

# 4 High Performance Catalysts

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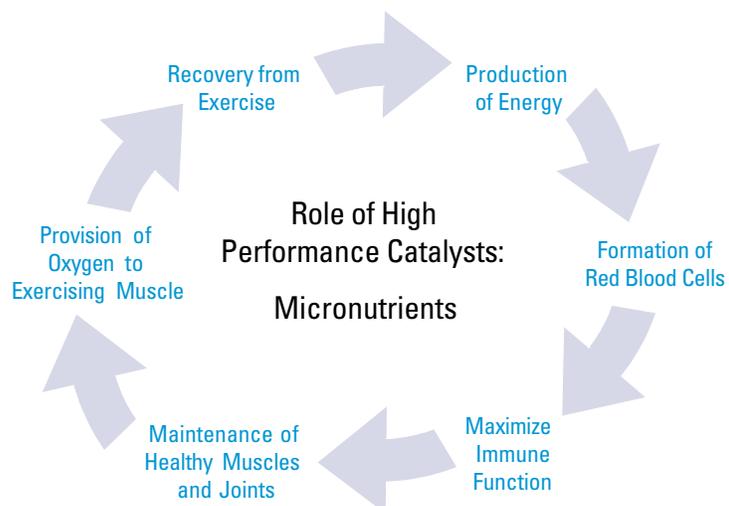
## Key Points

- Vitamin and mineral needs can be met by eating a variety of foods.
- Vitamin-mineral supplements do not provide energy.
- Vitamin-mineral supplementation is warranted only when energy balance is not met through the diet.
- Mega-dosing on vitamins and minerals can be detrimental to health and performance.
- Foods naturally high in antioxidants (fresh and colorful foods) should be eaten daily.

**H**igh performance catalysts, or micronutrients, allow performance at a high level. Catalysts include vitamins, minerals, and other essential nutrients required by the body in very small amounts to perform vital metabolic and physiologic functions. Taking in too little or too much of these nutrients can interfere with normal body functions.

## Role of High Performance Catalysts in Warfighters

Some of functions of high performance catalysts are presented below.



If energy intake is sufficient, the high catalyst requirements of Warfighters should be adequate.

#### Dietary Reference Intake (DRI):

The amount of particular vitamins and minerals a typical person should consume to prevent a deficiency or reduce the risk of chronic diseases.

#### Tolerable Upper Intake Level (UL):

The highest daily average of a particular vitamin or mineral to consume safely.

#### Recommended Daily Allowance (RDA):

The average nutrient level sufficient for nearly all healthy individuals.

#### Adequate Intake (AI):

Provides a general nutritional goal.

#### Reference Intake:

DRI's applied to the healthy military population.

☀ Click here for more information on Dietary Reference Intakes.

Different amounts of catalysts are needed by individuals, depending on gender, age, activity, and environment. The best way to obtain the required amounts is to eat well-balanced meals with foods that are nutrient dense. A daily diet of diverse foods can provide the necessary amounts of high performance catalysts for a well-tuned body.

## Dietary Reference Intakes and Definitions

Various terms have been developed to explain how much of these “catalysts” are needed. The term **Dietary Reference Intakes** (DRI's) refers to the amount of particular vitamins and minerals a typical person should eat to prevent a deficiency. The DRIs also have a **Tolerable Upper Intake Level** (ULs) that tells us how much is *too* much. The term **% Daily Value** (DV) on a food label represents how much one serving contributes nutritionally to a 2,000-calorie-a-day diet. If the label says 15% DV for Vitamin C, then one serving provides 15% of the DRI for Vitamin C. Other terms and definitions are noted on the side bar.

The U.S. Military also has **Military Dietary Reference Intakes** (MDRIs) based on the U.S. DRIs. They are for planning, assessing diets, and developing rations for the military population. Neither DRIs or MDRIs consider the nutrient needs of Warfighters, who train and operate under diverse, often grueling, environmental conditions.

## Nutrient Density

The term “nutrient density” is important to understand. It is the amount of a particular nutrient (vitamin, mineral, carbohydrate, protein, fat, etc.) per unit of energy in a given food, or per gram of food. It is also an index of nutritional quality. In the following table, Comparison 1 shows the nutrient density of the food label for granola versus glazed donuts. Comparison 2 shows the information for orange juice versus coca cola. The granola and orange juice are clearly more “nutrient dense” than their comparative foods.

Table 4–1. Examples and Comparisons of Nutrient Density

Comparison 1		Comparison 2	
<b>Kashi Go Lean Crunch (1 oz)</b>	<b>Glazed Donut (1 oz)</b>	<b>Orange Juice (100 ml)</b>	<b>Coca Cola (100 ml)</b>
0% DV for Vitamin A	0% DV for Vitamin A	4% DV for Vitamin A	0% DV for Vitamin A

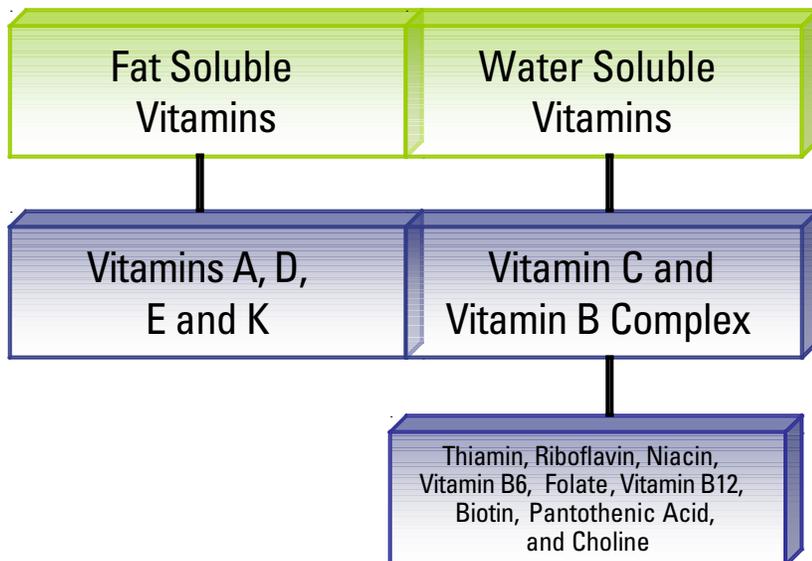
Table 4–1. Examples and Comparisons of Nutrient Density

Comparison 1		Comparison 2	
<b>Kashi Go Lean Crunch (1 oz)</b>	<b>Glazed Donut (1 oz)</b>	<b>Orange Juice (100 ml)</b>	<b>Coca Cola (100 ml)</b>
3% DV for Calcium	1% DV for Calcium	1% DV for Calcium	0% DV for Calcium
0% DV for Vitamin C	0% DV for Vitamin C	83% DV for Vitamin C	0% DV for Vitamin C
5% DV for Iron	3% DV for Iron	1% DV for Iron	0% DV for Iron
20 g Fiber	0 g Fiber	0 g Fiber	0 g Fiber
10 g Protein	1 g Protein	1 g Protein	0 g Protein

Many other examples could be presented, but clearly foods with more fiber, “high performance catalysts,” and less fat and simple sugars should be selected. At least 90% of the diet should be comprised of nutrient dense foods.

## Vitamins

Vitamins are organic compounds that allow for energy to be produced, among other functions. They are broadly classified as water- and fat-soluble: water-soluble vitamins dissolve in water and are not stored, but rather eliminated through urine; therefore, a continuous supply is needed in the



**Vitamins:**

Organic compounds that do not provide calories, but are essential to life.

diet. However, fat-soluble vitamins are not required every day because they are stored in fat tissue and the liver. Fat-soluble vitamins are best absorbed with dietary fat. Choline is another essential nutrient and similar to the B-vitamins, but not officially listed as a B-vitamin.

## Functions of Vitamins

- Production of energy from macronutrients (CHO, fats, and proteins).
- Repair and growth of tissue.
- Maintenance and support of reproductive function.
- Development of immune response.

Some functions may be specific to only one vitamin, whereas other functions may require more than one vitamin. For example, several B vitamins and some minerals are required to produce energy from foods.

[Click here for a list of vitamins and their functions.](#)

## Good Food Sources of Vitamins

No single food is a good source of all vitamins, which is why it is important to eat a variety of foods. Some processed foods provide many vitamins because they have been fortified with nutrients, whereas other foods may contain few, if any, vitamins. When eating at home or dining away from home, the key to eating a balanced meal is choosing a variety of foods, whenever possible. To obtain the necessary vitamins, a dinner plate should include:

- A heaping pile of vegetables (excluding potatoes and corn).
- Black, pinto, or kidney beans and whole grains or corn.
- Fish, lean poultry, or lean cuts of red meat, tofu, dairy products.
- Nuts/seeds.

If eating field rations during training or deployment, eat the entrees as well as the other food and beverage items provided in the pack since different food/beverage items are fortified with different micronutrients. For example, cocoa in the Meal Ready to Eat ration is a source of vitamin B1, calcium and magnesium.

[Click here for a list of good food sources of vitamins.](#)

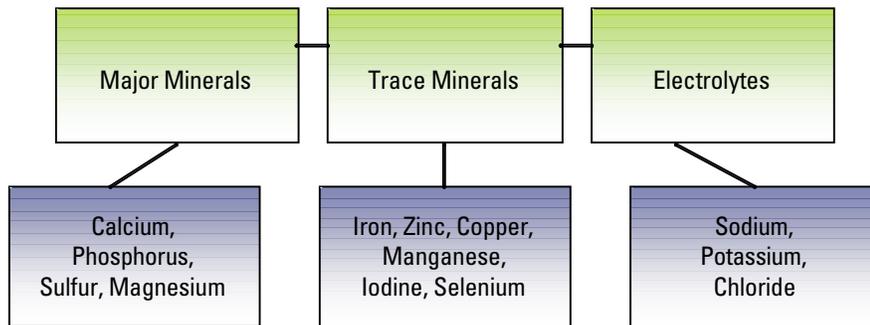
## Preserving Vitamins in Foods

Proper food storage and preparation can minimize vitamin losses. All vitamins are destroyed by light and many are destroyed by excessive heat. Water-soluble vitamins are easily washed out when foods are over-cooked. Steps that should be taken to increase the retention of vitamins during storage and preparation include:



- Keep foods out of direct light as much as possible, especially milk and grains.
- Keep fresh produce refrigerated.
- Avoid soaking vegetables in water.
- Cook in just enough water to prevent burning.
- Use the shortest cooking time by cooking to a crisp and tender stage.
- Steaming and stir frying result in the best vitamin retention.
- Cut and cook vegetables shortly before serving or refrigerate in an airtight storage container.

## Minerals



Minerals are inorganic substances that can be single elements, such as magnesium (Mg) and calcium (Ca), simple salts (electrolytes), or metals, such as iron (Fe). Numerous minerals are required by the body, and may account for 4–5% of a person's body weight. Typically, minerals are classified as major minerals, trace minerals, or electrolytes, depending on function and how much is in the body.

**Major minerals** are required in relatively large amounts (> 200 mg/day), whereas **trace minerals** are required in smaller amounts (< 200 mg/day). They can occur naturally in food or be added in elemental or mineral form. Appropriate dietary intakes of minerals must be sustained to maintain physical health. Excessive intakes may lead to adverse consequences because of the competitive nature between minerals in the body. For example, zinc and copper, and calcium and magnesium are needed in particular ratios. Electrolytes include sodium, potassium, and chloride.

## Functions of Minerals

- Brain and neural function.
- Bone structure and maintenance.

- ☀ More information on vitamin C.
- ☀ More information on vitamin E.
- ☀ More information on chromium.
- ☀ More information on zinc.
- ☀ More information on iron.
- ☀ More information on vitamin A.
- ☀ More information on vitamin B6.
- ☀ More information on choline.

### Minerals:

Inorganic compounds found in all body tissues and essential for life.

- Muscle function and growth.
- Production of energy.
- Reproductive functions.
- Immune function.

[Click here for a list of minerals and their functions.](#)

## Good Food Sources of Minerals

As with vitamins, a variety of foods should be eaten in order to meet requirements for these essential nutrients. Table 4–2 provides a list of foods that are high in selected minerals.

Table 4–2. Primary Food Sources for Some Minerals

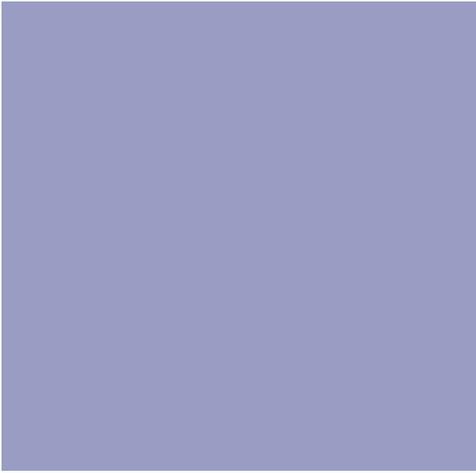
Food Products	Major Mineral
Green leafy vegetables and dairy products	Calcium
Nuts, soy beans, and cocoa	Magnesium
Milk and spinach	Sodium
Legumes, whole grains, and bananas	Potassium
Table salt	Chloride, iodine
Meat, eggs, and legumes	Sulfur
Red meat, poultry and seafood	Zinc
Red meat and leafy vegetables	Iron

[Click here for a list of good food sources of minerals.](#)

## Mineral Requirements for Military Garrison Training

The MDRIs reflect the Institute of Medicine (IOM) Dietary Reference Intakes (DRIs). Modifications to these requirements should only be made when sufficient scientific evidence exists to support different requirements and intakes. The recommended values for some minerals should take into account enhanced mineral losses caused by high-performance activities.

Evidence strongly indicates that sweat mineral losses of copper, iron and zinc might be significant during garrison training. New recommendations reflect this evidence (See Table 4–3). However, insufficient data exists for sweat losses of calcium, magnesium and selenium to recommend an increased in-



take. Also, requirements might be different for specific military situations and more research is required prior to changing current recommendations.

Table 4–3. Mineral Intakes for Men: Institute of Medicine Dietary Reference Intakes, Current Military Dietary Reference Intakes, and Recommended Levels for Military Garrison Training and Assault Rations

Nutrient	IOM RDA or AI*	MDRI	RDA of AI for MGT	RDA for Assault Rations*
Calcium (mg)	1,000	1,000	1,000	750–850
Copper (µg)	900	ND	1,800	900–1,600
Iron (mg)	8	10	14	8–18
Magnesium (mg)	420	420	420	400–550
Selenium (µg)	55	55	55	55–230
Zinc (mg)	11	15	15	11–25

**Note:** Institute of Medicine = IOM; RDA= Recommended Dietary Allowance; AI=Adequate Intake; MDRI = Military Dietary Reference Intakes; MGT= Military Garrison Training; ND= Not Determined; \*Institute of Medicine (2006).

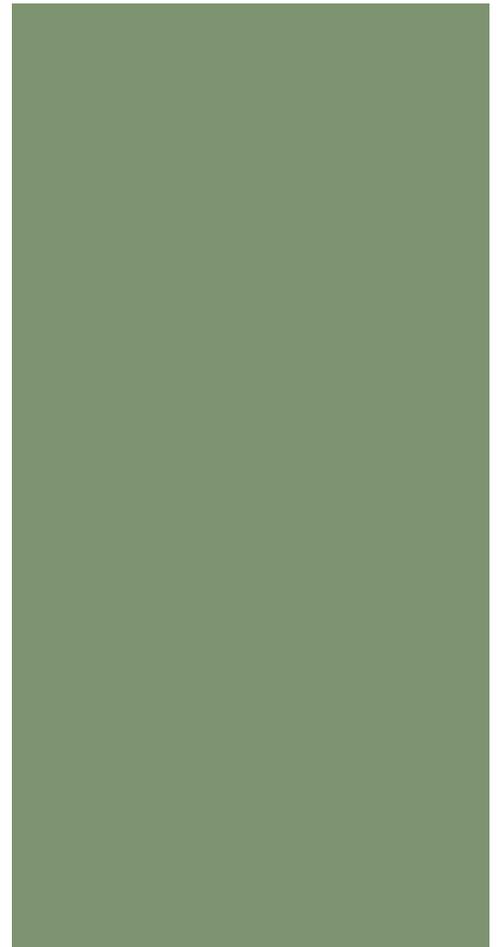
## Special Catalysts: Antioxidants

Antioxidants are substances in foods that neutralize highly reactive, destructive compounds called free radicals. Note the following key points about free radicals and antioxidants:

- Free radical damage can lead to cancer and heart disease.
- Free radicals from harmful pollutants are neutralized by antioxidants.
- Foods rich in antioxidants are the best source of antioxidants.
- Smokers should consume foods high in antioxidants.

Some well known antioxidants include:

- Vitamin E.
- Selenium.
- Beta Carotene.
- Glutathione.



☀ [Click here for more information on antioxidants.](#)

- Cysteine.
- Vitamin C.
- Flavonoids.
- Glutathione.

Some critical antioxidants are enzymes, such as superoxide dismutase, and catalase. Additional antioxidant details are discussed in Chapter 18.

[Click here for a list of foods high in antioxidants.](#)

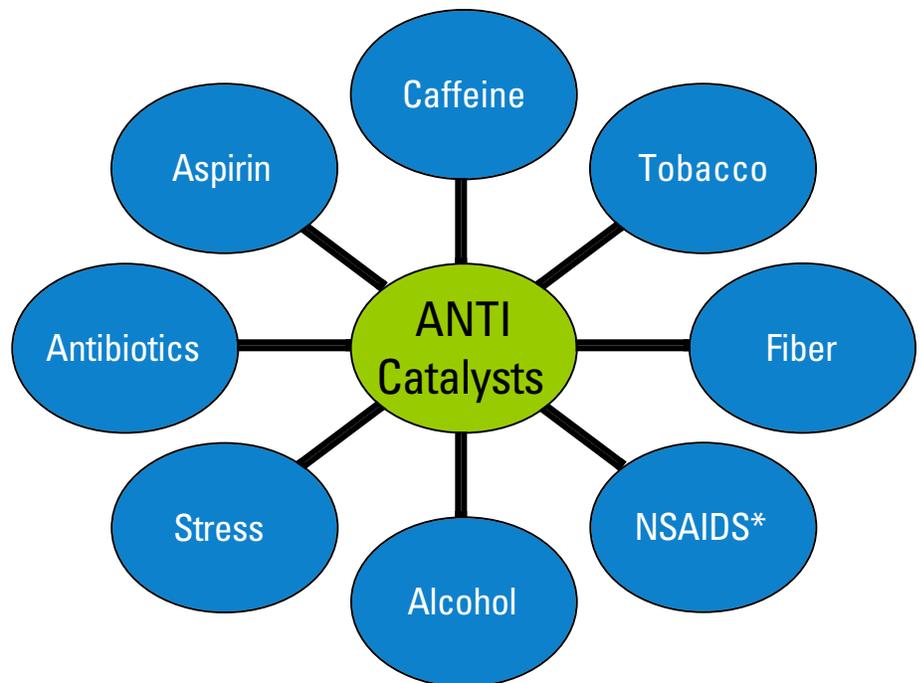
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Antioxidants should come from food.

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## Substances That Interfere With High Performance Catalysts

Many substances affect both the absorption and loss of high performance catalysts. For example, the amount absorbed from foods can be influenced by dietary constituents (such as fiber), other factors (such as medications), the body's need for the nutrient, the chemical form of the nutrient, and the integrity of the digestive tract. "ANTI-catalysts" that can interfere with how well the body uses nutrients are shown below:



\*Nonsteroidal Anti-Inflammatory Drugs

To minimize the potential effects of ANTI-catalysts, one should:

- Eat a variety of foods.
- Use good food preparation techniques.

## Vitamin and Mineral Dietary Supplements

The DRI for high performance catalysts provide a wide safety margin, but some adjustments may be required in individuals with very high energy expenditures. Nutrient requirements for antioxidant vitamins (C, E and carotenoids), B vitamins, magnesium, zinc, copper, selenium and iron needs may be slightly higher in Warfighters because of activity levels. But, a good, varied diet will allow the DRI to be met. Despite this, the supplement industry encourages physically active people to purchase vitamin and mineral supplements to enhance performance. About 40–80% of military personnel use some form of vitamin and/or mineral supplements. These include single vitamins (vitamin C), minerals (calcium) and/or multivitamin-mineral combinations. In many cases the doses range from amounts similar to or far in excess of the DRI. Vitamin and mineral supplements are useful when:

- An existing vitamin or mineral deficiency is present.
- Individuals have poor nutrient intakes and dietary habits.
- Energy requirements cannot be met by food.
- Individuals are exposed to extreme environments, such as strenuous exercise, cold exposure, and at high altitude.

[Click here for approved vitamins by the United States Pharmacopeia \(USP\).](#)

### Vitamin and Mineral Supplement Use and Performance

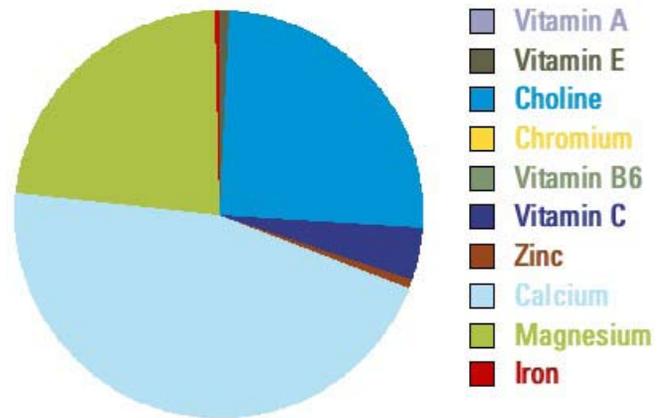
Taking a general multivitamin/mineral supplement appears to be without measurable performance benefit in healthy, well-nourished, physically active men. Whether supplementation with such nutrients produces beneficial effects on performance in Warfighters is unknown. For example, supplementation with selected vitamins/minerals may accelerate recovery or reduce susceptibility to infections. Some information to confirm these possibilities is available, but studies have not been conducted in military populations. If a vitamin and/or mineral supplement is desired, the supplement should provide nutrients in amounts that meet the DRI, and no supplement should provide more than the Upper Limit as indicated by the National Academy of Sciences.





The illustration below presents the relative amounts of “popular” vitamin and minerals needed on a daily basis.

#### Relative Daily Intake of Vitamins and Minerals (mg/d)



[Click here for the upper limit for vitamins.](#)

[Click here for the upper limit for minerals/elements.](#)

### Risks of Vitamin and Mineral Supplements

Excessive intakes of some vitamin and mineral supplements can cause multiple side effects, and some vitamins and minerals can be toxic. Although some people take excessive amounts of nutrients on a regular basis, it is important to distinguish between excessive and toxic. Excessive amounts of single or multiple nutrient supplements can upset overall nutrient balance and cause a deficiency of other nutrients. Iron, zinc and copper are good examples, since all three are absorbed via the same route. An excessive intake of zinc can prevent the proper absorption of the others. Additionally, excess vitamin E (in the form of alpha tocopherol) has been shown to slow healing, inhibit the immune system, and increase the risk of bleeding. Symptoms may include fatigue, weakness, headache, blurred vision, and diarrhea. Other fat-soluble vitamins, such as vitamin A and D, can also be taken in excess. Vitamin C overdoses are unlikely, but taking a lot of vitamin C followed by low levels can lead to “rebound scurvy.” Importantly, intakes above DRI upper limits may have significant adverse effects. Table 4–4 provides a list of various nutrients and levels considered to be toxic.

To avoid harmful effects from high doses of supplemental vitamins and minerals, refer to the DRI upper limits.

Vitamin and mineral supplements are absorbed best when taken with food.

Table 4–4. Nutrients and Their Toxicity Values

Nutrient	Toxicity (units/day)	Nutrient	Toxicity (units/day)
Vitamin A	>25,000 IU	Magnesium	>6,000 mg
Beta Carotene	None	Boron	>100 mg

Table 4–4. Nutrients and Their Toxicity Values

Nutrient	Toxicity (units/day)	Nutrient	Toxicity (units/day)
Vitamin D	>50,000 IU	Chromium	>10 mg
Vitamin E	>1,200 IU	Copper	>35 mg
Vitamin B6	>2,000 mg	Iron	>100 mg
Vitamin C	Rare	Selenium	>1 mg
Calcium	>2,500 mg	Zinc	>150 mg

[Click here for information on popular vitamins and minerals.](#)

Do not take a vitamin/mineral supplement with a carbohydrate-protein drink that already contains vitamins and minerals or the supplement and money will be wasted: excess amounts are excreted in the urine.