The Water-Soluble Vitamins

B Vitamins
and
Vitamin C

The Vitamins - Characteristics

<table>
<thead>
<tr>
<th>Water-Soluble Vitamins: B Vitamins and Vitamin C</th>
<th>Fat-Soluble Vitamins: Vitamins A, D, E, and K</th>
</tr>
</thead>
<tbody>
<tr>
<td>Absorption</td>
<td>Directly into the blood.</td>
</tr>
<tr>
<td>Transport</td>
<td>Travel freely.</td>
</tr>
<tr>
<td>Storage</td>
<td>Circulate freely in water-filled parts of the body.</td>
</tr>
<tr>
<td>Excretion</td>
<td>Kidneys detect and remove excess in urine.</td>
</tr>
<tr>
<td>Toxicity</td>
<td>Possible to reach toxic levels when consumed from supplements.</td>
</tr>
<tr>
<td>Requirements</td>
<td>Needed in frequent doses (perhaps 1 to 3 days).</td>
</tr>
</tbody>
</table>

NOTE: Exceptions occur, but these differences between the water-soluble and fat-soluble vitamins are useful generalizations.

Vitamins B - Function

• Coenzymes

Without coenzymes, compounds B, and C2 both react to their enzymes.

With the coenzymes in place, compounds are attacked further either on the enzymes...and the reactions proceed instantaneously. The compounds often donate or accept electrons, atoms, or groups of atoms.

The reactions are completed with the formation of one product, All, or the breaking apart of a compound to two new products, C and D, and the release of energy.
**Thiamin - Doses**

- Other names: Vitamin B₁
- RDA
  - men: 1.2 mg/day
  - women: 1.1 mg/day

**B₁ - Function**

- Chief functions in the body
  - Part of coenzyme TPP (thiamin pyrophosphate) used in energy metabolism

**Thiamin - Sources**

- Significant sources
- Whole grain, fortified, or enriched grain products
- Moderate amounts in all nutritious food
- Pork
- Easily destroyed by heat
Riboflavin – B₂

• RDA
  • Men: 1.3 mg/day
  • Women: 1.1 mg/day

Riboflavin - Function

• Chief functions in the body
  • Part of coenzymes FMN (flavin mononucleotide) and FAD (flavin adenine dinucleotide) used in energy metabolism.

Riboflavin sources:

Milk products (yogurt, cheese)
Enriched or whole grains
Liver
**Niacin – Names and Doses**

- Other names
  - Nicotinic acid; Nicotinamide; Niacinamide
  - Vitamin B₃
  - Precursor: dietary tryptophan
- RDA
  - Men: 16 mg NE/day
  - Women: 14 mg NE/day
  - Upper level for adults: 35 mg/day

**Niacin**

- Chief functions in the body
  - Part of coenzymes NAD (nicotinamide adenine dinucleotide) and NADP (its phosphate form) used in energy metabolism

**Niacin Sources:**

- Milk, eggs, meat, poultry, fish
- Whole-grain and enriched breads and cereals
- Nuts
- All protein-containing foods
Biotin

- Adequate intake (AI)
  - Adults: 30 µg/day

- Chief functions in the body
  - Part of a coenzyme used in energy metabolism, fat synthesis, amino acid metabolism, and glycogen synthesis

Biotin Sources

- Significant sources
  - Widespread in foods
  - Organ meats, egg yolks, soybeans, fish, whole grains
  - Also produced by GI bacteria

Pantothenic Acid

- Adequate intake (AI)
  - Adults: 5 mg/day

- Chief functions in the body
  - Part of coenzyme A, used in energy metabolism
Pantothenic Acid - Sources

- Significant sources
  - Widespread in foods
  - Organ meats, mushrooms, avocados, broccoli, whole grains
- Easily destroyed by food processing

Vitamin B₆ - Pyridoxine

- Other names
  - Pyridoxine
  - Pyridoxal
  - Pyridoxamine
- RDA
  - Adults (19-50 years): 1.3 mg/day
  - Upper level for adults: 100 mg/day

Vitamin B₆ - Functions

- Chief functions in the body
  - Part of coenzymes used in amino acid and fatty acid metabolism
  - Helps to convert tryptophan to niacin and to serotonin
  - Helps to make red blood cells
Folate - Function

- Chief functions in the body
  - Part of coenzymes used in DNA synthesis and therefore important in new cell formation (fetus development)

✓ Present in foods as glutamic acid derivative and requires B12 for activation
### Folate Sources:

- Fortified grains
- Leafy green vegetables
- Legumes
- Seeds
- Liver

### Vitamin B₁₂ – Names and Doses

- **Other names:** cobalamin

- **RDA**
  - Adults: 2.4 µg/day

### B₁₂ - Functions

Chief functions in the body:

- Part of coenzymes methylcobalamin and deoxyadenosylcobalamin used in new cell synthesis
- Helps to maintain nerve cells
- Reforms folate coenzyme
- Helps to break down some fatty acids and amino acids
Vitamin B<sub>12</sub> - Sources

- Significant sources
  - Animal products (meat, fish, poultry, shellfish, milk, cheese, eggs)
  - Fortified cereals
- Easily destroyed by microwave cooking

Vitamin C – Names Doses

- Other name: ascorbic acid
- RDA
  - Men: 90 mg/day
  - Women: 75 mg/day
  - Smokers: +35 mg/day
- Upper level for adults: 2000 mg/day

Vitamin C - Functions

Chief functions in the body
- Collagen synthesis
  - Strengthens blood vessel walls, forms scar tissue, provides matrix for bone growth
- Antioxidant
- Thyroxin synthesis
- Amino acid metabolism
- Strengthens resistance to infection
- Helps in absorption of iron
Vitamin C Sources

Significant sources
- Citrus fruits
- Cabbage-type vegetables, dark green vegetables (such as bell peppers and broccoli)
- Cantaloupe, strawberries
- Lettuce, tomatoes, potatoes
- Papayas, mangoes

- Easily destroyed by heat and oxygen

Vitamin C - Overdose

- Toxicity symptoms
  - Nausea, abdominal cramps, diarrhea
  - Headache, fatigue, insomnia
  - Hot flashes, rashes
  - Interference with medical tests, aggravation of gout symptoms, urinary tract problems, kidney stones
Vitamin And Mineral Supplements

Arguments for supplements
- Correct overt deficiencies
- Improve nutrition status
- Reduce disease risks
- Support increased nutrient needs
- Improve the body’s defenses

Arguments against supplements
- Toxicity
- Life-threatening misinformation
- Unknown needs
- False sense of security
- Other invalid reasons
- Bioavailability and Antagonistic actions

END