- **Alcohol abuse** (Wernicke-Korsakoff): confusion, depression, psychosis, coma;
- **Sub clinical beriberi**: fatigue, weight loss, slow nerve reflexes, loss of memory, irritability, stomach upset, generalized weakness, even in areas of adequate diet;
- **Mild deficiency** can produce apathy, mood changes, mental confusion, depression, disorderly thinking, vague fears; indigestion, poor appetite, insomnia; loss of intestinal muscle tone, colon distension, constipation; paraesthesia (numbness or burning of extremities); elevated blood pyruvic & lactic acid levels, producing oxygen deficiency probably accounts for most symptoms; possible neurological damage from deficiency during pregnancy; possible role in Alzheimer’s disease;
- **Toxicity**: not recorded; excess B-1 excreted in urine; 100 times RDA completely safe;  

**Therapy with thiamine**

- Usual therapeutic doses range from 1.5 - 100 mg/day;
- Rapidly reverses B-1 deficiency symptoms;
- Used to treat alcohol-induced psychosis;
- May restore injured nerve function (neuropathy), neuritis, neuralgia & pains of various origins; used to treat diseases of central nervous system;
- Used in treatment of cardiovascular symptoms;
- Treats multiple sclerosis, in conjunction with vitamin B-3;
- Improves muscle tone of digestive tract, eliminating a major cause of constipation;

**VITAMIN B-2 (Riboflavin)**

**General** - water-soluble; the “yellow enzyme”;

- Bright yellow vitamin; imparts brilliance to urine of those consuming large quantities;
- First isolated as fluorescent material in milk whey & shown to be essential for rats;
- B-2 is manufactured by all plants & most bacteria & fungi, but not produced by animals;
- History: yellow enzyme recognized as vitamin in 1917; isolated in 1932; synthesized in 1935;

**Nutrition**

- **Sources**: widespread in whole foods; brewer’s yeast, dairy products, green leafy vegetables, fruit, grains, meats (esp. organ meats);
- **Supplements**: B-2, B-complex, multi-vitamin, multi-mineral-vitamin;
- **Absorption** from the upper portion of small intestine; freely circulates throughout body;
- **Improved by**: other B-complex factors & anti-oxidant vitamins C & E; better absorption if taken with meals;
- **Antagonized by**: alcohol; antibiotics;
- **Stability**: destroyed by light, UV or alkali; 10 - 30% lost in cooking; 60% lost in milling grains; 75% of B-2 in milk lost in making cheese;
- **Storage**: in endoplasmic reticula of all cells; elevated concentrations found in the liver, heart, kidneys; only minute amounts of B-2 are retained; daily replenishment is vital;
- **Excretion**: through urine;
- **Interactions**: oral contraceptives deplete B-2;
Functions of vitamin B-2

- Essential respiratory co-enzyme flavin adenine di-nucleotide (FAD) & flavin mono-nucleotide (FMN) in all cells; contributes to the capacity of several co-enzymes to accept & transfer hydrogen atoms or positive charges;
- Converts protein into usable energy;
- Helps cells use oxygen; prevents free radical damage by involvement with glutathione;
- Maintains good vision; helps prevent development of cataracts;
- Helps convert amino acid tryptophan to vitamin B-3; also activates B-6 & folic acid, affecting DNA synthesis, cell division & growth, that require B-3, folacin & B-6;
- Necessary for synthesis of glycogen;
- Maintains integrity of skin, nails & hair;
- Required for synthesis of: somatotrophic hormone (STH) that regulates growth; thyroxine that regulates metabolic rate; adrenocorticotropic hormone (ACTH) that stimulates adrenal hormone production & growth; insulin that regulates energy metabolism;
- Enhances uptake of iron & B-6;
- Necessary to synthesize red blood cells in bone marrow;
- Controls growth & development of unborn foetus;
- Co-factor in breakdown of fatty acids for energy;
- Works together with vitamin A to maintain healthy mucous membranes;
- Important for providing energy necessary for tissue repair; important during pregnancy for normal development of foetus;
- May protect against oesophageal cancer;
- Functions helped by: other B-complex factors & antioxidant vitamins C & E;

Quantities

- **Measurement:** in milligrams (thousandths of a gram);
- **Optimum:** (SONA) average ranges from 1.8 to 2.5 mg/day;
- **Individual** optimum must be established for each individual; need increases with body size, energy requirement, exercise, protein consumption & metabolic rate; biochemical individuality dictates different needs for different people; exceptional need arises from gastrointestinal maladies, prescription antibiotics, oral contraceptives, alcohol, poor diet;
- **Minimum:** (DRI) set at 1.3 mg/day;
- **Less than RDA:** 34% of population, according to a U.S. government survey;
- **Deficiency:** one of most common vitamin deficiencies in North America;
- Results from inadequate diet; alcohol consumption; strenuous exercise; poor absorption;
- increased requirement; usually part of multiple (B-complex) deficiencies;
- **At risk:** elderly, alcoholics, athletes (esp. women); pregnant women; foetuses;
- **Symptoms** include: personality disturbances from faulty nerve cell metabolism; congenital malformations;
- **Sub-clinical deficiency** can manifest as: fatigue; digestive upset; hypertension; anorexia; lesions of lips, tongue, mouth, eyes, skin & genitalia; grainy, burning sensation of eyes & conjunctiva; difficult urination; baldness; sensitivity to light; oily, flaky skin; cataracts; vaginal itching; dizziness; increased effectiveness of cancerogens; growth retardation, birth defects; rapid involuntary eye movements (nystagmus); personality changes include hypochondriasis, depression, hysteria; reduced hand grip strength;
- **Toxicity:** for B-2 has not been recorded; harmless nutrient, even in doses 100x RDA;
Therapy with riboflavin

- Usual therapeutic dose ranges from 1.7 to 100 mg/day;
- Corrects conditions that result from riboflavin deficiency;
- Used to treat conjunctivitis, glaucoma & growth retardation;
- Prevent & reverse developing cataracts;
- Enhances iron absorption, protecting against anaemia;
- With B-6, B-2 may help in treatment of carpal tunnel syndrome;
- Boosts physical performance by making efficient energy production possible during intense physical activity & preventing free radical damage;

VITAMIN B-3

(Niacin = Nicotinic Acid; Niacinamide = Nicotinamide)

General  water-soluble; anti-pellagra factor;

- Deficiency disease of niacin — pellagra — was known in 1735 by physician to Philip V of Spain;
- Virtually unknown in North America until beginning of 20th century;
- 250,000 annual cases of pellagra reported world-wide from 1910 to 1935;
- Niacin, nicotinic acid, niacinamide & nicotinamide are equivalent in niacin activity;
- “Niacin Equivalents” in dietary tables = sum of these 4 forms + tryptophan, that human cells can convert to niacin;
- History: obtained from oxidation of nicotine in 1867; identified as pellagra preventive factor in 1937; transformation of tryptophan to niacin understood in 1945;

Nutrition

- Sources: brewer’s yeast; liver; lean meats, fish & poultry;
- Absorption: rapid, from small intestine; circulates freely in body;
- Stability: stable to heat, light, acid, alkali & oxidation;
- Storage: in all cells; slightly higher amounts found in liver, brain, heart, skin & gut;
- Excretion: through urine;
- Metabolism: about 65% of RDA can be made from the amino acid tryptophan; sugars & starches increase requirement;
- Interactions: alcohol, antibiotics increase need;

Functions of niacin & niacinamide

- Co-factor (NAD, NADP), energy-producing reactions of carbohydrates, lipids, proteins;
- Maintains normal growth rates; needed in synthesis of DNA, fats, proteins & cholesterol;
- Promotes production of bile salts & metabolism of fats & fat soluble vitamins;
- Regulates synthesis of sex, thyroid & pancreatic (insulin) hormones;
- Maintains healthy nervous system & brain function, skin, mouth & digestive tract;
- Niacin, but not the amide form, increases blood flow to the extremities, accompanied by “flush” reaction; improves circulation & skin health;