the activation of methionine synthase, which is the rate-limiting step in the synthesis of methionine from homocysteine and 5-methyltetrahydrofolate. Methylcobalamin corrects pernicious anemia. Methylcobalamin is also used in the treatment of peripheral neuropathy, diabetic neuropathy, and as a preliminary treatment for amyotrophic lateral sclerosis.

**Copper**

45. **Copper bicarbonate**, only exists in liquid state, i.e., it cannot be dried into a powder; most gentle and least toxic of all copper salts or it can be described as being the most compatible copper salt physiologically.

46. **Copper citrate, copper(II) citrate or cupric citrate**, blood and bone marrow absorption preference.

47. **Copper hydrosol**

48. **Copper lysinate HCl** has absorption preference in connective tissue serving as a source of inflammation control.

49. **Copper superoxide dismutase (CuSOD)** most powerful molecule for inflammation control in the body.

50. **Copper-zinc superoxide dismutase**. This SOD is the second most powerful inflammation control compound in the body: a copper- and zinc-containing protein-enzyme which is present in the cytosol, nucleus, peroxisomes, and mitochondrial intermembrane space of human cells acting as an antioxidant enzyme, lowering the steady-state concentration of superoxide radicals changing these radicals into molecular oxygen and hydrogen peroxide. Reactive forms of oxygen, such as superoxide, leak from the respiratory chain and wreak havoc on the cell. Superoxide is a powerful free radical molecule which readily accepts electrons. These free radicals can strip electrons from cellular molecules essential for proper cell function such as DNA, amino acids or other enzymes, causing dysfunction and possibly resulting in cell death. Cu, Zn superoxide dismutase is an important antioxidant defense in nearly all cells exposed to oxygen and oxygen radicals. It forms a crucial component of the cellular response to oxidative stress by
detoxifying the superoxide radical via a special reaction known as dismutation. Dismutation is a term which refers to a special type of reaction where two equal but opposite reactions occur on two separate molecules. SOD takes two molecules of superoxide radicals, strips the extra electron off of one, and places it on the other. So, one radical structure ends up with one less electron and normal oxygen forms, and the other radical ends up with an extra electron. The one with the extra electron then rapidly picks up two hydrogen ions to form hydrogen peroxide. One cell study showed that for every 10,000 electrons transferred down the respiratory pathway in \textit{Escherichia coli} cells, about 3 electrons end up on superoxide radicals instead of the proper place. Excess CuZnSOD1 in chemical form levels can inactivate enzymes containing iron-sulfur clusters and can lead to the formation of other highly oxidizing species that are damaging to other cellular constituents. In the motor neuron disease known as amyotrophic lateral sclerosis (ALS), a familial subset of ALS or FALS is caused by dominantly inherited mutations of SOD1. This pathogenic mutation leads to aggregation of SOD1 proteins and these insoluble protein complexes accumulate in spinal cord neurons. Many of the FALS mutations fall directly at the intrasubunit disulfide bond and in regions which affect metal binding.

51. \textbf{Sodium copper chlorophyllin}, water-soluble organic salt derived from chlorophyll. The green color is due to the copper rather than a magnesium atom as found in chlorophyll. Because chlorophyll is insoluble in water, food sources of chlorophyll do not bind to mutagenic or cancer-causing substances. Chlorophyllin, being water-soluble, can significantly bind to environmental mutagens such as the polycyclic aromatic hydrocarbons benzo[a]pyrene and dibenzo[a,i]pyrene. Chlorophyllin binds to mutagens twenty times better than resveratrol and thousands of times better than xanthines. Promotes wound healing especially wounds associated with radiation burns. With hygiene, ingested chlorophyllin reduces odors associated with incontinence, colostomies and similar procedures, as well as body odor in general.

\textbf{Gold} in general protects genetic material, especial reproductive genes from radiation damage and mutation; it is found in sea salt, pollen, royal jelly and certain sprouts such as alfalfa..., if gold is present in the soil or grow media.

52. \textbf{Gold chloride} is most concentrated in male seminal fluid; outside of seminal fluid, even small amounts can adversely affect cardiac tissue displacing the copper necessary for tone, thus, a cardiomyopathy can begin to form.

53. \textbf{Gold colloid} where \( n = \) particulates under 20nm can absorb best into the body wherever edema occurs along the lumen of the gut and these particulates are distributed primarily to the reproductive system.

54. \textbf{Gold hydrosol} concentrates in male seminal fluid, the ovaries, testes and the pineal gland. It promotes penile erection therefore helps to correct erectile dysfunction (ED). Used with lithium, it is a moderately strong mood leveling mixture. Used daily or regularly, there is a decrease in systemic inflammation and CNS inflammation; in turn, the need for sleep decreases.

\textbf{Iodine} is a non-metal, essential nutritional element, constituent of thyroid hormones, associated with the amino acid tyrosine, copper and selenium in the thyroid gland. Iodide is an antioxidant and because of its atomic size, iodide forms relatively weak bonds with most elements. Iodine is necessary for optimal function of a number of additional body systems, including lactating breast, gastric mucosa, salivary glands, oral mucosa, and arterial walls. Chronic insufficiency or deficiency is associated with the onset of mental retardation, cretinism, goiter, breast and stomach cancer and autism. Toxic levels of bromide will be displaced by iodides. There are 4 different forms of iodine for the body to choose from.

55. \textbf{Lugol’s iodine introduced in 1829} mixture of 5% elemental iodine (I\(_2\)) and 10% potassium iodide (KI) in water, aka I\(_2\)KI.

56. \textbf{Potassium iodide}

57. \textbf{Sodium iodate}

58. \textbf{Sodium iodide}

\textbf{Iridium} 20 parts per trillion of iridium in human tissue.

59. \textbf{Iridium dioxide}

60. \textbf{Iridosmium or iridian osmium}

61. \textbf{Organoiridium compounds}
Iron absorption increases in the presence of Vitamin C; rheumatoid arthritics are often hypersensitive. Because one of the functions of elevated ferritin (an acute phase reaction protein) during acute infections is thought to be to sequester iron from bacteria, iron supplementation (which circumvents this mechanism) should be avoided in patients who have an active bacterial infection. Serious iron toxicity may result from ingestions of more than 60 mg/kg. Iron exerts both local and systemic effects: it is corrosive to the GI mucosa, it can have a negative impact on the heart and blood (dehydration, low blood pressure, fast and weak pulse, shock), lungs, liver, gastrointestinal system (diarrhea, nausea, vomiting blood), nervous system (chills, dizziness, coma, convulsions, headache), and skin (flushing, loss of color, bluish-colored lips and fingernails).

62. **Iron Catalase** (Lipoxygenases) catalyse the dioxygenation of polyunsaturated fatty acids in lipids containing a cis,cis-1,4-pentadiene structure. It catalyses the following reaction: fatty acid + O₂ = fatty acid hydroperoxide)

63. **IRE-BP or iron-responsive element-binding proteins** (iron transport and regulation of human iron metabolism) contained within the mRNA sequences.

64. **Iron amino acid chelate**, iron glycinate or iron bis-glycinate or ferrous bis-glycinate

65. **Iron(II) chloride** or ferrous chloride converts easily in stomach acid to ferric chloride

66. **Iron(III) chloride or ferric chloride** behaves as a corrosive acid. Used in veterinary practice to treat over-cropping of an animal's claws, particularly when the over-cropping results in bleeding. Used in municipal water treatment to precipitate phosphate as iron(III) phosphate.

67. **Iron elemental powder or “reduced iron”** is slowly absorbed [33% efficiency of iron sulfate] so it is added to foods such as breakfast cereals or enriched wheat flour.

68. **Iron (II) fumarate** or ferrous fumarate

69. **Iron(II) gluconate** or ferrous gluconate, used as an effective treatment of hypochromic anemia with a relatively rapid reticulocyte response with daily increases in hemoglobin. Ferrous gluconate is also used as a food additive when processing black olives and imparts a uniform jet black color to the olives. Children may show signs of toxicity with ingestions of 10–20 mg/kg ferrous gluconate.

70. **Iron(III)-hydroxide polymaltose complex (IPC)**

71. **Iron(II) sulfate** high incidence of adverse effects or hypersensitivities, men more than women.

72. **Iron sulfide or iron(II) sulfide** associated with DNA evolution or modified expression of DNA.

73. **Lactoferrin** aka lactotransferrin [apo-lactoferrin (metal free form) and holo-lactoferrin (iron-rich form)] reversibly binds two ions of iron, zinc, copper or other metals; its affinity for iron is 300 times higher than that of transferrin. Lactoferrin acts first as an antioxidant and in turn, serves as an immune support agent; it is an anti-inflammatory agent; inhibits cancer cell replication; inhibits development of obesity through inhibition of fat accumulation in adipocytes and inhibits formation of new fat cells; anabolic agent which stimulates bone growth and bone repair; may play a role in glucose control; stimulates the growth of several symbiotic bacterial species in the small intestine especially *bifidobacteria* species; suppresses gut toxin producing bacteria such as *Listeria, Clostridium, Staphylococcus aureus, Salmonella* and *Escherichia coli*. Binds with lipopolysaccharide, a proinflammatory endotoxin (metabolic endotoxemia) which is known to increase insulin resistance. Apo- and holo-lactoferrin forms are both effective but apo-lactoferrin appears to be more potent. It is a natural component of human mother's milk.

74. **Lactoferricin** is an amphipathic, cationic peptide with anti-microbial and anti-cancer properties. It can be generated by the pepsin-mediated digestion of lactoferrin.

75. **Protein heme cofactors** (hemoglobin and myoglobin to carry oxygen and carbon dioxide and cytochrome P450 to transfer electrons and build other enzymes in the liver to detoxify a wide range of substances and drugs)

76. **Protein cofactors** (ferritin and rubredoxin)

**Lithium** can be used in supplement form in small doses to treat certain medical conditions, such as stress, bipolar disorder, depression, suicidal ideations, alcoholism (especially when mixed with bioavailable gold compounds), ADHD, attention deficit disorder, aggression, Post-Traumatic Stress Disorder, Alzheimer’s and to improve memory. Intake of lithium has well documented positive neurological effects, and appears to be effective even in trace amounts.

77. **Lithium aspartate** used most often to treat Alzheimer’s disease.

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78. **Lithium carbonate** / Dilithium carbonate. In 1843, lithium carbonate was used as a new solvent for stones in the bladder. In 1859, some doctors recommended a therapy with lithium salts for a number of ailments, including: urinary calculi, rheumatism, mania, depression, and headache. In 1949, John Cade discovered the anti-manic effects of lithium ions. This finding led lithium carbonate, to be used to treat mania associated with bipolar disorder. Lithium carbonate is used to treat mania, the elevated phase of bipolar disorder. Lithium ions interfere with ion transport processes (see “sodium pump”) that relay and amplify messages carried to the cells of the brain. Mania is associated with irregular increases in protein kinase C (PKC) activity within the brain. Lithium carbonate acts in the brain by inhibiting PKC’s activity and helps to produce other compounds which also inhibit PKC. Some studies have suggested therapeutic benefit of lithium carbonate in certain neuromuscular conditions like spinal muscular atrophy.

79. **Lithium Chloride**

80. **Lithium citrate** / Trilithium citrate used as a mood stabilizer in psychiatric treatment of manic states and bipolar disorder.

81. **Lithium Orotate**

**Magnesium** ions play a major role in manipulating important biological polyphosphate compounds like ATP, DNA, and RNA and metabolism of amino acids, fats, and carbohydrates. Hundreds (330+) of enzymes require magnesium ions to function. Intracellular magnesium is correlated with intracellular potassium and mitochondrial aging is directly related to organelle magnesium content. Magnesium also plays an important role in preventing stress and mood swings as the body releases magnesium into the bloodstream when stressed physically, mentally and emotionally. Caffeine, sodium intake, alcohol and high-fructose corn syrup all leach magnesium from the bloodstream. Insufficient or low levels of magnesium in the body have been associated with the development of a number of human illnesses such as asthma, diabetes, osteoporosis, venous degeneration (varicosities), sleep disorders, arterial hypertension, chronic renal diseases and increased DNA transcription error rates. High protein intake inhibit magnesium absorption, and other factors such as phosphate, phytate, and fat affect absorption. Excess dietary magnesium is excreted in feces, urine, and perspiration.

82. **Magnesium amino acid chelate**, e.g. Mg lysyl-glycinate

83. **Magnesium aspartate** (an amino acid chelate)

84. **Magnesium chloride**

85. **Magnesium citrate** probably the most bioavailable of common forms

86. **Magnesium fluoride** is a micro-trace element of living bone; the cell salt supports remineralization of the bone.

87. **Magnesium gluconate**

88. **Magnesium glycinate** (an amino acid chelate) used by myofibrils to relax tissues; most natural muscle relaxant; helps with induction of sleep when taken at bedtime; smooth muscle relaxant, therefore dilates veins and decreases peripheral vascular resistance or decreases blood pressure (essential hypertension) especially when taken with Vitamin D3.

89. **Magnesium hydroxide** very good antacid.

90. **Magnesium lysinate** (an amino acid chelate) has a preferential absorption in fascial tissue, therefore also helps to relax fascial tension or “contractures”; aids in tissue alkalinization which helps to correct tissue stiffness.

91. **Magnesium malate** has a preference for muscle absorption; helps to counteract scar tissue formation (fibrosis).

92. **Magnesium orotate** helps with premature ventricular contractions (PVCs) a form of cardiac dysrhythmia.

93. **Magnesium phosphate** most soluble and bioavailable mineral salt form of magnesium.

94. **Magnesium stearate** can give rise to competitive absorption rates or absorption capacity; high doses have down-regulating characteristics on the immune system and T-lymphocytes which can be counter-acted with niacin and medium chain fatty acids.

95. **Magnesium Sulfate** or Magnesium(II) Sulfate is an acidic mineral salt.

96. **Magnesium taurate** preferential absorption by cardiac tissue, therefore helps to relax cardiac muscle; supports cardiac cell mitochondrial function and production of ATP.
**Manganese** is an essential trace mineral and assists absorption of calcium; it is concentrated in decreasing amounts in the following organs: 1) kidneys, 2) pancreas, 3) liver, 4) bones, and 5) CNS and neural tissues. Chronic insufficiency of manganese has been found to delay processing of cholesterol, slowed transformation of cholesterol into sex hormones (female infertility), may decrease the body’s ability to use sugar (carbohydrates) properly and slows fat and protein metabolism, causes improper formation of bone and cartilage, is associated with severity of symptoms of premenstrual syndrome (PMS), chronic anemia or “tired blood”, associated with chronic bronchitis and obstructive pulmonary disease (COPD) and causes growth problems. Deficiency is associated with decreased visual acuity, decreased auditory acuity, memory loss and tremors. Manganese is a cofactor for thyroxine in the thyroid. Manganese is an important cofactor in DNA transcription and a key cofactor component of DNA polymerase; therefore, it decreases transcription error rates. It is a catalytic cofactor in the absorption and metabolism of Vitamin B1 (thiamin) and Vitamin E. In the gut, manganese is a cofactor in the metabolism of glutamine. Because of its role in bone formation, manganese is sometimes included with chondroitin sulfate and glucosamine hydrochloride in multi-ingredient products promoted for osteoarthritis. When copper alone does not completely correct epilepsy in children, using copper and manganese together will correct another percentage of situations.

**Manganese ascorbate** is a very gentle source of manganese on the body.

**Manganese aspartate or manganous aspartate** (an amino acid chelate complex)

**Manganese(II) chloride tetrahydrate**

**Manganese citrate** very rich source of bioavailable manganese.

**Manganese gluconate**

**Manganese glycerophosphate**

**Manganese sulfate monohydrate or Manganese(II) sulfate**

**Molybdenum**

**Molybdenum aspartate**

**Molybdenum citrate or molybdenum(IV) tetracitrate**

**Phosphorus** (non-metal element)

**Tetrasodium pyrophosphate**

**Potassium**

**Potassium alpha-ketoglutarate** or Potassium hydrogen 2-oxoglutarate (Krebs cycle)

**Potassium aspartate** or Dipotassium aspartate or Dipotassium 2-aminosuccinate (an amino acid salt) rich source of bioavailable potassium.

**Potassium aspartate HCl** helps with digestion and provides potassium to gastric cells; helps with stomach cramps.

**Potassium and magnesium aspartate** (1:1 ratio) very good combination for cramping and claudication symptoms.

**Potassium asporotate mixture**: potassium aspartate, citrate and orotate, very rich source of potassium especially helpful to cardiac muscle.

**Potassium bisulfate** non-meat food preservative

**Potassium bromated** used in food as a strong oxidizer and to improve dough strength and height of rising.

**Potassium chloride** [cell salt Kali Mur] primary electrolyte of the blood; used in oral rehydration treatment (ORT); used in conjunction with Rx diuretics; treats muscle cramps, especially calf cramping. This salt is more concentrated inside each cell in order to create electrical gradients. Homeopathic doses are known to treat lymph adenitis (swollen glands), white mucus and white discharges from the nose and eyes, white or gray coated tongue indicative of too much mucus and phlegm production and indigestion from rich food.

**Potassium citrate** (Krebs cycle)

**Potassium fumarate** or dipotassium fumarate (Krebs cycle)

**Potassium gluconate** or potassium D-gluconate

**Potassium glycinate** or potassium aminoacetate (amino acid salt)
Potassium-Magnesium taurate 2:1 ratio for the heart.

Potassium malate or dipotassium malate (Krebs cycle)

Potassium orotate

Potassium phosphate

Potassium sodium tartrate aka Rochelle salt

Potassium succinate or dipotassium succinate (Krebs cycle)

Potassium sulfate supports skin health and hair follicle health. With silica and sodium chloride, aids with congestion of mucus membranes. If supplement form is chosen, it can be used with greater efficacy with 50mg – 100mg of niacin to metabolize histamine while simultaneously making mucus more liquid.

Selenium, an essential micronutrient is a component of the antioxidant enzymes glutathione peroxidase and thioredoxin reductase which indirectly reduce certain oxidized molecules in animals and some plants. It is also found in three deiodinase enzymes, which convert one thyroid hormone to another. In its selenide form (H2Se) in the liver, it is the key cofactor in Phase II liver detoxification glutathione conjugation pathways to remove excess metallic elements, heavy metals and toxic heavy metals from the body. The glutathione peroxidase family of enzymes (GSH-Px), catalyze certain reactions which remove reactive oxygen species (ROS) such as hydrogen peroxide and organic hydroperoxides. Selenium inhibits Hashimoto’s disease, in which the body’s own thyroid cells are attacked as alien. Selenium aids the physiology and structure of the eye; chronic insufficiency may lead to retinal detachment; arcus senilis is directly linked to insufficiency. The physical integrity of the capillary bed and control of capillary inflammation is linked to selenium levels, therefore collapse of capillary beds is linked to chronic insufficiency of selenium. Topically, selenium sulfide (approximate formula SeS2) is the active ingredient in some anti-dandruff shampoos. This selenium compound kills the scalp fungus *Malassezia*, which causes shedding of dry skin fragments. The ingredient is also used in body lotions to treat Tinea versicolor due to infection by a different species of *Malassezia* fungus. A number of correlative epidemiological studies have implicated selenium deficiency (as measured by blood levels) in a number of serious or chronic diseases, such as cancer, diabetes, HIV/AIDS, and tuberculosis.

Selenocysteine exists naturally in all kingdoms of life as a building block of selenoproteins. This is the most bioavailable water soluble form of selenium. It is present in several enzymes, for example, glutathione peroxidases, tetraiodothyronine 5’ deiodinases, thioredoxin reductases, formate dehydrogenases, glycine reductases, selenophosphate synthetase 1, methionine-R-sulfoxide reductase B1 (SEPX1), and some hydrogenases. Selenocysteine has both a lower pKa (5.47) and a higher reduction potential than cysteine. These properties make it very suitable in proteins that are involved in antioxidant activity.

Selenomethionine is a naturally occurring amino acid containing selenium. It is a common natural food source of selenium found in Brazil nuts, cereal grains, soybeans and grassland legumes. Selenomethionine antioxidant activity arises from its ability to deplete reactive oxygen species (ROS). Chemically, it is 19% more bioavailable than the mineral salt “selenite”; selenite is irritating to the liver vs. selenomethionine causes no inflammatory irritation. The anticancer activity associated with selenomethionine is believed to be due primarily to enzymatic (methioninase) cleavage to methylselenol (CH3SeH), believed to be the critical metabolite involved.

Methyl-selenocysteine or Se-methyl-selenocysteine is the major form of selenium found in *Astragalus, Allium* and *Brassica* species. It has equal antioxidant properties as selenomethionine. It is the most fat soluble of the organic selenoamino acids.

Silicon

Orthosilicic acid – choline stabilized

Silica [cell salt silicon dioxide] supports liver detoxification; helps strengthen hair, nails and skin; counters dry and sensitive skin; supports retention of hair (falling hair syndrome). Cosupportive of potassium sulfate [kalium sulphaticum]. With potassium sulfate and sodium chloride, aids with congestion of mucus membranes.
132. **Silver hydrosol** in chemistry is a nanoparticulate suspension of silver clusters with broad-spectrum anti-microbial properties: virostatic, bactericidal, fungicidal, fungistatic, parasiticidal, effective at 10ppm. It is the least toxic of all bioactive forms of electrically charged silver.

133. **Silver lactate** aka Aragentum lacticum found naturally in human mother’s milk and mammalian milk where it acts as a natural preservative, especially against bacteria. This form of silver is also bioavailable for support of myelin tissue in the peripheral nervous system. There are two forms, one where the silver cation interacts with the carboxylic acid group and one where the silver cation interacts with the central oxygen. The carboxylic group reaction results in a neutral organic salt of silver. The reaction with the central oxygen form remains a mild organic acid. In human mother's milk, there is approximately 97.5% of the carboxylic silver salt form and 2.5% the more reactive form.

134. **Silver oxide** can be particulate in suspension and if the clusters are 10nm in size or smaller, it is an effective silver hydrosol species. In bulk form powder, it is bacteriocidal.

**Sodium**

135. **Sodium chloride** or Natrum Muriate [cell salt Nat Mur] used in oral rehydration treatment (ORT). Homeopathically it is used to treat dryness of body openings, clear thin mucus; effects of excess overheating; itching of hair at nape of neck; early stage of common colds with clear, running discharge. Used as a topical treatment for insect bites.

136. **Sodium phosphate** or Phosphasoda, are used in medicine for constipation and to prepare the bowel for medical procedures; used in foods as leavening agents and anti-caking agents. Cell salts Nat Phos treats simple morning sickness; acid reflux; crown-centered headache; eyes glued together / morning mattering; and grinding of teeth during sleep.

137. **Sodium sulfate** aka sodium sulphate [cell salt Nat Sulph] acts as a diuretic. If the actual supplement is used for diuresis, then potassium should be supplemented.

**Vanadium** essential ultra-trace mineral element; niacin increases absorption; in cells, V³⁺ and V⁴⁺ predominate because of largely reducing conditions; in plasma, V⁵⁺ predominates. According to the WHO, Estimates of total dietary intake of humans range from 11 to 30 μg/day. Levels in drinking-water range up to 100 μg/litre [2001 Concise International Chemical Assessment Document 29VANADIUM PENTOXIDE AND OTHER INORGANIC VANADlUM COMPOUNDS]. Oral studies in rats and mice demonstrate greater toxicity of vanadium as oxidation state increases. During mitosis, vanadium interacts with cell replication during the spindle formation phase with a net inhibitory effect. Vanadium may be necessary for the formation of bones, teeth, and cartilage. The mineral may also play a role in growth and reproduction as well as affect the processing of cholesterol and insulin in the body. In studies of mice, vanadium has been shown to lower blood sugar and levels of low-density lipoprotein (LDL) cholesterol and triglyceride. Studies in animals with type 1 (insulin-dependent) and type 2 (non-insulin-dependent) diabetes indicate that vanadium can help to improve blood sugar levels. Several human studies suggest that vanadium may help to control blood sugar levels in diabetics. The mineral appears to work by increasing the body’s sensitivity to the hormone insulin due to inhibition of the enzyme tyrosine phosphatase. Vanadium compounds may reduce gluconeogenesis and increase glycogen deposition. Use of vanadium by body builders has proven that vanadium does not mimic insulin or increase insulin’s efficacy in healthy people. Vanadium is converted in vivo to a vanadyl cation where it can form complexes with substances such as ferritin and transferrin. Bone is the main area of vanadium storage in the body followed by the liver and kidneys. Excretion occurs through both the liver and the kidneys. A daily intake of 10-100 mcg is considered safe and adequate from food sources. The average diet supplies between 6-18mcg of vanadium daily. If the supplement version were to be used, a therapeutic dosage for management of type 2 diabetes is at least 50 mg vanadyl sulfate twice daily.

138. **Vanadium citrate** water soluble 51% bioavailable form.

139. **Vanadium glutarate** a mildly acidic amino acid chelate 77% bioavailable.

140. **Vanadium glycinate or vanadium triglycinate** a neutral amino acid chelate 93% bioavailable.

141. **Vanadium nicotinate glycinate chelate** or vanadium chelavite a combination product with 99% bioavailability.
142. **Vanadyl sulfate** or vanadyl(IV) sulfate is 24% bioavailable with approximately a 3% absorption rate by adults when used in supplement form. Slightly stressful to the liver to transform into other forms with different anions. Often used in I.V. injections or with parenteral nutrition infusions.

**Zinc** is a heavy metal and an essential mineral; antioxidant; natural antimicrobial; cofactor in all structural protein pathways and 100+ enzymes; up-regulates fibroblast function and activity, therefore, can cause fibrotic tissue to form / scar tissue; regulated or governed by copper (scar prevention); accelerates tissue healing after injury; supports immune function; all granulocytes secrete zinc; leached from body with diarrhea, therefore supplementation is anti-diarrheal; deficiency associated with major depressive disorders; protects genetic material from microbes ( seminal fluid); anti-proliferative effects in the prostate gland; protects the eyes. Zinc fingers form parts of some transcription factors, which are proteins that recognize DNA base sequences during the replication and transcription of DNA. Each of the nine or ten Zn$^{2+}$ ions in a zinc finger helps maintain the finger's structure by coordinately binding to four amino acids in the transcription factor. The transcription factor wraps around the DNA helix and uses its fingers to accurately bind to the DNA sequence. Zinc effectively competes with copper for absorption, therefore, if these are going to be used in their chemical/supplement form, both minerals are best absorbed away from one another, i.e., one mineral supplement in the morning and the other in the evening. Used homeopathically it does not matter. Zinc deficiency is usually due to insufficient dietary intake, but can be associated with malabsorption, acrodermatitis enteropathica, chronic liver disease, chronic renal disease, sickle cell disease, diabetes, malignancy, and other chronic illnesses.

143. **Zinc(II) acetate or zinc diacetate** for treating pharyngitis and the common cold.
144. **Zinc aspartate** (amino acid chelate)
145. **Zinc bisaspartate** (amino acid salt)
146. **Zinc citrate** or trizinc dicitrate, very rich source of water soluble and bioavailable zinc. Very competitive at absorption channels in the upper small intestine, for example, with this form of zinc present, no copper species can be absorbed until this form of zinc has been absorbed first or is no longer present in the lumen of the gut.
147. **Zinc gluconate** or zinc di(D-gluconate).
148. **Zinc glycinate** or zinc bis(aminoacetate) highest bioavailability and is absorbed lower in the small intestine than other forms of zinc.
149. **Zinc picolinate** more bioavailable than gluconate or citrate.
150. **Zinc sulfate** for treating pharyngitis and the common cold.