

Water and Nutrition

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Numerous articles, as well as blogs in the Web, discuss the importance of minerals and natural nutrients in water. Some are factual, some are not. This technical brief aims to disprove pseudo science and clarifying key issues on this important subject.

The human body has some essential requirements: nutrients that come from the food we eat, oxygen from the air we breathe, and water that we drink. All of these enter the body through the process of membrane absorption. Oxygen is absorbed by the lungs. Water and nutrients enter the body through our digestive system. Some chemicals may also be absorbed through the skin, but since the function of the skin is to protect our bodies from the open environment, that process is extremely slow, and inconsequential compared to digestion and breathing.

Although each of us has somewhat different needs for vitamins and minerals, we all need a certain basic supply of nutrients. Based on research, experts have drawn up a set of nutrition guidelines that are universally used as a standard of measurement by the federal government. The nutrition information that you'll find on any packaged food—and on most bottles of vitamins and minerals—is based on those guidelines. The Daily Value (DV) column on a product label lists the percentages of the DV for calories, vitamins or minerals in a serving of food or in a single dose of a supplement, based on an intake of 2,000 calories a day.

Since each of us has different needs, your vitamin requirements might be higher than the DV if you're older, if your immune system needs some boosting, if you are a pregnant or breastfeeding female, if you are a smoker, or if you're recovering from an infection. All of these and other factors have an impact on individual nutrient requirements. The common dictum "everything in moderation" appears to hold true for nutrition. As the sections that follow demonstrate, too many vitamins or minerals can be harmful to your health.

Basic Caloric Intake

The customary means of meeting our need for calories is in the food we eat (e.g., protein, carbohydrates, fats), and we get these nutrients by eating plants or animals that make or store these compounds. Plants use sunlight, air, water, and nutrients from the soil to synthesize nutrients in their leaves (phytonutrients). Animals transform the vegetables they eat into protein. Eating a balanced diet means combining these various food sources to obtain the basic caloric intake on a daily basis. Consuming up to 2,000 calories per day is not enough—the nutritional value of that food must be considered as well. For example, hard liquor packs a lot of calories, but little nutritional value, which is why so many alcoholics suffer from malnutrition.

Despite what you were told, or even what you told your kids, "you will not die if you do not eat broccoli—but you may not be as healthy, either. The beta-carotene that you get from carrots and some other fruits and vegetables is changed by your body into different compounds, one of which is much-needed vitamin A. So, even though you can survive without vegetables, you do need them. The mixture of these nutrients that you get naturally from carrots, blueberries, broccoli, and other plant foods provides some benefits that generally can't be duplicated by a laboratory-produced pill.

Vitamins

The scientific definition of a vitamin is "an organic compound, not a lipid or amino acid, required in very small amounts for essential functions in the body. By definition, anything officially labeled a "vitamin" is in some way absolutely necessary to human health. As early as 1601, some noted that consuming citrus fruits (which contain vitamin C) prevented scurvy, a disease that wiped out countless crews of sailors who lived on salted meat and dried biscuits while at sea. Vitamin D¹ is another cause célèbre of the government's nutrition program. Since the 1940s, vitamin D has routinely been added to milk to help prevent childhood rickets, a disease that causes bones to become deformed or soften. Vitamin A is also added to milk, particularly reduced-fat, low-fat, and fat-free milk. Since 1942, white flour, cornmeal, and polished (white) rice have been enriched with three B-complex vitamins—thiamin, riboflavin, and niacin—and with iron. In 1998, folic acid was added to the list of required fortifications.

Today, vitamins are routinely added to foods that many of us eat nearly every day. When this is done, the foods are called fortified or enriched. This program, regulated by the federal government, has been highly successful in helping to eliminate severe nutritional deficiencies.

However, as in the case of food, everything in moderation, Table 1 below recommends the daily intake of vitamins, compiled from various health experts and government agencies. Note that dosages in excess of such recommended values can be harmful. In particular, excessive amounts of fat-soluble vitamins such as vitamin A can become toxic, while other vitamin supplements taken in large doses are simply eliminated by the body.

Table 1
Recommended daily intake of Vitamins

| <u>Vitamin</u> | <u>Recommended Daily dosage</u> | <u>Information Source</u> | <u>Effects of over-dosage</u> |
|-----------------------|---------------------------------|---------------------------|--|
| Biotin (B-complex) | 30 µg | Ref.#4 | No information found |
| Folate (B-complex) | 400 µg | Ref. #5 | >400 µg may cause anemia and may mask symptoms of a vitamin B ₁₂ deficiency |
| A | 600 µg | Ref. #6 | >9000 mg) can cause dry, scaly skin, fatigue, nausea, loss of appetite, bone and joint pains and headaches |
| B1 (Thiamin) | 1.4 mg | Ref. #7 | No toxic effects observed |
| B2 (Rivoflavin) | 1.6 mg | Ref. #8 | >200 mg may cause urine color alteration |
| B3 (Niacin) | 18 mg | Ref. #9 | >150 mg may cause problems ranging from facial flushing to liver disease |

¹ Given enough exposure to the sun's ultraviolet rays, our bodies convert one kind of fat in the skin to vitamin D. Sunlight has traditionally been considered health-reviving for that reason.

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| B5 (Pantothenic acid) 6 mg | Ref. 10 | >1200 mg may cause nausea and heartburn |
| B6 (Pyridoxine) 2 mg | Ref. #11 | >100 mg may cause numbness and tingling in hands and feet |
| B12 (Cobalamin) 6 mg | Ref. #12 | >3000 µg may cause eye conditions |
| C (Ascorbic acid) 75 mg | Ref. #13 | No proven effects |
| D (Calciferol) 5 µg | Ref. #14 | >50 µg obtained from food can cause eating problems and ultimately disorientation, coma and death |
| E (Tocopherol) 10 mg | Ref. #15 | >1000 mg cause blood clotting, which results in increased likelihood of hemorrhage in some individuals |
| K 80 mg | Ref. #16 | Excess of menadione or K ₃ may result in liver damage or anemia |

Minerals

Minerals are inorganic, but these, too, are available from organic sources. Plants absorb minerals from the ground, and animals get them from the plants they eat. Essential minerals, also known as “trace elements,” are substances found in food that have a well defined biochemical function in the human body. However, it may take many years of research before scientists know whether an element is essential or not. Essential nutrients may be parts of hormones. The trace mineral iodine, for instance, is needed to manufacture thyroxine, the thyroid gland’s major hormone. Nutrients may also be needed to break down food for energy, as many of the B vitamins are. The trace mineral manganese serves this role, converting the toxic ammonia that we form in our bodies into urea, which is excreted in urine. Some nutrients appear to be essential even though their biochemical functions have yet to be defined. Chromium, nickel, and boron are examples. Arsenic, a substance that we label as poison, is another possibly essential nutrient, since we don’t know why our bodies need it.

Table 2 summarizes the recommended daily intake of essential minerals, and the effects of over-dosage. As before, amounts in excess of 2-5 times the recommended daily dosage can cause health problems. Since many such minerals naturally occur in the food we eat, and since the body stops absorbing such nutrients beyond its needs, it is best not to overload our bodies with minerals that may be present in the water.

Table 2
Essential Trace Elements

| <u>Element</u> | <u>Recommended Daily Dosage</u> | <u>Effects of Over-dosage*</u> |
|------------------------|---------------------------------|---|
| Boron | <20 mg | No information available |
| Calcium | 1000 mg | >1500 mg may cause stomach problems for sensitive individuals |
| Chlorine (as chloride) | 3,400 mg | No information available |
| Chromium | 120 µg | >200 µg are toxic and may cause |

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|-------------|----------|--|
| Copper | 2 mg | Kidney or liver problems and fainting |
| Fluorine | 3.5 mg | > 10 mg of copper can have a toxic effect Excess fluorine can cause white spots in teeth. |
| Iodine | 150 µg | No information available |
| Iron | 15 mg | >20 mg may cause stomach upset, constipation and blackened stools. |
| Magnesium | 350 mg | >400 mg may cause stomach problems and diarrhea. |
| Manganese | 5 mg | Excess manganese may hinder iron adsorption. |
| Molybdenum | 75 µg | >200 µg may cause kidney problems and copper deficiencies. |
| Nickel | <1 mg | Excess nickel may cause skin rash and cause allergies. |
| Phosphorous | 1,000 mg | The FDA states that >250 mg may cause stomach problems for sensitive individuals. |
| Potassium | 3,500 mg | Excess may cause stomach upsets, intestinal problems or heart rhythm disorder. |
| Selenium | 35 µg | >200 µg can be toxic. |
| Sodium | 2,400 mg | Excess can cause hypertension. |
| Vanadium | <1.8 mg | No information available. |
| Zinc | 15 mg | >25 mg may cause anemia and copper deficiency. |

* Maximum values are based on Food and Drug Administration (FDA) values, the World Health Organization (WHO), BBC Health values, the European Union Directive (based on FDA values) and values from various other governmental and private agencies in the USA and the UK.

Natural versus Synthetic

Of course, food is the most obvious natural source of vitamins, and the Earth is the most natural source of minerals. However, the vitamins and minerals in supplements are several times removed from their original sources. For example, while some manufacturers isolate vitamin E from soybean oil and derive vitamin C from acerola berries, supplemental vitamins are not made in the same way due to the associated costs.

Although some people think "natural" means "better," there's a practical reason for synthetic vitamins: The laboratory process is much more efficient and less expensive than isolating these nutrients from foods. Also keep in mind that even vitamins labeled "natural" undergo several steps in processing before they arrive in the final product form. In some cases, the chemical structure of so-called synthetic vitamins is slightly different from what's found in nature, but manufacturers can change concentrations or quantities to compensate for the differences.

Water constitutes about 2/3 of our body: 77% in new-born babies, 65% of adult men, 58% of adult women, and roughly 50% in the elderly. The primary function of water in our bodies is

twofold: it is the mechanism for delivering oxygen and nutrients throughout our bloodstream, and the means of removing daily toxins and waste products. Every living cell in our body contains mainly water. Other important functions of water include temperature regulation (through perspiration), lubrication of joints, and cushioning of internal organs. However, none of the above requires the presence of minerals in the water. Minerals and vitamins are primarily obtained from the food we eat, not from the water we drink.

About the Author

Prior to joining Sylvan Source, Dr. Eugene Thiers served as senior director of Technology Commercialization at SRI International. During his 29 years at SRI, he specialized in water and energy technologies. He is also a former professor at Columbia and Stanford Universities. Dr. Thiers currently serves as a director for CODELCO, the world's largest copper mining company.

References

- 1) NutritionData (ND) provides a complete nutrient analysis for any food or recipe, and helps you select foods that best match your dietary needs. <http://www.nutritiondata.com/>
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<http://www.eatright.org/cps/rde/xchg/ada/hs.xsl/index.html>
- 3) US Dept of Agriculture, food and nutrition information center.
http://fnic.nal.usda.gov/nal_display/index.php?tax_level=1&info_center=4
- 4) www.lenntech.com/vitamins/biotin.htm
- 5) www.lenntech.com/vitamins/folate.htm
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