Vitamins & Supplements

- Definition: Vitamins are minute quantities of organic substances essential for the regulation of metabolic processes.
- Researchers mistakenly named these minute nutrients as amine containing water soluble substances.
- Vita=vital for life
- Min=amine

A table of vitamin deficiency and overdose data from the web

Vitamins

- Water soluble:
  - B, C, G, (riboflavin) H (biotin)
- Water insoluble:
  - A, D, E and K

Retinol (Vitamin A)
Carotene is a provitamin A.
- It is yellow in color (highly conjugated).
- Air oxidation at the right carbon positions (red) will give Vitamin A.

- Needed for:
  - Growth of tissues
  - Reproduction
  - Vision
- Deficiency –
  - Night blindness

Vitamin B1 ((thiamine) the name implies sulfur and amine in the molecule).
- Water soluble
- Found in polishings of yeast and rice (about 5-10 grams from 1 ton of rice)
- Deficiency
  - Beriberi (degeneration and inflammation of the nerves, heart and digestive system)
B1
• Thiamine (or a thiazolium salt)

\[
\begin{array}{c}
\text{Thiamine} \\
R = \text{mon, di or triphosphate}
\end{array}
\]

Stetter reaction for Lipitor Synthesis
• A thiamine catalyst was used in the synthesis of an important intermediate toward the commercial production of Lipitor.

B2
• Vitamin B2 (riboflavin)
  – Water soluble
  – Found in liver, heart and kidney, vegetables and fruits
• Deficiency
  – Impaired growth, dermatitis (pellagra, or lip lesions)

B2
• Bitter taste (amine)
• Yellow color (because it is highly conjugated)
- Vitamin B6 (paradoxine)
  - Water soluble
  - Found in rice and bran
- Deficiency
  - Pellagra (especially in lesions of the tongue)

- Folic Acid
  - Water insoluble
  - Found in vegetables, liver and yeast
- Deficiency
  - Essential for the growth of red and white blood cells
  - Implicated in child birth defects in women with folic acid deficiency

- Vitamin B12 (Cobalt amine)
  - Water soluble
  - Found in liver
- Deficiency
  - Pernicious anemia (3-6 micrograms per individual is sufficient to prevent this disorder)
B12

Vitamin C

- 1535 Jacques Cartier and his sailors were cured by Newfoundland Indians by drinking the extract from spruce tree needles.
- 1747, British navel surgeon prescribed lime to sailors to prevent scurvy. Thus the slang *limey* for British sailor.

C

- It came from D-glucose, D-galactose or D-glucaric acid. It has the following structure:

Vitamin C

- Vitamin C
  - Water soluble
  - Found in fresh fruit and vegetables
  - White crystalline sour taste (acid)
- Deficiency
  - Scurvy (limey – a nickname for British sailors)
Vitamins & Supplements

- Vitamin D
  - Water insoluble
  - Found in egg yolk, liver
- Deficiency
  - Vision defects

D

- Vitamin D
  - Water insoluble
  - Found in egg yolk, liver
- Deficiency
  - Vision defects

Vitamins & Supplements

- Vitamin E
  - Water insoluble
  - Found in egg yolk, liver
- Deficiency
  - Vision defects
**Vitamin E**

- Found in wheat germ, corn, sunflower seeds, soy bean oil, alfalfa and lettuce
- Has three chiral centers
- Anti-oxidant
- Oil soluble

![Vitamin E structure](image)

**Vitamin H (BIOTIN)**

- It functions as a cofactor for enzyme reactions

![Biotin structure](image)

**Vitamin H (BIOTIN)**

- The first commercial process was developed by Leo Sternbach (inventor of Valium and Librium) at Hoffmann-La Roche
- Deficiency in human is rare because intestinal flora biosynthesis of biotin from cysteine.
- Deficiency symptoms are dermatitis, weight loss and loss of appetite.
Vitamin K1 and K2

- Found in green vegetables
- Promote blood clotting

The top 50 most prescribed drugs

- [http://www.3dchem.com/top50.asp](http://www.3dchem.com/top50.asp)

Drugs for common aches and pains

- NSAID (Non-Steroidal Anti-inflammatory Drugs) commonly OTC products such as Aspirin, Tylenol, Midol etc.
Aspirin

- Invented by Author Eichengruen in Bayer in 1897
- John Vane in 1971 published the paper on aspirin and related products on inhibition of prostaglandin synthesis (1982 Nobel laureate in Physiology)

COX 2 Inhibitors

VIOXX $2.5 B in 2002
CELEBREX $1.5 B in 2002

COX 2 inhibitors

- Cyclooxygenase 2 inhibitors
- They also prevent the biosynthesis of prostaglandins, thus reduce pain.
- They are more gentle on the stomach thus avoid the common side effects of stomach bleeding of NSAID

Morphine analogs

THERAINE
CODINE
OXCODION
with aspirin in Percodan
with acetaminophen in Percocet
with propoxyphene in Ortyl Cadex
Morphine

- These are extremely habit forming
- The most abused drug in the US
- Heroin is derived from morphine

Drugs history

for hypertension
ACE inhibitor

- The discovery of Captopril (1981)
- 1960 John Vane discovered the pit viper venom to be an angiotensin II inhibitor

Other ACE inhibitors
2002 sales value MM$

- Accupril (Quinapril) Parke-Davis 706
- Altace (Ramipril) King Pharma 527
- Zestril (Lisinopril) Astra Zeneca 478
- Lotensin (Benazepril) Novartis 483
- Captopril Bristol Myer and generics<100

Drugs history

- Cows feeding on sweet clover were dying from internal bleeding (over 100 year ago)
- U of Wisconsin ag school found the active material named it after the Wisconsin Alumni Research Foundation (WARF)
- Warfarin (coumadine) a rat poison as well as a blood thinner for DVT
Warfarin

Antibiotics

- Beta lactams (penicillin)
- It disrupt the gram positive bacteria cell wall

Problems in penicillin

- **Allergy/hypersensitivity**
- **Allergic** reactions to any β-lactam antibiotic may occur in up to 10% of patients receiving that agent. **Anaphylaxis** will occur in approximately 0.01% of patients
- Resistance to penicillin because of misuse.

Other anti-infectives

- Macrolides
- Erythromycin
Azithromycin
• This is a second generation erythromycin

Anti-infective
• Linezolide (invented by Upjohn scientists)

Linezolide
• Also known as Zyvox
• Came on the market in 2000
• 2003 bacteria resistance was reported