Nutritional Benefits of Animal Products

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Outline

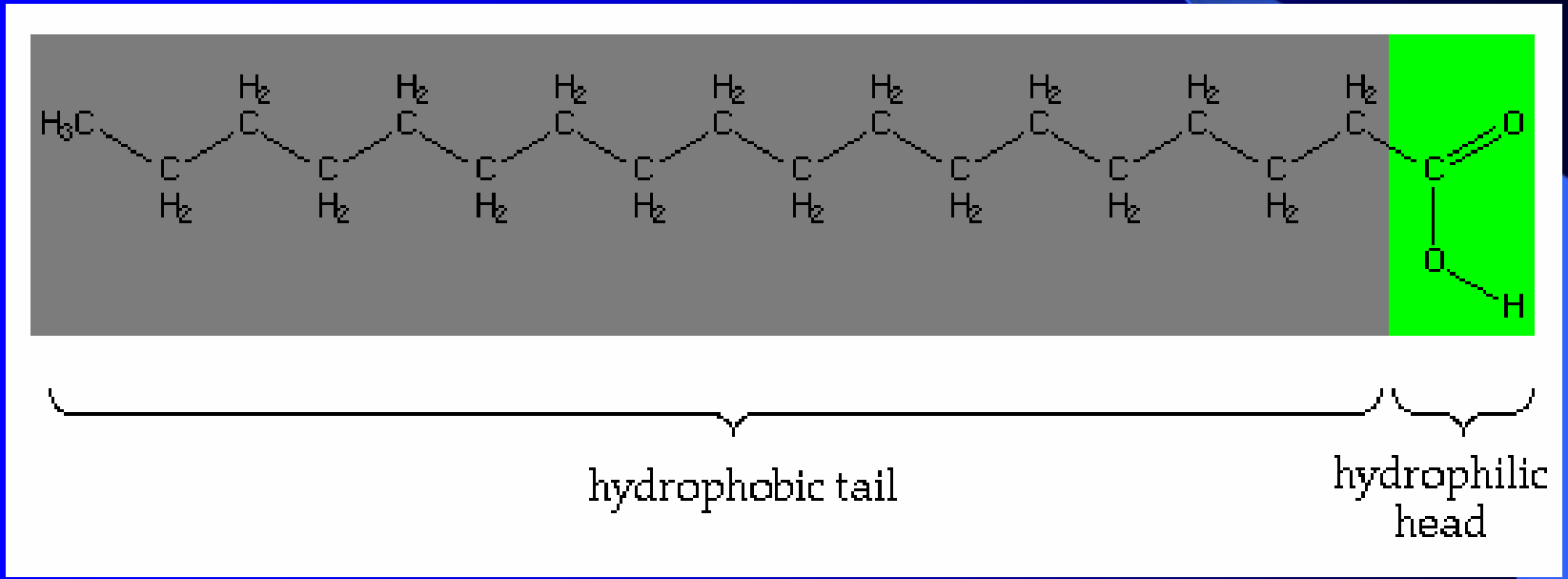
- Lipids
  - Conjugated linoleic acid
- Protein
  - Relationship to bone metabolism
- Minerals
  - Zinc and Iron
- Vitamins
  - B_{12}

Lipids

Lipid Chemistry

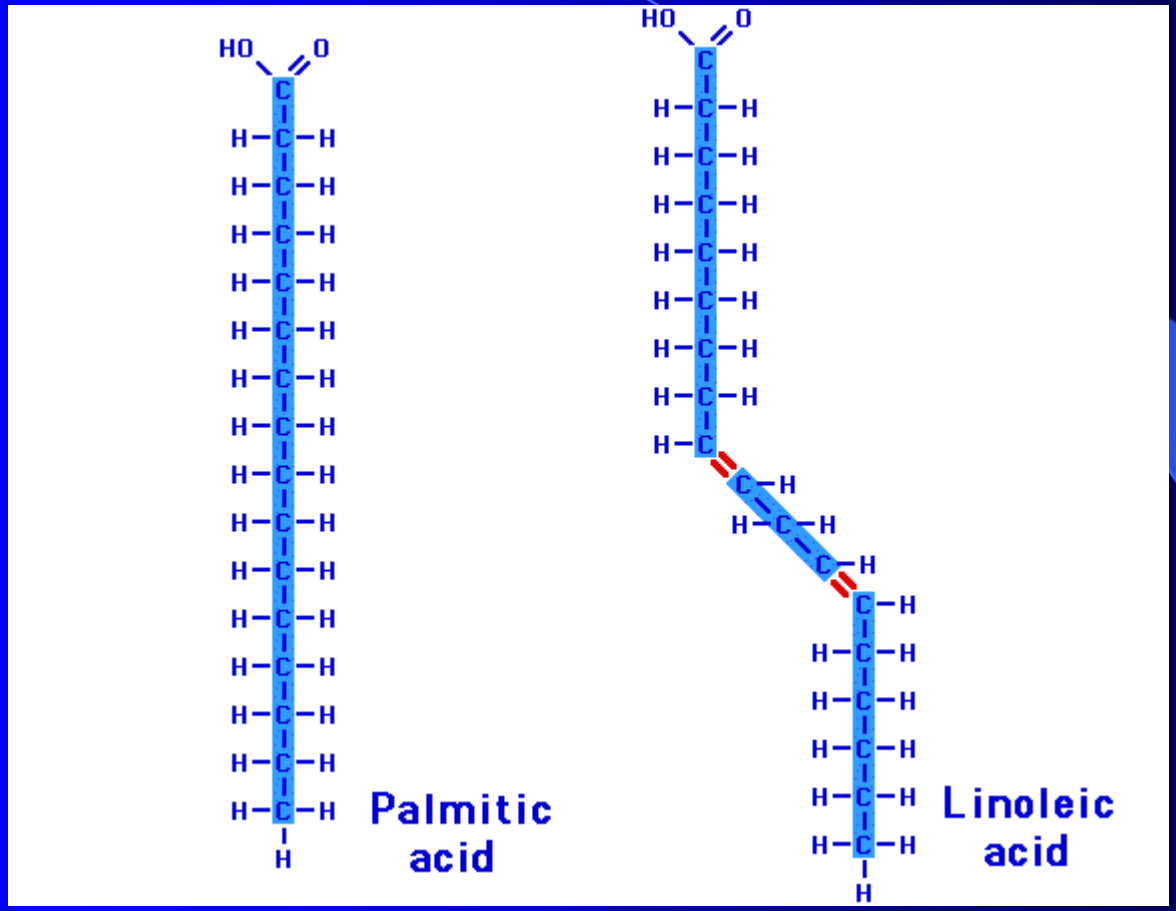
- Composed of a string of carbon molecules with an acid group attached
- Saturated or unsaturated
- Function
  - Membrane component
  - Thermal insulation and mechanical protection
  - Hormones
  - Energy storage

Lipid Chemistry
(Saturated fatty acid)



C18:0 or Stearic acid

chemlabs.uoregon.edu/.../stearic_acid.html



Saturated

Unsaturated

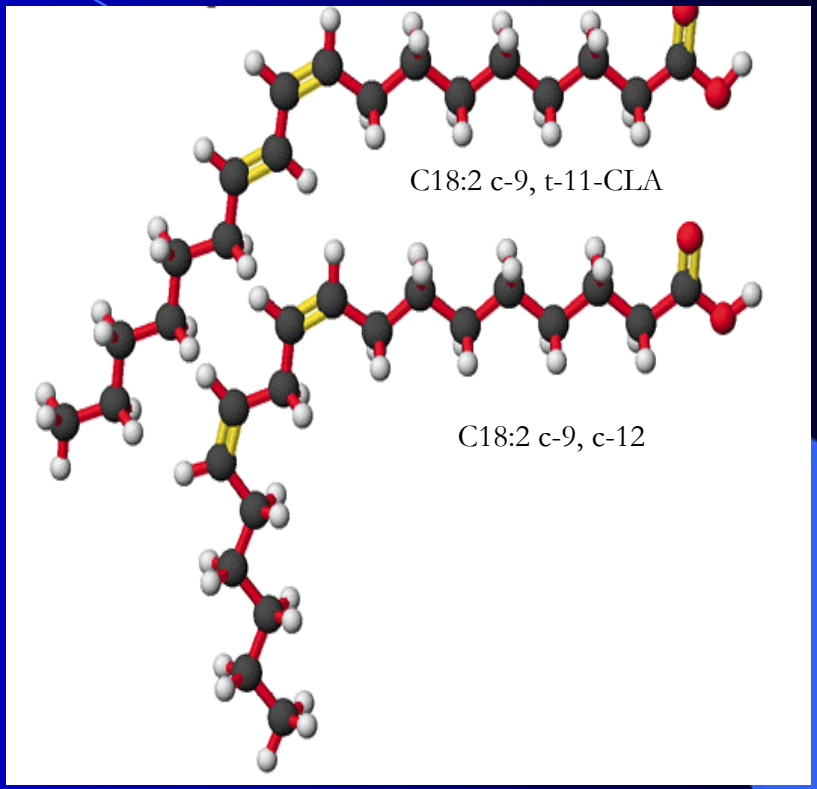
www.agen.ufl.edu/.../lect/lect_02/3_16.gif

What is CLA?

What are CLA’s ?

CLA

- Class of lipids
- Discovered in grilled ground beef (1987)
- Anticarcinogenic activity
- Antiatherogenic activity
- Enhance the immune system
- Enhance growth
- Reduce body fat



jchemed.chem.wisc.edu/.../ dec96pa302_2.gif

Conjugated dienoic isomers of linoleic acid in uncooked meats

Foodstuff[a]	Total CLA (mg/g fat)[b]	c-9,t11 (%)[c]
Round beef (n=4)	2.9 ± 0.09	79
Fresh ground beef (n=4)	4.3 ± 0.13	85
Lamb (n=4)	5.6 ± 0.29	92
Pork (n=2)	0.6 ± 0.06	82
Chicken (n=2)	0.9 ± 0.02	84

[a]Samples were from commercially available, uncooked edible portions

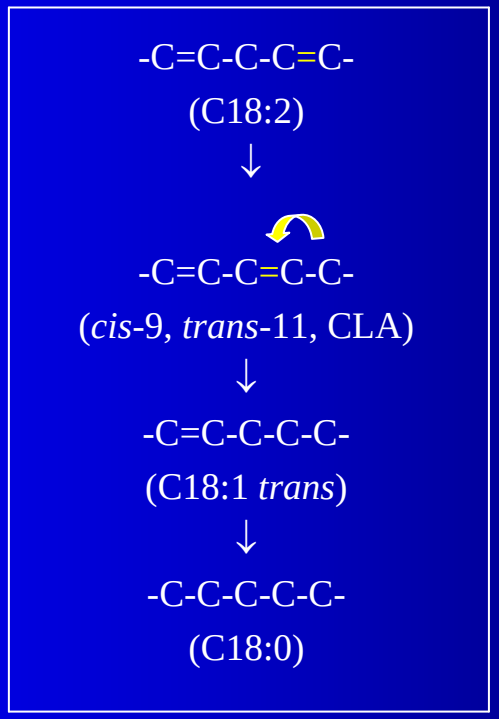
[b]Values are means ± standard error for the number of samples indicated.

[c]Values are means for the number of samples indicated. All standard values are less than 3%. Data were expressed as % of total CLA isomers.

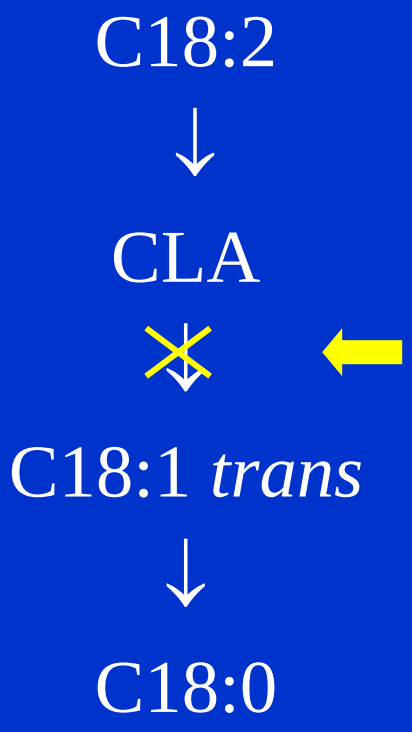
J. Food Comp. and Anal. 1992. 5:185

- Plants contain very little CLA.
- So why is CLA so high in ruminant tissues?

Ruminal Biohydrogenation



Ruminal Biohydrogenation



Protein

Animal Proteins and Bone Metabolism

- Catabolism of dietary protein → ammonium ion and sulfates from sulfur-containing amino acids.
- Bone citrate and carbonate are mobilized to neutralize these acids → increase in urinary calcium
- Excess dietary protein can increase bone loss
- Milk and meat:
  - Milk – amount of calcium in milk can compensate for urinary loss of calcium by milk protein.
  - Meat – good amino acid profile and contains available phosphorus which can partially offset the hypercalciuric effect of protein.

J. Nutr. 133: 862S-865S, 2003

Minerals

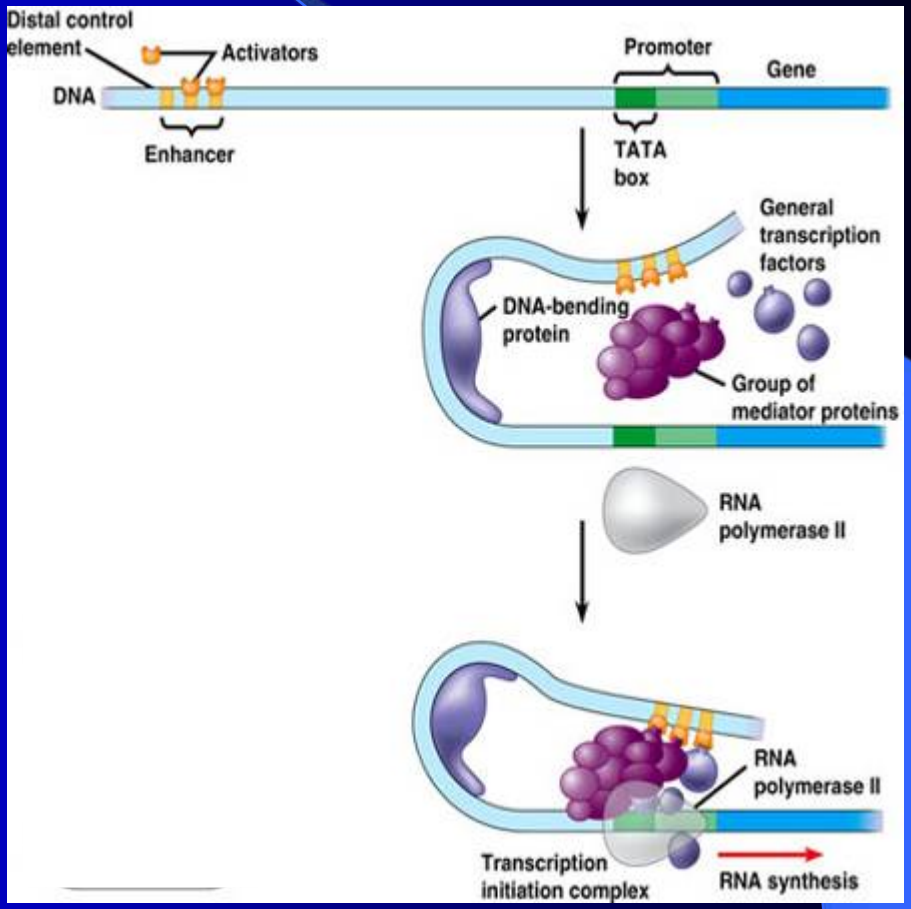
- Zinc and Iron

Zinc

- Functions
  - Component of numerous enzymes
    - Carbonic anhydrase ($CO_2 + H_2O \rightarrow H^+ + HCO_3^-$)
    - Alcohol dehydrogenase
    - Malic dehydrogenase (Malate $\longrightarrow$ Ox)
    - Superoxide dismutase
    - Collagenase
  - DNA and RNA polymerase
  - Lipid metabolism
  - Immunity
- Deficiency signs
  - Parakeratosis
  - Decreased wound healing
  - Decreased immune function
  - Decreased insulin release
  - Reduction in bone collagen turnover
  - Impaired Vit A metabolism (decreased synthesis of retinol-binding protein)

Zinc and gene expression

- Zinc fingers – transcription factors
- DNA replication (replication protein A)
- DNA repair (endonuclease IV)
- Apoptosis (TFp53)
- Antioxidant protection of DNA

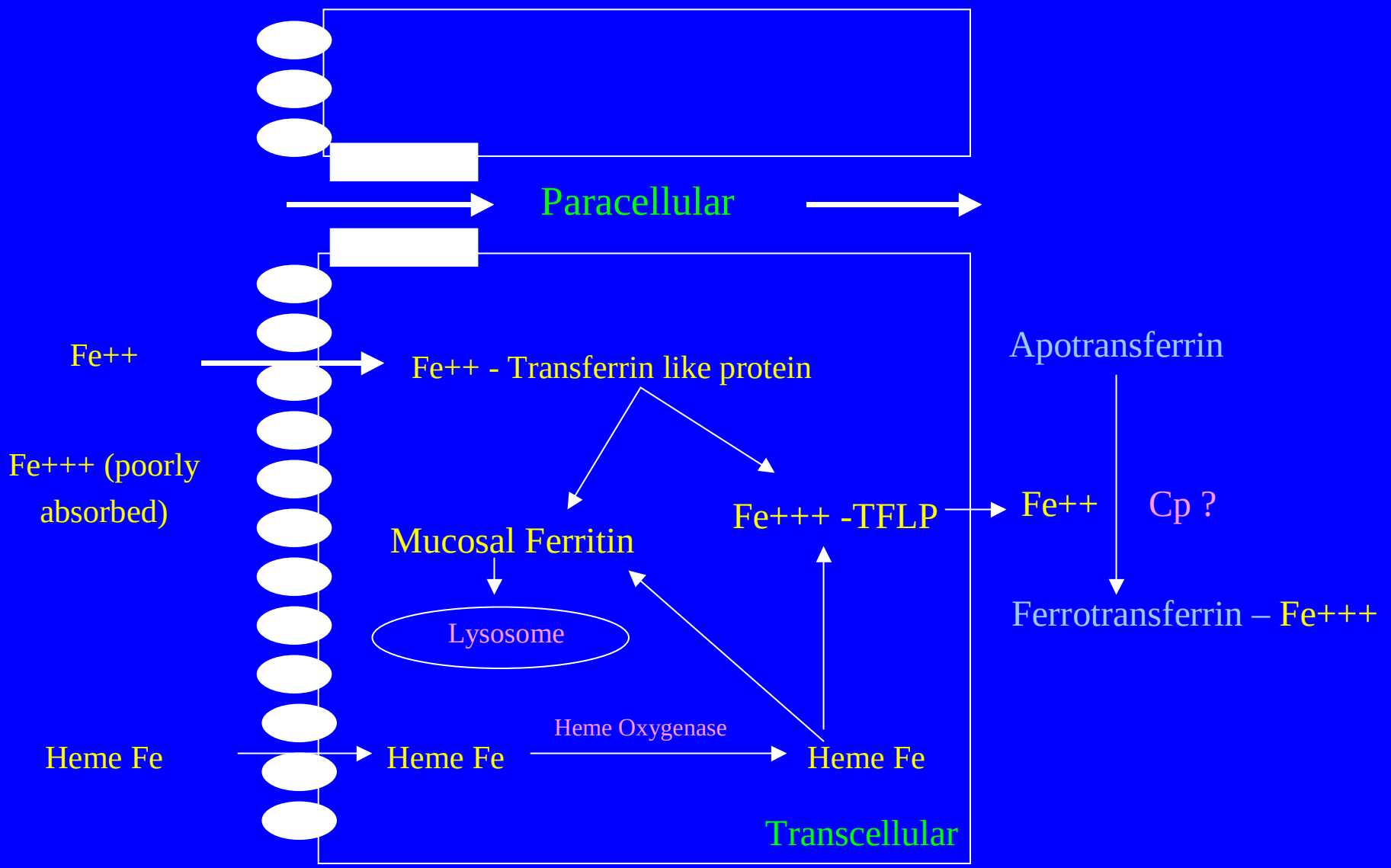


Mineral Res. 2001. 475:161-167.

fig.cox.miami.edu/~cmallery/ 150/gene/mol_gen.htm

Iron

- Functions
  - Oxygen transport
  - Electron transport (cytrochromes)
  - Enzymes
    - Catalase
    - Succinate dehyrogenase



Beard and Dawson, 1997. In: Handbook of Nutritionally Essential Mineral Elements

Vitamins

- Functions
  - Mediators in biochemical pathways
    - Ex. B vitamins act as co-factors in enzyme systems (Cobalt - B_{12} prop. → succ.-CoA)
  - Antioxidants
  - Amino acid metabolism
- Classifications
  - Water or fat soluble

Vitamins

- Fat soluble
  - Vitamin A
  - Vitamin D
  - Vitamin E
  - Vitamin K
- Water soluble
  - Vitamin C
  - B vitamins
    a) Thiamin (B-1)
    b) Riboflavin (B-2)
    c) Niacin (B-3)
    d) Pantothenic acid (B-5)
    e) Vitamin B-6 (pyrodoxine)
    f) Biotin
    g) Vitamin B-12 (cobalamin)
    h) Folic acid

Vitamin B_{12}

- Functions
  - B_{12} – dependent enzymes
    - 1) Methylmalonyl-CoA Isomerase requires B_{12} as a coenzyme (Smith, 1987)
      - Propionate-CoA → Methylmalonyl-CoA → Succinyl CoA
    - 2) 5-methyltetrahydrofolate homocysteine methyltransferase (Smith, 1987; Matthews, 1999)
      - -methyltetrahydrofolate + Homocysteine → Methionine + tetrahydrofolate

Vitamin A

- Functions:
  - Aids in vision
  - Cellular division and differentiation
    - Growth
    - Reproduction
    - Bone development
    - Immune system
  - Direct antioxidant (β-carotene)

Vitamin A

- Deficiencies
  - Night blindness
  - Xerophthalmia –deterioration of tissues in eye → blindness
  - Decreased growth, reproduction, immune function (increase in infection)
- Toxicity can occur
  - Bone abnormalities – over growth
  - Impaired vision and motor function

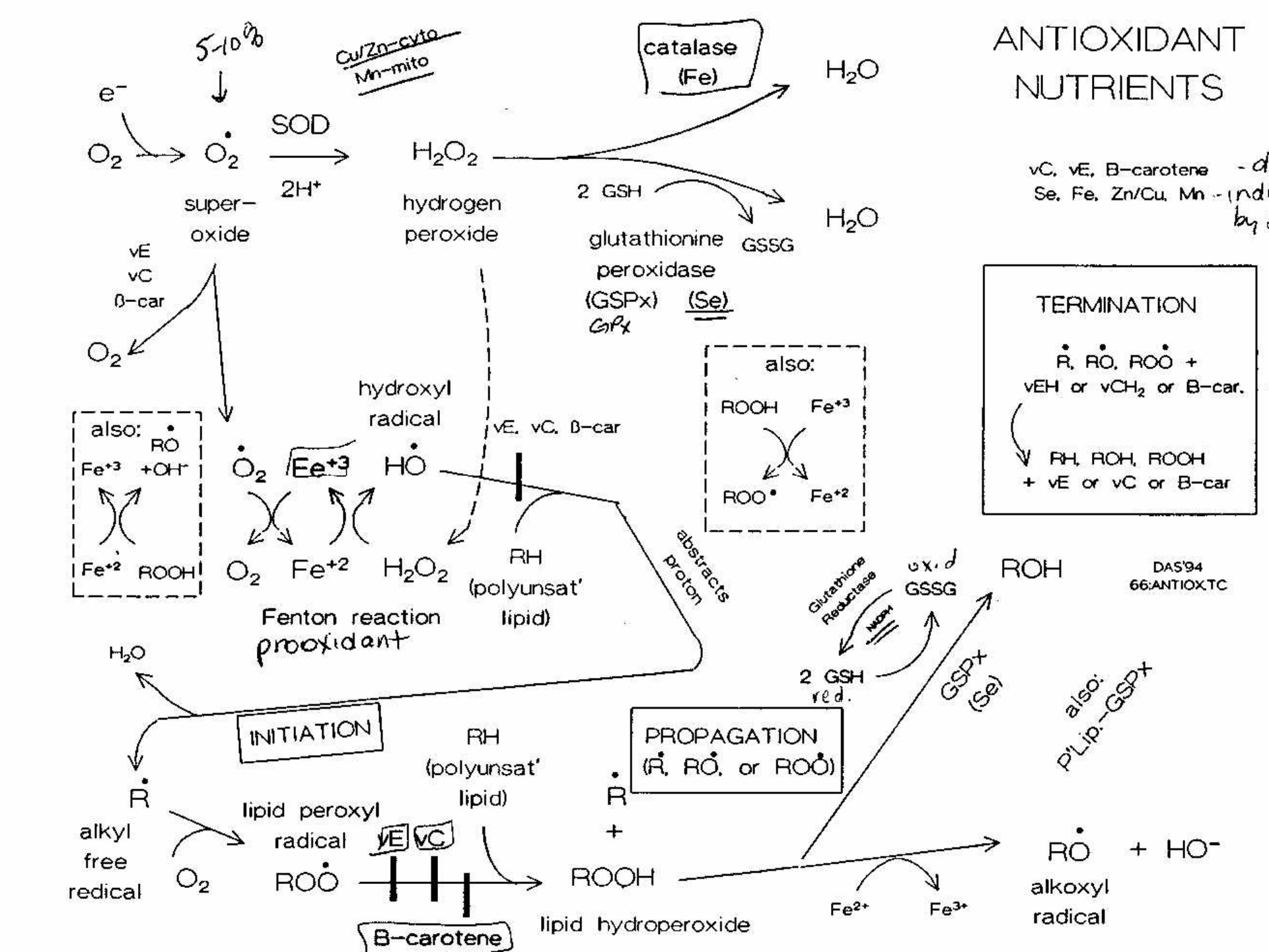
http://www.ag.unr.edu/hussein/406/2002/Handouts/Lecture30.pdf

http://mark.asci.ncsu.edu/Nutrition/NutritionSlides/slides.htm

Selenium and Vitamin E

- Both nutrients are involved in the cellular antioxidant defense mechanism
  - Se - Glutathione peroxidase
  - Vitamin E - scavenges free radicals

ANTIOXIDANT NUTRIENTS



vC, vE, B-carotene - d
Se, Fe, Zn/Cu, Mn - (nd
by

The End