Pharmacology 203
Windward Community College

Herbs, Vitamins, Minerals and Supplements

The FDA regulates dietary supplements under different regulations

**Dietary Supplement Health and Education Act** – says that the dietary supplement or dietary ingredient manufacturer is responsible for ensuring that a dietary supplement or ingredient is safe before it is marketed. Dietary supplements are not registered with the FDA and manufacturers must make sure that product label information is truthful and not misleading.

Dietary supplements are defined as vitamins, minerals, herbs or other botanicals, amino acids, and substances such as enzymes, organ tissues, glandulars, and metabolites.

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**Nutrition Facts**

<table>
<thead>
<tr>
<th>Serving Size 1 cup (229g)</th>
<th>Serves Per Container 2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Amount Per Serving</strong></td>
<td></td>
</tr>
<tr>
<td>Calories: 250</td>
<td>Calories from Fat 110</td>
</tr>
<tr>
<td><strong>Total Fat</strong>: 12g</td>
<td>16%</td>
</tr>
<tr>
<td><strong>Saturated Fat</strong>: 3g</td>
<td>15%</td>
</tr>
<tr>
<td><strong>Trans Fat</strong>: 3g</td>
<td></td>
</tr>
<tr>
<td><strong>Cholesterol</strong>: 30mg</td>
<td>10%</td>
</tr>
<tr>
<td><strong>Sodium</strong>: 470mg</td>
<td>20%</td>
</tr>
<tr>
<td><strong>Potassium</strong>: 700mg</td>
<td>20%</td>
</tr>
<tr>
<td><strong>Total Carbohydrate</strong>: 31g</td>
<td>10%</td>
</tr>
<tr>
<td><strong>Dietary Fiber</strong>: 8g</td>
<td>0%</td>
</tr>
<tr>
<td><strong>Sugar</strong>: 5g</td>
<td></td>
</tr>
<tr>
<td><strong>Protein</strong>: 5g</td>
<td></td>
</tr>
</tbody>
</table>

**Vitamin A**: 4%

**Vitamin C**: 2%

**Calcium**: 20%

**Iron**: 4%

*Percent Daily Values are based on a 2,000 calorie diet. Your Daily Values may be higher or lower depending on your calorie needs.*

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**Resources**

- **FDA**: Reporting an adverse event with a dietary supplement
- **Medline**: Drugs, Supplements, and Herbal Information
- **National Library of Medicine**: Dietary Supplements Labels Database
- **Linus Pauling Institute OSU**: Micronutrient Information Center

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National Center for Complementary and Alternative Medicine, NCCAM, National Institutes of Health
Fat soluble vitamins

Vitamins A, D, E and K are all lipid soluble. The lipid soluble vitamins can be taken in excess and cause toxicity.

Excess Vitamin A can cause bone demineralization, blurred vision, ataxia, nausea and death. However, excess consumption of β-carotenes is not generally associated with significant risk... except in smokers and in smokers exposed to asbestos in whom increased mortality is seen. Synthetic retinoids, such as Isotretinoin, can cause birth defects.

**Vitamin D** is a prohormone that is metabolized to a variety of active forms. It is not present naturally in most foods; it is added as a supplement. Vitamin D is required for the proper absorption and distribution of calcium. A deficiency of Vitamin D leads to rickets in kids and osteomalacia in adults. Vitamin D is also critical for a number of other functions including immune function, neuromuscular activity, and cell growth, proliferation, differentiation and apoptosis.

**Vitamin E** is a family of 8 antioxidants. Only α tocopherol is biologically active in humans. Any other form on a supplement is not providing Vitamin E in an active form, but is supplying calories!

**Vitamin K** is required as a cofactor for proteins in the clotting cascade. Without vitamin K clots do not form properly.

Vitamin K is synthesized in the GIT by bacteria. Oral antibiotics can lead to a vitamin K deficiency.

Vitamin K is also available in a number of foods, especially leafy green vegetables including spinach, kale, Swiss chard, mustard greens, turnip greens and others. Broccoli, cabbage and Brussels spouts also contain vitamin K.
Water soluble vitamins

The water-soluble vitamins are easily obtained from a balanced diet containing fruits, vegetables and various animal products. They are also frequently added to foods to “fortify” them.

Ascorbic acid, or vitamin C, is toxic at high doses. It is also critical to have enough vitamin C. It is required for the synthesis of collagen, without it, the skin becomes fragile, you bleed easily, your hair and teeth fall out and joints become painful and swollen: you get Scurvy. It is also required for the synthesis of norepinephrine and more importantly, carnitine, a molecule that is required to transport lipids into mitochondria for energy metabolism.

There are many B vitamins. Actually, it was originally thought that the 8 vitamins we now call the B vitamins, were one vitamin because they often occur together in foods. They have many overlapping effects related to metabolism, immune function, nervous system function, and cell growth and differentiation.

B₁ is Thiamine. It was the 1st vitamin to be isolated and is required as a cofactor for a small number of critical enzymes used by mitochondria mainly, but also to synthesize nucleic acids, DNA and RNA. Beriberi is the deficiency disease and it comes in three types, Cerebral (a type of psychosis), Dry (peripheral neuropathy) and Wet (heart failure).

B₂ is Riboflavin. Riboflavin is a coenzyme used in numerous metabolic pathways. A deficiency of Riboflavin usually occurs in concert with a deficiency of other B vitamins. Low levels of riboflavin are seen in pregnant women who develop preeclampsia and in alcoholics.

B₃ is Niacin. This is nicotinic acid. Niacin is a precursor of a pair of critical coenzymes, nicotinamide adenine dinucleotide (NAD) and nicotinamide adenine dinucleotide phosphate (NADP). A deficiency of niacin causes the disease known as Pellagra, which was very common in the US before WWI and why many foods are now fortified with niacin. It is used to treat hyperlipidemia (Niacor), which is not the same thing as taking megadoses of an OTC supplement.

B₅ is Pantothenic acid is a component of coenzyme A (CoA), which is a critical coenzyme in many vital reactions involving lipid processing, steroid hormone synthesis, neurotransmitter synthesis and so on. It is critical to life and deficiencies are almost unheard of. There is not actually an RDA (Recommended Daily Allowance) for pantothenic acid.

Other supplements:

- Acidophilus is a probiotic found in dairy products. It may aid digestion. Use of probiotics may be beneficial.
- Creatine phosphate is normally found in muscles and provides the 1st few seconds of energy for power movements. Supplements probably don’t help.
- Dehydroepiandrosterone (DHEA) is a precursor of sex steroids. It is abused by athletes to build muscle mass.
Continued from page 3.

B₆ is Pyridoxine, Pyridoxal and Pyridoxamine. We are unable to synthesize B₆, so it must be gotten from the diet. It acts as a coenzyme in neurotransmitter synthetic pathways (for the catecholamines, GABA and serotonin). It is a coenzyme for 100's of metabolic reactions and is required to synthesize heme.

B₇ is Biotin. Biotin is required by all organisms, but only bacteria, some fungi including yeasts, algae and some plants can synthesize it. It acts as a cofactor of five enzymes required for metabolism. It is also a required cofactor for DNA replication and transcription.

B₉ is Folic Acid or folate. The name comes from the fact that naturally occurring folates are so common in leafy vegetables (leaf = foliage). It sounds a bit unimportant, but the only role of folate coenzymes in the body seems to be to mediate the transfer of one-carbon functional groups, but this process is critical to DNA metabolism. There are a number of reasons why someone may become deficient in folic acid, but dietary deficiency and alcoholism are the two most common causes.

A deficiency of folate leads eventually to a type of anemia called macrocytic or megaloblastic anemia, in which the RBCs do not mature into functional adults. In pregnant women with a folate deficiency, birth defects and preeclampsia are common. There has been convincing work over the years to justify giving pregnant women megadoses of folic acid to prevent preeclampsia.

B₁₂ is Cyanocobalamin. This large vitamin contains a cobalt ion. Cyanocobalamin is the form used in supplements and the body readily converts it to the active form of the vitamin. B₁₂ is required for the functioning of a folate-dependent enzyme. Therefore, low levels of B₁₂ can cause megaloblastic anemia just like low levels of B₉. Low B₁₂ is also associated with an increased risk of heart disease.

Vitamin B Complex

This is the name for all the B vitamins together. You should be able to get all the Vitamin B complex vitamins needed if you eat a balanced diet consisting of 5 daily servings of fruits, vegetables, and grains.

Supplementation is recommended for:

- People older than 50
- Pregnant women
- Breast-feeding women
- Women of child-bearing age
Botanicals are plants or plant parts used for their medicinal properties. To be classified as a dietary supplement, the product must meet the definition given in the Dietary Supplement Health and Education Act.

Most people think that because botanicals are “natural” the products are safe. They do not realize that some of these products are actually quite potent, some have a delayed onset, and some have significant interactions with medications. It is also impossible to gauge how much of the active principals are present in any given product since this is not standardized in these products.

Black cohosh is an herbal product used to treat menopausal symptoms such as hot flashes. It is one of many plants that produce “phytoestrogens.” Phytoestrogens are compounds produced by plants that mimic, or sometimes antagonize, endogenous estrogen. They are non-steroidal but their chemical structure resembles estrogen.

Chamomile is a flowering plant in the Aster family. It has long been used in teas and tinctures to relieve stress or upset stomach. It may contain coumarin.

Echinacea is a coneflower. There are several species of Echinacea, all of which are native to the US. There have been many reports over the years of products claiming to be Echinacea to have no Echinacea actually in them. Echinacea is used primarily to prevent or treat upper respiratory tract infections like the common cold. Echinacea may have sympathomimetic effects.

Ginger root has known antiemetic properties. For many people, fresh ginger will also be a CNS stimulant much like caffeine causing jitteriness, anxiety and difficulty sleeping.

Ginseng is a generic name for a number of plants long used medicinally. All kinds of claims are made for Asian ginseng; it is a tonic used to treat everything from depression to erectile dysfunction to diabetes and hypertension. It may help lower blood glucose and may have positive effects on immune function. American ginseng is another plant in the same general family. It is used primarily in an attempt to improve the immune system and help with GIT issues.

St. John’s Wort is taken OTC to self-medicate for depression. There isn’t much evidence to support this use, but taking St. John’s Wort along with many prescription antipsychotics, some antipsychotics, and some OTC decongestants may lead to serotonin syndrome. It also decreases the effectiveness of a number of medications because it INDUCES P450’s (CYP3A4 especially) thus ramping up metabolism of many drugs.

See also, American Association of Clinical Endocrinologist Medical Guidelines for the Clinical Use of Dietary Supplements and Nutraceuticals. Endocrine Practice 2003;9(5):417-470

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Herbals you want your patient to tell you about

- Due to a risk of bleeding
  - Chamomile, Gingko biloba, Garlic, Ginseng, Fish oil, Angelica, Feverfew
- Due to sedative activity
  - Kava, St John’s wort, Valerian root
- Because they may cause hypertension
  - Ephedra, Garlic
- Due to dangerous drug interactions
  - Licorice, St. John’s wort, Kava, Valerian root, Echinacea, Goldenseal

See: When “Natural Remedies mean danger for Cosmetic Surgery”
And Are Herbal Supplements Putting Aesthetic Surgery Patients at Risk?

Most people do not realize that the herbal products they are taking can have dramatic effects in combination with prescription medicines. They often won’t remember to tell you about them when you ask.

Images from the National Library of Medicine Image Collection.

Homework and Exercises

1. Read the “START HERE” announcement in Laulima for updates and instructions.
2. Read about Vitamins and Minerals in Chapter 64 of Adams & Urban, PHARMACOLOGY Connections to Nursing Practice.
3. Review the Powerpoints and listen to the audio from the face-to-face lecture. You may opt to watch the appropriate videos for this lecture. Review any handouts available for this lecture in the Course Index.
5. Use “Chat,” “Discussions and Private Messages” or the lecture “Forum” to ask questions and find answers or to seek assistance.
6. Complete the online quiz in Laulima, Tasks, Tests and Surveys.

If you have any questions, email me at abeale@hawaii.edu