Teacher Enrichment Program

Bite of Science

November 13th, 2017

Loyola University Maryland
Baltimore, MD
Complementary and Alternative Medicines: Friend, Foe, or Fraud?
Overview

• What is CAM?
• CAM usage
• Why am I studying this?
• What do I actually study?
• Immune system overview
• Our experiments and data
• Take home
• Take to the classroom
What is Complementary and Alternative Medicine (CAM)?

• Defined as “a group of diverse medical and health care systems, practices, and products that are not presently considered to be part of conventional medicine.”

• Examples: Acupuncture, Tai Chi, Yoga, Herbs, etc.
Percentage of US adults claim to have used CAMs (of any form) in the past.
CAM Usage in the U.S. (Barnes, 2004)

• 62% of adults 18+ used CAM in the past year
  • More women than men; higher educated; sicker; with more pain
What do you think are the most commonly used forms of CAM?
Here are the top 10 CAMs used each year. How do you think they rank?

- Meditation
- Deep breathing exercises
- Massage
- Natural products (e.g., herbal remedies)
- Participation in a prayer group
- Praying for self
- Yoga
- Diet-based therapies (e.g., gluten-free, paleo, etc.)
- Chiropractic

Start the presentation to activate live content.

*If you see this message in presentation mode, install the add-in or get help at PollEv.com/app*
CAM Usage in the U.S. (Barnes, 2004)

Top 10:

- 43% prayed for self
- 24% others prayed for you
- 19% natural products
- 12% deep breathing exercises
- 10% participate in prayer group
- 8% meditation
- 8% chiropractic
- 5% yoga
- 5% massage
- 4% diet-based therapies
Complementary and Alternative Medicines

• Recent interest by the National Institutes of Health
  • Formation of National Center for Complementary and Integrative Health (formerly NCCAM)

• NIH’s Goal: Functional Integrative Medicine

• Barriers to that goal:
  • Treatments not regulated by FDA
  • High consumption
  • Low funding, therefore relatively little research
  • The funding/research is beginning to change
Why am I studying this?

- Graduate and post-doctoral work
- Shift to research at Loyola
  - Involves the innate immune system
  - Can involve undergraduates
  - Safe
  - Publishable
  - Move slowly

The Localization and Activity of Sphingosine Kinase 1 Are Coordinately Regulated with Actin Cytoskeletal Dynamics in Macrophages

Received for publication, January 8, 2007, and in revised form, May 14, 2007. Published, JBC Papers in Press, May 22, 2007. DOI 10.1074/jbc.M700193200
What do I actually study?

Top 10:
- 43% prayed for self
- 24% others prayed for you
- 19% natural products
- 12% deep breathing exercises
- 10% participate in prayer group
- 8% meditation
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• Bacteria, the nasty black ovals below have entered into the wound. Oh no!
• Our own damaged cells release distress signals such as histamine
• …and the bacteria release their own products, also serving as distress signals

• The distress signals make their way into the bloodstream, alerting our immune system that there is a problem.
• The distress signals are picked up by various white blood cells.
• Neutrophils are often the first to get the signal.
• Many neutrophils will receive this signal.

C'mon everyone... something's wrong

• They all speed off to the problem area.
Yikes! The bacteria are multiplying! At least the neutrophils are arriving.

The neutrophils migrate out of the circulatory system and to the site of the infection.

The area is now inflamed.

Macrophages then migrate to the infection.

Both the neutrophils and the macrophages are phagocytes. Together they begin phagocytosis of the bacteria (and even our own damaged cells).

During this same time, platelets arrive to seal the wound.
• Finally, dendritic cells arrive on the scene.
• Let’s take a closer look!
Both macrophages and dendritic cells can phagocytize bacteria and other antigens (Ag).
Both of these cells can also process and present bits of the Ag on their surface, displaying the Ag fragments.

- Because they present Ag we call them Ag-presenting cells or APCs for short.

- The macrophage and dendritic cell then travel, either through the circulatory system or the lymphatic system (although the two systems are connected via the thoracic duct).
• The macrophages and dendritic cells travel to the spleen (filters the blood), or lymph nodes (filter the lymphatic fluid).
Our Experiments

What effect do green tea and echinacea have on macrophage activities?
Complementary and Alternative Medicines: Green Tea

- *Camellia sinensis*
  - Flowering plant native to S and SE Asia
  - White, Green, Oolong, and Black teas
  - Marketed for antioxidant properties
  - Differences in brewing
Complementary and Alternative Medicines: Green Tea

- Epigallocatechin 3-gallate (EGCG) appears to be the bioactive component
  - Other polyphenols may also be involved
- Protect against/slow certain types of cancer
- Important in macrophage function
  - Inhibits HMGB1, TNF-a, iNOS
  - Enhance killing of L. pneumophila
  - Protects against anthrax lethal factor
Complementary and Alternative Medicines: Echinacea

- *Echinacea purpurea*
  - Perennial prairie wildflower
  - AKA Purple coneflower
  - Echinacea products = one of the largest portions of the several billion dollar herbal medicine market
Complementary and Alternative Medicines: Echinacea

• Historically, uses have included
  • Treatment/Prevention of Cold and Flu
  • Wounds
  • Skin Infections

• Results Conflicting
  • Alkylamides = bioactive component
  • Cold treatment and prevention
  • Immunomodulation

• Differences in study design
Our Experiments

• Simulated gastric fluid (NaCl, HCl, pepsin)
• Neutralize with NaOH
• Simulated intestinal fluid (K$_2$HPO$_4$, NaH$_2$PO$_4$, pancreatin)
• Centrifuge
• Filter sterilize supernatant
• Treat cells with equivalent of 1, 2, or 6 pills for 24hrs
Effect of Green Tea on Microbicidal Activity

![Graph showing reduction of bacterial growth by GTE-treated macrophages.](image)
Effect of Green Tea on Phagocytosis

![Bar chart showing the effect of Green Tea on Phagocytosis](chart.png)
Effect of Green Tea on Cytokine Secretion

Green Tea Influence on TNF-α Secretion in RAW264.7 Macrophages

Green Tea Influence on IL-6 Secretion in RAW264.7 Macrophages
Summary- Green Tea

• Increases killing of S. aureus ~40%
• No major impact on phagocytosis
• Faster release of pro-inflammatory cytokines
Effect of Echinacea on Microbicidal Activity

*S. aureus*, 30 minutes
Effect of Echinacea on Phagocytosis

![Bar graph showing the effect of Sim. Digestion and SD Echinacea on phagocytosis as a percentage of control. The graph indicates a significant increase in phagocytosis with SD Echinacea compared to Sim. Digestion.]
Effect of Echinacea on Cytokine Secretion

- TNF-alpha

- IL-10
Summary- Echinacea

- Increases killing of *S. aureus* ~50%
- Increases phagocytosis 20-60%
- Increases IL-1β (24h), IL-12 (0.5-2h)
- Increases IL-6 (4-24h), TNF-α (2h), and IL-10 (2-24h) via cannabinoid receptor 2
• Both green tea and echinacea alter macrophage microbicidal activity
• Both alter phagocytic activity
• Both drastically alters cytokine secretion
• Echinacea and fever are antagonistic
Take Home Points

• So, does Green Tea help fight off infections?
  • Yes... maybe
  • Drink it!!!

• Does echinacea help fight off infections?
  • Yes, unless you are sick
Take to Class Points

- How do you know if this works?
  - NCCIH website
  - Research literature
  - International Food Information Council

- Critical Thinking and Reasonable Skepticism
  - Anthrax
  - Prayer
Current and Future Directions

• Green tea
  • Phagocytosis vs. killing issue
  • Cytokines
  • Fever
  • Antigen presentation
  • Different preparations including black tea

• Echinacea
  • Cytokines
  • Fever
  • Different preparations
  • Plant stress
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