

# Vitamins

Monday, December 8, 2014  
6:12 PM

## Outline

- Vitamin A
- Vitamin B<sub>1</sub> (Thiamine) - review (CAC: 10/7)
- Vitamin B<sub>2</sub> (Riboflavin) - review (CAC: 10/7)
- Vitamin B<sub>3</sub> (Niacin) - review (Olycolysis: 9/30)
- Vitamin B<sub>5</sub> (Pantothenate) - review (CAC: 10/7)
- Vitamin B<sub>6</sub> (Pyridoxine) - review (AA, met: 10/18)
- Vitamin B<sub>7</sub> (Biotin) - review (CAC: 10/7)
- Vitamin B<sub>9</sub> (Folate) - review (1C: 11/18)
- Vitamin B<sub>12</sub> (Cobalamin) - review (1C: 11/18)
- Vitamin C - new/review (PP shunt: 10/2)
- Vitamin D - review (Steroids: 11/15)
- Vitamin E - review (PP shunt: 10/2)
- Vitamin K - review (Blood coagulation: 9/15)

Essential Cofactors	A, (1,2,6,7,12)
Recycled Substrates	(3,5,9), C, E, K
Antioxidants	A, C, E, K
TF Ligands	A, D

Water-Soluble (never toxic)	Lipid-Soluble (can be toxic)
-B -C	-A -D -E -K

## Antioxidants

Water-Soluble	C, GSH, BR
Lipid-Soluble	E

## Vitamins

VITAMINS - original pharmaceutical molecules; foundations of modern biochem

		Functions	RDA	Source	Deficiency
	A	- vision (3-photon: cis → trans) - transcription (RETINOIC ACID - metabolite) - gene (ISOTRETINOIN - 13-cis-retinoic acid)	900 ug	- liver - carrots - golden rice	- blind - abnormal fetus development
Thiamine	1	- sugar remodeling for CAC: - pyruvate dehydrogenase (PD) - ketoglutarate dehydrogenase (KD) - transketolase (TK) - "coma cocktail"	1.5 mg	- cereals	- Beriberi: - ↓ energy - ↑ glutamate - Wernicke's encephalopathy (nerves) - Wernicke's cardiomyopathy (heart)
Riboflavin	2	- FMN/FAD precursor - Glycerol Phosphate Shuttle (GPP): [NADH + FAD → NAD <sup>+</sup> + FADH <sub>2</sub> ] - migraines	1.2 mg	- cereals - milk - meats - green veggies	
Niacin	3	- NAD <sup>+</sup> /NADP <sup>+</sup> precursor - Lipids (↑ HDL) - gout (↓ sulfipyrazones)	20 mg	- Trp - corn, grains (Mexican w/ alkaline soil)	- Pellagra: (Diarrhea, Dementia, Dermatitis)  *isolated by: chemo (5-fluorouracil) & tuberculosis tx (isoniazid)
Pantothenate	5	- CoA precursor (acetyl groups)	5 mg	- avocado - yogurt	
Pyridoxine	6	- Schiff Base (decarboxylation, racemization, transamination, β-elimination, retroaldol cleavage, etc) - PLP precursor (cofactor for many enzymes) - morning sickness	2 mg	- cereals - meat	  *isolated by: isoniazid + Cyclosporine (DD interaction)
Biotin	7	- A-CoAC cofactor (Acetyl-CoA → Malonyl-CoA)	30 ug	- variety of foods - intestinal flora - Biotinidase	  *isolated by: Avidin, ↓ Biotinidase
Folate	9	- TS cofactor (formation of dTMP)	400 ug 800-1000	- cereals - grains - citrus - green veggies	- ↓ dTMP, ↓ DNA replication - Anemia (↓ hematopoiesis) - Diarrhea - Birth Defects (spinal bifida)
Cobalamin	12	- MS cofactor (formation of SAM) - Methylmalonyl-CoA Mutase (Methylmalonate → Succinyl-CoA)  *uptake requires IF & Cobam-F	2-3 ug	- meat - dairy - bacteria in some fish	- Pernicious Anemia: autoimmune; destroys stomach (P-cells) - ↓ Sensation - ↓ Mental
Ascorbate	C	- Antioxidant - Teeth/Hair holding (collagen) - Vit E regeneration (Peroxidation to GSH) - Atherosclerosis - Cold Prevention *too much = kidney stones	100 mg	- citrus	- Scurvy (scurvy): - Teeth/Hair fall out - Bleeding, Swelling, Bruising
Calcitriol	D	- regulates Ca <sup>2+</sup> , BP, cell differentiation (via VDR-R) - regulates Ca <sup>2+</sup> , Pi (Calcitriol) - Tumor Suppression?	400 IU	- UV - dairy - fish	- Rickets - Osteoporosis - Schizophrenia, Depression - Autoimmunity: DM1, MS, Crohn's, RA - Cancer - Muscle Aches
	E	- Antioxidant (lipid radicals, etc)	50 IU	- vegetable oil - nuts	- MI - Cancer - Dementia - Cataracts  *DD interaction = Warfarin, Plavix *isolated by: Olestra
	K	- Glutamate Carbonylase cofactor (Factors 2,7,9,10) - Bone - ↓ Blood Vessel Calcification - Cell growth	100 ug	- green veggies - (cheese)	- Bleeding, Bruising - ↓ Clotting

## SUMMARY

A	- lipid-soluble - cofactor (Rhodopsin) - TF ligand (Retinoic Acid Receptor)
B	- metabolism - cofactors (1,2,6,7,12) - substrates (3,5,9)
C	- antioxidant - collagen hydroxylation
D	TF ligand (bone, ↑ differentiation, ↓ proliferation)

E	antioxidant
K	cofactor (Glutamate Carboxylase)