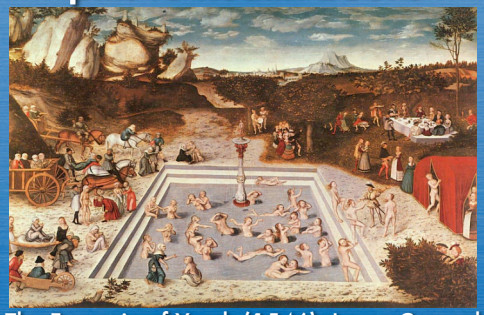
Junk science and reversing the course of aging: from monkey pills to health books



The Fountain of Youth (1546), Lucas Cranach

A&S300-002 Jim Lund

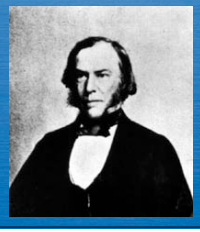
Early attempts to reverse aging

- Gilgamesh, legendary king of the Sumerian city of Uruk, sought immortality and failed.
- In the 8th century, the Chinese advocated the use of extracts of testicles for treatment of impotence.
- Ponce de Leon, searched for the Fountain of Youth in Florida, 1513.

- Ko Hung, Chinease Taoist, believed transformation from sickness to health could be mediated by 'vitalizing substances': herbs, minerals, chemicals, gold, cinnabar.
- Alchemy, the art of transformation, spread to the Arab world by the 8th century, and then to Europe by the Middle Ages.
- Roger Bacon, 13th century English natural philosopher, pursued Alchemical approaches to reversing aging.
- In Bacon's time, the young were thought to have large amounts of 'vital breath', and old men sought to absorb it by close association with young women.
- Luigi Cornaro, 15th century Italian, recommended conserving 'vital principal' by moderate and healthful living, small meals.

Charles-Edouard Brown-Sequard

- Dr. Brown-Sequard, 72, distiguished professor at the College de France
  - In 1889 (year Eiffel Tower opened)
  - Injections of liquid extract of testicles of guinea pigs and dogs -> rejuvenate a man.
  - Experimented on himself.



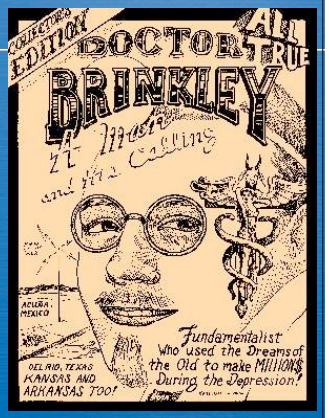
Brown-Sequard CE. (1889) Effects in man of subcutaneous injections of freshly prepared liquid from guinea pig and dog testes. CR Seances Soc Biol Ger 9:415–419.
Brown-Sequard CE 1889 Note on the effects produced on man by subcutaneous injections of a liquid obtained from the testicles of animals. Lancet 2:105–107.

Testosterone is discovered!

- In the early 1900's Eugen Steinach discovered testosterone.
- Grafted young testicles on old animals, reported rejuvenation and 25%+ lifespan extension.
- 1916, Chicago: Frank Lydston, well-known and respected surgeon:
  - Grafted slices of animal testicle onto his, reported rejuvenation (+sex!), started craze.
  - Experimented with transplantation or implantation of either human or animal testicular tissue.

Goat balls!

- Fad of quack 'gland' treatments.
- Most famous: John Romulus Brinkley, Kansas, 1917
  - goat testicle grafts
- 1930s, monkey glands.
- Sheep extracts.
- Fad finally died out.



Anti-aging treatments

- No proven treatment reverses aging!
- Some of the outward signs of aging can be partially reversed.
  - Skin treatments: retinoids, alpha-hydroxy acids.
- **No proven treatment reverses aging!**

Anti-aging treatments

- Unproven or hypothetical treatments.
- Pseudoscience.

The Seven Warning Signs of Bogus Science by Robert L. Park

1. The discoverer pitches the claim directly to the media.
2. The discoverer says that a powerful establishment is trying to suppress his or her work.
3. The scientific effect involved is always at the very limit of detection.
4. Evidence for a discovery is anecdotal.
5. The discoverer says a belief is credible because it has endured for centuries.
6. The discoverer has worked in isolation.
7. The discoverer must propose new laws of nature to explain an observation.

Scientification: using scientific sounding jargon to puff up the claims.

Aging junk science

- Monkey glands
- Human growth hormone
- DHEA
- Melatonin
- Vitamins
- Herbs
- Supplements
- Oxygen chambers
- "Purification"

Classic pseudoscience

- L-carnosine:
- "a uniquely important anti-aging discovery."
- "Astounding News"
- "What's the Secret?"
- "discovered in Russia in the early 1900s"
- "That's a 600% improvement in how they felt."
- "A new Russian study on mice has shown that mice given carnosine are twice as likely to reach their maximum lifespan as untreated mice. "

http://www.jonbarron.org/anti-aging-program/01-01-2005.php

VITAMINS AS ANTIOXIDANTS

Do certain vitamins, taken at levels much higher than RDA, protect the body from heart disease, cancer, and other problems by acting as *antioxidants*?

WHAT ARE ANTIOXIDANTS?

- We need oxygen (O_2) to get energy from food.
- But some times side products (*Reactive Oxygen Species, ROS*) are formed.
- These include superoxide anion, hydroxyl radical, and hydrogen peroxide.
- Reactive oxygen species can damage fats (lipids), proteins, and nucleic acids, leading to disease.
- *Antioxidants* are chemicals that protect against this damage.

ANTIOXIDANT VITAMINS AND MINERALS

- Vitamin E (alpha tocopherol) and beta carotene can intercept free radicals and prevent oxidative damage.
- Vitamin C can help restore vitamin E.
- Selenium is part of enzymes (glutathione peroxidase, thioredoxin reductase) that help deal with oxidative damage.

ANTIOXIDANT VITAMINS IN FOOD: GOOD

Many *retrospective* studies have shown that large amounts of vitamin E, vitamin A/beta carotene, and vitamin C in the diet are associated with less chance of some serious diseases. These include heart disease, cancer, Parkinson's, disease, and stroke (not all of these vitamin/disease combinations have clear links).

ANTIOXIDANTS FROM SUPPLEMENTS: IN GENERAL

NO BENEFIT; MAY BE HARMFUL

Doesn't slow or reverse aging!

Several very large studies of antioxidant vitamins taken as *supplements* have, in general, found no benefits.

In some cases the doses tested seemed slightly harmful.

Possible: A *diet high in fruits and vegetables is more healthful than the typical Western diet.*

MEGADOSES OF VITAMIN C

- Large doses (thousands of milligrams) advocated by Linus Pauling and followers.
- But studies have shown that it does not prevent colds (may reduce symptoms slightly).
- Does not improve survival of cancer patients.
- Above about 200 mg per day gives no further increases in plasma levels.
- Doesn't affect lifespan.

DIETARY SUPPLEMENTS: REGULATION

- Supplements (including herbs) are regulated under 1994 *Dietary Supplement Health and Education Act* (DSHEA)
- Basically supplements are **unregulated—companies don't have to prove supplements are safe or that they work. Quality and dose can vary wildly.**
- Burden is on the FDA to show that products are not safe, but FDA lacks resources to enforce (except in a few cases).
- Products are often promoted with little or no evidence of effectiveness

DIETARY SUPPLEMENTS – LABELING REGULATIONS

- *Health claims* refer to prevention and treatment of a specific disease; must be approved by FDA. Example: soluble fiber from whole grain oat foods, as part of a diet low in saturated fat and cholesterol, may reduce the risk of heart disease.
- There are also *qualified health claims*. Example: supportive but not conclusive research shows that omega-3 fatty acids may reduce the risk of heart disease.
- *Structure and function claims* – vague statements about supporting functions of body. Do not need FDA approval.

Label from glucosamine/chondroitin product illustrating structure and function claim

GENERAL QUESTIONS TO CONSIDER IN EVALUATING A SUPPLEMENT

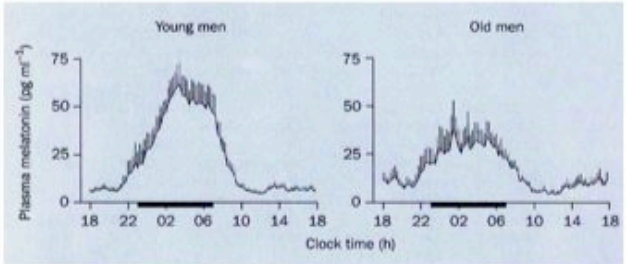
- Will the product survive the acidic conditions in the stomach, and the digestive enzymes in the intestine? (Enzymes and other proteins will be degraded.)
- Will the product be absorbed, reach the blood, and enter the cell where it is supposed to work (crossing at least three cell membranes)?
- Is the product likely to be incorporated or used in an effective manner at that site?

Many products do not satisfy these conditions.

Hormone supplements as anti-aging therapy

- A number of powerful hormones decline with age: DHEA, growth hormone (GH), testosterone, melatonin.
- **1990 growth hormone study reignited interest in hormone replacement.**
  - The study involved 12 men, aged 61 to 81, who were apparently healthy but had IGF-I levels below those found in normal young men.
  - The 12 men were given growth hormone injections three times a week for six months and compared with 9 men who received no treatment.
  - The treatment resulted in a decrease in adipose (fatty) tissue and increases in lean body (muscle) mass and lumbar spine density
  - Rudman et al., Effects of human growth hormone on men over 60 years old. New England Journal of Medicine 323:1-6, 1990.

Melatonin levels decline with age



Daily plasma melatonin levels in young men (20–27-year-olds) and old men (67–84-year-olds) (mean + s.e.). Despite the decline in maximum nocturnal levels of melatonin with age, there is little direct evidence in humans that melatonin supplements can attenuate or reverse age-related changes in health. Black bar, bedtime. Adapted from ref. 8.

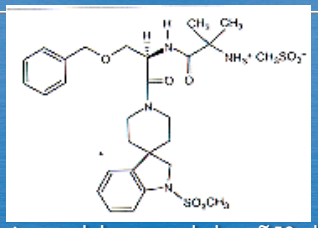
Turek, 1996, Nature v379, 295-6.

DHEA

- Dehydroepiandrosterone, a natural steroid hormone that declines with age.
- Animal studies show many benefits.
- Some positive results in recent human trials (fat reduction, hypertension).
- Not known if long-term use is safe.
- Not known if over-the-counter doses are effective.
- Not shown to affect aging.

Restoration of Growth Hormone Levels

Restoration of Growth Hormone Levels
Non-peptide Secretagogues



- Merck. Inc has invented dozens and has ~50 plus patents
- Continuous infusion generates pulsatile GH release in the elderly
- Apparently in cooperation with the suppressive effect of Somatostatin.
- Ineffective (may not release GH, releasing GH will not have these effects!
- Not proven safe!

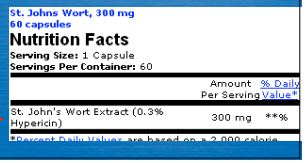
Glucosamine and Chondroitin Sulfate

- Glucosamine is a sugar that (in modified form) is part of complex molecules (proteoglycans) in cartilage.
- Made in body, not needed in diet
- Promoted as arthritis treatment
- Possibly could act outside the cell to prevent proteoglycan breakdown
- Controversial whether it works. Some trials (sponsored by manufacturers) have had positive results, while others have been negative.
- Often sold with *chondroitin sulfate*. Highly unlikely that this large molecule could be taken up and delivered to a place where it would be useful.

HERBS – GENERAL CONSIDERATIONS

- Regulated along with dietary supplements.
- Can vary considerably in the concentration of active ingredients depending on source, season, growth conditions.
- Manufacturers may make *standardized* preparations to deal with this problem.
- However, sometimes the active ingredients are not known.
- Some products are adulterated with conventional drugs, or contaminated with heavy metals (more likely with imported products).

Standardized to presumed active ingredient


St. Johns Wort, 300 mg
60 capsules
Nutrition Facts
Serving Size: 1 Capsule
Servings Per Container: 60
Amount Per Serving | % Daily Value*
St. John's Wort Extract (0.3% Hypericin) 300 mg **%

RECOMMENDATIONS

- Discuss use of supplements and herbs with your physician and other health care providers (some of them are weak in the head too).
- Remember that "natural" does not mean safe.
- Be watching for results of new research. Often results from one study are contradicted by later studies.
- People who are trying to sell you something are not reliable sources of information.
- Examples of reliable sources: federal agencies, medical organizations, universities, and major organizations fighting disease.

RESOURCES

- National Center for Complementary and Alternative Medicine, "Dietary and Herbal Supplements"
  http://www.nccam.nih.gov/health/supplements.htm
- Food and Drug Administration, Dietary Supplements site
  http://vm.cfsan.fda.gov/~dms/supplmnt.html
- National Institutes of Health, Office of Dietary Supplements
  http://dietary-supplements.info.nih.gov/
  (see especially "Dietary Supplement Fact Sheets")
- Stephen Barrett's "Quackwatch" site, "'Dietary Supplements,' Herbs, and Hormones"
  http://www.quackwatch.org/01QuackeryRelatedTopics/DSH/suppsherbs.html
- On-line reading and handouts for "A Scientific Look at Alternative Medicine"
  http://biochemistry.louisville.edu/education/altmed.htm
  (see pages on Dietary Supplements and Weight Loss; Herbs and Mind-Body Medicine)

"Anyone who claims that they can stop or reverse the aging process is lying to you - even if they're a doctor. It is not currently possible,"

"Anti-aging medicine is an industry intended to make money for those who are selling these products."

-S. Jay Olshansky, demographer, University of Illinois at Chicago.