SUPPLEMENTS: FACT OR FALLACY?

Understanding Bio-Active Components of Plant-derived Dietary Supplements

Essential Oils

Milk Thistle

Cayenne

Goldenseal

Bruce H. Woolley
Professor Emeritus, Brigham Young University

NUTRITION GUIDELINES

HISTORY

- 1894: USDA's first nutrition guidelines. These essentially were: moderation in everything, eat a variety of nutrition-rich foods, watch your portion size, and avoid eating too much fat.
- 1943: USDA updated this to their "Basic 7″, which was spurred on by wartime rationing. These basic seven were: green and yellow vegetables; oranges, tomatoes, grapefruit, raw cabbage or salad greens; potatoes, fruits and vegetables; milk based products; meat and eggs; bread, flour, and cereals; and butter or margarine.
- 1956: "The Basic Four": "vegetables and fruits", milk, meat, and "cereals and breads".
- 1992:The Food Pyramid.
- Since 1980: USDA also has produced much more detailed nutrition guides than the quick-fix picture versions,
- 2010: Includes exercise. However, like the food pyramid and MyPlate, they seem to be heavily influenced by various groups within the agriculture industry.

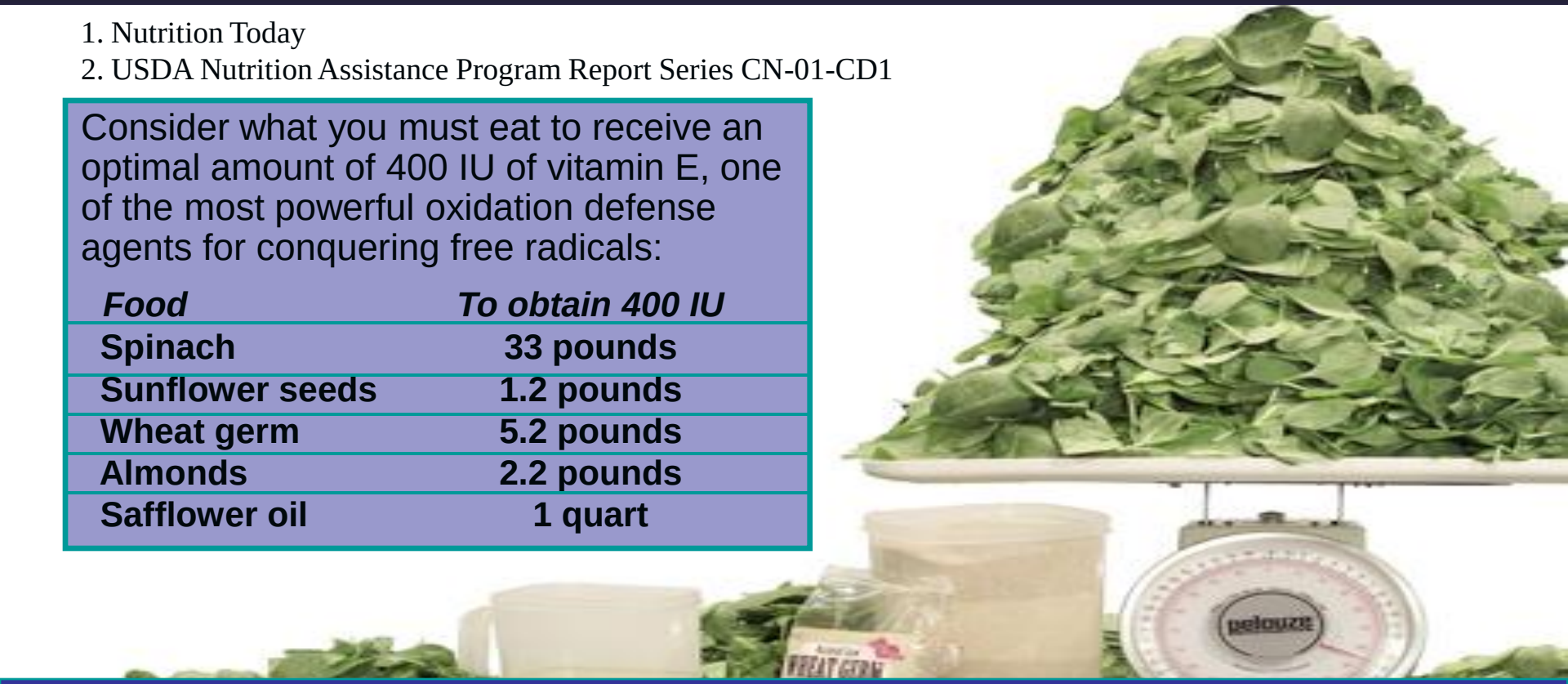
AM I RECEIVING THE NUTRIENTS I NEED?

The USDA surveyed 16,000 Americans and found that not one person obtained 100 percent of essential nutrients such as magnesium, vitamin E, and zinc.[1] Similarly, children and adolescents did not obtain enough essential nutrients such as folate, vitamin C, and calcium.[2]

1. Nutrition Today
2. USDA Nutrition Assistance Program Report Series CN-01-CD1

Consider what you must eat to receive an optimal amount of 400 IU of vitamin E, one of the most powerful oxidation defense agents for conquering free radicals:

Food	*To obtain 400 IU*
Spinach	**33 pounds**
Sunflower seeds	**1.2 pounds**
Wheat germ	**5.2 pounds**
Almonds	**2.2 pounds**
Safflower oil	**1 quart**

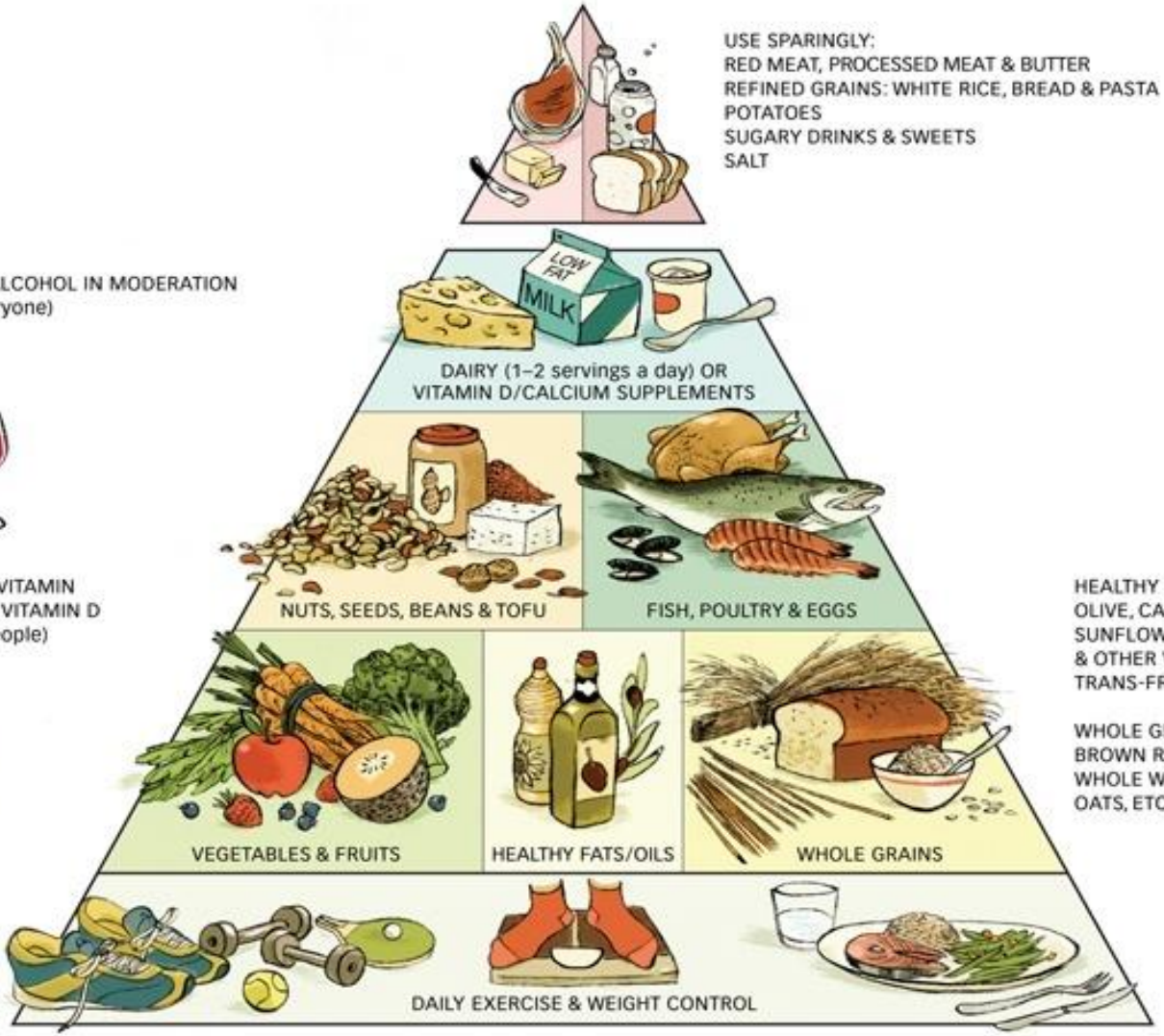


ARE WE USING SUPPLEMENTATION AS A SOLUTION?

10 HEALTH & FREEDOM

THE HEALTHY EATING PYRAMID

Department of Nutrition, Harvard School of Public Health



For more information about the Healthy Eating Pyramid:

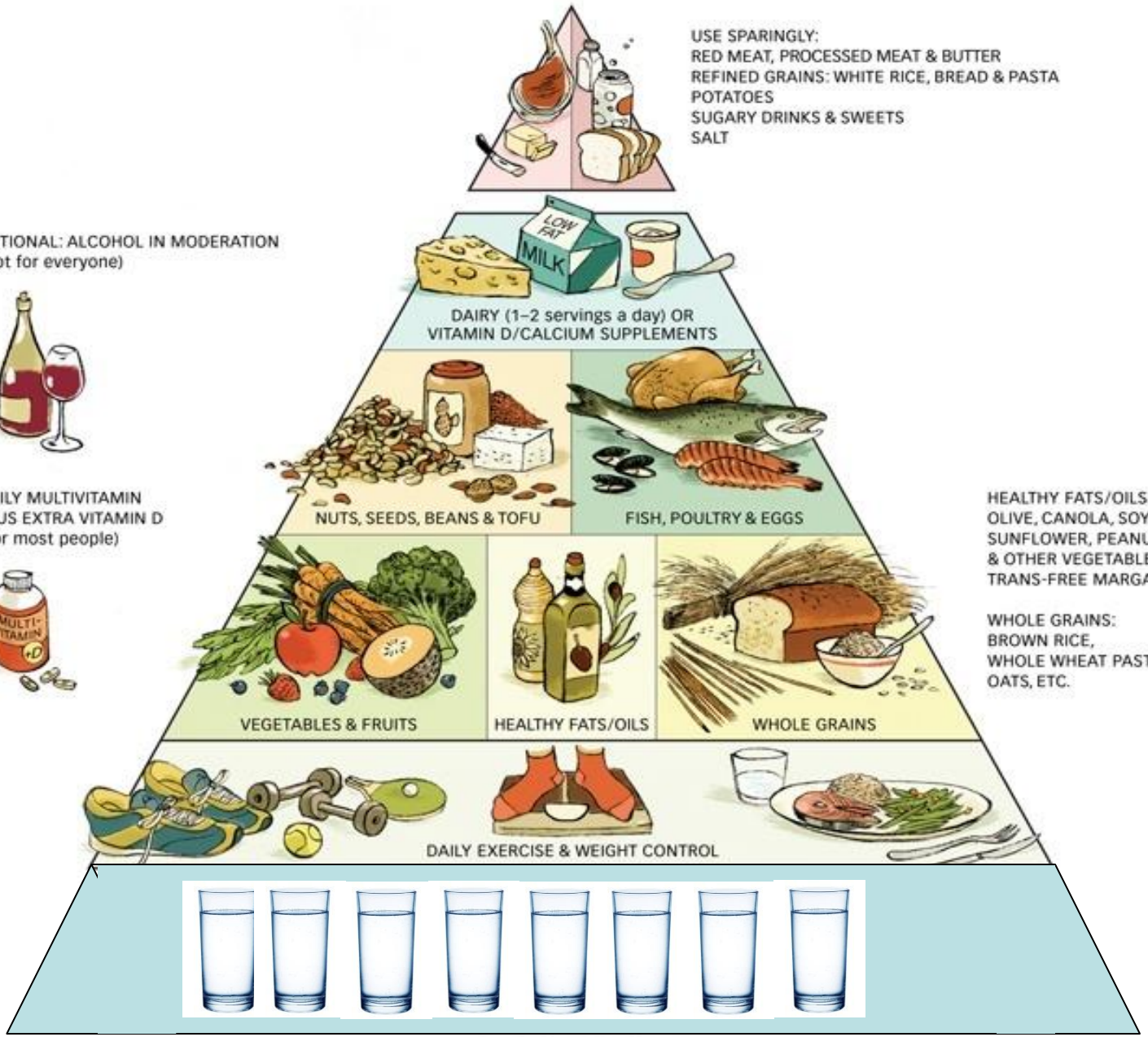
WWW.THE NUTRITION SOURCE.ORG

Eat, Drink, and Be Healthy
by Walter C. Willett, M.D. and Patrick J. Skerrett (2005)
Free Press/Simon & Schuster Inc.

Woolley

THE HEALTHY EATING PYRAMID

Department of Nutrition, Harvard School of Public Health



WHAT DOES "CLINICALLY PROVEN" MEAN ?

- Common claim/buzz word in health product advertising
  - Used to prey on your weaknesses
  - Very common in alternative medicine, weight loss, and food ads
- No official definition or regulation of the term [since DSHEA]
  - No method to determine if there is an actual clinical trial

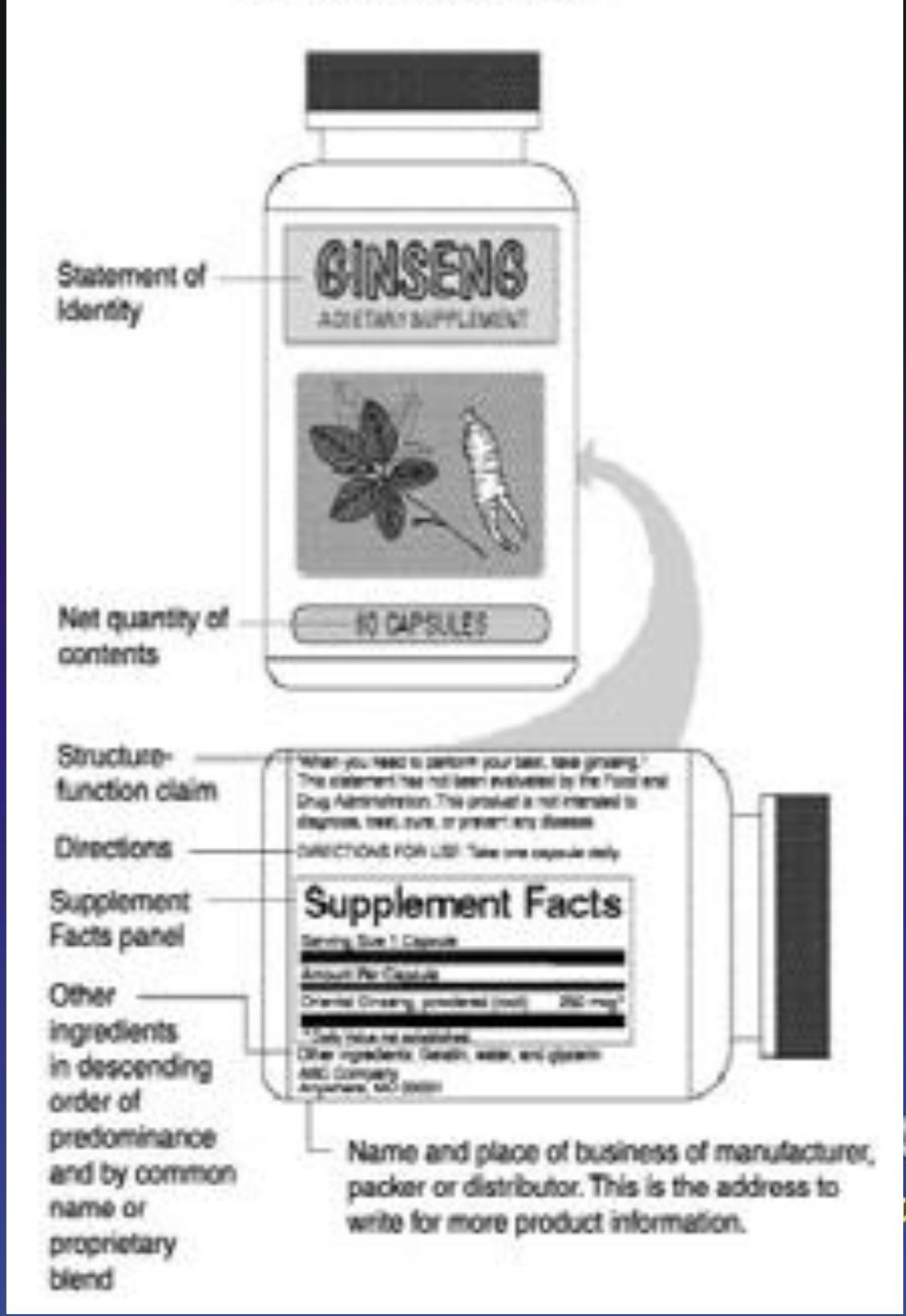
- Can mean different things to different people and is used to give a deceptive stamp of approval to a product which, in many cases, has no legitimate scientific evidence to support its efficacy.

First question should be, says who?

OBJECTIVES

- Understand the role of supplements in disease and health
- Identify various commonly used supplements along with their proposed uses
- Identify evidence based resources for providers and patients
- Discuss epidemiology and promotion of alternative medicines in U.S.
- Advise patients on risks and benefits of CAM

DIETARY SUPPLEMENTS LABELING



It is rapidly becoming the norm on social media that a “google degree” is considered by many to be equivalent to [or more valid than] an accredited medical or pharmacy degree.

May be necessary to hyphenate re-search because information may be based on looking up one article on google or yahoo and then re-turning back to read a second article.

TEN COMMON SUPPLEMENT CATEGORIES

- Multi- or single vitamins
- Essential Oils
- Meal Replacements / Weight Loss
- Sports Nutrition / Ergogenic Aids
- Anti-aging / Restorative Compounds
- Antioxidants
- Pre-, Pro-, Symbiotics
- Homeopathic Medicines
- Fish/animal Oil
- Glucosamine and Chondroitin

- Megadoses

NUTRITIONAL SUPPLEMENTS

DESIRED RESULTS

- Revitalize immune system
- Weight control
- Enhance healing and recovery
- Retard aging
- Heighten performance
- Alleviate perceived food allergies
- Diminish fatigue
- Enhance libido, potency, fertility
- Resist stress, anxiety, and depression

PubMed Dietary Supplement Subset

Search Dietary Supplements on PubMed

Search

About the PubMed Dietary Supplement Subset

ODS and the National Library of Medicine (NLM) partnered to create this Dietary Supplement Subset of NLM's PubMed. PubMed provides access to citations from the MEDLINE database and additional life science journals. It also includes links to many full-text articles at journal Web sites and other related Web resources.

The subset is designed to limit search results to citations from a broad spectrum of dietary supplement literature including vitamin, mineral, phytochemical, ergogenic, botanical, and herbal supplements in human nutrition and animal models. The subset will retrieve dietary supplement-related citations on topics including, but not limited to:

- *chemical composition;*
- *biochemical role and function — both in vitro and in vivo;*
- *clinical trials;*
- *health and adverse effects;*
- *fortification;*
- *traditional Chinese medicine and other folk/ethnic supplement practices;*
- *cultivation of botanical products used as dietary supplements; as well as,*
- *surveys of dietary supplement use.*

The PubMed Dietary Supplement Subset succeeds the International Bibliographic Information on Dietary Supplements (IBIDS) database, 1999-2010, which was a collaboration between the two U.S. government agencies, ODS and United States Department of Agriculture National Agricultural Library.

PHYTOCHEMICALS CLASSIFIED BY BOTANICAL METABOLIC PATHWAY

Echinacea

Milk Thistle

Cayenne

Goldenseal

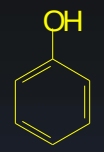
PHYTOCHEMICALS

"Phytochemicals have evolved due to the demands of an abiotic environment, natural enemies that attack plants and the plant's physiological regimes. These demands are referred to as *selection pressures* which represent powerful forces that over evolutionary time have lead to enormous structural diversity in phytochemicals. This structural diversity imparts to these genetically controlled chemicals a great variety of ecological and bioactive functions. The diversity of chemicals result from **three major pathways**; the shikimic acid pathway, mevalonic acid pathway, and metabolic activities that result in the production of a broad group of compounds that contain nitrogen and have physiologic activity."

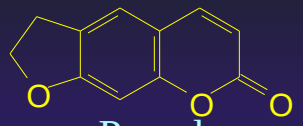
Rex G. Cates, PhD

PHYTOCHEMICALS

SHIKIMIC ACID PATHWAY

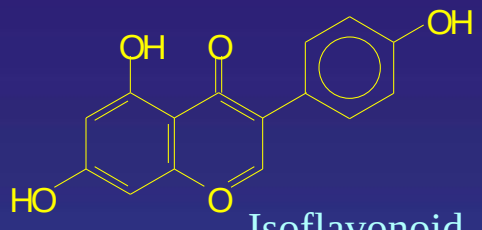
[Aromatic Compounds with a Phenol Group ]

- Phenolics
  - Phenylpropanes
  - Phenylpropane Lactones [coumarins, furanocoumarins]
  - Benzoic Acid Derivatives



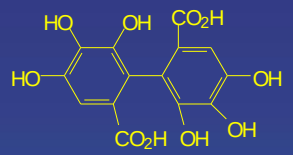
Psoralen
a furanocoumarin

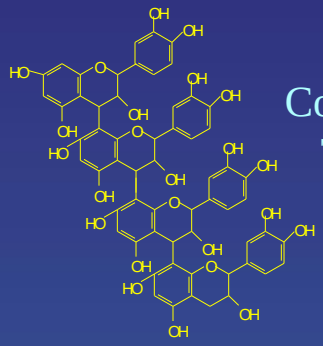
- Flavonoids (anthoxanthins) [glycosides with a benzopyrone foundation] [six classes – >4,000 structures]
  - Flavones
  - Flavonols
  - Isoflavonoids [phytoestrogens]
    - Anthocyanidin
    - Flavonones
    - Flavononols



Isoflavonoid

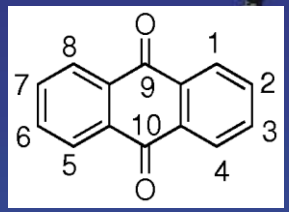
- Anthraquinone Glycosides
- Tannins
  - Hydrolyzable
  - Condensed





Condensed Tannin

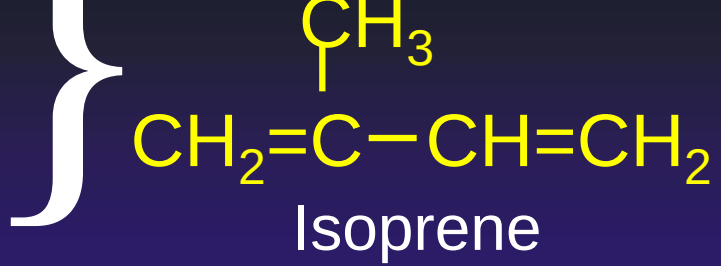
9,10 Anthraquinone



PHYTOCHEMICALS

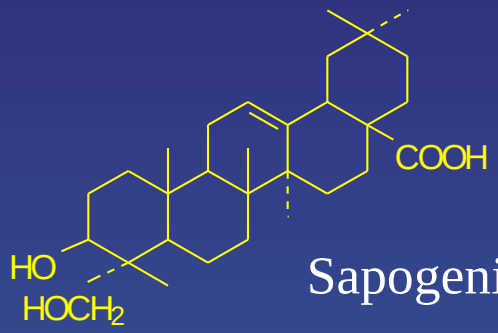
MEVALONIC ACID PATHWAY

- Monoterpenes [2 isoprenes]
- Sesquiterpenes [3 isoprenes]
- Diterpenes [4 isoprenes]
- Triterpenes [6 isoprenes]



Isoprene

- Limonoids [carotenoids]
- Cardiac glycosides
- Saponin glycosides [sapogenin released upon hydrolysis]



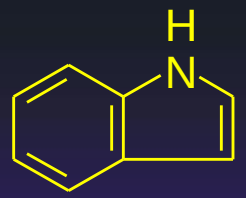
Sapogenin

isoprene is converted by free radicals and ozone into various species, such as aldehydes, hydroperoxides, organic nitrates, and epoxides, which mix into water droplets and help create haze

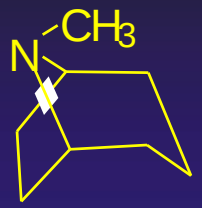
PHYTOCHEMICALS

NITROGEN-CONTAINING COMPOUNDS

- Alkaloids [cyclic nitrogen compounds]
  - Indoles [>25% of all known]



  - Tropanes



  - Quinolines
  - Isoquinolines
  - Pyrrolizidines
  - Pyridines
  - Purines
- Noncyclic nitrogen
- Cyanogenic glycosides [seeds, pits] [hydrogen cyanide]
- Isothiocyanates (Mustards) [chemical group –N=C=S, formed by substituting the oxygen with a sulfur]

Medicines Derived from Plants

- Atropine *(Atropa bellodonna)*
- Capsaicin *(Capsicum frutescens)*
- Colchicine *(Colchicum autumnale)*
- Cocaine *(Erythroxylon coca)*
- Codeine *(Papaver somniferum)*
- Digoxin *(Digitalis purpurea)*
- Ephedrine *(Ephedra sinica)*
- Ipecac *(Cephaelis ipecacuanha)*
- Physotigmine *(Physostigma venenosum)*
- Quinine *(Chinchona officinalis)*
- Salicylin *(Salix purpurea)*
- Senna *(Cassia acutifolia)*
- Scopolamine *(Datura fastuosa)*
- Resperpine *(Rauvolfia serpentina)*
- Taxol *(Taxus brevifolia)*
- Vincristine *(Catharanthus roseus)*

A LOOK AT SOME CURRENTLY POPULAR SUBSTANCES

Echinacea

Milk Thistle

Cayenne

Goldenseal

ECHINACEA
(*Echinacea purpurea*)

Active Compounds: Alkylamides, caffeic acid deriv., polysacharrides , arabinogalactane

Pharmacology: Inc macrophage phagocytosis, inh hyaluronidase, nonselective COX inhibitor, enhance WBC count & migration

Clinical trials: Immunostimulant effect, dec. duration of flu/cold symptoms, prevent colds (?)

Toxicity: Unpleasant taste; N/V, diarrhea (>0.5%), hepatitis [root], hypertension, related to ragweed [cross allergenicity?]

Precautions: Artificially stimulating immune system may induce immunofailure upon withdrawal

Interactions: Antihistamines, glucocorticoids, cyclosporine

Contraindications: Pregnancy, autoimmune disease, TB, lupus, HIV, Multiple Sclerosis [long-term use]

GINKGO
(*Ginkgo biloba*)

Active Compounds: Ginkgolides, biloballides, flavonoid glycosides [only use 24% flavone glycosides & 6% terpenes]

Pharmacology: Improves cerebral blood flow, antioxidant, anti-clotting, intermittent claudication

Clinical trials: Cerebrovascular insufficiency, intermittent claudication, early Alzheimer's disease

Toxicity: GI irritation, headache, allergic skin reactions

Precautions: Avoid using unprocessed leaves in any form [contains urushiol - causes the itch in poison ivy]

Interactions: Aspirin, anticoagulants [garlic, ginger, fevefew, dong quai, vitamin E, omega-3 FA]

Contraindications: Allergy, [not studying for exams]

MA HUANG
(Ephedra sinica)

Active Compounds: Ephedrine
Pharmacology: CNS and cardiovascular stimulant
Clinical trials: Increases cardiac blood flow [at the expense of other tissues/organs], ?weight loss
Toxicity: Nervousness, seizures, hypertension, cardiac arrhythmias, CVA, MI, death
Interactions: Stimulants, decongestants, MAOI, CV agents, caffeine [exacerbates the effects]
Precautions: No long-term use [>7 days], products not contain >8mg, no more than 24 mg daily

St. JOHN'S WORT

(*Hypericum perforatum*)

370 members of Hypericum genus
4 subspecies of perforatum

Active Compounds: Naphodianthrones, flavenoids, phloroglucinols, essential oils, tannins, coumarins,carotenoids

Pharmacology: Antidepressant , antibiotic, antiviral [simplex 1&2,Sindhis, parainfluenza 3]

Clinical trials: MAOI inhib; inhib serotonin, NE, DOP reuptake [only one that alters all three]; stim. mononuclear phagocytes; suppresses interleukin 6 release

Toxicity: GI irritation, allergic reactions [itching], fatigue, restlessness , photosensitivity, cataracts, dizziness

Contraindications: Pregnancy [positive Ames mutagenicity test]

Interactions: Antidepressants, cisaparide, losartan, OCs,anesthetics theophylline, indinavir plasma conc decreased [P4503A4, 1A3 inducer], tacrolimus [decreased plasma conc] [*Transplantation* 2002.73:1009]

Woobley

ALGAE

(Chlorella [green]) (Spirulina [blue-green])

Active Compounds: single-celled photosynthesis
Pharmacology: weight loss, super food, boost immune system, high cholesterol, memory loss, cure blood malignancy
Clinical trials:

Caution: ~30% cannot tolerate chlorella. If at anytime one develops nausea or starts "burping up" the chlorella taste, then the chlorella should be stopped immediately as a food sensitivity is developing that will only worsen if you continue taking it.
Toxicity: nausea, stomach upset, fatigue, lethargy
Precautions: diabetes, alcohol dependence, liver disease
Contraindications: pregnancy, breast feeding

KAVA
(*Piper methysticum*)

Active Compounds: Kavalactones

Pharmacology: Antianxiety (Polynesia), CNS depression, serotonin effects, rodent studies

Clinical trials: Positive trials in anxiety (small sample size)

Side effects: Skin yellowing [excessive dose], scaly dermatitis, [long-term use], “puffy face”, over-sedation [short-term use], Parkinson-like acute reactions

Interactions: Serotonergic substances; may potentiate ethanol, barbiturates, benzodiazepines

Precautions: CNS depressants & stimulants [due to euphoric response]

Contraindications: Pregnancy, allergy

Woolley

SAW PALMETTO
(*Serenoa repens*)

Active Compounds: Liposterolic extract, compds not certain

Pharmacology: Inhibits testosterone-activating hormones, binding to prostate receptors

Clinical trials: Relief of BPH, compared with Rx meds
2 controlled studies – opposite conclusions

Side effects: GI upset, headache [rare, mild]

Interactions: None reported

Contraindications: Pregnancy, r/o prostate cancer

GARLIC
(Allium sativum)

Active Compounds: Thiosulfides [allicin, ajoenes, vinyldithiins]

Pharmacology: Anti-clotting, lower cholesterol, vasodilator, antibiotic, anticancer

Clinical trials: Antihyperlipidemic, mild hypertension, prevent atherosclerosis, peripheral arterial disease

Side effects: Oral and GI irritation, cardiodepression, botulism carrier

Interactions: Anticoagulants, hypoglycemics, synergism with eicosapenhtenoic acid [EPA]

Contraindications: Allergy

GINSENG
(Panax ginseng)

Active Compounds: Eleutherosides [lignans, triterpenes], senticosides
Pharmacology: Adaptogen, resistance to stress
Clinical trials: Normalize blood pressure, lower cholesterol, positive mental state and outlook
Side effects: [Long-term] drowsiness, insomnia, irritability; [Acute] pericardial pain, palpitations, headache
Interactions: Hypoglycemics, antihypertensives, hormones, caffeine, antipsychotics
Precautions: Diabetes, cardiac patients, steroid therapy
Contraindications: Febrile states, rheumatic heart disease

VALERIAN ROOT
(*Valeriana officinalis*)

Active Compounds: Volatile oil, Valepotriates [alkaloids]

Pharmacology: CNS depression, benzodiazepine receptor binding. [Sedative in agitation. Stimulant in fatigue.]

Clinical trials: Improve sleep quality, latency, & insomnia in normal subjects.

Side effects: Insomnia, headache, addiction potential , hepatotoxicity. Large doses may cause: central paralysis, ataxia, hypothermia, ↓heartbeat, ↓intestinal motility, ↓muscle relaxation, etc.

Interactions: Sedative-hypnotics, antidepressants, alcohol, benzodiazepines, St. John's wort, melatonin

Contraindications: Pregnancy

GINGER
(Zingiber officinale)

Active Compounds: Gingerols, shogaols, flavonoids
Pharmacology: Antiemetic [morning sickness] (stomach not CNS), nonselective cyclooxygenase inhibiton, increases bile secretion, anti-clotting, heartburn
Clinical trials: Double-blind trials in seasickness, post-operative nausea, questionable in morning sickness
Side effects: CNS depression, cardiac arrhythmias [overdose], liver damage [in animals]
Interactions: Anticoagulants, alcohol [“Jake Walk”, neuralgic problem from Ginger Beer in 30's]
Contraindications: Gallbladder disease, pregnancy

HerbalGram 38:47-50

Woolley

ALOE
(Aloe vera)

Active Compounds: Socaloin, barbaloin, capaloin, [unstable]
Pharmacology: Activates macrophages & fibroblasts, inhibits thromboxane synthesis, stimulates colonic peristalsis
Clinical trials: Decreases skin inflammation, stimulates wound and burn healing, antibacterial & antifungal [topical]
Side effects: Skin rash, catharsis, kidney irritation
Interactions: None reported
Precautions: Delay healing in vertical surgical wounds [topical]
Contraindications: Allergy, pregnancy, hemorrhoids

CAYENNE

(*Capsicum annuum, Capsicum frutescens*)

Active Compounds: Capsaicin, carotenes, Vits. A & C

Pharmacology: Stimulates appetite, gastric secretion. Raises metabolic rate

Clinical trials: Treatment of anorexia, intranasal for chronic allergic rhinitis, cluster migraines, post-herpetic neuralgia

Side effects: GI irritation

Interactions: MAOI, stimulate hepatic metabolism of drugs, monitor antiplatelet or anticoagulant drugs

Contraindications: Allergy

Precautions: Handwashing to prevent direct transfer to mucous membranes

CHAMOMILE

(Matricaria recutita [German]
Chamaemelum nobile [Roman])

Active Compounds:
Pharmacology: Antianxiety, antiinflammatory, diarrhea, hemorrhagic cystitis, exzema, hemorrhoids, vaginitis
Clinical trials: Sedation, wound healing
Toxicity: Allergy, anaphylaxis, enhance CytP 3A3, 2D6
Interactions: inc CNS effects, inc antiplatelets, vomiting with metronidazole & disulfiram, inc antiestrogenic effects with red clover & soy
Precautions: Cross allergy
Contraindications: pregnancy, breast feeding

Woolley

"SUPERFRUIT" ANTIOXIDANTS

- *Morinda citrifolia*
- *Garcinia mangostena*
- *Euterpe oleracea [Açai palm]*
- *Theobroma grandiflorum*
- *Opuntia Ficus Indica*

Finding the next big obscure, 'superfruit' flavor purported to have concentrated nutrient value.

NONI FRUIT
(Morinda citrifolia)

Active Compounds:

Traditional Uses: Analgesic, promotes healing, antidiarrheal, insecticide, antibiotic, emmenagogue, asthma, lumbago, and dysentery.

Pharmacology: $5HT_2$ receptor inhibition [hypotensive]

Clinical trials: increased concentrations inhibited growth of DMBA capillary vessels[9], prevented formation of cancer cells in rats (using detection methods of reduced DNA adducts) and compared the free-radical properties of vitamin C, grape seed powder (GSP), and pycnogenol (PYC) at daily dose U.S. RDAs. [11]

Toxicity: neurotoxic, hyperkalemia, transaminase elevation

MANGOSTEEN FRUIT

(Garcinia mangostana)

Active Compounds: Xanthones, gartanin, 8-disoxygartanin, and normangostin [Xanthones introduced as insecticide, 1939

Traditional Uses: Antioxidant, antibacterial/fungal, anti-tumor, antihistamine and antiinflammatory. Arthritis, diabetes, cholesterol, cardiovascular diseases [including ischemic heart disease, atherosclerosis, hypertension, thrombosis fibromyalgia], and immune disorders

Pharmacology: Source of EFA, vitamins and minerals, especially A, C and E, flavinoids,other bio-active compounds

Clinical trials: extracts [lab tests] stop growth of certain bacteria and fungi. No antioxidants in sufficient concentration. No published clinical trials showing evidence that either the fruit or its juice is effective treatment for arthritis, cancer or any other human disorder.

AÇAI PALM
(*Euterpe oleracea*)

Active Compounds: Anthocyanins, polyphenols, vanillic acid, p-hydroxybenzoic acid. [All degrade substantially during storage or heat]

Traditional Uses: Used a pesticide, livestock feed. Purported reversal of diabetes and other chronic illnesses, expanding size of penis and increasing men's sexual virility. Recently marketed as a weight-loss supplement.

Pharmacology: Source of EFA [oleic, palmitic, linoleic], neglible vitamin C, calcium, iron, protein, carbohydrates, other bio-active compounds

Clinical trials: Invitro studies report extracts have some antioxidant capacity, but little, if any, after ingestion. As of April 2012, there are no scientifically controlled studies providing proof of any health benefits from açaí. No açaí products have been evaluated by the FDA, and their efficacy is doubtful

Cupuaçu,
[coop-oo-ah-Soo]
(*Theobroma grandiflorum)*

Active Compounds: Polyphenolic tannins [theograndins] theobromine, catechins, quercetin, kaempferol, isoscutellarein. Tree grows 70' tall. Fruit is a foot long, contains seeds and white pulp [similar to cacao].

Traditional Uses: Emollient [high fat content], used as defoliant in Amazon, analgesic, ease childbirth, vigor and potency,energy, alertness.

Pharmacology: Taste similar to chocolate, Source of EFA, vitamins and minerals, especially A, C and E, flavinoids,other bio-active compounds

Clinical trials: extracts [lab tests] stop growth of certain bacteria and fungi. No antioxidants in sufficient concentration. No published clinical trials showing evidence that either the seeds or its 'butter' is effective treatment for arthritis, cancer or any other human disorder.

Prickley pear cactus juice

NOPALEA CACTUS
(Opuntia Ficus Indica)

"There is no scientific evidence that this juice works. There is evidence that it has the same healthy properties you would find from eating your fruit and vegetables every day nothing more. There are no medical reviews or tests that have taken place; it's just the manufacturer's word you have to go on. There have been claims that the juice has caused hot flushes and chest pains in some users, but this is a tiny handful in comparison to all the happy customers all over the world."

"…partially correct about phytochemicals having anti-inflammatory properties… they also have antioxidant properties and hundreds of other beneficial health boosters.
BUT, they are contained naturally in all plants and really, a variety of fruits, vegetables and whole grains is what you need. You can't focus in on one phytochemical because they ALL work together"

Woobbey

SUMMARY AND CONCLUSION

Echinacea

Milk Thistle

Cayenne

Goldenseal

RULES OF THUMB

Avoid using herbs in:

- Infants and children
- Pregnant women and nursing mothers
- People with allergies to plants of *Compositae*
- Chronic medical conditions where contraindications to certain herbs are unforeseen
- In people who take multiple medications

- With drugs having similar active ingredients or actions
- At the same time with other medications or supplements
- That increase or decrease time for absorption or excretion

Prevention's Guide Healing Herbs, July 27, 2009, p. 31