Coffee and Health

World Coffee Conference
17-19 May 2001 (London)
• To systematically investigate the pharmacological actions of the various compounds found in coffee
• To identify potential health benefits and/or therapeutic uses of coffee based on a fundamental understanding of its constituents
• To disseminate results and promote educational exchange with partner nations
No compelling evidence that coffee consumption in moderation is detrimental to health

Epidemiological evidence suggests potential health benefits of coffee (suicide, cirrhosis, cancer, heart disease, Parkinson’s disease)

ICS investigations are intended to elucidate fundamental mechanisms of health benefits of coffee consumption rather than to disprove adverse health effects
ICS scientists are all faculty of Vanderbilt University or affiliated academic institutions.

- All publications appear in peer-reviewed journals without censorship.
- Unrestricted research grants.
- Regular external review by leaders in relevant scientific disciplines.
Physicians are still taught in medical school that coffee is detrimental to health and advise their patients accordingly.

- **Fundamental mechanisms** underpinning health benefits of coffee consumption interest clinical scientists who determine medical curriculum content.

- Implications for medical education, physician attitudes, and accepted health behaviors.
**Green coffee beans**→ **Roasted coffee beans**

<table>
<thead>
<tr>
<th></th>
<th>Green Coffee Beans</th>
<th>Roasted Coffee Beans</th>
</tr>
</thead>
<tbody>
<tr>
<td>CGA (8%)</td>
<td>2</td>
<td>CGA (4%)</td>
</tr>
<tr>
<td>quinides (0%)</td>
<td>0</td>
<td>quinides (4%)</td>
</tr>
<tr>
<td>caffeine (2%)</td>
<td>0.5</td>
<td>caffeine (2%)</td>
</tr>
</tbody>
</table>

*Percentage of total weight and grams in 3 cups of coffee*
General research strategy at ICS

• Synthesize CGA quinides *de novo* and chemically modify to alter properties
• Screen these compounds for binding at many different neuroreceptors
• Determine detailed binding characteristics of compounds
• Coffee extracts *and* individual compounds studied in parallel
General research strategy at ICS

- Appropriate other *in vitro* measures of function implemented/developed
- Actions in animal models
- Actions in healthy humans, disease states
- Population studies
Effects on adenosine and opioid systems

Antioxidant effects

Behavioral interactions with caffeine

Neuroprotective effects

Endothelial protective effects
Adenosine

- Inhibits release of several neurotransmitters
- Increases regional blood perfusion
- Stabilizes membrane potentials and decreases heart and brain tissue excitability
- Prevents cellular damage during various tissue insults (e.g., oxidant stress, excitotoxicity)
- Caffeine is a recognized adenosine antagonist

- Do CGAs contribute to coffee effects on
• Endogenous opioids affect ‘pleasure’, pain, and ‘drive’ centers in the brain much as does morphine
• Opioid antagonist can prevent relapse in alcoholism
• CGA quinides inhibit mu-opioid receptors
• Can quinides in coffee be used to treat alcoholism or other addictions?
Antioxidants

- Highly reactive oxygen species formed in body can damage DNA, lipids, proteins, etc.
- ROS implicated in cancer, heart disease, degenerative brain disorders, and aging
- Natural ingredients in coffee can reduce adverse effects of ROS (roasted > green)

Do antioxidants present in coffee
Antioxidant effects of CGAs *in vitro*

- **Uptake** of CGAs by human erythrocytes
- Ferric reduction *antioxidant potential*
- Preserve *natural* antioxidants (Vitamin E)
- Protect *cell membranes & human plasma* against oxidant stress
- Decrease generation of *free radicals* (toxic)
- Ongoing studies to investigate beneficial effects *in vivo*
Diseases with endothelial dysfunction:

- Chronic and acute smoking
- Hypertension
- Hypercholesterolemia
- Diabetes
- Congestive heart failure
- Unstable angina
- Atherosclerotic coronary vascular disease
Study of coffee constituents may help us better understand, prevent, and treat common diseases

- Depression/anxiety (suicide)
- Atherosclerosis (cardiovascular mortality)*
- Degenerative brain disorders (Parkinson’s and Alzheimer’s diseases)*
- Cancer*
- Alcohol/drug addiction (cirrhosis)*

*Antioxidant mechanisms can be implicated
Future directions

• Pursue the latest biomedical research via Pilot and Feasibility Award Program
• Coffee Heart Study (ICS and WHF)
• Recruit trainees from partner nations
• Facilitate international scholarly activities at Vanderbilt through ICS
• Continue dissemination of ICS findings
Implications of ICS research

- New horizons for traditional coffee industry research (agronomy, chemistry of ‘quality’)
- Other options than decaffeination
- Maximize coffee content of beneficial constituents through genetic engineering, roasting, blending, etc.
• Develop “different” medicinal coffees (mood, memory, antioxidant, etc.)
• Develop new medications from natural constituents of coffee (“nutriceutical”)
Acknowledgments

- Association of Coffee Producing Countries (Brazil and Colombia)
- Coalition of Central American Coffee Producing Nations
- National Coffee Association (USA)
- All-Japan Coffee Association
- Kraft Foods (USA)
ICS Website

http://mc.vanderbilt.edu/coffee/