MORE THAN NUTRITION AND BASIC HELATH

FOOD SCIENCE & TECHNOLOGY
AGRO-INDUSTRY
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What is Nutrition?

- Nutrition is a study of foods, their nutrients and other chemical constituents, and the effects of food constitutes on health.
- Nutrition is an interdisciplinary science.
- Nutrition recommendations for the public always change as new knowledge about nutrition and health relationships is gained.
- Healthy individuals require the same nutrients across the life cycle but in differing amounts. Nutritional needs can be met a wide variety of cultural and religious practices.

What should we know about nutrition?

Nutrients	Chemical substances in foods that are used by the body for growth and health.	
Food Security	Access at all times to a sufficient supply of **safe, nutritious** foods to meet their dietary needs and food preference for active and healthy life.	FAO (2009)
Food Insecurity	Limited or uncertain availability of safe, nutritious foods.	
Nutrition Security	Access at all times to an adequate utilization and absorption of nutrients in food, in order to be able to live healthy and active life.	International Fertilizer Association (2016)

Food Security Dimensions

Nutritional Status

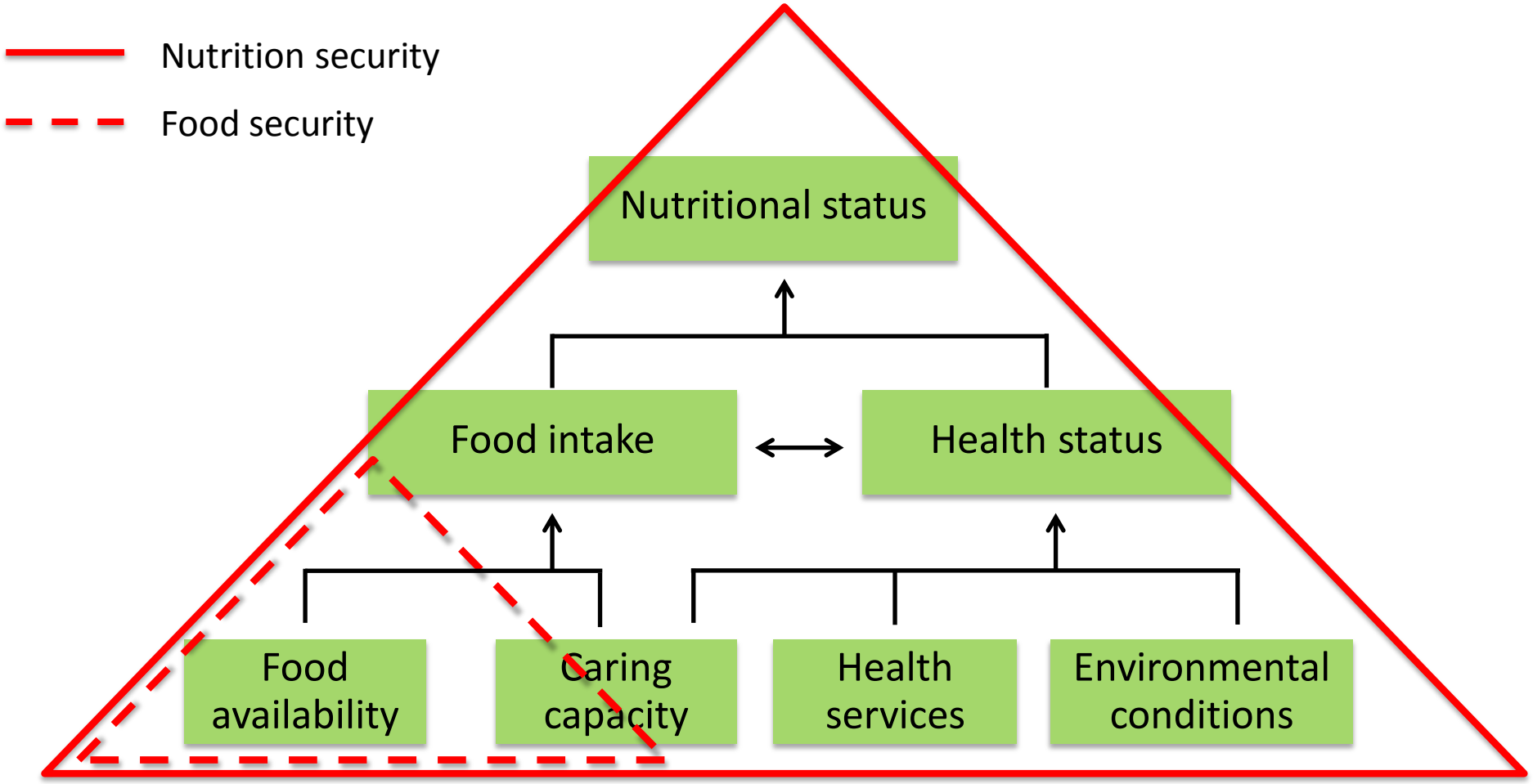
Utilization

Accessibility

Availability

Stability

Nutritional Status at Household Level



Nutrients

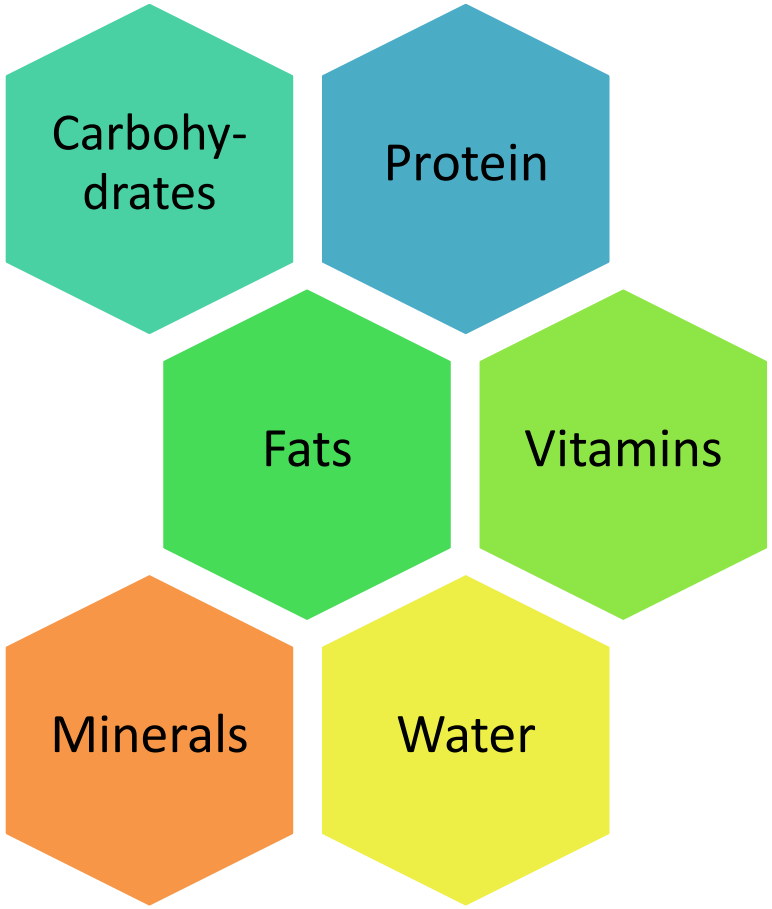
Essential nutrients

- Body cannot make or generally produce in sufficient amounts
- “Must be obtained from the diet”

Nonessential nutrients

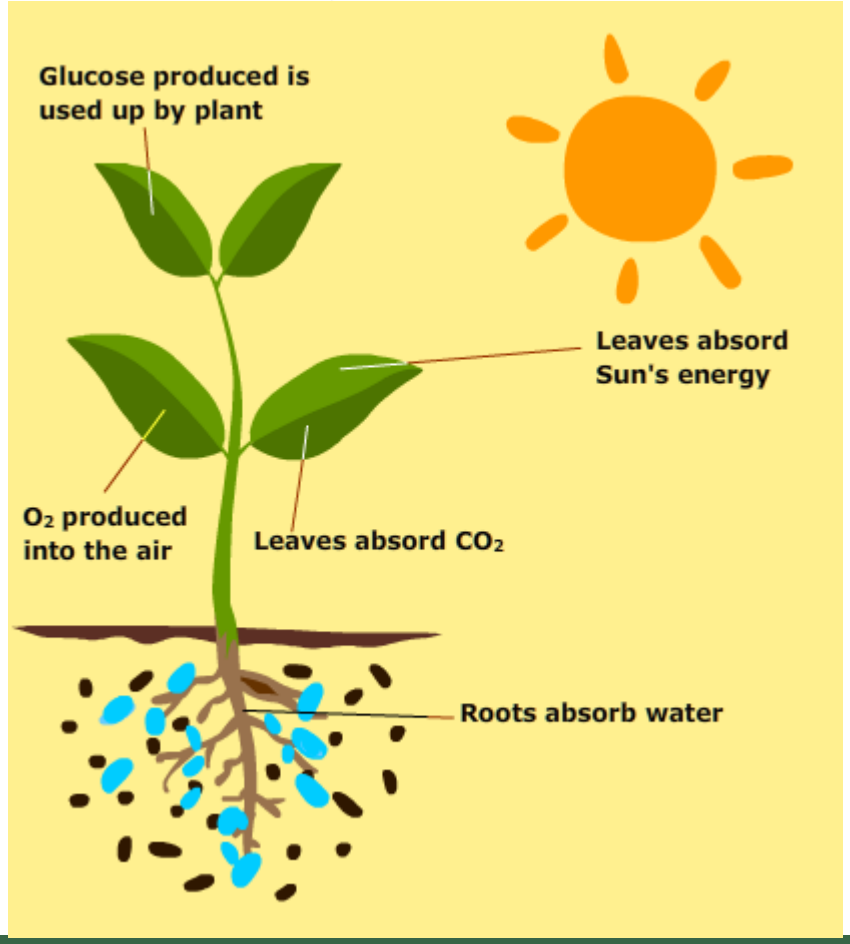
- Required for growth and health that can be produced by the body from other components of the diet

Essential Nutrients



Carbohydrates

Photosynthesis



Carbohydrates

- Used as a source of readily available energy
- Consists of **simple sugars, complex CHO, dietary fiber, alcohol sugars**
- Provides 4 calories/gram

Carbohydrates

- **Fibers** do not count as a source of energy because they cannot be broken down by human digestive enzymes
- Main function of fiber is to provide "**bulk**" for normal elimination.
- High-fiber diets reduce the rate of glucose absorption and help prevent cardiovascular disease and some types of cancers.

Carbohydrates

Dietary Fiber

- Indigestible
- Insoluble or Non-fermentable fiber
  - Cellulose, hemicellulose, lignin
  - Not fermented by the bacteria in the colon
- Soluble or Viscous fiber
  - Gum, pectin, mucilage
  - Fruits, vegetables, rice bran, psyllium seed

Carbohydrates

Functional Fiber

- Fiber added to food
  - Provides health benefits
- Prebiotics (type of functional fiber)
  - Stimulate growth or activity of beneficial bacteria in the large intestine

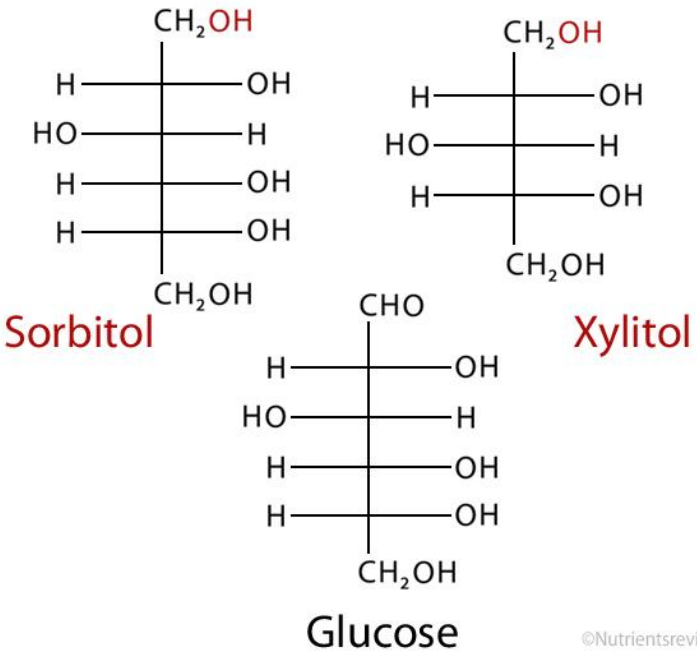
Carbohydrates

Alcohol sugars (Polyols)

In case you were wondering…

Carbohydrates

Alcohol sugars (Polyols)



Carbohydrates

Alcohol sugars

- Alcohol sugars are like simple sugars, except that they contain a chemical component of alcohol.
- Xylitol, mannitol, sorbitol
- Unlike simple sugars, they do not promote tooth decay.

Functions of Carbohydrates

- Energy source
- Protein sparing
- Prevent ketosis
- Sweeteners

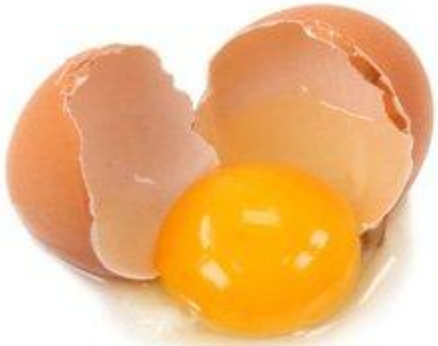
Proteins

- Provides the body with amino acids used to build and maintain tissues
- Can be used as a sources of energy
- Provides 4 calories/gram
- Some amino acids are essential amino acids.
- Some are non-essential amino acids.

Protein in Foods

Food Group	Grains	Vegetables	Fruits	Oils	Milk	Meat & Beans
Sources of protein	-Bread -Breakfast cereal -Rice -Noodles	-Carrots -Corn -Broccoli	-Apples -Oranges -Bananas	None	-Milk -Yogurt -Cheese	-Meat -Eggs -Fish -Dry beans -Nuts
Gram per serving	2-3	2-3	<1	<1	8-10	7

Are all proteins the same?



Health and Plant Proteins

- Provide protein with minerals and dietary fiber
- Contain no cholesterol
- Limited saturated fat
- High fiber

  However, time is needed to adjust to the higher fiber load

- Heart healthy
- Cancer-fighting
- Bone health
- Better glucose control
- Soy and menopause symptoms

What could we do to get high-quality protein?

Grains

Low in Lys

High in S-containing amino acids

Legumes

Low in Met

High in Lys

Vegetables

Low in Met

Nuts

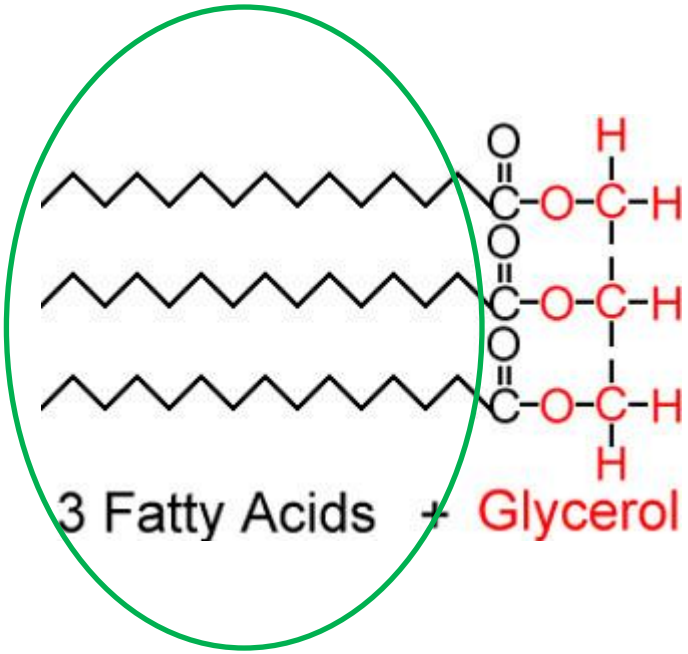
Low in Lys

Functions of Proteins

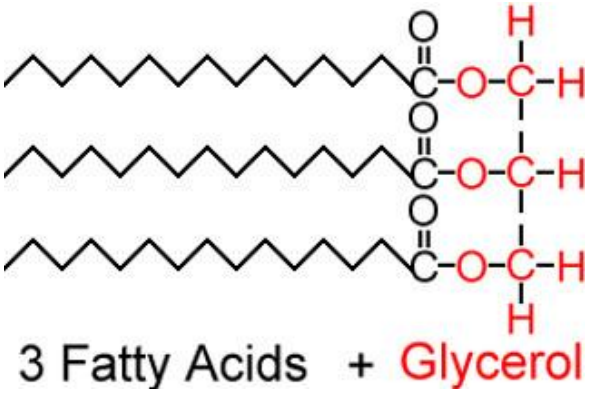
- Building blocks of body components
- Fluid balance maintenance
- Acid/Base balance
- Building blocks of hormones and enzymes
- Immune function
- Gluconeogenesis
- Energy yielding (non-preferred source)
- Provides highest feeling of satiety after meal

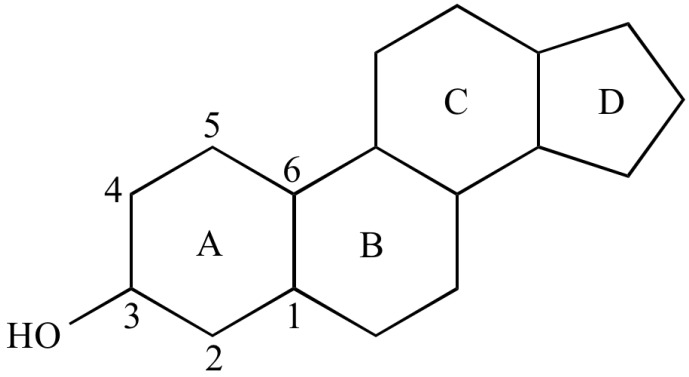
Lipids

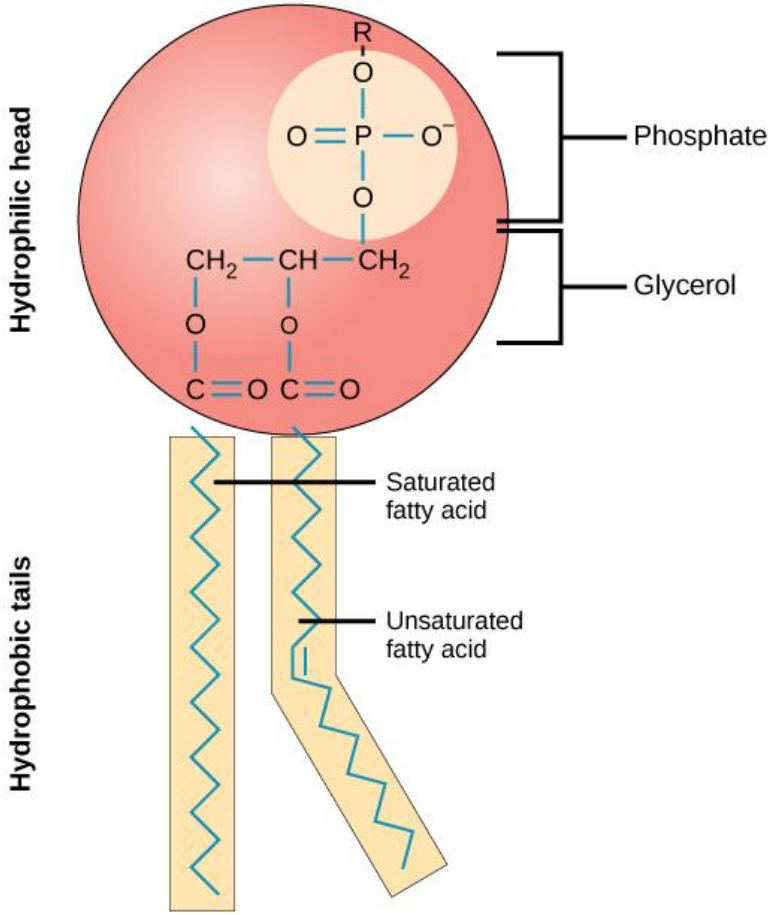
- Include fats, oils and related compounds such as cholesterol
- Types of lipids
  - Triglycerides
  - Phospholipids
  - Sterols (Cholesterol)
- Provides 9 calories/gram



Types of Lipids



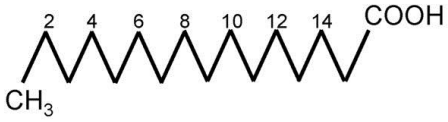




Fatty acids

Saturated Fatty Acids

Palmitic Acid



Unsaturated Fatty Acids

Oleic Acid

ω6 Polyunsaturated Fatty Acids

Linoleic Acid

Arachidonic Acid

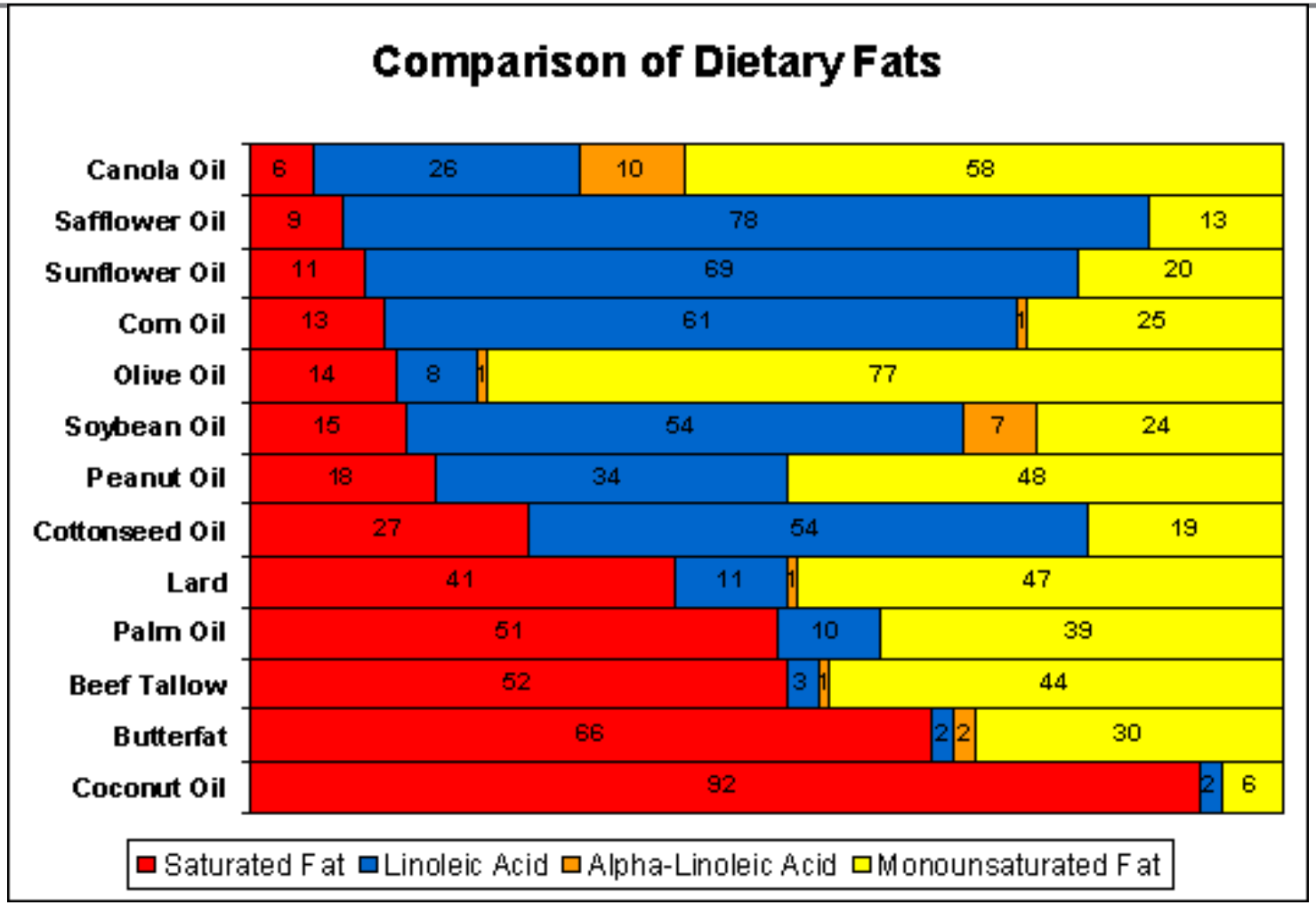
ω3 Polyunsaturated Fatty Acids

α-Linolenic Acid

Eicosapentaenoic Acid

Docosahexaenoic Acid

Fatty Acids



http://oregonstate.edu/instruct/css/330/seven/index2.htm

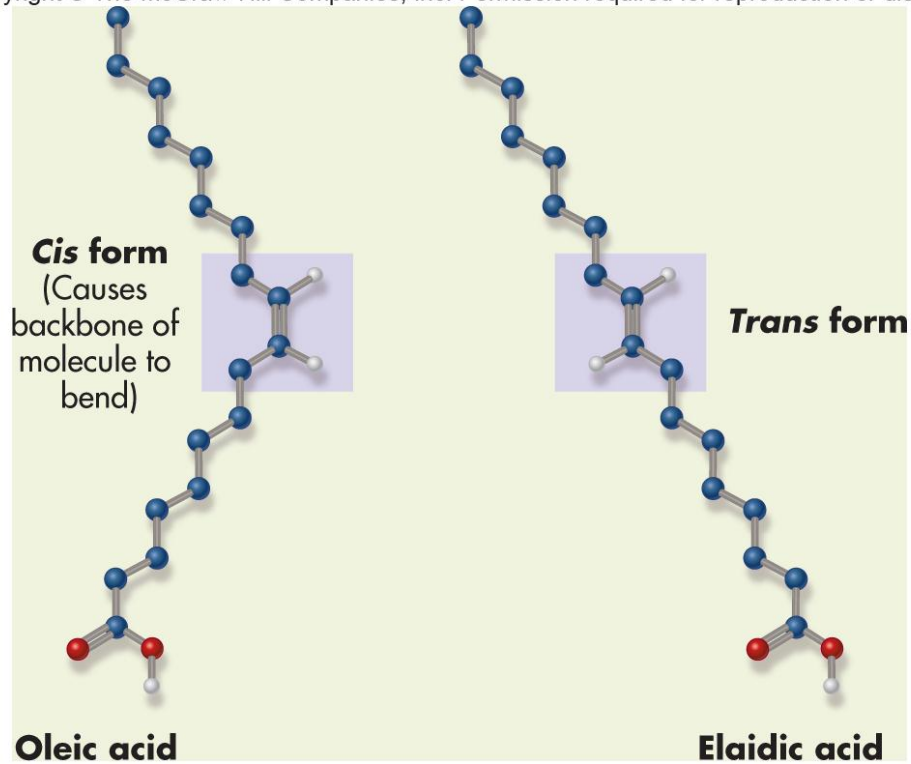
How to choose oils?

Be aware, though, that using any cooking oils too generously, even healthier oils and ingredients, can result in weight gain.
All fats typically contain more than double the calories of either carbohydrates or protein.

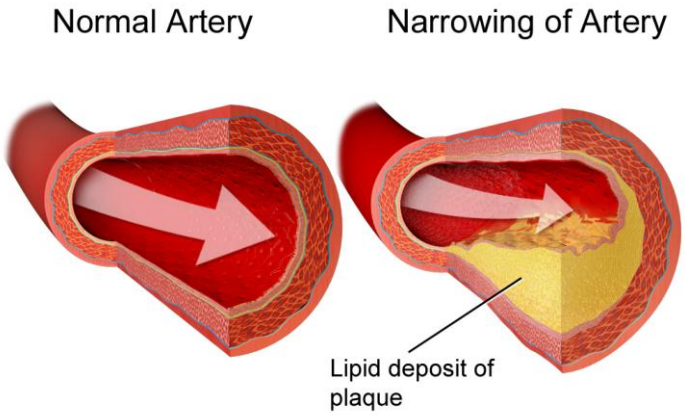
Essential Fatty Acids

- Omega-3 fatty acids (alpha-linoleic acid)
- Omega-6 fatty acids (linoleic acid)
- Body can only make double bond after the 9th carbon from the omega end.
- Functions
  - Immune function, vision, cell membrane and production of hormone-like compounds

Trans Fat



- Hydrogenation: adding hydrogen to the double bonds
- Enhance storage life and baking qualities

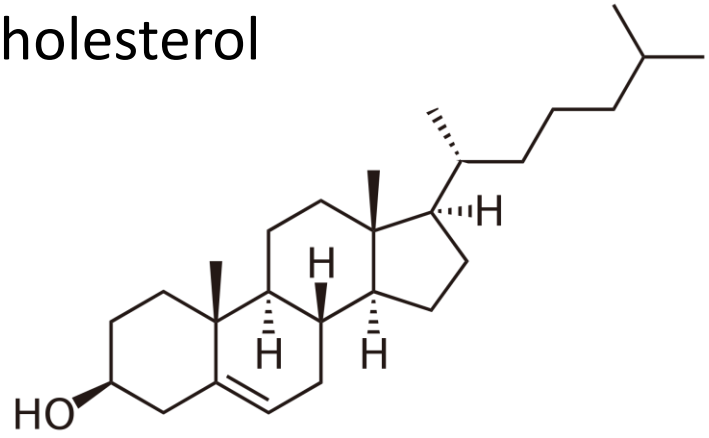


Coronary Artery Disease

Trans fat

Cholesterol

- A component of animal cell membranes, the brain, and the nerves.
- Precursor of estrogen, testosterone, vitamin D, which is manufactured in the skin upon exposure to sunlight.
- Precursor of bile acid
- Body generally produce 1/3 of the cholesterol our bodies use.
- Produced by the liver
- Found only in animal products



Fat in Foods

Reduced-fat food

- Calories content is about the same.
- Sugar is commonly added in place of fat.

Vitamins

- Essential organic substances
- Produce deficiency symptoms when missing from diet
- Yield no energy, not serve as structural components of the body
- Basic functions:
  - Facilitate energy-yielding chemical reactions
  - Function as co-enzymes
- Fat-soluble vitamins
- Water-soluble vitamins

Fun Facts about Vitamins

- Vitamins were names in order of discovery (A, B, C, D, …)
- Other substances found not be essential were dropped (e.g. vitamin P)
- B-vitamins were thought to be one vitamin; turn out to be many (e.g. B1, B2, B3, …)
- Scientists believe they have discovered all the vitamins

Vital Dietary Components

- Megadose (> 3-10x needs as a starting points)
- Plant and animal foods provide vitamins
- Most synthesized vitamins work equally well in the body

Vitamin Toxicity

- Fat-soluble vitamins

  Can accumulate in the body

- Water-soluble vitamins

  Some can cause toxicity, but tend to last a shorter time and more quickly remedied.

- Mostly likely due to supplementation

Preservation of Vitamins

- Decreased vitamin content due to:
  - Improper storage
  - Excessive cooking
  - Exposure to light, heat, air, water, and alkalinity
- Eat foods soon after harvest
- Freeze foods not consumed within a few days
- Blanching destroys enzymes

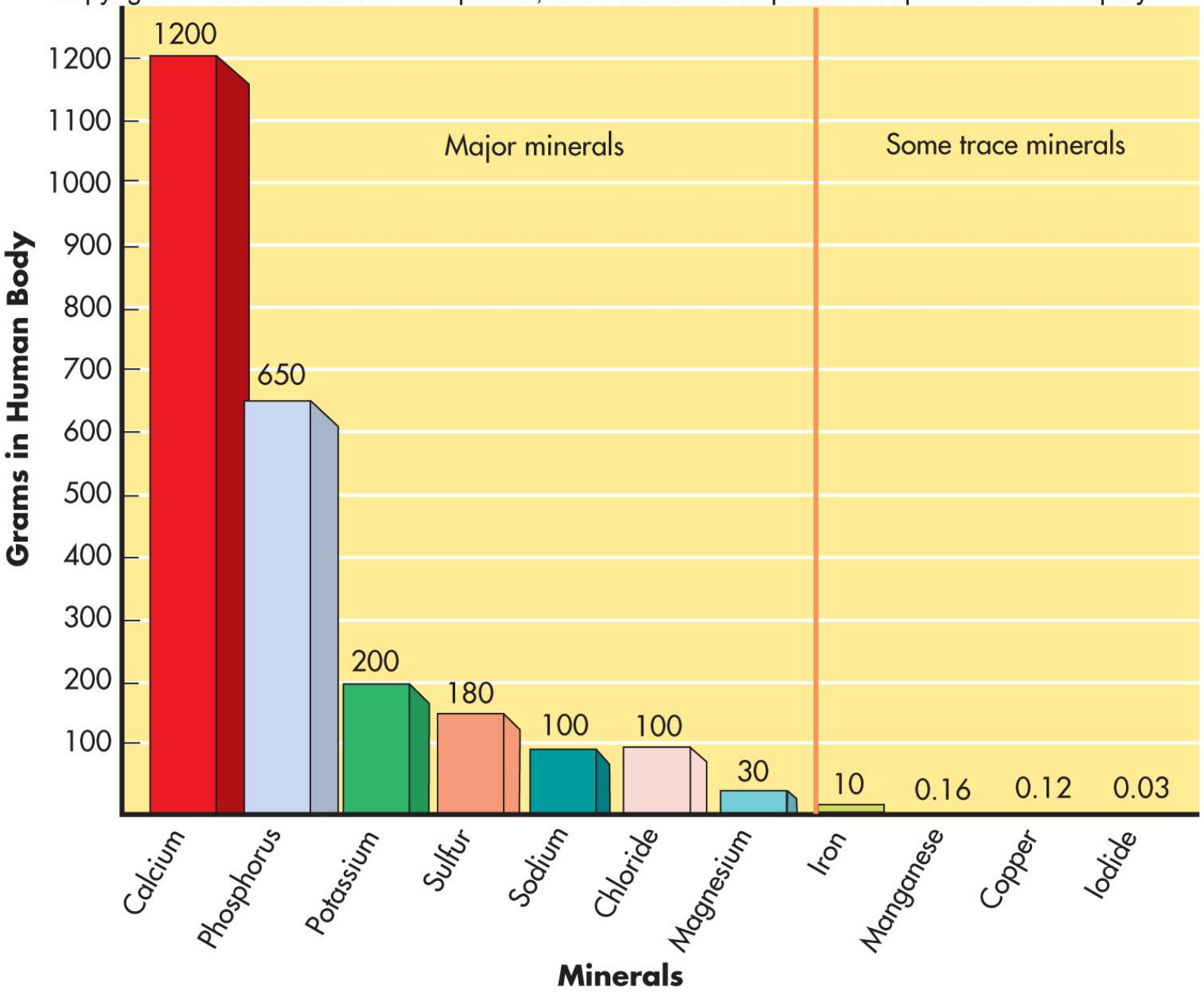
  Slow down vitamin degradation

Vitamin-like Compounds

- Carnitine (energy production)
- Inositol (promote hair growth, reduces skin disorder, diabetic nerve pain, depression)
- Taurine (cardiovascular function, central nervous system)
- Lipoic acid (restore vitamin E, C levels)
- Coenzyme Q10 (cell growth and maintenance, antioxidant)
- Synthesized in the body at the expense of amino acids and other nutrients

Minerals

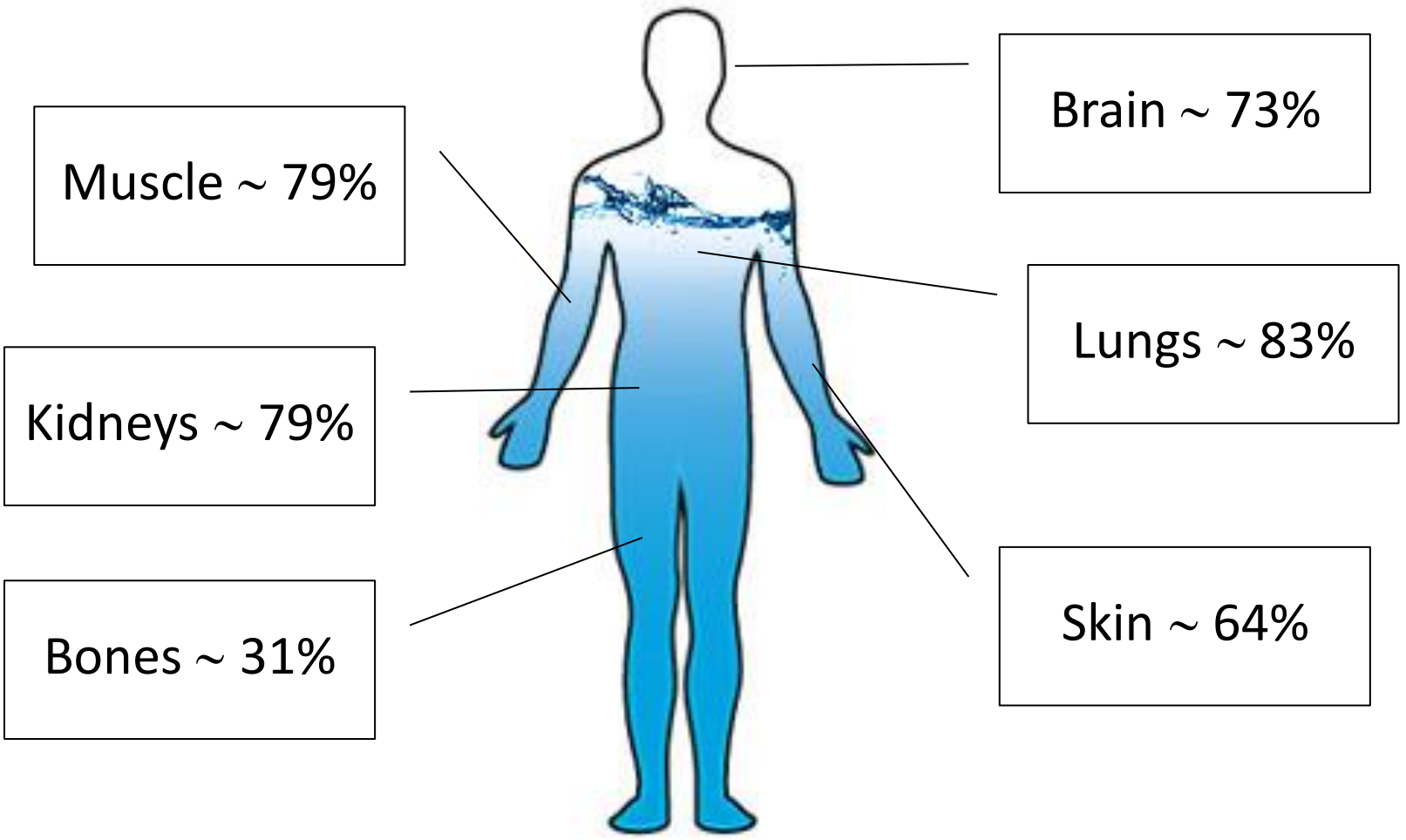
- Various functions in the body
- Major minerals
  - Require > 100 mg / day
  -
- Trace minerals
  - Require < 100 mg / day
  -



Bioavailability of Minerals

- Degree of absorption
- Presence of binders and fiber
- Animal products are better absorbed
- Plants depend on mineral content of soil
- Refinement lowers mineral content
- Mineral-mineral competition
- Vitamins-mineral competition

Water



Functions of Water

- Body temperature regulator
  - By sweating and respiration
- Vital nutrient to the life of every cell, acts first as a building material
- CHO and proteins that our bodies use as food are metabolized and transported by water in the bloodstream
- Assists in flushing waste mainly through urination
- Acts as a shock absorber for brain, spinal cord, and fetus
- Forms saliva
- Lubricates joints

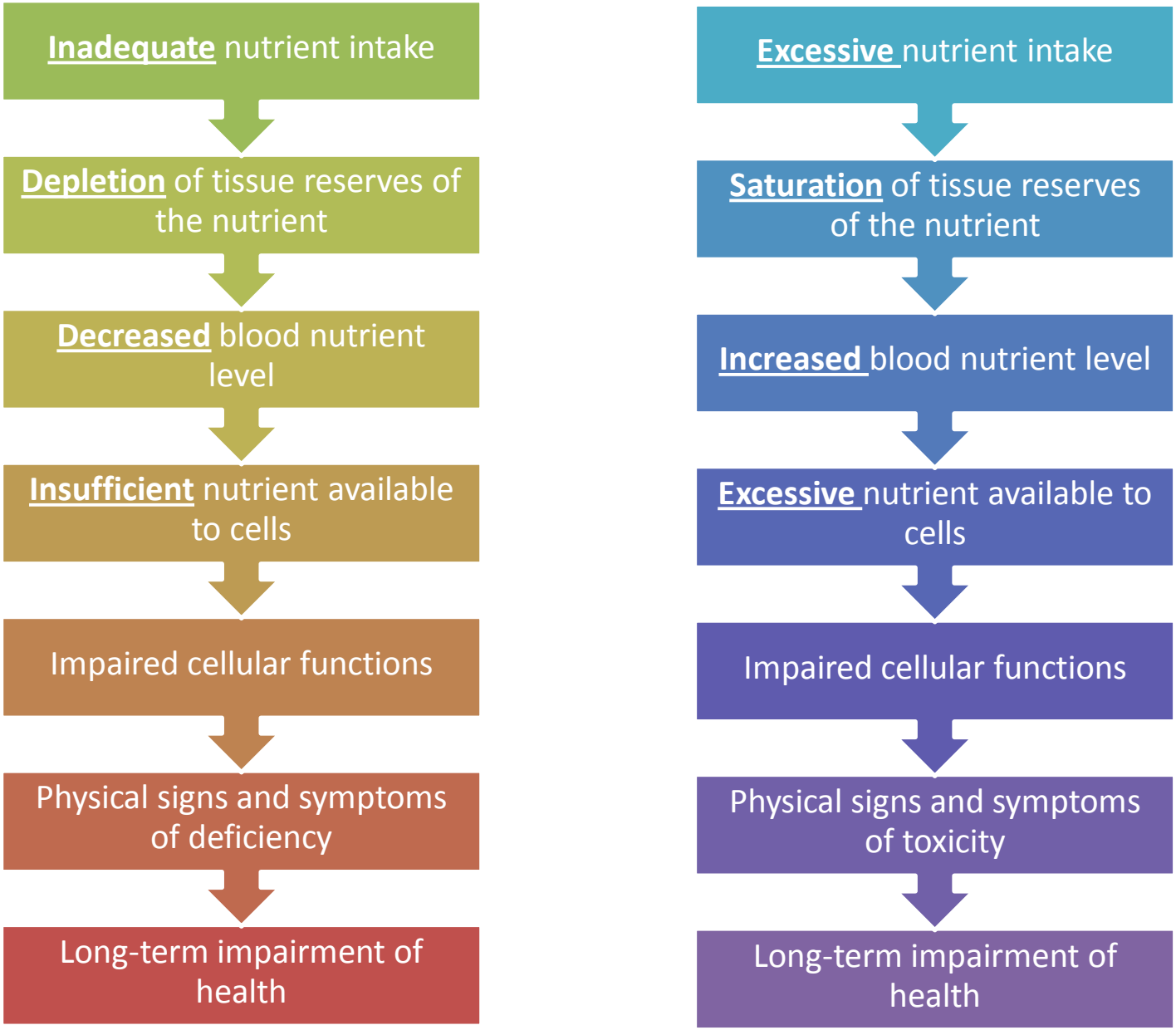
Ignoring the Thirst Signal

- Shortage of water increases fluid conservation
- Antidiuretic hormone
  - Released by the pituitary gland
  - Forces kidneys to conserve water (reduce urine flow)
- Aldosterone
  - responds to drop in blood pressure
  - Signals the kidney to retain sodium (water)

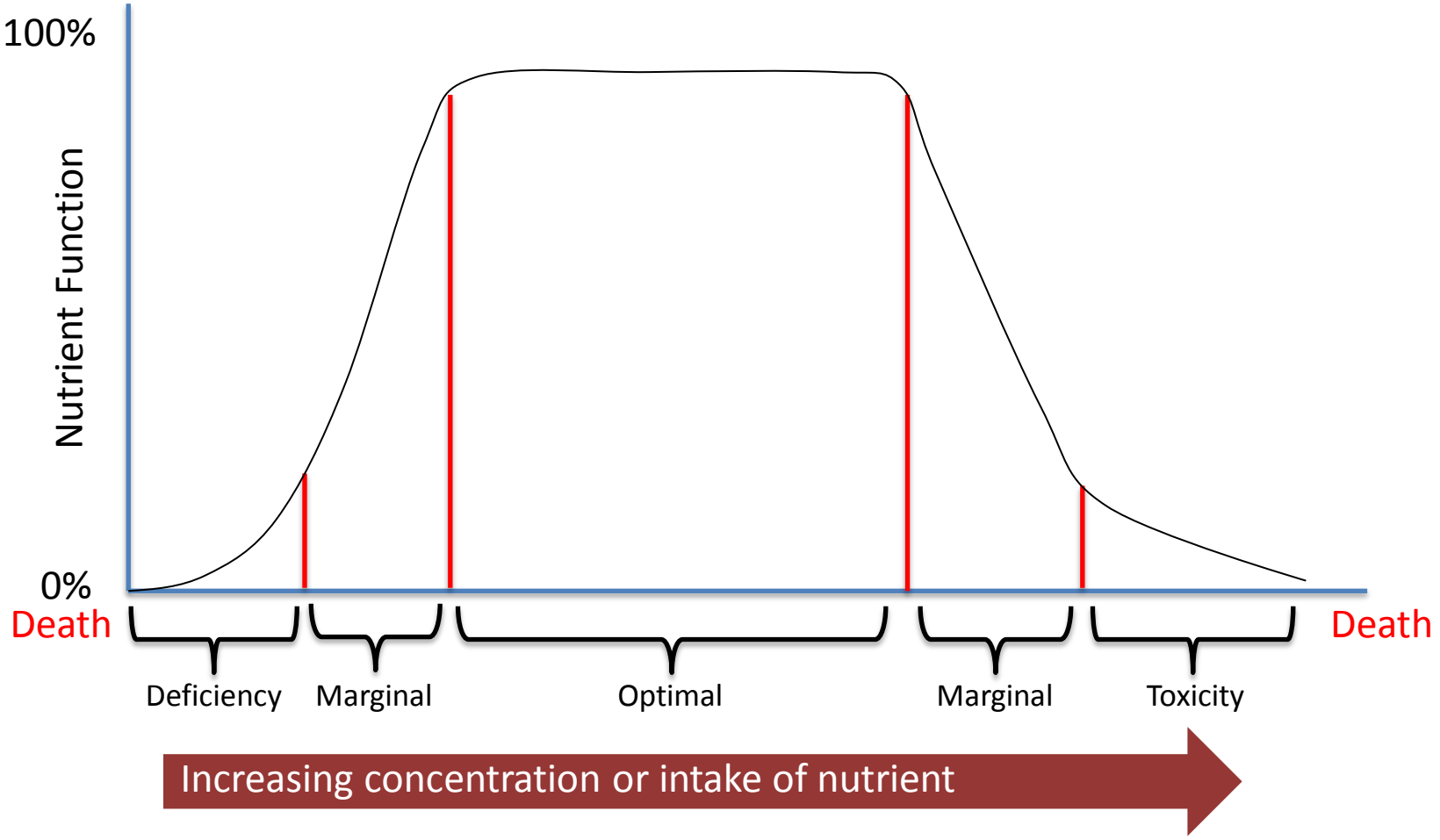
Too Much Water

- Overburden the kidneys
- Low blood electrolyte concentrations
- Blurred vision

Development of Nutrient Deficiencies and Toxicities



Food Security Dimensions

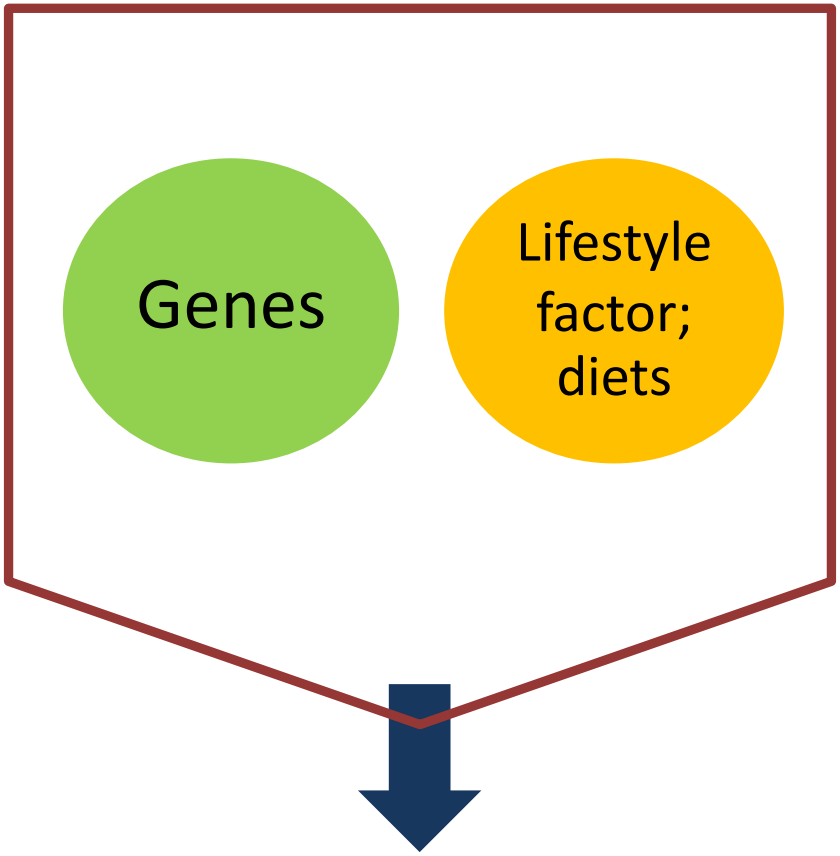


Notes to Care

Nutrient deficiencies are usually multiple

Malnutrition can result from poor diets, disease states, genetic factors or combinations of theses causes

Nutrient – Gene Interactions



Nutrigenomics & Nutrigenetics

Nutrient – Gene Interactions

- Consumption of whole oats lowers blood cholesterol level in some people but not others.
- High alcohol intake during pregnancy in some women sharply increases the risk of fetal alcohol syndrome in her fetus, but the fetuses of other women with different genetic traits are not affected by high alcohol intake.
- Regular consumption of green tea reduces the risk of prostate cancer in certain individuals with a particular genetic trait.

Secondary Metabolism in Plants and Fungi

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November 14, 2017

Primary and Secondary Metabolism

Primary Metabolites

- Amino acids & Proteins
- Carbohydrate
- Lipids

Secondary Metabolites

- Alkaloids
- Polyphenols
- Sterols
- Terpernoids

Primary and Secondary Metabolism

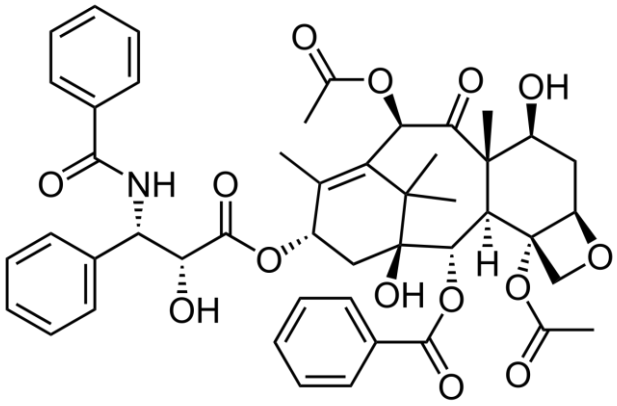
Primary Metabolites

- Limited structural variety
- Play key role in basic organism functions
- “Extra” biological effects limited

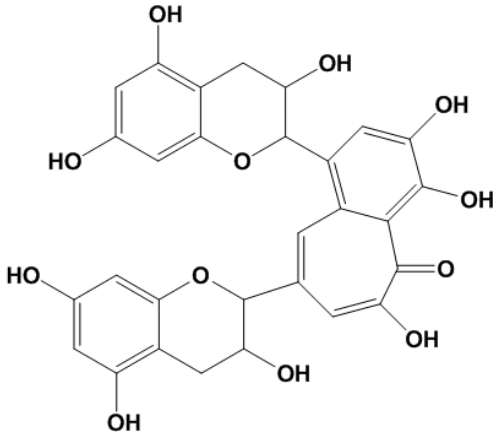
Secondary Metabolites

- Significant chemical diversity
- Role in organism function unclear
- Large number of “extra” biological effects

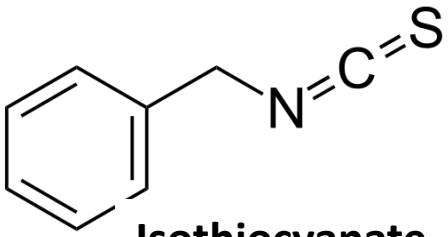
Secondary Metabolites



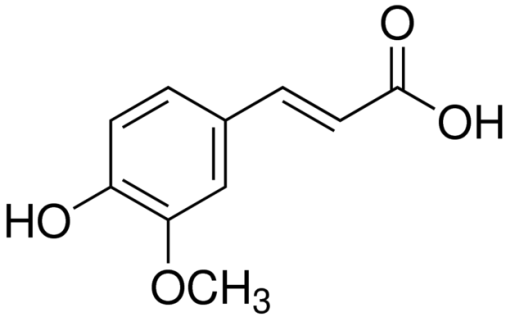
Taxol (anticancer)



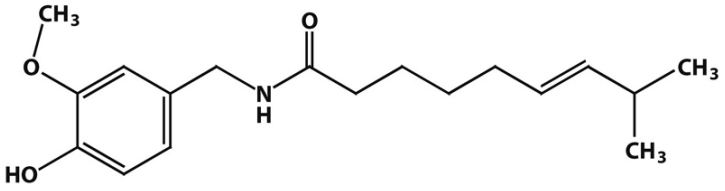
Theaflavin



Isothiocyanate

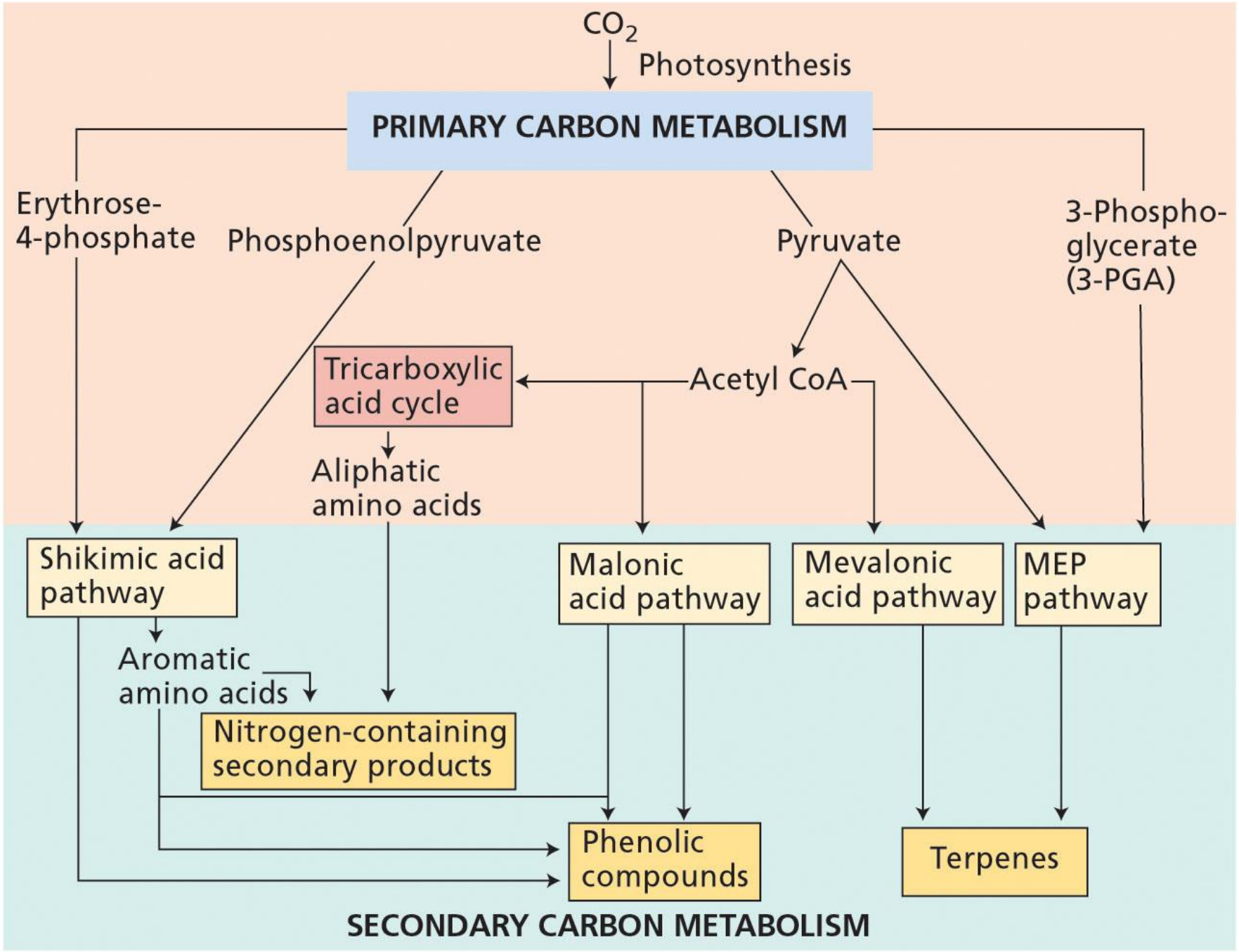


Ferulic acis



Capsaicin

Diversity of structures



What's the point of secondary metabolites?

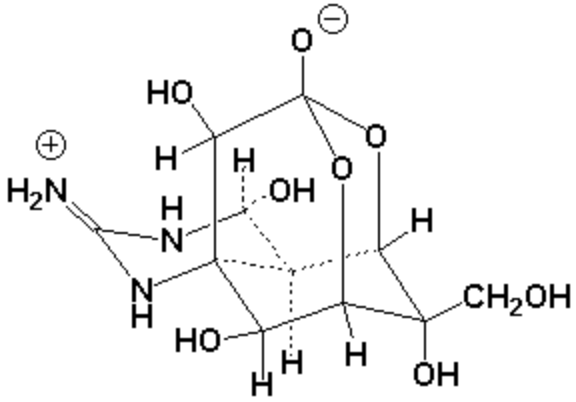
Two alternative hypotheses:

1. Secondary metabolites are "metabolic errors" and work to lock up waste products.

2. Secondary metabolism are evolutionarily selected defense mechanism.

Secondary Metabolites for Defense

- Tetrodotoxin is a potent sodium channel blocker.
- Produced by puffer fish.
- Removed during preparation.

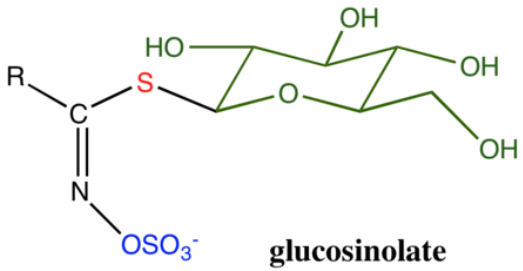


Lethal dose of TTX:

Cat: 10 µg/kg b.w.
Mouse: 334 µg/kg b.w.
Human (est.): 16 µg/kg b.w.

www.rsmas.miami.edu/groups/niehs/science/fugucontent.htm

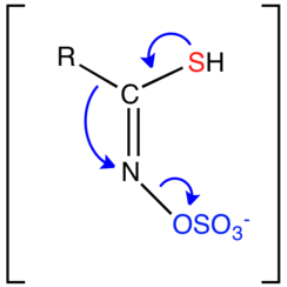
Secondary Metabolites for Defense



glucosinolate

myrosinase

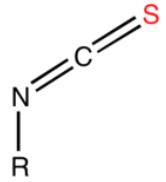
H_2O D-glucose



aglycone
(thiohydroximate-O-sulfonate)

neutral pH

sulfate, H^+

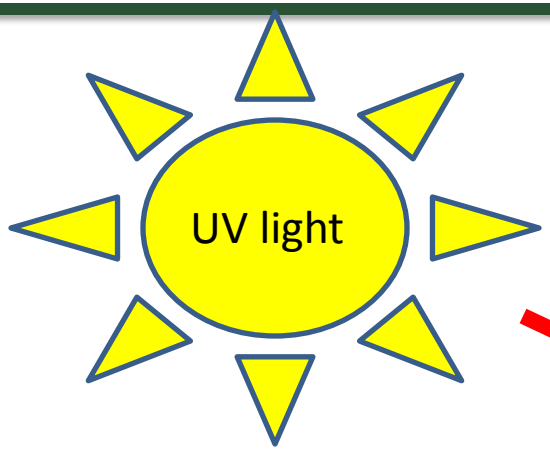


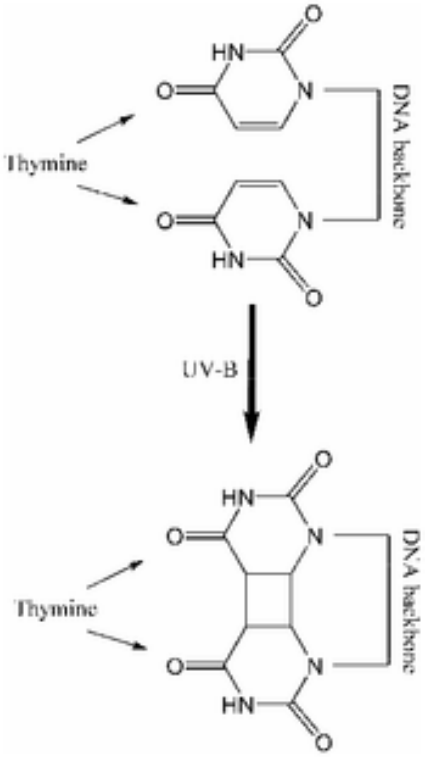
isothiocyanate

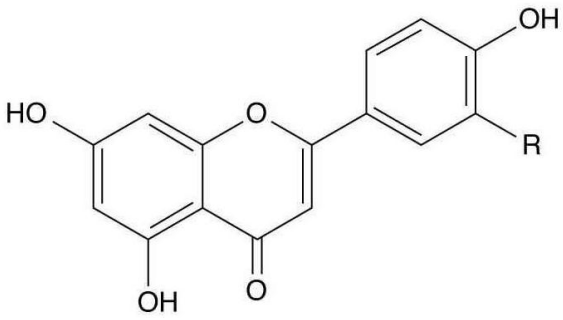
Eats cabbage

myrosinase

Secondary Metabolites for Defense

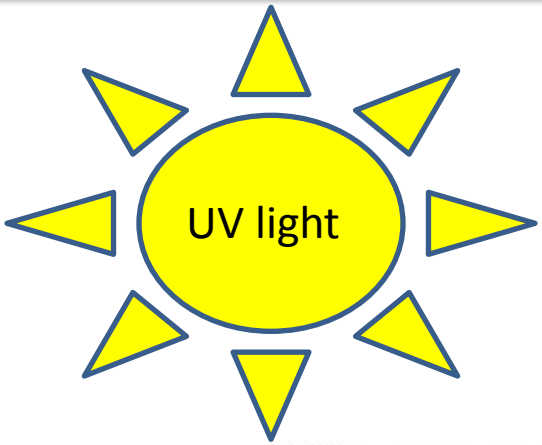


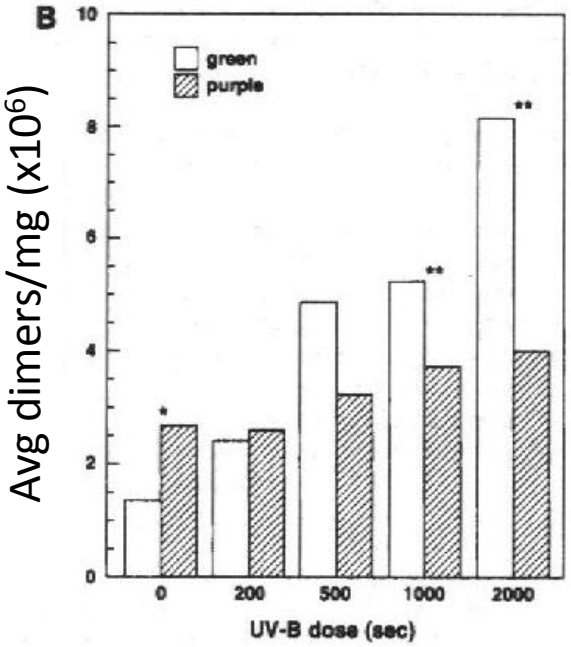


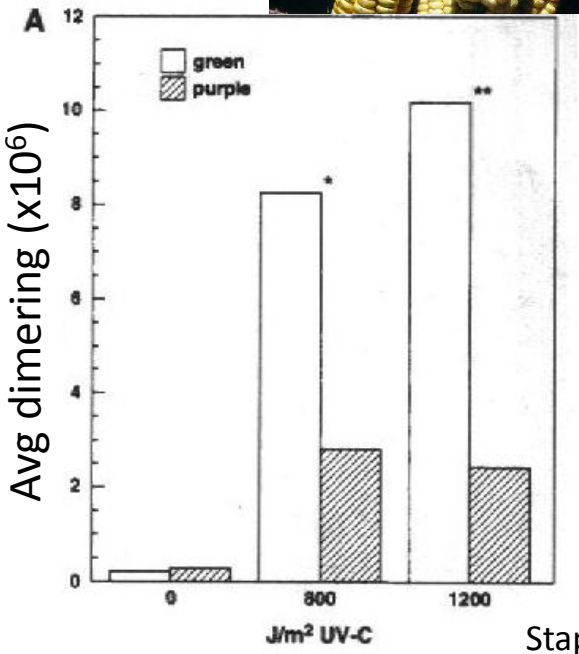


Mutation

Secondary Metabolites for Defense







Stapleton and Walbot, 1994

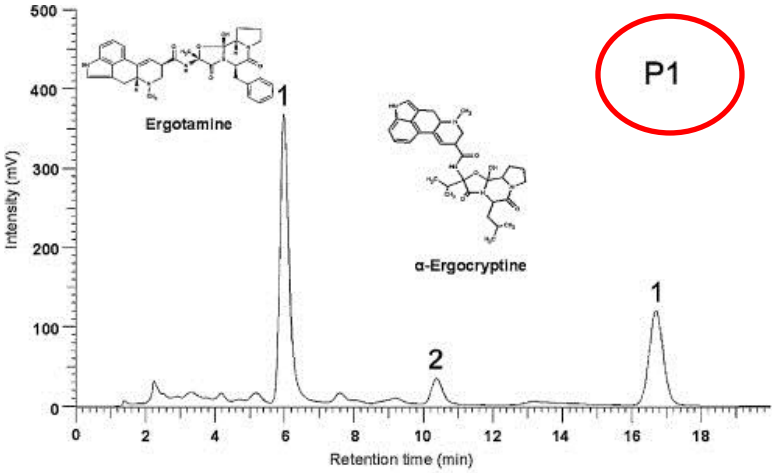
The levels and composition of secondary metabolites are affected by several factors.

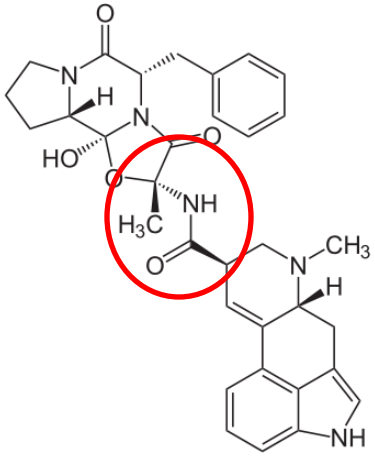
Genetics affect secondary metabolites

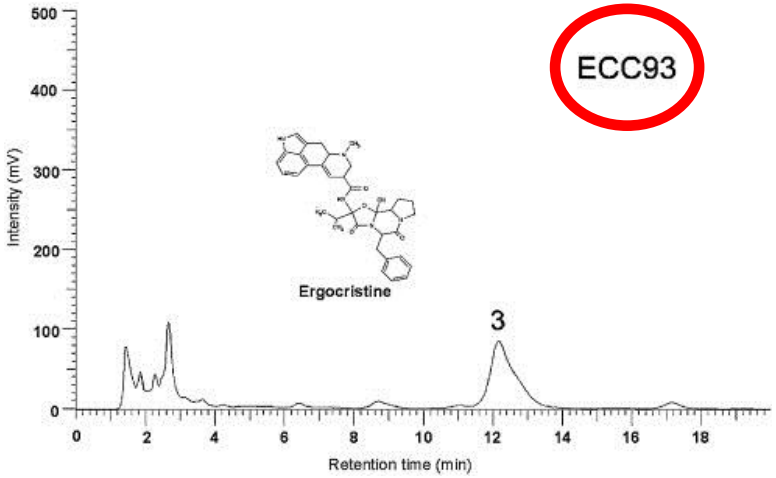
Altered anthocyanidin metabolism

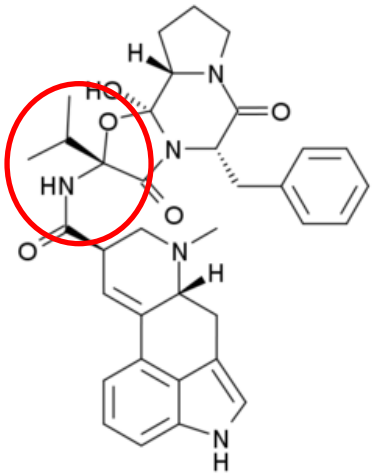
Genetics affect secondary metabolites

Claviceps purpurea (ergot)



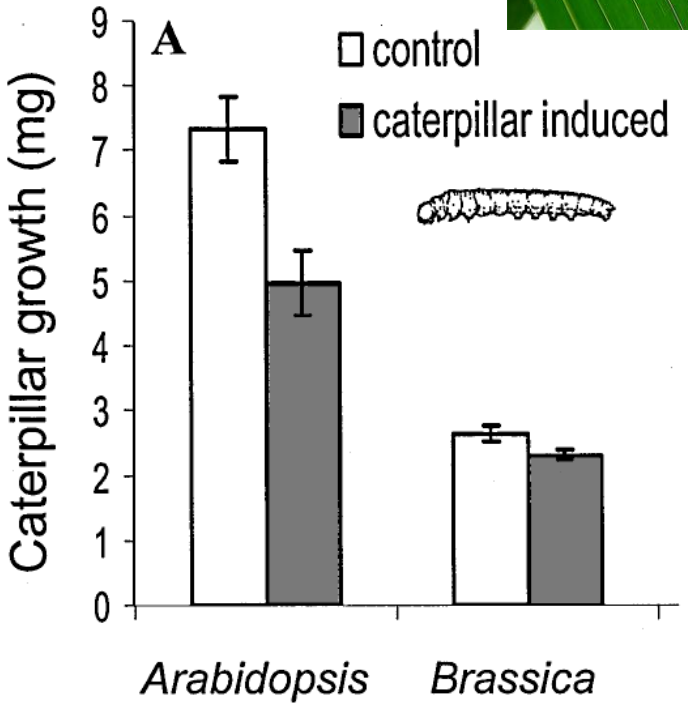






Phytochemistry 66 (2005) 1312

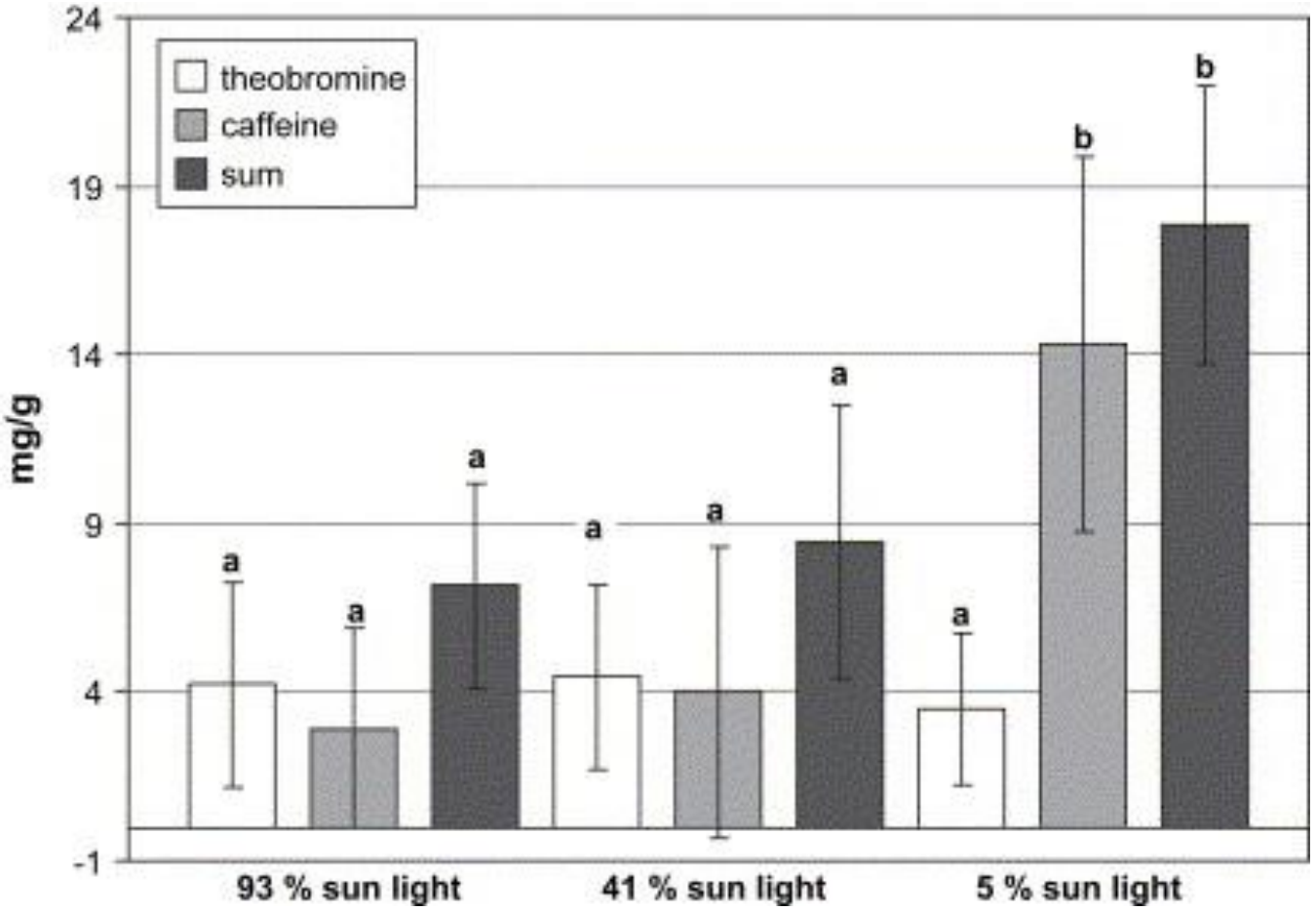
Environment affects secondary metabolites



J. Chem. Ecol 29 (2003) 1403

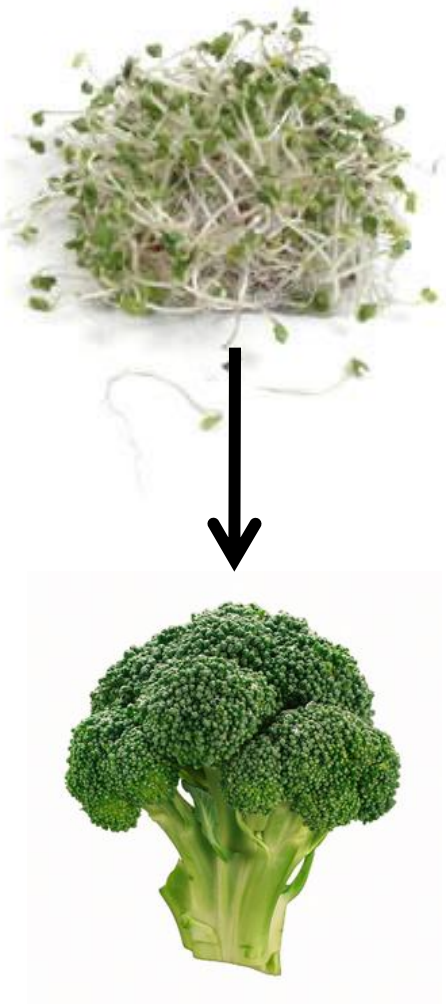
Environment affects secondary metabolites

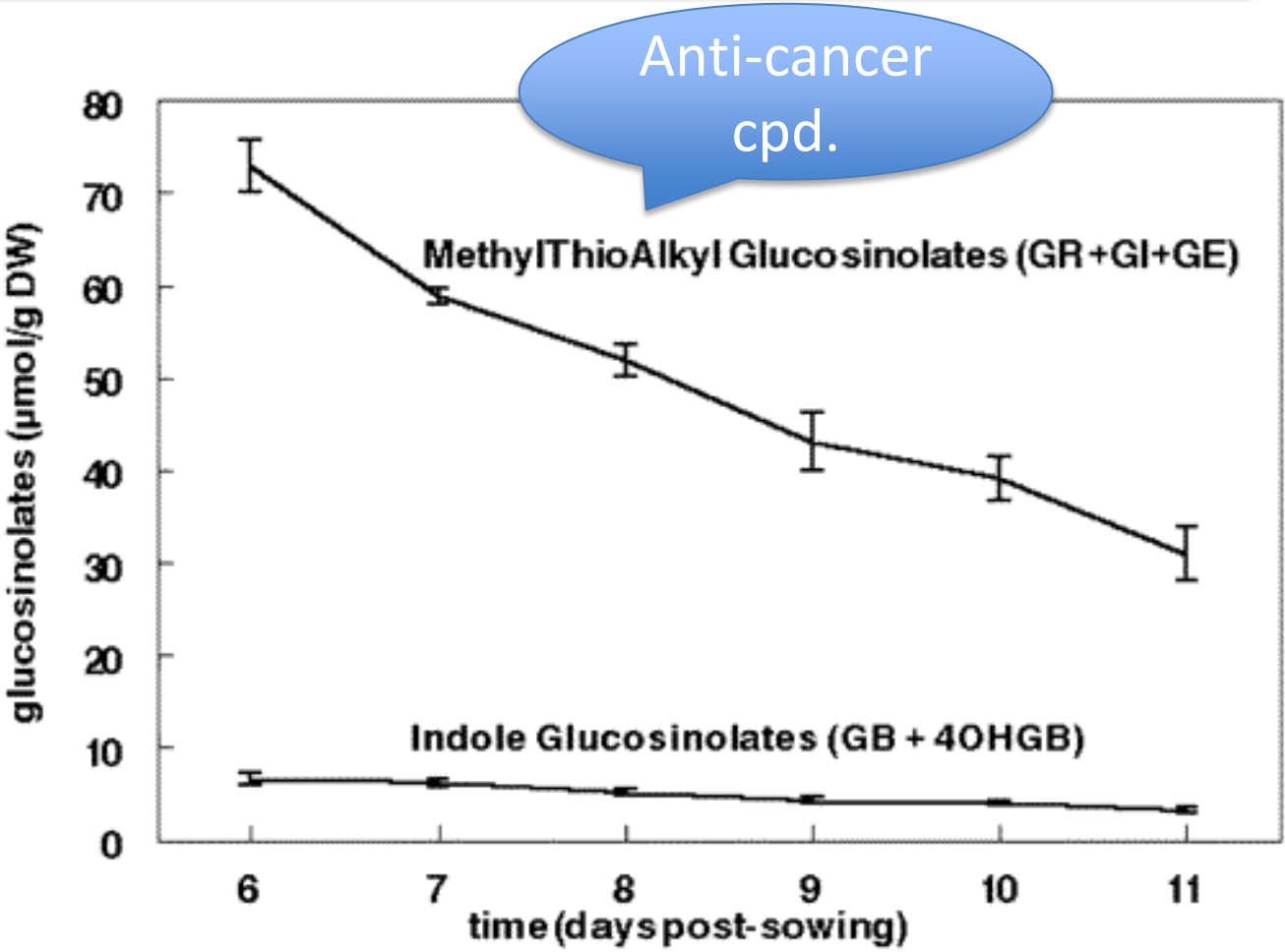
Maté



Biochem Systematics Ecol 35 (2007) 75

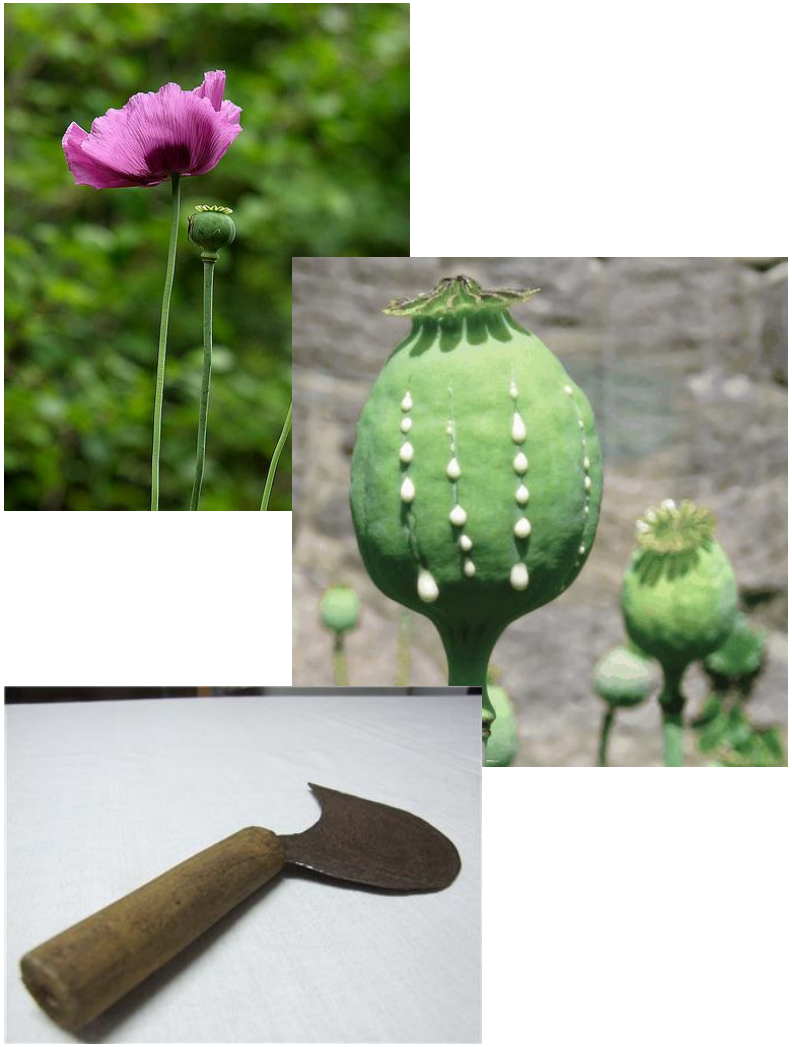
Ontogeny affects secondary metabolites

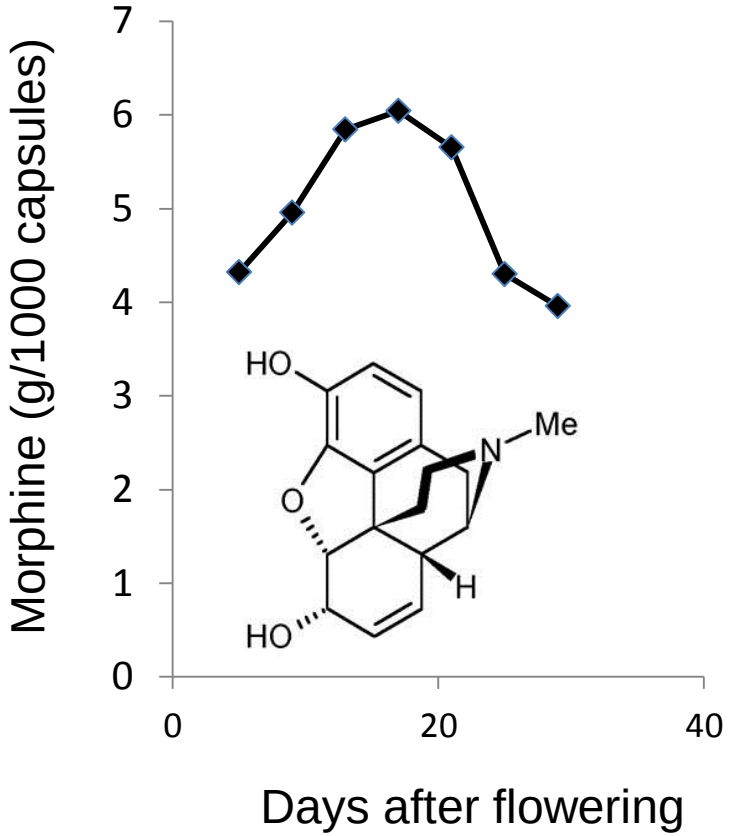




J. Agric. Food Chem. 50 (2002) 6239

Ontogeny affects secondary metabolites





Biochem J. 14 (1920) 618

Processing affects secondary metabolites

Green tea

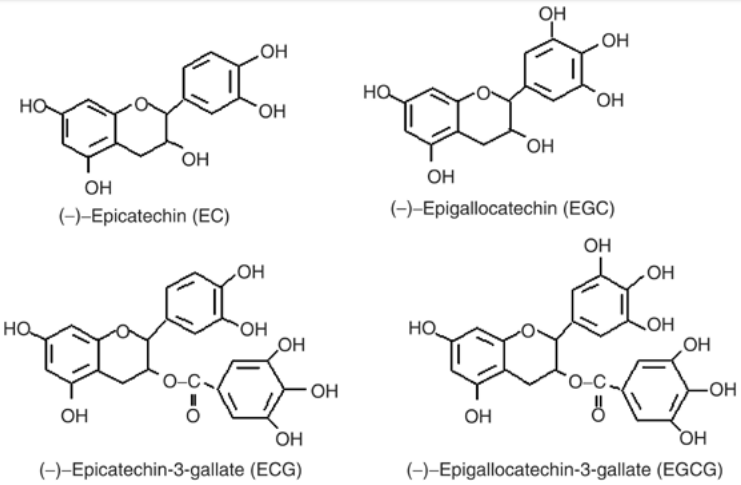
Oolong tea

Black tea

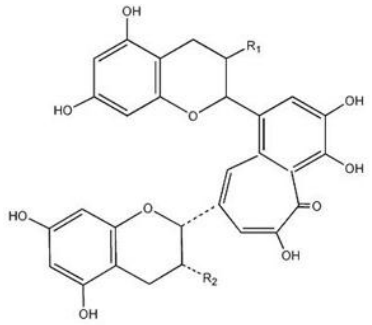
Processing affects secondary metabolites

Crush tea leaves

Polyphenol-mediated oxidation



catechins



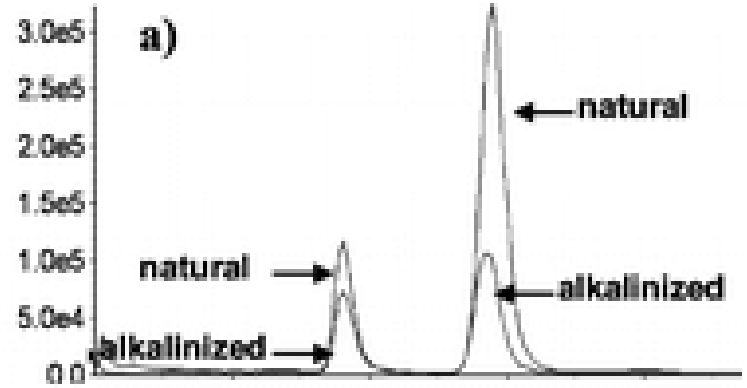
theaflavins

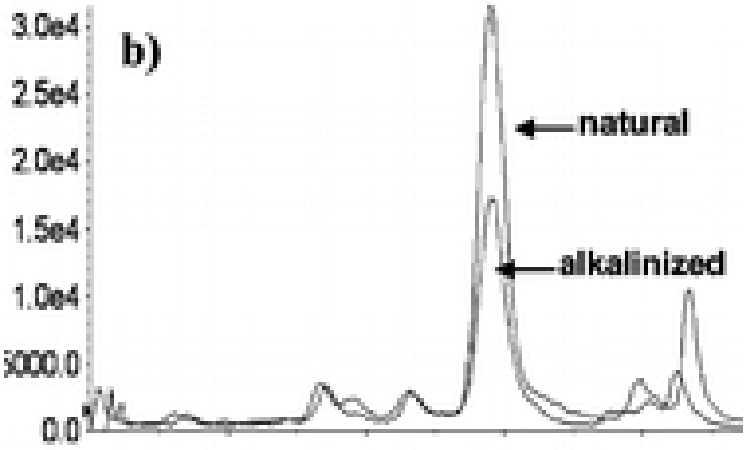
Processing affects secondary metabolites

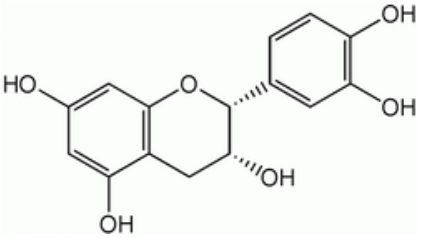
Natural Cocoa

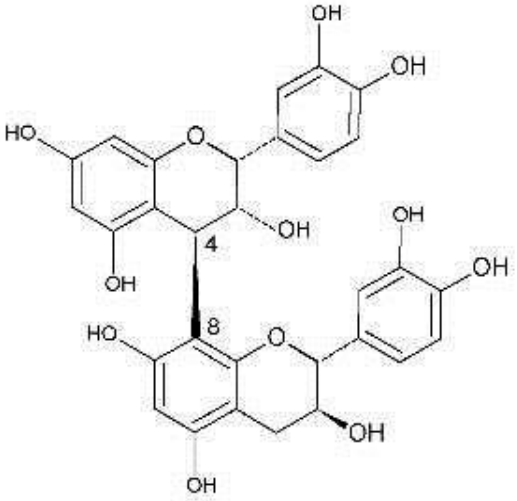
"Dutching"

Chocolate









Major classes of secondary metabolites

- Phenylpropanoids
- Alkaloids
- Terpenoids
- Glycosides
- Sterols

Flavonoids

Flavonoids

- There are more than 2000 known flavonoids
- Flavonoids and anthocyanins are conspicuous plant pigments.
- Flavones are responsible for the yellow and orange colors; and the anthocyanins are the source of red, violet and blue colors.

Flavonoids

- The flavonoids play a major role in attracting insects to feed and pollinate these plants.
- Some of them also have a bitter taste and repel harmful insects like caterpillars.
- Flavonoids are thought to be antioxidants, and play a major role in our diet, preventing the ravages of aging caused by free-radicals.

Thank You !

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