

# FOURTH INTERNATIONAL SCIENTIFIC SYMPOSIUM ON TEA AND HUMAN HEALTH

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American Society  
for Nutrition



**Tuesday, September 18, 2007**  
**U.S. Department of Agriculture, Washington, D.C.**

# Fourth International Scientific Symposium on Tea & Human Health

Studies to be Presented at USDA Jefferson Auditorium  
14<sup>th</sup> & Independence Ave., S.W. Washington, DC

Tuesday, September 18, 2007

The Fourth International Scientific Symposium on Tea & Human Health will be a full-day scientific session of the international scientific community during which researchers will review new findings on the role of tea in the human diet. Key scientists will present their research and answer questions pertaining to the results.

## Meeting Agenda

- 8:15 AM      **Welcome and opening remarks**  
Edward B. Knipling, PhD, Administrator, Agricultural Research Service, U.S. Department of Agriculture
- 8:25          **Introduction to Symposium and Morning Session**  
**History of Tea & Health**  
Lenore Arab, PhD, UCLA
- 8:45          **Bioavailability of Green and Black Tea Polyphenols**  
Susanne M. Henning, PhD, RD, UCLA
- 9:10          **Absorption and Metabolism of Green Tea Flavan-3-ols**  
Alan Crozier, PhD, University of Glasgow, Scotland
- 9:35          **Tea Consumption Contributes to Flavanoid Intake Among US Adults**  
Won O. Song, PhD, MPH, RD, Michigan State University
- 10:00        **Green Tea and Cardiovascular Disease Mortality: Evidence From a Prospective Cohort Study**  
Shinichi Kuriyama, MD, PhD, Tohoku University, Japan
- 10:30-10:50   **Tea Break**
- 11:00        **Tea and Cardiovascular Protection**  
Claudio Ferri, MD, University of L'Aquila, Italy
- 11:30        **Tea and Cancer Epidemiology**  
Ilja C. W. Arts, PhD, Maastricht University, Netherlands
- 12:00 PM     **Tea Intervention Trial for Protection Against Smoking-Related Oxidative Stress**  
Iman Hakim, MD, PhD, MPH, University of Arizona
- 12:30-2:30   **Poster Session/Lunch**
- 2:30          **Introduction to Afternoon Session**  
**Future Directions for Tea Research**  
Jeffrey Blumberg, PhD, FACN, CNS, Tufts University
- 2:45          **Investigating the Role of Tea in Human Cognition: Theanine and Caffeine Alter the Neurophysiology of Attention**  
John Foxe, PhD, City University of New York
- 3:15          **Multifunctional Neuroprotective Activities of Green Tea Polyphenols**  
Sylvia Mandel, PhD, Eve Topf and USA National Parkinson Foundation Centers of Excellence for Neurodegenerative Disorders, Israel
- 3:45 -4:00    **Tea Break**
- 4:00          **Green Tea and Weight Management**  
Eva M. R. Kovacs, PhD, Unilever North America
- 4:30          **Tea Consumption, Insulin Sensitivity and Diabetes**  
Dave J. Baer, PhD, U.S. Department of Agriculture
- 5:00          **Summary/Recap**  
Jeffrey Blumberg, PhD, FACN, CNS, Tufts University



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## **Symposium Co-Sponsors**



### **American Cancer Society**

The American Cancer Society (ACS), a community-based health organization, is committed to eliminating cancer as a major health concern by promoting cancer prevention through research, education, advocacy, and service. ACS inspires over 3 million volunteers nationwide to donate their time and service in the name of cancer awareness and prevention, and the search for a cure. With chartered divisions throughout the country and over 3,400 local chapters, it is one of the oldest and largest volunteer health organizations in the United States. Internationally, ACS mentors developing cancer societies and collaborates with various cancer-related organizations to reach shared goals.

Since its early beginnings in 1913, ACS has invested roughly \$3 billion in cancer research and has provided grant support to 40 Nobel Prize winners. Prevention education efforts have included tobacco control; the study of the relationship between diet, physical activity and cancer; promotion of school health education; and efforts to reduce the risk of skin cancer. To ease the suffering of cancer patients and their families, ACS also provides service and rehabilitation programs, as well as patient and family education programs.

Some recent efforts of the ACS include the increase of tobacco excise taxes in three states; the increase of tax on smokeless tobacco in an additional state; helping to lead the effort in implementing the Breast and Cervical Cancer Treatment Act; leading the way to ensure comprehensive coverage for colorectal screening; launching the American Cancer Society Cancer Action Network to facilitate voter education and direct advocacy for cancer legislation; and convincing Congress and the Administration to enact new legislation to extend Medicare coverage of colonoscopy to average-risk individuals age 50 or older.



### **American College of Nutrition**

Since its establishment in 1959, the American College of Nutrition (ACN) has been dedicated to promoting scientific endeavors in the field of nutritional sciences. The mission of the ACN is to enhance nutrition and metabolism knowledge among physicians and professionals from all disciplines with a common interest in nutrition, and to promote the application of such knowledge to the maintenance of health and treatment of disease.

Additional goals of the American College of Nutrition are as follows: Provide an organization, which encompasses the needs of physicians and professionals from all disciplines with a common interest in nutrition; provide a forum for interchange of views, professional and educational experiences, and research results in the general field of nutrition; encourage the incorporation of a strong, clearly defined nutrition-teaching module in the curriculum of all medical schools and to promote the inclusion of nutrition education in medical postgraduate training; and to promote educational programs at all levels and provide advocacy support for non-MD nutrition professionals.

ACN prides itself on providing a forum where an interchange of views, professional, education experiences, and research results can be conducted in a congenial atmosphere. ACN publishes a bimonthly journal, the *Journal of the American College of Nutrition*, and organizes an annual meeting each year. For more information about ACN please visit: [www.amcollnutr.org](http://www.amcollnutr.org).



## American Medical Women's Association

The American Medical Women's Association (AMWA) functions at the local, national, and international level to advance women in medicine and to improve women's health. With the power of 10,000 women physicians and medical students dedicated to serving as the unique voice for women's health and the advancement of women in medicine, AMWA achieves its goals by providing and developing leadership, advocacy, education, expertise, mentoring and strategic alliances.

AMWA was founded in 1915 by early pioneer in surgery, Dr. Bertha VanHoosen, at a time when women physicians were an under-represented minority. Women now make up 50 percent of students in medical school. AMWA empowers women to lead in improving health for all within a model that reflects the unique perspective of women by taking a leading role in efforts to increase knowledge about women's health issues.

AMWA has recently advocated for the State Children's Health Insurance Program, Cytology Proficiency Improvement Act of 2007, and greater access to Medicare/ Medicaid family planning services for low-income women. AMWA has opposed funding cuts to breast cancer and osteoporosis screenings; proactively supported microbicide research that may be helpful in the prevention of HIV/AIDS; and planned a grassroots campaign to reduce the incidence of cervical cancer by increasing human papillomavirus (HPV) vaccination in young women ages 11-26. AMWA is also planning to launch a campaign surrounding universal access to healthcare called **Conversations with the Candidates**. Please look for more information surrounding this campaign in the coming months on AMWA's website at [www.amwa-doc.org](http://www.amwa-doc.org).

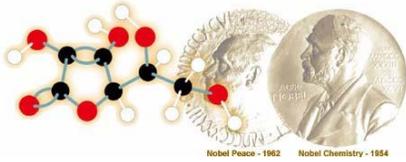


## American Society for Nutrition

The American Society for Nutrition (ASN) is the only non-profit organization dedicated to bringing together the world's top researchers, clinical nutritionists and industry to advance knowledge and application of nutrition for the sake of humans and animals. Their focus ranges from the most critical details of research and application to the broadest applications in society, in the United States and around the world.

Through excellence in nutrition research and practice, the Society's 3,300-plus members daily enhance scientific knowledge and quality of life. ASN supports its members and fulfills its mission by: fostering and enhancing research in animal and human nutrition; providing opportunities for sharing, disseminating, and archiving peer-reviewed nutrition research results (at its annual meeting and in its official publications); fostering quality education and training in nutrition; upholding standards for ethical behavior in research, the protection of human subjects, and the care and treatment of research animals; providing opportunities for fellowship and support among nutritionists; and bringing scientific knowledge to bear on nutrition issues through communication and influence in the public domain.

ASN was founded in 1928 and publishes the *Journal of Nutrition* and the *American Journal of Clinical Nutrition*. For more details, please visit the website at [www.nutrition.org](http://www.nutrition.org).



## The Linus Pauling Institute

The philosophy of the Linus Pauling Institute (LPI) states that an optimum diet and lifestyle is the key to optimum health. LPI's mission is to determine the function and role of vitamins, minerals, phytochemicals, and antioxidants in promoting health, and preventing and treating disease, with the overall goal of helping people everywhere to achieve a healthy and productive life, full of vitality, with minimal suffering, and free of cancer and other debilitating diseases.

LPI was founded in 1996 at Oregon State University, though it previously existed as Linus Pauling Institute of Science and Medicine in California from 1973-1996. It is named after Linus Pauling, winner of two Nobel Prizes: he was awarded the Nobel Prize for Peace in 1962 and for Chemistry in 1954.

Major areas of research at LPI encompass cardiovascular and metabolic diseases, cancer, aging, and neurodegenerative diseases. Specific research topics include: antioxidants, lipoic acid, and metals in atherosclerosis; vitamin E metabolism and biological functions; nitrate and oxidative stress in Lou Gehrig's disease; oxidative stress, antioxidants, and mitochondrial dysfunction in aging; cancer chemoprevention by phytochemicals in tea and vegetables; transplacental cancer chemoprevention; zinc and antioxidants in prostate cancer; novel biological functions of vitamin C; antioxidants and gene expression in diabetes; and dietary fats and whole body carbohydrate and lipid metabolism.

A major function of the Linus Pauling Institute is to provide scientifically accurate information regarding the role of vitamins, minerals, phytochemicals, and other nutrients for health. LPI maintains an on-line micronutrient information center ([LPI.OregonState.edu/InfoCenter](http://LPI.OregonState.edu/InfoCenter)), lists recommendations for reaching optimum health through diet and lifestyle, publishes a biannual newsletter and hosts a biennial scientific conference called Diet and Optimum Health, at which the LPI Prize for Health Research (\$50,000 and a medal) is awarded.



## The Tea Council of the USA

The Tea Council of the USA was formed in 1950 as a partnership between the packers, importers, and allied industries of tea within the United States, and the major tea producing countries outside the United States. The Tea Council's primary goal is to increase the overall awareness of tea through education about its many health benefits.

One of the Council's primary objectives is the dissemination of key scientific findings about tea to the public. The Tea Council does this in several ways, including: funding scientific meetings where tea researchers from around the world share key information and identify next steps for future research projects; and working with health organizations and international scientists who can communicate the potential positive health effects of tea consumption to the public. The Tea Council also reaches out to the health professional community, supports and monitors key scientific meetings internationally, and maintains open communication with leading tea researchers.

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## **Symposium Co-Chairs**

**Lenore Arab, PhD**

**Professor, Division of Internal Medicine and Health Services Research**

**Director, Energetics Project**

**David Geffen School of Medicine at University of California at Los Angeles**

**Director, World Health Organization Collaborating Center for Nutritional Epidemiology**

Currently a professor in the Division of Internal Medicine and Health Services Research at the David Geffen School of Medicine at the University of California at Los Angeles (UCLA) where she serves as director of the Energetics Project, Dr. Arab is also director for the World Health Organization's Collaborating Center for Nutritional Epidemiology.

Her research covers a range of topics in the fields of nutrition, cancer, and epidemiology. Dr. Arab's major research interests include anticarcinogens in foods, such as tea components, glucosinolates, carotenoids, and tocopherol. She is also strongly interested in diet and cancer progression (apoptosis and angiogenesis), breast cancer, prostate cancer, iron nutriture, and multi-media, web-based approaches to dietary assessment.

Published in over 110 peer-reviewed publications, Dr. Arab is an editor for *Public Health Nutrition*, and serves on numerous editorial boards including the boards of *The Journal of Clinical Epidemiology*, *Nutrition and Cancer: An International Journal*, and *Nutrition in Clinical Care*. In addition, she is a member of several professional organizations, including: American Society of Clinical Nutritionists, American College of Epidemiologists, and The Nutrition Society.

Dr. Arab earned her PhD in Nutrition and Epidemiology from Justus Liebig University in Geissen, Germany; her MS in Nutrition from Harvard University; and her BS in Biology from Colgate University, Hamilton, New York.

## **Symposium Co-Chairs**

**Jeffery Blumberg, PhD, F.A.C.N., C.N.S.**

**Professor, Friedman School of Nutrition Science and Policy, Tufts University**

**Senior Scientist and Director, Antioxidants Research Laboratory**

**Jean Mayer USDA Human Nutrition Research Center on Aging, Tufts University**

Currently a senior scientist and director of the Antioxidants Research Laboratory at the Jean Mayer USDA Human Nutrition Research Center on Aging at Tufts University, Dr. Blumberg's research efforts are focused on the biological basis for the role of antioxidants and their dietary requirements in health promotion and disease prevention during the aging process via their modulation of oxidative stress status.

As professor in the School of Nutrition Science and Policy at Tufts University, Dr. Blumberg teaches graduate students, trains post-doctoral fellows, and participates in activities relevant to the incorporation of sound nutrition science into public health policy. Prior to accepting his position at Tufts, he was an associate professor in the College of Pharmacy and Allied Health Professions at Northwestern University and served as head of the Section of Pharmacology, and director of the Program in Toxicology, which he incepted.

In addition to his roles at Tufts University, Dr. Blumberg serves on the American College of Nutrition Certification Board for Nutrition Specialists, and on scientific advisory boards for the Rosenthal Center for Complementary & Alternative Medicine at Columbia University, and for the Center for Clinical and Molecular Nutrition at Emory University. He has served on numerous committees, including: the Department of Health and Human Services Year 2000 Health Objectives Committee; Surgeon General's Workshop on Health Promotion and Aging; and the Food Advisory Committee of the FDA. He has testified before the U.S. House of Representatives; and before the FDA Conference on Antioxidant Vitamins and Cancer and Cardiovascular Disease. He also serves as a consultant to several food and pharmaceutical companies and related trade associations.

He is a member of the American College of Nutrition, American Society for Nutrition, American Society of Parenteral and Enteral Nutrition, Society for Free Radical Biology and Medicine, International Society for Free Radical Research, Gerontological Society of America, American Association for the Advancement of Science, Sigma Xi Scientific Research Society and New York Academy of Sciences.

Dr. Blumberg had published over 180 scientific articles, and serves on several editorial boards including: *Journal of the American College of Nutrition*; *Tufts Health & Nutrition Letter*; *Journal of Environmental Pathology*; *Toxicology and Oncology*; *Nutrition in Clinical Care*; *Arbor Clinical Nutrition Updates*; and *Journal of Nutrition for the Elderly*.

Dr. Blumberg earned his PhD in Pharmacology from Vanderbilt University School of Medicine, and received postdoctoral training in cyclic nucleotide metabolism at the Tennessee Neuropsychiatric Institute at the University of Calgary. He received his Bachelor's degrees in Pharmacy and Psychology from Washington State University.

## **Symposium Speakers & Abstracts**

**Ilja C.W. Arts, PhD**  
**Assistant Professor, Department of Epidemiology**  
**University of Maastricht, The Netherlands**

Currently an assistant professor of epidemiology at the University of Maastricht in the Netherlands, Dr. Arts is also involved in research on the effects of bioactive compounds on cancer and inflammatory diseases. The title of her thesis was *Dietary catechins and their potentially protective role in cardiovascular diseases and cancer*.

Dr. Arts worked for nine years as a research scientist at RIKILT Institute of Food Safety, an independent scientific organization that is a part of Wageningen University and Research Centre in the Netherlands. She has been involved in several research programs on polyphenols from the Commission of the European Communities, and worked as a research fellow at the School of Public Health, University of Minnesota in Minneapolis (USA), at the National Institute of Public Health and the Environment in Bilthoven (The Netherlands), and at the Department of Pediatrics, Uppsala University, Uppsala (Sweden).

In 2004, she received a prestigious Innovational Research Grant from the Netherlands Organisation for Scientific Research (NWO VENI) to study the behaviour of dietary flavonoid metabolites during chronic inflammation.

Dr. Arts earned both her MSc and PhD in Human Nutrition from Wageningen University, the Netherlands. She earned a second MSc in Epidemiology from the Netherlands Institute for Health Sciences.

## **Symposium Speakers & Abstracts**

**Ilja C. W. Arts, PhD**  
**Assistant Professor, Department of Epidemiology**  
**University of Maastricht, The Netherlands**

### **Tea and Cancer Epidemiology**

Tea has been associated with human cancer for several decades. The first paper on tea and gastrointestinal cancer was published in 1966. Since then, an increasing number of epidemiological studies on tea intake and cancer have appeared. In recent years the collective evidence available for several types of cancer has been summarized in systematic reviews and meta-analyses.

Although it may sound like that, tea is not a univocal type of exposure. All tea is produced from the leaves of *Camellia sinensis*, but differences in processing results in several types of tea, of which green and black tea are most consumed worldwide. Moreover, tea is a complex mixture of a large number of bioactive components, including catechins, flavonols, lignans, and phenolic acids. Theaflavins and thearubigins are present only in black tea as a result of oxidative processes. All types of tea and the major phenolic compounds present in tea have been the subject of epidemiological studies. The debate is still open which one of these phenolic compounds might be of primary importance, whether the combination of compounds is essential, or if perhaps unknown components might be responsible for any health modulating effects of tea. Different methods to brew tea also affect internal exposure, but these are usually not taken into account, because epidemiological studies have until recently not collected this type of information. Cancer is also not a single disease. In fact, cancer is nowadays considered to be a group of more than 100 different kinds of diseases that differ in etiology, treatment, and prognosis. Epidemiological studies on tea and cancer include a wide variety of tumor types, but gastrointestinal cancers have been studied most frequently.

It is clear that giving a complete overview of the whole field would be impossible. Therefore, in this presentation, I will focus on observational cohort studies considering cancer incidence in relation to green tea, black tea, and catechins. Where needed, data from case-control studies will be presented as well, but these studies are particularly vulnerable to recall bias, a phenomenon that leads to attenuation of associations and that occurs because diseased subjects often remember their diet differently from control subjects. Reviews and meta-analyses will be used where appropriate. Excellent systematic reviews have recently been published on various types of cancer, and these will be updated with more recently published studies.

## **Symposium Speakers & Abstracts**

**David J. Baer, PhD**

**Research Physiologist, Beltsville Human Nutrition Research Center  
Agriculture Research Service, U.S. Department of Agriculture**

Dr. Baer is currently a Research Physiologist with the Beltsville Human Nutrition Research Center, a part of the Agricultural Research Service, the U.S. Department of Agriculture's (USDA) principal in-house science research agency. Dr. Baer has worked with the USDA for 17 years, and is currently the chief scientist of the Functional Foods and Health Promotion Group within the Center's Food Components and Health Laboratory.

Dr. Baer conducts controlled dietary intervention studies to investigate the relationship between diet and the risk for chronic, degenerative diseases, especially cardiovascular disease, cancer and diabetes in people. He has also conducted studies on the health impacts of weight gain and calorie content of foods. Some of the dietary interventions he has investigated include the nutritional and health effects of tea, alcohol, various lipids and fatty acids, fiber, plant sterols, salad dressings and soy protein.

In addition to dietary intervention studies, Dr. Baer is involved in research studies to validate food survey methodologies, and to develop new methods for dietary assessment. He is the author of numerous scientific articles and book chapters; his scholarly articles have been published by peer-reviewed journals such as: *American Journal of Clinical Nutrition*; *Journal of Nutrition*; *Journal of the American Medical Association*; *European Journal of Clinical Nutrition*; and the *American Journal of Epidemiology*. Dr. Baer has been invited to present his research findings nationally and internationally. He is also active in several professional societies and serves on the editorial board for several journals.

Dr. Baer earned his PhD degree in nutrition from Michigan State University, and his Bachelor's degree from the University of Illinois. Prior to joining the USDA, he worked as a private consultant in nutrition.

## **Symposium Speakers & Abstracts**

**David J. Baer, PhD**  
**Research Physiologist, Human Nutrition Research Center**  
**U.S. Department of Agriculture**

### **Tea Consumption, Insulin Sensitivity and Diabetes**

Almost 21 million Americans have diabetes and at least 90% of diabetes in the United States is type 2 diabetes (a condition where the body does not produce enough insulin or the cells do not respond to the insulin being produced to appropriately metabolize blood sugar). Moreover, about 30% of diabetes cases are undiagnosed. Relative to cardiovascular disease and cancer, less is known about the effects of tea on diabetes. However, some data suggest that tea may reduce risk for diabetes and may also improve insulin sensitivity. In cell culture studies, black, green and oolong teas have been reported to improve insulin sensitivity. In animal studies, green tea has also been reported to increase insulin sensitivity and reduce blood glucose levels. In humans studies, except for one retrospective cohort study in Japan that reports a risk reduction of type 2 diabetes for individuals consuming more than 6 cups of green tea per day, epidemiological data are lacking. In this same study, similar reductions in type 2 diabetes risk were also observed for individuals consuming more than 3 cups of coffee daily, suggesting that caffeine intake may also be important. In a clinical study conducted in Taiwan, oolong tea was reported to reduce blood glucose and improve fructosamine levels in free-living subjects with type 2 diabetes. Conversely, two other clinical trials did not show an effect of green tea on blood glucose or insulin resistance in type 2 diabetes patients. Despite the inconsistent findings from clinical studies, there is evidence linking tea consumption with reduced risk of type 2 diabetes and the mechanism of action appears to be linked to tea flavon-3-ols. Moreover, data from animal studies and evidence from *in vitro* experiments suggest that green tea may ameliorate tissue damage, which is a serious clinical complication associated with diabetes. Currently, research is being conducted to try and identify what class of tea compounds may be important in improving insulin sensitivity.

## **Symposium Speakers & Abstracts**

**Alan Crozier, PhD**

**Professor of Plant Biochemistry and Human Nutrition, University of Glasgow**

Currently a professor of Plant Biochemistry and Human Nutrition at the University of Glasgow, Scotland, Dr. Crozier's research is focused on flavonols and other protective dietary flavonoids in fruits, vegetables and beverages.

He has published more than 200 research papers in several peer-reviewed journals, including: *American Journal of Clinical Nutrition*; *Nutrition, Metabolism and Cardiovascular Disease*; *Phytochemistry*; *Journal of Agricultural and Food Chemistry*. His research group uses a number of approaches to investigate the bioavailability of dietary phenolics, principally those occurring in berries, red wine, tea and coffee.

Having served on the editorial boards for: *Plant, Cell & Environment*; *Forest Science*; and *Seed Science Research* in the past, he currently serves on the editorial boards for: *Physiologia Plantarum*; *Molecular Nutrition Food Research*; *Journal of the Science of Food and Agriculture*; *Phytochemistry*; and the *University of Mauritius Research Journal*. In addition, he currently sits on the Scientific and Medical Council for Alcohol in Moderation. In 1999, he was awarded the title *Eminent Scientist of RIKEN* for internationally distinguished achievements in the field of plant hormones and secondary metabolites by the Institute of Physical and Chemical Research (RIKEN), Wako-shi, Saitama, Japan.

Dr. Crozier earned his PhD from Bedford College at the University of London, after which he completed work as a postdoctoral fellow in the Department of Biology at the University of Calgary in Alberta, Canada. He received a Bachelor of Science degree, with honors, in Botany from the University of Durham, UK.

## **Symposium Speakers & Abstracts**

**Alan Crozier, PhD**

**Professor of Plant Biochemistry and Human Nutrition, University of Glasgow**

### **Absorption and Metabolism of Green Tea Flavan-3-ols**

There is much evidence of the long-term protective effects of green tea that are attributed to the high concentration of flavan-3-ols. In most teas main flavan-3-ols are (–)-epigallocatechin, (–)-epigallocatechin gallate, (–)-epicatechin, (–)-epicatechin gallate and (+)-gallocatechin with smaller amounts of (+)-catechin (+)-gallocatechin-3-gallate. The fate of these compounds has been monitored in plasma and urine by HPLC-tandem mass spectrometry after the ingestion of green tea by healthy human volunteers. A parallel study has also been carried out with subjects with an ileostomy in which, as well as plasma and urine, ileal fluid was collected and analyzed. Substantial amounts of flavan-3-ols were detected in ileal fluid indicating that in healthy subjects they would pass from the small to the large intestine where they would be degraded to phenolic acids by colonic bacteria. In keeping with this possibility, GC-MS analysis of urine from subjects with an intact colon revealed the presence of several phenolic acids which occurred in only trace amounts in urine from volunteers with an ileostomy. To investigate these events in more detail the *in vitro* degradation of (–)-epigallocatechin and (–)-epigallocatechin gallate in fecal slurries has been investigated. The inhibitory effects of green and black tea consumption on aortic fatty streak deposits in Syrian Golden hamsters on an atherogenic diet will also be discussed.

## **Symposium Speakers & Abstracts**

**Claudio Ferri, MD**

**Full Professor, Internal Medicine**

**Director, Department of Internal Medicine and Public Health**

**Director, Division of Internal Medicine I, Hypertension & Cardiovascular Prevention Center**

**University of L'Aquila, Italy**

Currently a full professor of internal medicine at the University of L'Aquila in Italy, Dr. Ferri is also the director of the Department of Internal Medicine and Public Health, and the director of the Division of Internal Medicine Hypertension and Cardiovascular Prevention Center. His areas of interest are: hypertension; endothelial function; flavonoids; and vascular health.

Dr. Ferri's research in the area of tea and prevention of cardiovascular disease examines the protective characteristics of tea due to its demonstrated wealth of polyphenols, in particular, flavonoids, a class of compounds that also occur in a wide variety of fruit, vegetables, cocoa and red wines. His publications include 120 peer-reviewed international papers, 250 papers in non-peer reviewed Italian journals, as well as books for medical students and post-graduate fellows in internal medicine. A recent monograph was Endothelial Function: From Bench to Bedside.

In addition to his many roles at the University of L'Aquila, Dr. Ferri is active in several professional societies. He is vice-president of the National Forum in Internal Medicine, president of the regional section of the Italian Society of Hypertension, president of the regional section of the Italian League for High Blood Pressure Control, national coordinator of the Italian Group for the Study of Plaque Instability (Italian Society of Hypertension), and a hypertension specialist for the European Society of Hypertension.

Dr. Ferri earned his medical degree with a specialty in internal medicine cum laude from the University of Rome La Sapienza in Rome, Italy.

## **Symposium Speakers & Abstracts**

**Claudio Ferri, MD**

**Full Professor, Internal Medicine**

**Director, Department of Internal Medicine and Public Health**

**Director, Division of Internal Medicine I, Hypertension & Cardiovascular Prevention Center**

**University of L'Aquila, Italy**

### **Tea and Cardiovascular Protection**

An increasing body of epidemiologic evidence supports the concept that a diet rich in fruits and vegetables promotes health and attenuates, or delays, the onset of various diseases, including cardiovascular disease, cancer, and other chronic diseases. In keeping with this, studies using animal models of atherosclerosis indicate that dietary flavonoid consumption has favorable effects on cardiovascular disease. Although a variety of factors may contribute to the beneficial effects of plant foods, much attention has been given to plant polyphenols. Apart from fruits and vegetables, both black and green teas contribute a major proportion of total phenol intake in the daily western diet. Indeed, tea has been demonstrated to be especially rich in polyphenols and particularly in flavonoids, a class of compounds that occur in a wide variety of fruit, vegetables, cocoa and red wines. In both black and green tea the major class of flavonoids are the flavanols, which include catechin, epicatechin, epigallocatechin (EGC), epicatechin gallate (ECG) and epigallocatechin gallate (EGCG). A large number of in vitro studies has characterized flavanols as powerful antioxidants capable of efficient scavenging of both reactive oxygen and reactive nitrogen species.

Studies using animal models of atherosclerosis indicate that dietary flavonoid consumption has favorable effects on cardiovascular disease. According to this, Hertog and his colleagues have observed an inverse association between flavanol intake and CVD in Europe, where black tea, together with apples and onions, contribute substantially to total flavanol consumption. Further, epidemiological evidence, particularly from a 10-to-15 year follow-up of cohorts of 550–800 men from the Zutphen Study in the Netherlands, reveals a strong inverse association between flavonoid intake and coronary heart disease (CHD) mortality and stroke incidence. Consistent with these observations, an inverse correlation between flavonoid intake and CHD mortality was found after the 25 year follow-up of 12,763 men from Seven Countries Study. Similarly, men and women from the Boston Area Health Study who consumed one or more cups a day of tea in the previous year had a 44% lower risk of myocardial infarction than those who drank no tea independently of other coronary risk factors. Additionally, tea consumption has been inversely associated with the development and progression of atherosclerosis. In this context, endothelial dysfunction is a key step in the development of atherosclerosis, thus playing a pivotal role in the pathogenesis of cardiovascular disease. Accumulating data indicate that flavonoids can improve endothelial function. In vitro studies provided evidence for direct effects of flavonoids on endothelium-dependent vasodilation. Human intervention trials showed that flavonoid ingestion could reverse endothelial dysfunction, as assessed by flow-mediated dilatation of the brachial artery. Acute as well as chronic ingestion of black tea and intake of red wine, grape-juice and cocoa have been shown to improve endothelial function. On the other hand, grape seed polyphenols have been reported also to impair it. Improved endothelial function might also contribute to lower blood pressure. In this regard, dietary flavonoids can reduce blood pressure in the spontaneously hypertensive rat, nevertheless studies in humans have provided mixed results. Our recent studies showed flavanol-rich dark chocolate ingestion is able to decrease blood pressure levels and improve endothelial function and insulin sensitivity in healthy subjects and hypertensive patients with and without glucose intolerance. Nevertheless, although a recent meta-analysis of 5 randomized controlled trials of cocoa involving 173 subjects with a median duration of 2 weeks showed that pooled mean systolic and diastolic blood pressure were decreased after cocoa ingestion by 4.7 mm Hg (95% CI: -7.6, -1.8 mmHg;  $p=0.002$ ) and -2.8 mmHg (95% CI: -4.8, -0.8 mm Hg;  $p=0.006$ ), respectively, the same analysis failed to show an effect for tea consumption on blood pressure. The estimated pooled changes were 0.4 mm Hg (95% CI, -1.3 to 2.2 mm Hg;  $P=.63$ ) in systolic and -0.6 mm Hg (95% CI, -1.5 to 0.4 mm Hg;  $P=.38$ ) in diastolic blood pressure compared with controls. On the other hand, investigations of the longer-term effects of tea flavonoids on blood pressure in cross-sectional studies reported an inverse relationship between tea intake with blood pressure, and the prevalence of hypertension.

Tea is an important dietary source of flavonoids. In vitro and animal studies continue to provide strong evidence that tea polyphenols may possess the capacity to affect the pathogenesis of several chronic diseases, especially cardiovascular disease and cancer. However, these experiments do not appear to readily extrapolate to human studies. The results from epidemiological studies of the relationship between tea and health are yet controversial. Conflicting results and part of the inconsistency in human intervention studies may be due to flaws in the study design and the different kinds of tea with flavonoid dose varying over a wide range.

As tea is already one of the most popular beverages worldwide, future studies, designed to accurately assess tea consumption and tea polyphenol status, should be directed to quantifying its role in the primary and secondary prevention of cardiovascular diseases.

## **Symposium Speakers & Abstracts**

**John Foxe, PhD**  
**Professor of Neuroscience, Biology and Psychology**  
**Director, Program in Cognitive Neuroscience**  
**City College, City University of New York**  
**Director, Cognitive Neurophysiology Laboratory**  
**Nathan S. Kline Institute for Psychiatric Research**

Currently a professor of neuroscience, biology and psychology at the City College of the City University of New York where he is director of the Program in Cognitive Neuroscience, Dr. Foxe is also director of the Cognitive Neurophysiology Laboratory at the Nathan S. Kline Institute for Psychiatric Research in Orangeburg, New York.

His laboratory uses a multi-methodological approach to issues in human cognition. This involves imaging the human brain using dense electrode array high-density electrophysiology (EEG), functional neuro-imaging (fMRI), and intracranial recordings in human epilepsy patients. He is specifically interested in the brain-mechanisms of selective attention, multi-sensory integration and visual object recognition.

In addition to his academic appointments, Dr. Foxe is section editor for *Neuroreport*, and has edited several special issues of journals, including: *Experimental Brain Research*; *Frontiers in Bioscience*; and *Cognitive Brain Research*. His laboratory receives its major financial support from the National Institute of Mental Health (NIMH) and the National Science Foundation (NSF).

Dr. Foxe earned his PhD in Neuroscience from the Albert Einstein College of Medicine in New York, where he completed his Master of Science degree in Neurophysiology. He received a Bachelor of Science degree in Experimental Psychology from Iona College, and a Bachelor of Arts degree in English and History from the University College Dublin.

## **Symposium Speakers & Abstracts**

**John Foxe, PhD**  
**Professor of Neuroscience, Biology and Psychology**  
**Director, Program in Cognitive Neuroscience**  
**City College, City University of New York**  
**Director, Cognitive Neurophysiology Laboratory**  
**Nathan S. Kline Institute for Psychiatric Research**

### **Investigating the Role of Tea in Human Cognition: Theanine and Caffeine Alter the Neurophysiology of Attention.**

The ability to deploy attention effectively is a key human cognitive function, and when it goes awry, as in Attention Deficit Disorder (ADD) for example, the consequences can be quite severe. Ingestion of the non-proteinic amino acid Theanine (L-N-ethylglutamine), found exclusively in tea, has been shown to increase oscillatory brain activity in the so-called alpha-band (8-14 Hz) during resting EEG recordings in humans. Independently, alpha-band activity has been shown to be a key component in selective attentional processes.

Here, we set out to assess whether theanine would cause modulation of anticipatory alpha activity during selective attentional deployments to stimuli in different sensory modalities, a paradigm in which robust alpha attention effects have previously been established. Electrophysiological data from 168 scalp electrode channels were recorded while participants performed a standard inter-sensory attentional cueing task. As in previous studies, significantly greater alpha-band activity was measured over parieto-occipital scalp for attentional deployments to the auditory modality than to the visual modality. Theanine ingestion resulted in a substantial overall decrease in background alpha levels relative to placebo while subjects were actively performing this demanding attention task.

Despite this decrease in background alpha activity, attention-related alpha effects were significantly greater for the theanine condition. This increase of attention-related anticipatory alpha over right parieto-occipital scalp suggests that theanine may have a specific effect on the brain's attention circuitry. We conclude that theanine has clear psychoactive properties and that it represents a potentially interesting 'naturally occurring' compound for further study as it relates to the brain's attentional system. Additional studies have shown that the effect of theanine may be synergistically potentiated by caffeine.

## **Symposium Speakers & Abstracts**

**Iman Hakim, MD, PhD, MPH**  
**Professor of Public Health, Nutrition, and Family and Community Medicine**  
**Interim Dean, Mel & Enid Zuckerman College of Public Health**  
**University of Arizona**

Currently the interim dean of the Mel & Enid Zuckerman College of Public Health (MEZCOPH) at the University of Arizona (UA) and a professor of public health, nutrition and family community medicine at the UA, Dr. Hakim also served as the director of the division of health promotion sciences at MEZCOPH for the last 5 years.

Dr. Hakim's work has broadened the area of cancer research to include black and green tea. The first doctor in her field to examine the association between tea consumption, by methods of preparation, and a lower incidence of skin cancer, Dr. Hakim's research focuses on squamous cell carcinoma, the antioxidant properties of tea polyphenols, and the decrease in oxidative DNA damage found in current and former smokers through tea consumption.

Dr. Hakim is an active member of numerous professional organizations and societies, including: the American Public Health Association; the American Society for Nutrition; and the American Association of Cancer Research. Her research is published in many peer-reviewed publications, including: *Nutrition and Cancer*; *Nutrition Research*; *Cancer Epidemiology, Biomarkers & Prevention*; *Journal of Food Compositions*; and *Analysis and BC Dermatology*.

Dr. Hakim earned her MD from Cairo University where she did her residency in Pediatrics, her PhD in Child Health and Nutrition from Ain-Shams University in Egypt, and her MPH in Preventive Medicine from the University of Arizona.

## **Symposium Speakers & Abstracts**

**Iman Hakim, MD, PhD, MPH**  
**Professor of Public Health, Nutrition, and Family and Community Medicine**  
**Interim Dean, Mel & Enid Zuckerman College of Public Health**  
**University of Arizona**

### **Tea Intervention Trial for Protection Against Smoking-Related Oxidative Stress**

Oxidative reactions have been implicated as important modulators of human health and can play a role in both disease prevention and disease development. The levels of tobacco-related DNA adducts in human tissues reflect a dynamic process that is dependent on the intensity and time of exposure to tobacco smoke, the metabolic balance between activation of detoxification mechanisms and the removal of adducts by DNA repair, and/or cell turnover. We have completed a Phase II randomized, controlled, 3-arm tea intervention trial to study the effect of high consumption of decaffeinated green or black tea, or water on urinary 8-OHdG, among heavy smokers over a 4-month period and to evaluate the roles of GSTM1 (susceptibility) and hOGG1 (repair) genotypes as effect modifiers. Among green tea drinkers, the change from baseline was significant in all GSTM1 positive smokers regardless of their hOGG1 genotype. Our finding suggests that green tea intervention might be effective in the subgroup of smokers who are GSTM1 positive regardless of their hOGG1 genotype.

A large number of studies have demonstrated an increased oxidant burden and consequently increased markers of oxidative stress in the airspaces, breath, blood, and urine of patients with chronic obstructive pulmonary disease (COPD). We have just completed a 6-month randomized, controlled, double-blinded tea intervention trial in a group of smokers and former smokers with COPD and 25 or more pack-years of smoking history. The participants are stratified on gender, smoking status, and inhaler use, and were randomized to green tea or black tea or a control intervention. The overall goal of this study is to develop a safe and feasible clinical research approach that will serve as a model for the prevention of oxidative stress related diseases such as cancer and heart diseases. Our immediate goal, that was addressed over a 4-year study period, is to determine the effects of high green and black tea consumption on biological markers of oxidative stress that mediate lung cancer risk, including, 8-hydroxydeoxyguanosine (8-OHdG), F2-isoprostanes (8-epi-PGF2), nitric oxide, and antioxidant enzymes. We will also determine if high green or black tea consumption can modulate the genes involved in the carcinogenic process in damaged bronchoepithelial cells. Changes in biomarkers of oxidative damage are measured in urine, blood and exhaled breath condensate. Changes in the gene expression of biomarkers of proliferation (EGFR, PCNA, JUN, FOS, Ki-67) and apoptosis (caspase 3) in induced sputum are assessed. Preliminary data will be presented.

## **Symposium Speakers & Abstracts**

**Susanne M. Henning, PhD, RD**  
**Associate Researcher, Center for Human Nutrition**  
**David Geffen School of Medicine at UCLA**

Dr. Henning is a research professor and the director of the Nutritional Biomarker Laboratory at the Center for Human Nutrition at the University of California at Los Angeles (UCLA).

She has had a longtime interest in the health benefits of polyphenols from green and black tea. Her tea research is focused on the bioavailability of tea polyphenols in tissue and the contribution of the intestinal microflora to the transformation of polyphenols. Dr. Henning's team was first to determine that tea polyphenols are present in the human prostate, which supports the potential of tea polyphenols in chemoprevention of prostate cancer. She received National Institutes for Health (NIH) funding for a phase II chemoprevention trial in men diagnosed with prostate cancer to determine the effect of green and black tea on markers associated with cancer progression. She has been the principal investigator (PI) or Co-PI on several NIH-funded research projects.

Her research is also involved in the investigation of the effect of flavonoids from citrus fruit and pomegranate in the prevention of oxidative damage and enhancement of the repair of oxidative DNA damage. Her laboratory is specialized in the measurement of oxidative DNA damage using highly specialized high performance chromatography with electrochemical detection.

Widely published in high caliber scientific journals, she is also a member of the editorial board for the *Journal of Nutrition* and serves as a reviewer for more than 10 professional journals. She also serves as a reviewer for grant applications for the Department of Defense, Congressionally Directed Medical Research Programs, Prostate Cancer Research Program, and as a member of the Scientific Advisory Panel of the USA Tea Council.

Dr. Henning earned her Ph.D. in Food Technology from the University of Hohenheim in Germany where she also completed her B.S. and M.S. degrees in Nutrition and Biochemistry. After completion of her post-doctoral training in Nutritional Sciences at UCLA, she also received her license as a registered dietitian.

## **Symposium Speakers & Abstracts**

**Susanne M. Henning, PhD, RD**  
**Associate Researcher, Center for Human Nutrition**  
**David Geffen School of Medicine at UCLA**

### **Bioavailability of Green and Black Tea**

Green tea contains gallated (EGCG-epigallocatechin gallate and ECG-epicatechin gallate) and non-gallated (EC-epicatechin, EGC-epigallocatechin) tea polyphenols. During the manufacturing of black tea these tea polyphenols undergo fermentation/ oxidation and form larger polymers called theaflavins and thearubigins, which also contribute to the health benefit of black tea. The chemical characteristics and metabolism of tea polyphenols are important factors influencing their bioavailability. At near neutral pH, tea polyphenols undergo oxidation leading to dimer and hydrogen peroxide formation. Further studies are needed to determine the bioactivity of the dimers. Other metabolic processes include conjugation and transport of tea polyphenols to the tissue, enterohepatic circulation, as well as gut metabolism resulting in the transformation to phenolic acids. Approaches to increase their bioavailability include the administration of tea in combination with fruit juices, piperine or peracetylation of EGCG.

Several human tea bioavailability studies have been performed in which the concentration of tea polyphenols were determined in plasma, urine, and prostate after the administration of green tea, black tea or green tea supplement. The percent of gallated tea polyphenols present in plasma and urine was decreased compared to non-gallated tea polyphenols. An in vitro study, simulating digestion in the human colon, examined the formation of EGC from black tea theaflavins as well as the formation of phenolic acids. It has been demonstrated that the phenolic acid products are absorbed into the circulation and excreted in the urine. Future intervention studies will focus on the chemopreventive effect of green and black tea polyphenols and their metabolites in prostate cancer.

## **Symposium Speakers & Abstracts**

**Eva M.R. Kovacs, PhD**  
**Clinical Research Manager, Unilever North America**

Currently working as clinical research manager at Unilever North America in Englewood Cliffs, New Jersey, Dr. Kovacs leads the clinical research program for Slim·Fast, and gives nutritional and scientific support to Slim·Fast and other Unilever brands in relation to weight management.

In a prior role, she worked as a research scientist within the Unilever Foods and Health Research Institute, Unilever R&D in Vlaardingen, the Netherlands, and was responsible for providing scientific support to Unilever brands, primarily Slim·Fast and Lipton, and for coordinating human clinical trials in the areas of energy metabolism and appetite regulation.

During her doctoral studies, she worked as a research scientist in the area of sports nutrition, particularly focusing on the effects of sport drinks and caffeine intake on re-hydration and endurance performance; and in the area of weight management, particularly focusing on the effects of food ingredients on satiety, food intake, energy expenditure, fat oxidation and changes in body weight and body composition.

Dr. Kovacs has published approximately 30 papers and numerous abstracts in international scientific journals and has given lectures at several scientific meetings both in the area of sports nutrition science and weight management. She is a member of the Dutch Association for the Study of Obesity, the Obesity Society, the Dutch Association for Dietetics and Food Technology, the Society for the Study of Ingestive Behavior and the European Nutrition Leadership Program Alumni Association.

She earned a PhD in Human Nutrition from Maastricht University in the Netherlands, and a Master of Science degree in Food Science and Technology from the Swiss Federal Institute of Technology in Zurich, Switzerland.

## **Symposium Speakers & Abstracts**

**Eva M. R. Kovacs, PhD**  
**Clinical Research Manager, Unilever North America**

### **Green Tea and Weight Management**

The scale of the obesity epidemic creates a pressing consumer need as well as a big business opportunity for development and marketing of foods and beverages with added benefits for weight control. A number of functional food ingredients have been proposed to benefit weight control through their effects on energy balance. Green tea and specifically green tea catechins have been suggested as such ingredients and green tea beverages claiming weight control related benefits have recently appeared in the United States as well as in other markets.

Green (and oolong) tea contain high quantities of catechin polyphenols and modest amounts caffeine, ingredients that have been proposed to increase and/or prolong the stimulatory effects of norepinephrine on energy and lipid metabolism.

There is increasing evidence from medium- and long-term studies (> 8 weeks) that green teas rich in catechins may improve body composition by reducing body fat and in particular visceral fat. Most of this evidence has been generated from studies that investigated the effects of catechin-rich green (or oolong) tea beverages in Asian populations. Some of these studies have also investigated the effects of chronic consumption of catechin-rich green teas on energy expenditure and/or fat oxidation, which seem to be increased. However, the body of evidence is so far very limited. Only few intervention studies have investigated the effects of consumption of catechin-rich green teas on body weight and/or body composition in Western populations, producing largely negative results. However, these studies tested green tea with a different purpose and in different contexts (e.g. during energy restriction or during weight maintenance after weight loss), mainly using capsules and allowing consumption of caffeine from various sources. This could possibly explain the lack of efficacy in these populations. Several short-term studies, mainly carried out in Western populations, have shown that green tea extracts may increase energy expenditure and/or fat oxidation. However, results are inconsistent, and large acute effects appear to be attributable to caffeine or a synergistic effect between caffeine and catechins, rather than catechins alone. Nevertheless, a small but cumulatively important effect of catechins alone is suggested by the emerging data on body composition.

Although green tea has shown positive effects with respect to weight control, especially with respect to long-term improvement of body composition and fat distribution, a number of questions related to green tea efficacy still need to be addressed and answered, e.g. long-term efficacy in a Western population, exact mechanism of action, optimal dosing level and schedule as well as formulation (caffeine:catechins ratio, catechins profile).

*Reference:* Kovacs EM, Mela DJ. Metabolically active functional food ingredients for weight control. *Obes Rev* 2006; 7(1): 59-78.

## **Symposium Speakers & Abstracts**

**Shinichi Kuriyama, MD, PhD**

**Associate Professor, Division of Epidemiology, Public Health and Forensic Medicine Dept.  
Tohoku University Graduate School of Medicine, Sendai, Japan**

Currently an associate professor in the Department of Public Health and Forensic Medicine at Tohoku University Graduate School of Medicine in Japan, Dr. Kuriyama is widely published in peer-reviewed journals in the areas of cancer, circulatory diseases, lifestyle-related diseases, and geriatric conditions. He performs a wide variety of epidemiologic research based on large-scale cohort studies, evaluation of cancer screening, and conduct of regional cancer registration. Dr. Kuriyama's research activities are devoted to clarifying the causes of these health problems and to develop preventive measures.

Some of Dr. Kuriyama's main publications investigate the protective characteristics of green tea. With his research team, he has examined green tea and cognitive function; and green tea and mortalities due to cardiovascular disease, cancer, and all causes. His research was some of the first to start filling the gap in the body of knowledge regarding the effects of green tea in human subjects. In one study, Dr. Kuriyama found that higher consumption of green tea was associated with a lower prevalence of cognitive impairment; another found that green tea consumption is associated with reduced mortality due to all causes and due to cardiovascular disease, though not with reduced mortality due to cancer.

He has published 58 original papers in peer-reviewed journals including: the *Journal of the American Medical Association*; *American Journal of Clinical Nutrition*; *Preventive Medicine*; *Journal of Epidemiology*; *International Journal of Cancer*; and *International Journal for Vitamin and Nutrition Research*.

In 2005, Dr. Kuriyama was awarded the Young Investigator Award of the Japan Epidemiological Association.

He earned his Ph.D. in Public Health and Forensic Medicine from Tohoku University Graduate School of Medicine, a graduate degree from Osaka City University Medical School, and his undergraduate degree in Physics from Tohoku University.

## **Symposium Speakers & Abstracts**

**Shinichi Kuriyama, MD, PhD**

**Associate Professor, Division of Epidemiology, Public Health and Forensic Medicine Dept.  
Tohoku University Graduate School of Medicine, Sendai, Japan**

### **Green Tea and Cardiovascular Disease Mortality: Evidence From a Prospective Cohort Study**

Green tea polyphenols have been extensively studied as cardiovascular disease (CVD) and cancer chemopreventive agents. Although substantial evidence from in vitro and animal studies indicate that green tea preparations inhibit CVD and carcinogenic processes, the possible protective role of green tea consumption against these diseases in humans remains unclear. If green tea does protect humans against CVD or cancer, it is expected that consumption of this beverage would substantially contribute to greater life expectancy, given that CVD and cancer are the two leading causes of death worldwide. To date, four studies have examined the association between green tea consumption and mortality, but their sample sizes were small and the results were inconsistent.

We therefore designed a prospective analysis to examine the association between green tea consumption and mortality from CVD, cancer and all causes, within a large population-based cohort study (the Ohsaki Study) of 40,530 persons in Miyagi prefecture, in northern Japan, where green tea is widely consumed. Within this region, 80% of the population drinks green tea, and more than half of them consume three or more cups per day.

The Ohsaki Study is a population-based, prospective cohort study initiated in 1994, of 40,530 Japanese adults, aged 40 to 79 years, without history of stroke, coronary heart disease or cancer at baseline. We followed the subjects for up to 11 years (1995-2005) for all-cause mortality and for up to seven years (1995-2001) for cause-specific mortality.

Over 11 years of follow-up, 4209 participants died and over seven years of follow-up, 892 participants died from cardiovascular disease and 1134 participants died from cancer. Green tea consumption was inversely associated with mortality from all causes and from cardiovascular disease. The inverse association with all-cause mortality was more pronounced in women compared to men ( $P = 0.03$ ). In men, the multivariate hazard ratios (95% confidence intervals) of mortality from all causes associated with different green tea consumption frequencies were 1.00 (reference) for <1 cup/day, 0.93 (0.83-1.05) for 1-2 cups/day, 0.95 (0.85-1.06) for 3-4 cups/day, and 0.88 (0.79-0.98) for  $\geq 5$  cups/day, respectively ( $P$  for trend = 0.03). The corresponding figures in women were 1.00, 0.98 (0.84-1.15), 0.82 (0.70-0.95), 0.77 (0.67-0.89) ( $P$  for trend <0.0001).

The inverse association with cardiovascular disease mortality was more remarkable than that with all-cause mortality. The inverse association was also more pronounced in women ( $P = 0.08$  for interaction with sex). In women, the multivariate hazard ratios (95% confidence intervals) of cardiovascular disease mortality across increasing green tea consumption categories were 1.00, 0.84 (0.63-1.12), 0.69 (0.52-0.93), and 0.69 (0.53-0.90) ( $P$  for trend = 0.004). Among the cardiovascular diseases mortality, the stronger inverse association was observed for stroke mortality. In contrast, the hazard ratios of cancer mortality were above unity in all green tea categories compared to the referent category.

This presentation will report the results of this study in detail and discuss the reason for the discrepancy between effects of green tea on CVD and on cancer deaths.

## **Symposium Speakers & Abstracts**

**Silvia Mandel, PhD**

**Vice-Director, Eve Topf Center of Excellence for Neurodegenerative Diseases Research  
Department of Pharmacology, Faculty of Medicine  
Technion Israel Institute of Technology, Haifa, Israel**

Currently vice-director of the Eve Topf Center of Excellence for Neurodegenerative Diseases Research at Technion Israel Institute of Technology in Haifa, Israel, Dr. Mandel has a worldwide reputation as one of the top experts in the field of expression profiling for novel neuroprotective drugs.

Dr. Mandel specializes in modern and sophisticated techniques of functional genomics, including identification of proteins via high-throughput proteomics, in order to investigate and gain insight into the molecular events occurring in neurodegeneration, in particular in Parkinson's disease (PD). Dr. Mandel was the first to study the mechanism of MPTP-induced dopaminergic neurotoxicity employing cDNA microarray gene expression, and published the first gene expression microarray profiling study of the human brain in individuals with PD (2004). The identified novel genes are currently serving as the basis for international multicenter research on the identification of serum biomarkers for early diagnosis and disease follow-up. In 2005, Dr. Mandel won the *Senior Researcher Award* at the 16th International Congress of Parkinson's Disease in Berlin.

Also a pioneer in the research on neuroprotective and neurorescue properties of green tea polyphenol flavonoids (catechins), Dr. Mandel was the first to experimentally demonstrate the beneficial effect of green tea extract in an MPTP model of PD and Alzheimer's disease. Since then, her work has revealed that the green tea catechins, originally considered simple antioxidants, are endowed with poly-pharmacological activities, acting at multiple targets to prevent or delay neuronal death in the degenerating brain.

Dr. Mandel has published a substantial body of original papers in high caliber scientific journals, as well as several book chapters and conference proceedings. She is a member of the scientific editorial board of *Neural Transmission* and *Synapse*, and serves as a reviewer for more than 15 professional journals. She is a series editor of *Handbook of Neurochemistry*. She also serves as a grant reviewer for organizations including the prestigious National Institute for Psychobiology in Israel, the Deutsche Forschungsgemeinschaft (DFG) in Germany, and the United States-Israel Binational Science Foundation (BSF).

In addition to her role as vice-director at Technion, Dr. Mandel lectures at the Universities of Murcia in Spain and Santiago in Chile. She organized an international master course on medical applications of biotechnology for the Socrates Erasmus program based in Perugia, Italy, and is regularly invited to speak at local and international conferences.

Dr. Mandel earned her PhD degree in Pharmacology at the Faculty of Medicine, Technion Israel Institute of Technology and completed her post-doctoral training in the field of yeast genetics and molecular biology at the Department of Biology at Technion.

## **Symposium Speakers & Abstracts**

**Silvia Mandel, PhD**

**Vice-Director, Eve Topf Center of Excellence for Neurodegenerative Diseases Research  
Department of Pharmacology, Faculty of Medicine  
Technion Israel Institute of Technology, Haifa, Israel**

### **Multifunctional Neuroprotective Activities of Green Tea Polyphenols**

Presently, tea is considered as a source of dietary constituents endowed with biological and pharmacological activities with potential benefits to human health. The increasing interest in the health properties of tea extract and its main catechin polyphenols have led to a significant rise in scientific investigation for prevention and therapeutics in several diseases. Accumulating evidence has demonstrated that green tea catechins exert a protective role in neurodegeneration. The major polyphenol component of green tea, (–)-epigallocatechin-3-gallate (EGCG), has been shown to improve age-related cognitive decline and to protect against cerebral ischemia/reperfusion injuries, brain inflammation and neuronal damage in experimental autoimmune encephalomyelitis. Similarly, either a green tea polyphenol extract or isolated EGCG, prevented the loss of substantia nigra dopamine-producing neurons in a mouse model of Parkinson's disease (PD) and more recently, EGCG was shown to reduce the levels of the Alzheimer's-associated amyloid-beta peptide in mice, a harmful molecule contributing to the lesions and cognitive impairment found in the brains of Alzheimer's disease (AD) patients.

In spite of the absence of clinical trials regarding tea polyphenols and PD, epidemiological studies have shown reduced risk of PD associated with consumption of 2 cups/day or more of tea and a much lower prevalence of PD in Chinese population than in white people. A recent cross-sectional analysis in elderly Japanese subjects, found that higher consumption of green tea is associated with lower prevalence of cognitive impairment in humans. The results might partly explain the relatively lower prevalence of dementia, especially AD, in Japan than in Europe and North America. Clearly, there is a need for well-designed controlled studies to determine effectiveness and long-term safety. Such an initiative is being undertaken by Prof. C. Chan from Xuanwu Hospital, Beijing, China via support of the Michael J Fox Foundation to investigate the safety, tolerability and potential neuroprotective effects of green tea polyphenols in patients with early PD and the ability to slow the disease progression.

Insights into the molecular mechanism of action of green tea catechins, have indicated that in addition to their known antioxidant and divalent metal chelating activity, other mechanisms such as modulation of signal transduction pathways, cell survival/death genes and mitochondrial function, contribute significantly to neuron viability, neurorescue and differentiation. This presentation will focus on the emerging view that green tea catechins are multifunctional, brain-permeable natural iron chelators-antioxidants, endowed with poly-pharmacological activities, acting at multiple targets to prevent or delay neuronal death in the degenerating brain. Considering the multiple etiological nature of neurodegenerative disorders, drugs with two or more mechanisms of action, targeted at multiple pathological aspects of the same disease may offer superior therapeutic benefit and less side effect profile than a so called, "magic bullet" mono-targeted molecules.

## **Symposium Speakers & Abstracts**

**Won O. Song, PhD, MPH, RD**  
**Professor of Human Nutrition and Associate Dean of Academic Affairs**  
**College of Human Ecology, Michigan State University**

Currently a professor of human nutrition and associate dean at Michigan State University (MSU), Dr. Song focuses her outreach on services and programs for economically disadvantaged subpopulation groups, especially focusing on the health status of low income women and families. Dr. Song's recent research on the characteristics of tea consumers compared to those who do not consume tea in the United States may reveal another piece of the health disparities puzzle: tea consumers tended to be older, female, Caucasian, and of higher income.

Additional research areas of interest include: dietary behaviors and nutritional status in health and disease; nutritional education and survey methods; nutritional epidemiology; worksite wellness programs; and computer application in nutrition education. Dr. Song is widely published in peer-reviewed journals such as *American Journal of Clinical Nutrition*, *Journal of Nutrition*, and the *Journal of the American Dietetic Association*. In addition, Dr. Song serves on the editorial boards for the *Journal of the Korean Nutrition Society* and the *MSU Book Series on Children, Youth and Families*.

In addition to her responsibilities at MSU, Dr. Song is an active member of numerous professional organizations and societies including: American Society for Nutrition; Society for International Nutrition Research; American Dietetic Association; Michigan Dietetic Association; Society for Nutrition Education; Society of Experimental Biology and Medicine; New York Academy of Science; American Public Health Association; Korean Nutrition Society; The Korean-American Scientists and Engineers Association in America; and the American Association of Family and Consumer Sciences.

Dr. Song earned her PhD in Human Nutrition at Utah State University where she completed post-doctoral work in nutrition research. She earned her MPH in Public Health Nutrition from Seoul National University, her MS in Human Nutrition from the University of Iowa, and a BS in Food and Nutrition from Ewha Womans University in South Korea.

## **Symposium Speakers & Abstracts**

**Won O. Song, PhD, MPH, RD,  
Professor of Human Nutrition  
Ok-Kyung Chun, PhD, MPH,  
Research Assistant Professor  
Michigan State University**

### **Tea Consumption Contributes to Flavanoid Intake Among US Adults**

Intake of flavonoids, through antioxidant properties, has been inversely associated with the incidence of many chronic diseases. The prevalence of many chronic diseases vary among different sociodemographic subgroups in the US determinants of flavonoid intake have not yet been identified in free-living adults in the US, nor the biomarkers of oxidative stress. We tested the hypotheses that tea is the major dietary source of flavonoids in adults 19+y; Tea consumers differ from tea non-consumers in sociodemographics, health-related behaviors, dietary and beverage intake, sum and type of flavonoid intake. In testing the hypotheses, we matched the recently released flavonoid contents of the USDA Flavonoid Databases with dietary intake data from the most recent consumption figures representative of the total US population from NHANES of 1999-2002. Participants (8,809 adults, aged  $\geq 19$  y) were divided into two groups according to tea consumption based on 24-hr dietary recalls as tea consumers vs. tea non-consumers.

We found that tea was consumed in a day by 21.3% of US adults. Daily total flavonoid intake of tea consumers was far higher than that of tea non-consumers (697.9 vs. 32.6 mg/d) and per capita flavonoid intake from tea averaged 157 mg/d. Tea consumers tend to be older, female, Caucasian, and higher income than tea non-consumers ( $p < 0.001$ ); have lower non-leisure time physical activity level ( $p < 0.01$ ) and take more dietary supplements ( $p < 0.001$ ) than tea non-consumers. Intake of flavonols and flavan-3-ols, the major tea flavonoids, differed between the two groups ( $p < 0.001$ ). Major dietary flavonoid sources without tea were citrus fruit juice, wine, and citrus fruits for both tea consumers and non-consumer groups. For tea non-consumers, flavonoids from wine and fruitades and drinks were higher than those from tea consumers. The most significant findings of our study are that flavonoid intake differs among subgroups mainly due to the percent of tea consumers and prevalence of tea consumption within each subgroup. Our findings may partially explain the health disparities observed in the US.

## **Tea & Health Research Summary**

Contact: Melissa McAllister / Kevin Hughes  
Pollock Communications, Inc.  
[mmcallister@pollock-pr.com](mailto:mmcallister@pollock-pr.com) / [khughes@pollock-pr.com](mailto:khughes@pollock-pr.com)  
212-941-1414



## **TEA AND HEALTH**

### **-- An Overview of Research on the Potential Health Benefits of Tea --**

#### **INTRODUCTION**

Tea is an ancient beverage steeped in history and romance and loved by many. In fact, so popular is tea that it is the most commonly consumed beverage in the world after water. Although tea had a modest beginning (it was discovered by accident), its popularity spread from its origins in China to Western Europe and the Americas. Throughout history, tea has been believed by many to aid the liver, destroy the typhoid germ, purify the body and preserve mental equilibrium. Over the past few decades, scientists have taken a closer look at the potential health benefits of tea and have discovered that much of the folklore about tea may actually be true.

#### **HOW TEA WORKS IN THE BODY**

Tea contains flavonoids, naturally occurring compounds that have been shown to have antioxidant properties. Antioxidants work to neutralize free radicals, which scientists believe, over time, damage elements in the body, such as genetic material and lipids, and contribute to many chronic diseases.

Recent research has explored the potential health attributes of tea through studies in humans and animal models, and through *in vitro* laboratory research. For the most part, studies conducted on Green and Black Tea, which are both from the *Camellia sinensis* plant, have yielded similar results. Recent research suggests that tea and tea flavonoids may play important roles in various areas of health and may operate through a number of different mechanisms still being explored.

Recent findings about tea and health include:

- The antioxidant properties of tea flavonoids may play a role in reducing the risk of cardiovascular disease by decreasing lipid oxidation<sup>1</sup>, reducing the instances of heart attacks and stroke<sup>2,3</sup>, and may beneficially impact blood vessel function<sup>4</sup>, an important indicator of cardiovascular health.
- Tea flavonoids may lower the risk of certain cancers by inhibiting the oxidative changes in DNA from free radicals and some carcinogens<sup>1</sup>. Tea may also promote programmed cell death, or apoptosis<sup>5</sup>, and inhibit the rate of cell division, thereby decreasing the growth of abnormal cells<sup>1</sup>.
- Tea-drinking has been associated with oral health<sup>6</sup> and bone health<sup>7</sup>.
- Compounds in tea other than flavonoids have been shown to support the human immune system<sup>8</sup>.
- Due to the substantial data documenting tea's health benefits, recently published *Healthy Beverage Guidelines* suggest water, tea and coffee should provide the majority of daily fluid intake. Unsweetened Tea (up to eight servings per day) is recommended because it is virtually calorie-free, delivers antioxidant phytonutrients and has less caffeine than coffee (about 40 mg per serving).<sup>9</sup>

#### **TEA'S ROLE IN CARDIOVASCULAR HEALTH**

Human population studies have found that people who regularly consume three or more cups of Black Tea per day have a reduced risk of heart disease and stroke. Clinical studies suggest that the risk reduction associated with Black Tea consumption may be due to improvement in some risk factors for cardiovascular disease, including blood vessel function, platelet function and a reduction in oxidative damage.

While researchers are still examining the various mechanisms by which tea flavonoids function, some studies suggest multifunctional mechanisms, meaning that several mechanisms work in tandem to collectively improve markers for cardiovascular health. Important areas of tea and cardiovascular health research include blood vessel and endothelial function, or the ability of the blood vessels to dilate to allow for proper blood flow, serum cholesterol levels and Low Density Lipoprotein (LDL) cholesterol oxidation. Each of these factors impact the risk of myocardial infarctions (heart attacks), stroke and cardiovascular disease. Study findings in the area of tea and the reduction in cardiovascular disease risk include the following:

### **Coronary Heart Disease (CHD)**

#### **Cardiac Events**

- A total of 3,430 men and women aged 30-70 years from the Saudi Coronary Artery Disease Study were examined and 6.3 percent were found to have indications of coronary heart disease (CHD). The researchers found that those who drank more than six cups of tea per day (>480 mL) had significantly lower prevalence of CHD than non-tea drinkers, even after adjustment for risk factors like age and smoking<sup>10</sup>. The researchers also found that drinking six or more cups of Black Tea per day was associated with decreased serum cholesterol and triglyceride concentrations.
- The Zutphen study, which assessed 805 male subjects over a period of five years, found that the incidence of fatal and nonfatal first myocardial infarction and mortality from stroke decreased significantly as intake of flavonoids, derived mainly from tea, increased in a dose-dependent manner<sup>2</sup>. A follow-up to this study found that high intake of flavonoids significantly lowered the risk of stroke in study participants<sup>3</sup>.
- A Harvard study examined 340 men and women who had suffered heart attacks and compared them to matched control subjects. They found that those who drank a cup or more of Black Tea daily had a 44 percent reduction in the risk of heart attack compared to non-tea drinkers<sup>11</sup>.
- Another recent Harvard study of 1,900 people found that those who consumed tea during the year prior to a heart attack were up to 44 percent more likely to survive over the three to four years following the event. Those who consumed fewer than 14 cups of tea per week experienced a 28 percent reduced death rate, and those who consumed more than 14 cups of tea per week were found to have a 44 percent reduced death rate, as compared to non-tea drinkers<sup>12</sup>.
- Dutch researchers assessed 4,807 subjects aged 55 years or older without prior history of heart attack. After a four to seven year follow up period, the researchers determined that those who drank three or more cups of tea per day (375mL) were 43 percent less likely to develop myocardial infarction and 70 percent less likely to die from myocardial infarction than non-tea drinkers<sup>13</sup>.
- A recent meta-analysis discovered that consumption of three cups of tea per day was associated with an estimated decrease of 11 percent in the incidence of myocardial infarction (heart attack)<sup>14</sup>.
- A large Japanese population study of over 40,000 middle-aged Japanese reported that, among men and women, those who drank just over two cups (about 17 ounces) of Green Tea per day reduced their risk of death from cardiovascular disease by 22 to 33 percent, compared to those who drank less than a half-cup (3.5 ounces) of Green Tea daily<sup>15</sup>.

#### **Cholesterol Reduction**

Researchers from the United States Department of Agriculture (USDA) studied the effect of tea on 15 mildly hypercholesterolemic adult participants following a "Step I" type diet moderately low in fat and cholesterol, as described by the American Heart Association and the National Cholesterol Education Program. After three weeks, researchers found that five servings of Black Tea per day reduced LDL ("bad") cholesterol by 11.1 percent and total cholesterol (TC) by 6.5 percent compared to placebo beverages<sup>16</sup>. Recent clinical trials have not confirmed these results, however additional work is being done in this area.

#### **Tea and Cardiovascular Disease (CVD) Risk Factors**

- Dutch researchers found that study participants who drank one to two cups of Black Tea daily had a 46 percent lower risk of severe aortic atherosclerosis, a strong indicator of cardiovascular disease. Those who drank more than four cups of tea a day had a 69 percent lower risk<sup>17</sup>.
- A recent clinical study showed that short- and long-term consumption of Black Tea by subjects with coronary artery disease restored endothelial and blood vessel function to levels similar to that of healthy subjects<sup>18</sup>. Endothelial function is the ability of the inner lining of blood vessels to dilate in response to increased blood flow.

- Another clinical study found that regular ingestion of tea resulted in a significant and consistent increase in endothelium-dependent and endothelium-independent blood vessel dilation<sup>19</sup>. Subjects with mild elevations in serum cholesterol or triglyceride concentrations consumed either five cups of Black Tea per day for four weeks or hot water. The researchers hypothesized that one mechanism for the apparent beneficial effects of tea on cardiovascular health could be this improved vasodilator function.
- An *in vitro* study found that Green Tea polyphenols inhibit the proliferation of aortic smooth muscle cells to prevent the development of atherosclerosis<sup>20</sup>.
- *In vitro* studies have shown that tea flavonoids protect low-density lipoproteins from oxidation, inhibit plasma lipid peroxidation, platelet aggregation and thromboxane formation – all factors important for maintaining a healthy circulatory system<sup>21,22</sup>. Studies in animals are promising, but human studies conducted to date on the effect of tea consumption on LDL oxidation are inconclusive.
- A double-blind crossover design clinical study found that Black Tea versus a caffeinated control beverage improved coronary flow velocity reserve, a measure of increased blood flow in vessels<sup>23</sup>.
- Animal model studies found that Green or Black Tea both improved risk factors for CVD, including reduced blood lipids, serum antioxidants levels and improvements in blood clotting factors<sup>24</sup>.
- A longitudinal study with more than 1,500 Taiwanese found that those who drank more than 2 1/2 cups of tea per day reduce their risk of developing high blood pressure by 65 percent compared to those who drank the least amount of tea<sup>25</sup>.

### **TEA'S ROLE IN CANCER RISK REDUCTION**

Preliminary research suggests that the flavonoids in tea could play a role in human cancer risk reduction possibly by combating free radical damage, inhibiting uncontrolled cell growth (cell proliferation), by promoting programmed cell death (apoptosis) and boosting the immune system to help fend off the development and promotion of cancer cells. Leading scientists worldwide are actively studying these potential mechanisms, and clinical trials and population studies are underway. More evidence is needed before any definitive conclusions can be drawn. Recent findings include:

#### **DNA Damage**

- A recent study found that smokers who drank four cups of decaffeinated Green Tea per day demonstrated a 31 percent decrease in biomarkers of oxidative DNA damage in white blood cells as compared to those who drank four cups of water. Oxidative DNA damage is implicated in the development of various forms of cancer<sup>26</sup>.
- Epigallocatechin gallate (EGCG) may protect normal cells from cancer-causing hazards as well as eliminate cancer cells through apoptosis. Researchers tested the potential anti-cancer benefits of Green Tea polyphenol, EGCG, in hamster cells and discovered that EGCG suppressed DNA changes and damage from carcinogens. EGCG also protected from further damage from the carcinogens and inhibited growth and multiplication of cancer cells<sup>27</sup>.
- An animal study identified beneficial changes in immune function after Black Tea ingestion in cancer-bearing animals. Black Tea beneficially altered immune responses that helped protect immune cells against harmful cancerous cells. The study found Black Tea acted like anti-cancer drugs that help boost the immune system without promoting the proliferation of cancerous cells<sup>28</sup>.

#### **Digestive Cancers**

- An epidemiological study conducted by the University of North Carolina found consumption of the equivalent of 2.5 cups of tea per day or more was associated with a 60 percent drop in rectal cancer risk among Russian women from Moscow, as compared to women who drank relatively less than 1.2 cups of tea per day. Those women who drank approximately 1.2 to 2.5 cups of tea per day had a 52 percent reduction in the risk of rectal cancer<sup>29</sup>.
- Based on data from the NHANES I Follow-Up study (NHEFS), researchers found that tea drinkers had about a 42 percent reduced risk of colon cancer as compared to non-tea drinkers. Men who drank more than 1.5 cups of tea per day were found to have a 70 percent lower colon cancer risk<sup>30</sup>.
- Researchers who followed a group of over 34,000 postmenopausal healthy women between 55 – 69 years of age for 12 years found that those consuming high levels of catechins experienced up to a 45 percent decrease in the instances of rectal cancer. Catechins are a class of flavonoids found in tea, fruits and vegetables. Catechins derived from tea were most strongly linked to a decrease in rectal cancer<sup>31</sup>.
- The Iowa Women's Study, which followed post-menopausal women between the ages of 55 and 69 for eight years, found that participants who drank two or more cups of tea per day had a 32 and 60 percent reduced risk of developing digestive and urinary tract cancers, respectively<sup>32</sup>.

- A study conducted with members of the Shanghai Cohort (18,244 men aged 45-64 years at recruitment with up to 12 years of follow-up) discovered a statistically significant inverse relationship between positive tea polyphenol levels (as measured in urine) and gastric cancer<sup>33</sup>.
- A large population-based case-control study found an inverse relationship between Green Tea consumption and the risk of colon, rectal and pancreatic cancer. Male participants, who drank the equivalent of 4.5 servings of tea per day, had an 18 percent decrease in colon cancer risk and 28 percent decreased risk of rectal cancer. Female participants, who drank 3 servings of tea per day, were observed to have a decreased risk of colon and rectal cancer by 33 percent and 43 percent, respectively. Risk of pancreatic cancer was also reduced in both men and women by 37 percent and 47 percent, respectively<sup>34</sup>.
- Researchers examined whether a combination of two compounds known to exhibit anti-cancer activity, Green Tea polyphenol, EGCG, and sulindac (a non-steroidal anti-inflammatory drug), would work synergistically to prevent colon cancer carcinogenesis in rats. Findings suggested that EGCG and sulindac worked together to suppress pre-cancerous lesion formation by enhancing programmed cell death (apoptosis)<sup>35</sup>.
- Researchers sought to investigate the effect of Black Tea polyphenols (BTP) on induced DNA damage to colon mucosa in an animal model. Findings suggest that induced DNA damage to the colon mucosa is prevented by consumption of Black Tea polyphenols<sup>36</sup>.
- Major compounds of Green and Black Tea, EGCG and theaflavins respectively, are known to inhibit proteins which are closely associated with tumor growth and metastasis. These polyphenols exhibited apoptosis-inducing activity for human colon cancer cell lines<sup>37</sup>.
- Researchers in Taiwan discovered a link between EGCG and cancer risk reduction. The researchers found that the Green Tea polyphenol inhibited proliferation of the cancer cells by inducing cell death and blocking cell cycle progression<sup>38</sup>.
- Researchers at the University of South Carolina used animals with colon cancer and provided them with either water or Green Tea as their beverage. They subsequently found that those given Green Tea significantly reduced their risk of developing new colon cancer tumors, suggesting that Green Tea was effective in the initial stages of colon carcinogenesis.<sup>39</sup>

### **Prostate Cancer**

- Researchers at the University of Wisconsin, Madison reviewed the existing literature about tea as a preventative measure for prostate cancer among men. Based on epidemiological, in vitro and in vivo studies, the researchers suggest that tea—especially Green Tea—may be a good public health recommendation that may help prevent prostate cancer.<sup>40</sup>

### **Skin Cancer**

- According to a study conducted by the University of Arizona, participants who drank iced Black Tea and citrus peel had a 42 percent reduced risk of skin cancer<sup>41</sup>.
- Hot Black Tea consumption is associated with a significantly lower risk of squamous cell carcinoma (SCC), a form of skin cancer; tea concentration (strength), brewing time and temperature all influence the potential protective effects of hot Black Tea on SCC<sup>42</sup>.
- Oral consumption of Green or Black Tea decreased the number of tumors in mice following exposure to UV radiation<sup>43</sup>.
- Green Tea polyphenols may have cancer prevention potential, especially in the case of solar UV-induced cancer<sup>44</sup>.
- Research suggests that compounds in Green Tea may protect skin from ultraviolet (UV) radiation-induced damage when applied topically<sup>45</sup>.
- Topical treatment of Green Tea polyphenols on human skin prior to UV exposure inhibited indicators of DNA damage, thus inhibiting photocarcinogenesis, or UV-induced skin cancer<sup>46</sup>.
- Experiments that show that administration of Green Tea, Black Tea or specific flavonoids in tea inhibited the growth of established nonmalignant and malignant skin tumors in tumor-bearing mice. In addition, oral administration of Black Tea inhibited DNA synthesis and enhanced cell death (apoptosis) in both nonmalignant and malignant tumors in tumor-bearing mice<sup>47</sup>.

### **Oral Cancers**

- A human intervention trial examined the effect of treating superficial precancerous lesions (leukoplakia) in the mucosal lining of the mouth with a mixed tea product. After the six-month trial, partial regression of the lesions was observed in 37.9 percent of the group treated with tea as compared to only 10 percent of those treated with a placebo<sup>48</sup>.

- Researchers examined the effects of tea and curcumin, a spice and food-coloring agent, on oral cancer in hamsters. Hamsters were treated with a topical cancer-causing solution inside the cheek three times a week for six weeks. Two days after the last treatment of the solution, the hamsters were given Green Tea as drinking fluid or curcumin applied topically three times per week, the combination of Green Tea and curcumin treatment, or no treatment for 18 weeks. At the end of this period, the scientists observed that the combination of tea and curcumin significantly decreased the number of visible tumors and tumor volume. Furthermore, tea alone and in combination with curcumin increased cancer cell death (apoptosis)<sup>49</sup>.

### **Lung Cancer**

- Studies comparing groups of mice treated with a tobacco-specific carcinogen and receiving either water or water enriched with tea-derived antioxidants found that the tea-fed mice developed 24 percent fewer lung tumors and the average size of the tumors was 38 percent smaller as compared to the water-fed mice<sup>50,51</sup>.
- Tea catechins were evaluated for their effects on cell proliferation, apoptosis and associated gene expression in highly metastatic human lung cancer cells. A significant reduction in cell proliferation after exposure to tea catechins was noted. It is suggested that tea compounds can influence genetic alteration to reduce the growth and survival of human lung cancer cells<sup>52</sup>.

### **Ovarian Cancer**

- A case-control study conducted in China, which employed 254 patients with histologically confirmed epithelial ovarian cancer and 652 control subjects, determined tea consumption based on a validated questionnaire and found that, after accounting for demographic, lifestyle and familial factors, ovarian cancer risk declined with increasing frequency and duration of overall tea consumption<sup>53</sup>.
- A population-based study involving over 61,000 Swedish women aged 40-76 found that drinking Black Tea was associated with a reduced risk of ovarian cancer. The study found that women who drank the most tea—green or black—were least likely to develop ovarian cancer over the 15-year study follow-up. Women who drank two or more cups of tea daily experienced a 46 percent reduction in risk compared to women who reported not drinking tea. Even small amounts of tea (less than one cup per day) reduced risk by 18 percent, while one cup per day reduced risk by 24 percent. Although previous studies evaluating the effects of tea consumption and ovarian cancer found inconsistent results, the researchers noted that the large size of this study and long-term follow-up provides compelling evidence that tea drinking may indeed offer protection against this type of cancer<sup>54</sup>.

### **TEA'S ROLE IN IMMUNE FUNCTION**

Researchers from Brigham and Women's Hospital and Harvard University recently published novel new data indicating that tea contains a component that can help the body ward off infection and disease and that drinking tea may strengthen the immune system.

The researchers identified a substance in tea, L-theanine, which primes the immune system in fighting infection, bacteria, viruses and fungi. A subsequent human clinical trial showed that certain immune cells of participants who drank five cups of Black Tea a day for two to four weeks secreted up to four times more interferon, an important part of the body's immune defense, than at baseline. Consumption of the same amount of coffee for the same duration had no effect on interferon levels. According to the authors, this study suggests that drinking Black Tea provides the body's immune system with natural resistance to microbial infection<sup>55</sup>.

### **TEA'S ROLE IN ORAL HEALTH**

- Tea may also contribute to oral health. The flavonoids in tea may inhibit the plaque-forming ability of oral bacteria and the fluoride in tea may support healthy tooth enamel<sup>56,57</sup>.
- A recent study conducted at the New York University Dental Center examined the effects of Black Tea extract on dental caries formation in hamsters. Compared to those who were fed water with their food, hamsters which were fed water with Black Tea extract developed up to 63.7 percent fewer dental caries<sup>58</sup>.

## TEA AND METABOLISM, OBESITY AND BODY COMPOSITION

Preliminary research suggests that drinking tea may have effects on body weight, fat accumulation and insulin activity. While it may be premature to draw firm conclusions based on early research, key findings include the following:

- Green Tea extract was found to significantly increase 24-hour energy expenditure and fat oxidation in healthy men<sup>59</sup>.
- After three months of consumption of Green Tea extract by moderately obese patients, body weight decreased by 4.6 percent and waist circumference decreased by 4.48 percent<sup>60</sup>.
- Researchers examined mice which were fed either a low-fat diet, high-fat diet or high-fat diet supplemented with 0.1-0.5 percent tea catechins for 11 months. The scientists then measured body weight, fat tissue mass and liver fat content and discovered that supplementation with tea catechins resulted in a significant reduction of high-fat diet-induced body weight gain and visceral and liver fat accumulation<sup>61</sup>.
- Researchers at the United States Department of Agriculture (USDA) conducted a study to examine the insulin-enhancing properties of tea and its components. An *in vitro* test using a fat cell assay found that tea, as normally consumed, increased insulin activity greater than 15-fold. Green, Black and Oolong Tea all yielded insulin-increasing results. The researchers separated the components of the tea using a high-performance liquid chromatography and discovered that several known compounds found in tea were shown to enhance insulin, helping cells recognize and respond to the hormone. The greatest activity was elicited by EGCG followed by epicatechin gallate, tannins, and theaflavins<sup>62</sup>.
- Researchers compared the body weight and fat mass of mice that were fed a low-fat or high-fat diet, with swimming or not, and with or without tea catechins. They found that, when fed a high-fat diet, tea catechins helped reduce fat accumulation by 18 percent and exercise alone reduced accumulation by 14 percent. However, mice that exercised and had catechins reduced fat accumulation by 33 percent. This evidence suggests that tea catechins may increase fat metabolism, enabling the body to burn more fat as fuel and store less in the body<sup>63</sup>.
- Animals fed a high-fat, high-calorie diet to promote excessive weight gain and obesity were given Green Tea extract or placebo and their energy expenditure and fat oxidation were measured. The researchers found that Green Tea extract alone, as well as when combined with exercise, increased energy expenditure and stimulated fat catabolism. The researchers concluded that Green Tea extract combined with regular exercise stimulates fat metabolism and may attenuate obesity caused by a high-fat diet more effectively than Green Tea extract or exercise alone<sup>64</sup>.
- Animals fed a diet high in catechin-rich green tea extract were found to increase running times to exhaustion by up to 30 percent compared to a control animal. In addition, Green Tea extract appeared to shift metabolism so that the animals burned body fat and spared muscle glycogen, thereby increasing endurance time to exhaustion<sup>65</sup>.
- A follow-up study of the effects of tea catechins on body fat reduction in humans was conducted by examining the effect of drinking Oolong Tea with added Green Tea extract in healthy, moderately overweight men. A double-blind study was performed in which the test subjects ingested one bottle of Oolong Tea containing 690 mg of catechins and control subjects ingested one bottle of Oolong Tea containing 22 mg of catechins for 12 weeks. Researchers found that body weight, body mass index (BMI), waist circumference, body fat mass and subcutaneous fat were all significantly lower in the high catechin-ingesting group as compared to the control group. Measures of LDL cholesterol oxidation were positively associated with the beneficial changes in body fat mass in the high catechin group. Researchers concluded that daily consumption of 690 mg of catechins, the equivalent of five cups of strong Green Tea, might be useful in preventing and improving obesity<sup>66</sup>.
- Japanese researchers found that in a 12-week, double-blind and placebo-controlled study, green tea catechins led to a reduction in body fat, blood pressure and LDL cholesterol compared to the control group. The authors suggest that Green Tea catechins may help prevent obesity and reduce risk for cardiovascular disease.<sup>67</sup>

## TEA AND REDUCED RISK OF KIDNEY STONES

Increased intake of fluids is routinely recommended for people who have had kidney stones to reduce the likelihood of recurrence. A recent study that followed 81,093 women for eight years suggests that beverage choice may also affect kidney stones development. The study found that for each eight-ounce cup of tea consumed daily by female participants with no previous history of kidney stones, the risk of developing stones appeared to be lowered by eight percent<sup>68</sup>. An earlier study of 45,289 men reported a similar relationship, suggesting that for each eight-ounce serving of tea consumed daily, a 14 percent decrease in risk of stone development was observed<sup>69</sup>.

## TEA AND REDUCED RISK OF OSTEOPOROSIS

Although high caffeine intake has been suggested to be a risk factor for reduced bone mineral density (BMD), research indicates that drinking tea does not negatively affect BMD, and while it may be too soon to state definitively, findings suggest that tea may even play a role in bone health. A study published recently in the *American Journal of Clinical Nutrition* found that older women who drank tea had higher BMD measurements than those who did not drink tea. The researchers concluded that the flavonoids in tea might influence bone mass and that tea drinking may reduce the risk of osteoporosis<sup>70</sup>. Another recent study found that habitual tea-drinking was seen to have a significant beneficial effect on the BMD of adults (30 years and older), especially in those who had been habitual tea-drinkers for six or more years<sup>71</sup>. Studies in adolescent<sup>72</sup> and postmenopausal women<sup>73</sup> found no relationship between caffeine intake and bone health.

## TEA AND NEUROLOGICAL DECLINE

- In an animal model study, researchers found that the Green Tea catechin EGCG was capable of reducing biomarkers associated with Alzheimer's disease. Using strains of mice transgenically bred to be prone to develop Alzheimer's disease, the researchers found that exposure to EGCG resulted in reduced production of amyloid protein, a marker for the development of plaques associated with Alzheimer's disease<sup>74</sup>.
- A prospective cohort study of nearly 30,000 Finnish adults aged 25 to 74 years old, who were followed for 13 years, found that tea drinking was associated with a reduced risk of Parkinson's disease. Among tea drinkers, those who reported drinking three or more cups of tea per day were 69% less likely to develop Parkinson's disease compared to those who reported not drinking tea<sup>75</sup>.
- In an animal model study, Japanese researchers found that theanine, the amino acid present virtually only in tea, may help prevent memory declines as we age by decreasing neuronal cell death. In their study, animals who were given theanine and were then subjected to repeated memory impairment, had less memory damage to their brains compared to animals who did not receive theanine.<sup>76</sup>

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## Glossary of Terms

### ***DEFINITION OF TEA TERMS***

***-- A Glossary of Key Terms Used to Explain the Health Benefits Of Tea --***

As scientists worldwide continue to discover new research findings on the health benefits of tea, it becomes increasingly challenging to understand the many terms used to communicate the research results. The Tea Council of the U.S.A., Inc. has developed the following list of commonly-used terms and their definitions:

#### **Terms Related to the Health Benefits of Tea:**

<b><i>Antioxidant</i></b>	A substance that helps prevent or delay oxidative damage caused by reactive oxygen and or reactive nitrogen species. Oxidative damage to the body, cells and tissues may contribute to diseases like cancer and heart disease.
<b><i>Phytochemicals</i></b>	Naturally occurring plant compounds. Many phytochemicals are thought to play a role in decreasing the risk of cancer and heart disease and may boost the immune system. Some phytochemicals such as tea flavonoids are also antioxidants.
<b><i>Polyphenols</i></b>	A broad class of antioxidant phytochemicals that are found throughout the plant kingdom.
<b><i>Flavonoids</i></b>	A class of polyphenolic phytochemicals found in tea that are effective antioxidants.
<b><i>Flavonols</i></b>	A group of flavonoids found in tea and many fruits and vegetables that are antioxidants and are thought to contribute to some of the potential health benefits in these plant foods. They include rutin, quercetin, and kaempferol.
<b><i>Catechins (Flavanols)</i></b>	A group of flavonoids found in tea and some fruits that are antioxidants and are thought to contribute to some of the potential health benefits of tea. Examples include epicatechin and epigallocatechin gallate.
<b><i>Epigallocatechin gallate (EGCG)</i></b>	The principle catechin in Green and Black Teas. EGCG is a strong antioxidant and has been shown to reduce formation of lung, esophageal and skin tumors in animal models of human cancer.
<b><i>Polyphenol oxidase</i></b>	A natural enzyme in the fresh Green Tea leaf that transforms colorless green catechins to red/brown Black Tea flavonoids. This conversion decreases bitterness and enhances the flavor and astringency of Black Tea.
<b><i>Theaflavins</i></b>	Black Tea flavonoids produced from catechins during tea manufacturing which have a red/orange color. Theaflavins are strong antioxidants and have been shown to reduce esophageal tumors and oxidative damage to lung tissue in animal models of human cancer.
<b><i>Thearubigins</i></b>	Black Tea flavonoids produced from catechins during the manufacturing which have brown color and astringency.
<b><i>Gallic acid</i></b>	A polyphenol in Black and Green Tea with established antioxidant activity. Gallic acid is chemically bound to many Green and Black Tea flavonoids such as EGCG.

<b>Theanine</b>	Theanine is an amino acid commonly found in tea that can cross the blood-brain barrier, therefore has psychoactive properties. It may reduce mental and physical stress, and may produce feelings of relaxation by increasing levels of gamma-aminobutyric acid (GABA), serotonin, dopamine, and alpha wave activity.
<b>Lignans</b>	A lignan is a type of phytochemical that is neither vitamin nor mineral. In a human diet, intestinal microflora convert lignans into enterodiol and enterolactone, which may reduce the risk of certain cancers and cardiovascular diseases. Lignans can be found in fruits, vegetables, tea, coffee, and grain products.

### Physiological Terms:

<b>Cytochrome P450 system</b>	A family of enzymes in the liver and most tissues, which helps metabolize drugs and natural and man-made chemicals. This enzyme system helps remove carcinogens but also activates carcinogens.
<b>Deoxyribonucleic acid (DNA)</b>	The molecule that contains the essential genetic information in living cells and is responsible for their genetic make-up.
<b>Enzyme</b>	Any of numerous complex proteins that are produced by living cells and catalyze specific biochemical reactions at body temperatures.
<b>Phase II enzymes</b>	A family of enzymes in the liver and most tissues which work with the cytochrome P450 system to help the body eliminate harmful chemicals and carcinogens.
<b>Free radicals</b>	Reactive oxygen and nitrogen compounds that are natural byproducts of metabolism and formed in the body as a result of smoking, air pollution and exposure to sunlight. Free radicals are unstable and highly reactive molecules that can damage cells and tissues causing adverse effects to physiology thought to contribute to cancer and heart disease.
<b>Heterocyclic amines</b>	A group of highly reactive molecules formed during the cooking and grilling of meats can cause mutations by attacking the DNA in living cells. These compounds are carcinogens thought to have a role in gastric, colon and esophageal cancers.
<b>Peroxides</b>	A class of reactive chemicals such as hydrogen peroxide that form hydroxyl and peroxy radicals that can damage DNA, lipids, and tissues causing adverse effects to physiology thought to contribute to cancer and heart disease.
<b>Peroxy and Hydroxyl radicals</b>	Reactive oxygen species that can damage DNA, lipids, and tissues causing adverse effects to physiology thought to contribute to cancer and heart disease.
<b>Fructosamine</b>	Fructosamine is a glycosylated serum protein (sugar bound to protein in the blood), levels of which are primarily tested to help diabetics monitor their blood sugar. Testing for fructosamine can measure the effectiveness of diet or medication adjustments after a couple of weeks rather than months compared to the standard test (hemoglobin A1c).
<b>Ileostomy</b>	When part of the intestines is removed, the body needs a new way to excrete stool. An ileostomy refers to the surgical attachment of the ileum (end of small intestine) to an opening outside the body (the stoma) from where stool may leave the body.

<b>8-hydroxydeoxyguanosine (8-OhDG)</b> <b>F2-isoprostanes (8-epi-PGF2)</b>	In medicine, a biomarker is a biochemical substance that can be used to measure the progress of a disease or the effects of treatment. The biomarkers listed here are markers of oxidative stress that mediate the risk for developing lung cancer.
<b>EGFR</b> <b>PCNA</b> <b>JUN</b> <b>FOS</b> <b>Ki-67</b>	In medicine, a biomarker is a biochemical substance that can be used to measure the progress of a disease or the effects of treatment. The biomarkers listed here are biomarkers of cell proliferation, which is relevant in the carcinogenic process.
<b>Capase 3</b>	An enzyme that plays a key role in apoptosis (cell death). Failure of apoptosis is one of the main contributions to tumor development and autoimmune diseases; unwanted apoptosis occurs with ischemia or Alzheimer's disease. Caspase-3 is also known as CPP32, apopain, and YAMA.
<b>Norepinephrine</b>	Norepinephrine, also called noradrenaline, is a chemical made in the adrenal gland, and by some nerve cells. It can act as both a neurotransmitter and a hormone. Norepinephrine is released from the adrenal gland in response to stress and low blood pressure. A lack of norepinephrine may be linked to Attention Deficit Disorders and depression.
<b>Ischemia/reperfusion injuries</b>	Ischemia refers to a restriction of blood flow. However, restoration of blood flow after a period of ischemia can actually be more damaging than the ischemia. Reintroduction of oxygen causes a greater production of damaging free radicals, resulting in reperfusion injury, and accelerated necrosis (tissue death).
<b>Substantia nigra</b>	A layer of deeply pigmented gray matter situated in the midbrain, which contains the cell bodies of a tract of dopamine-producing nerve cells whose secretions tend to be deficient in Parkinson's disease.
<b>Amyloid-beta peptide</b>	Made up of 39-43 amino acids, Amyloid-beta is the main constituent of the amyloid plaques in patients with Alzheimer's disease.
<b>Chelator</b>	A chelator, or chelating agent, is a compound that binds particular ions, removing them from solution. Chelators combine with metals to form chelates; this binding is used medically in the treatment of metal poisoning (e.g. by lead).

### Research Terms:

<b>Epidemiology</b>	The study of the distribution of diseases in populations and of factors that influence the occurrence of disease. Epidemiology examines epidemic (excess) and endemic (always present) diseases; it is based on the observation that most diseases do not occur randomly, but are related to environmental and personal characteristics that vary by place, time, and subgroup of the population.
<b>Phase II trial</b>	Commonly, there are four phases of pharmaceutical clinical trials in the drug development process. Phase II trials are performed on larger groups (20-300) to assess efficacy and dosing requirements, after the initial safety of the therapy has been confirmed in Phase I trials.
<b>Laboratory experiment</b>	A controlled <i>in-vitro</i> or <i>in-vivo</i> study done to suggest a possible hazard or benefit of a substance or circumstance; or a study to elaborate on observations that have been made in people.

<b><i>In-vitro (test tube)</i></b>	A study conducted with tissues, cells, or substances in a controlled or model system and not a living animal or organism.
<b><i>In-vivo (“in life”)</i></b>	A study conducted using a living animal or person such as a clinical trial.
<b><i>Experimental</i></b>	<ul style="list-style-type: none"> <li>a. <b>Randomized controlled trial (RCT)</b> - considered the most reliable form of scientific evidence, the RCT is mainly used in clinical studies. The clinical RCT involves randomly allocating participants to treatment or control groups. This ensures that the different treatment groups are statistically equivalent.</li> <li>b. <b>Double-blind</b> - used to prevent research outcomes from being influenced by either the placebo effect or the observer bias. Researchers and participants are unaware of to which group (treatment or control) participants have been assigned.</li> <li>c. <b>Parallel study</b> – different groups in a study receive different treatments, and do not ever receive any of the other treatments.</li> <li>d. <b>Crossover design</b> – commonly, each patient receives all of the treatments being studied.</li> </ul>
<b><i>Observational studies</i></b>	<ul style="list-style-type: none"> <li>a. <b>Prospective</b> – a study that begins in the present, and follows a group forward in time to see if they develop the outcomes of interest (for example, certain cancers).</li> <li>b. <b>Retrospective</b> – a study that is set in the present with a study group that may or may not have the outcome of interest, and looks back into the past to examine what variables from the participants’ past might be predictors of their current condition.</li> <li>c. <b>Cohort</b> - a study in which cases (patients who presently have a certain condition and/or receive a particular treatment) are followed forward in time and compared with another group that is not affected by the condition under investigation.</li> </ul>
<b><i>Significance</i></b>	Significance is a statistical term used in research, and does not carry the same meaning of “important” as it does in laymen’s terms. In research, significance levels show how likely a result is due to chance. Being true does not necessarily make a result clinically important. Referred to as a p-value, the standard cut-off is 0.05 for significance. That is, if a result is labeled with $p=0.05$ , it is significant, meaning that there is a 5% possibility that the result was due to chance.

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## **Symposium Press Announcement**

### **FOR IMMEDIATE RELEASE:**

Contact: Kevin Hughes/Barbara King  
Pollock Communications, Inc.  
[khughes@pollock-pr.com](mailto:khughes@pollock-pr.com)/[bking@pollock-pr.com](mailto:bking@pollock-pr.com)  
212-941-1414



## **FEELING ANXIOUS OR DISTRACTED? NEW RESEARCH SHOWS A CUP OF TEA COULD HELP**

### ***New Findings Show How Tea Impacts Brain Waves***

***Other Research Links Drinking Tea to Weight Management and Reduced Risk of Heart Disease, Certain Cancers & Diabetes***

**WASHINGTON, DC, September 18, 2007** – Leading scientists from around the world convened today in Washington, DC for the **Fourth International Scientific Symposium on Tea & Human Health** to review the latest findings on the potential health benefits of tea, including studies on how it may help maintain a healthy body weight, control blood sugar and even help us think more clearly. New studies adding to the body of knowledge regarding the comfort beverage’s potential ability to reduce risk for several chronic diseases, such as heart disease and certain cancers were also presented.

#### **Tea Theanine Link to Attention and Focus**

The results of several ongoing human trials presented by John Foxe, Ph.D., Professor of Neuroscience, Biology and Psychology at City College of the City University of New York, have found that theanine from tea actively alters the attention networks of the brain. Theanine is an amino acid present almost exclusively in the tea plant. After drinking tea, the amino acid theanine, which is present in Green, Black and Oolong varieties, is known to be absorbed by the small intestine and cross the blood-brain barrier where it affects the brain’s neurotransmitters, and increases alpha brain-wave activity. This alpha brain rhythm is known to induce a calmer, yet more alert, state of mind.

Dr. Foxe and his team used electrophysiological measures to monitor brain activity after individuals drank solutions containing either 250 mg theanine or placebo. The subjects were asked to complete a variety of attention-related computerized tasks. “Our results showed that after having theanine, individuals showed significant improvements in tests for attention and that activity in cortical regions responsible for attention functions was enhanced,” said Dr. Foxe.

New research in Dr. Foxe’s laboratory, the Cognitive Neurophysiology Laboratory at the Nathan S. Kline Institute for Psychiatric Research in Orangeburg, New York, suggests that the effects of theanine in combination with caffeine are even greater than with either one alone in improving attention. Theanine may work synergistically

with caffeine to help induce a more calming, relaxed state, but one that allows the mind to focus and concentrate better at tasks. A cup of tea contains an average of 20-25 mg of theanine.

"What's more, we have seen that just 20 minutes after consuming theanine, the blood concentrations increase and the brain's alpha waves are impacted. It lasts about three to four hours, which we have speculated may be why people tend to drink a cup of tea every three-to-four hours during the day," added Dr. Foxe.

### **Tea May Help Maintain Brain Health**

Numerous studies have concluded that diets rich in fruits and vegetables support the body in fighting neurological decline through antioxidant mechanisms associated with their high flavonoid content. However, the importance of polyphenolic flavonoids in supporting healthy brain cells appears to go beyond the simple oxygen species scavenging, involving pleiotropic effects on numerous biological pathways to help keep human brain cells from dying and even help repair them when they are subjected to insults that damage the cells' DNA.

Human epidemiological and new animal data from around the world suggest that drinking tea, especially rich in catechins, may help support the brain as we age. Indeed, tea consumption is inversely correlated with the incidence of dementia, Alzheimer's disease and Parkinson's disease, which may help to explain why there are significantly lower incidence rates of age-related neurological disorders among Asians than in Europeans or Americans.

Dr. Silvia Mandel, of the Eve Topf Center for Neurodegenerative Diseases in Israel, has been studying the effects of tea on brain functions in laboratory and animal models for over a decade. Her most recent studies, presented at the symposium, looked at animal models of neurological diseases such as Parkinson's and Alzheimer's. Her group provided an amount of purified EGCG equal to about two to four cups of Green Tea per day to animals with induced Parkinsonism as part of their diet to evaluate how their symptoms improved or progressed.

They found that when the animals are fed Green Tea EGCG, the polyphenol appeared to prevent brain cells from dying, and showed improvements in reducing compounds that lead to lesions in the brains of animals with Alzheimer's disease.

According to Dr. Mandel, "not only may the EGCG help prevent brain cells from dying, it appears that the polyphenol may even rescue the neurons once they have been damaged, to help them repair. In the past, it was thought that once brain cells were damaged, there was no way to repair them. The major question is whether these promising results are reproducible in humans."

### **Further Evidence that Tea Promotes Good Health**

The latest data provide further evidence of tea's role in helping individuals maintain good health and vitality. Research scientists from top medical institutions in Asia, the Middle East, Europe and North America gathered to share their new data.

Some of the other exciting findings presented at the Fourth International Scientific Symposium on Tea & Human Health relevant to public health were:

- Tea flavonoids may improve cardiovascular health by reducing inflammation and improving blood vessel function;
- Tea drinking may play a role in gene expression that is involved in cancer cells;
- Tea may play a role in shifting metabolism to favor weight loss and better manage blood sugar levels;
- Tea is a major contributor of flavonoids in the US diet.

The symposium, which was sponsored by the American Cancer Society, American College of Nutrition, American Medical Women's Association, American Society for Nutrition, The Linus Pauling Institute and the Tea Council of the U.S.A., was held at the United States Department of Agriculture (USDA). Leading researchers from around the world joined American scientists in presenting the latest clinical, laboratory and epidemiological data on the role of tea in promoting healthfulness and reducing the risk of disease.

"The list of health benefits associated with tea consumption continues to grow. And, unlike medications, there are no known medical reasons not to enjoy tea as part of a healthy diet and lifestyle," said meeting co-chair, Jeffrey Blumberg, Ph.D., Professor, Friedman School of Nutrition Science and Policy and Director, Antioxidants Research Laboratory, Jean Mayer USDA Human Nutrition Research Center on Aging at Tufts University, Boston.

"The scientific community around the world is making tremendous advancements in better understanding the mechanisms by which tea may reduce risk for heart disease, certain cancers, type II diabetes, and help maintain neurological function. Researchers are finding out exactly how bioactive compounds in tea exert their positive effects on human health," commented co-chair Lenore Arab, Ph.D., Professor of Internal Medicine at the University of California, Los Angeles.

### **New Findings About Tea and Weight Management**

With over two-thirds of the U.S. adult population overweight or obese, scientists are looking for medically sound ways to help consumers manage their weight. One area of intense research is Green Tea and tea catechin polyphenols specifically. To clarify the status of the research to date, Eva Kovacs, Ph.D., Clinical Research Manager at Unilever North America, reviewed the existing scientific literature on Green Tea, weight loss and metabolism. Dr. Kovacs reviewed several research studies conducted in recent years that suggest that Green Teas rich in catechins may aid in weight management by reducing body fat and in particular visceral fat, possibly through increased resting energy expenditure and fat oxidation. "A few studies have found modest benefits on metabolism from Green Tea extract, but more research is needed before recommending drinking Green Tea as a 'fat burner,'" said Dr. Kovacs.

Since Green and Black Tea can be enjoyed without added calories, tea drinkers may find that they can eliminate liquid calories in their diet by drinking tea in lieu of sugar-laden beverages that are nutrient-poor but calorie-rich. Dr. Kovacs warned consumers that Green Tea products are no magic bullet for weight loss and Green Tea should be included as part of an overall diet and exercise strategy to achieve a healthy body weight.

### **Studies Suggest Tea Consumption Tames Inflammation, Improves Blood Vessel Function**

New research presented by Claudio Ferri, M.D., Professor of Internal Medicine at the University of L'Aquila in Italy provided additional insights into how tea flavonoids provide support for cardiovascular health by promoting healthy endothelial function. In his studies, subjects were given either low, intermediate or high doses of tea flavonoids and then the researchers measure endothelial dysfunction via flow-mediated dilation of the brachial artery and arterial stiffness. "Our studies have found that tea flavonoids improved endothelium-dependent vasorelaxation and decrease arterial stiffness in study participants, thereby suggesting that tea consumption may have favorable effects on cardiovascular disease."

These new developments in artery endothelium research add to the growing body of evidence suggesting that drinking as little as two to four cups of tea daily can promote cardiovascular health in several different ways. Tea flavonoids are thought to support cardiovascular health through several mechanisms, including: providing antioxidants to help temper inflammatory markers such as C-reactive protein; reducing blood cholesterol levels; and providing dilation of blood vessels to help manage blood pressure.

### **Tea May Impact Genes Involved in Cancer Initiation and Development**

Results from tea intervention trials on the role of Green Tea on the prevention of cancer provided insights into the cutting edge field of nutri-genomics, or how gene susceptibility toward chronic diseases can be altered through dietary interventions. Iman Hakim, M.D., Ph.D., M.P.H., Professor and Interim Dean of the Mel and Enid Zuckerman College of Public Health and Professor at the Arizona Cancer Center, University of Arizona, has conducted several human clinical trials over the past decade on the role both Green and Black Tea may play in certain cancers. Her latest human clinical trial suggests that bioactive compounds in tea have a significant effect on genes that impact cancer susceptibility and repair from environmental insults.

"The good news is that we are seeing that Green Tea is impacting genes that play a role in cancer, but we cannot at this point pinpoint who will be responders versus non-responders," noted Dr. Hakim. "In addition, our recent preliminary data show a beneficial effect of Green Tea on lipid profile among smokers and former smokers. Therefore, since there is no known downside of consuming tea, and it may be beneficial, there's no reason not to recommend drinking it." Dr. Hakim's lab is currently analyzing the study data to determine if Black Tea has similar effects to Green. The amount of tea that Dr. Hakim recommends is at least four cups per day.

### **Tea Drinkers Consume Over 20 Times More Flavonoids**

Flavonoids are a type of antioxidant that are known to be biologically active and are found primarily in plant-based foods and beverages, including fruits and vegetables, chocolate, wine and tea. Intake of flavonoids has been

inversely associated with the incidence of many chronic diseases, including cardiovascular disease and certain cancers. While research is ongoing to fully understand the roles of flavonoids in human health, they are thought to exert their health benefits, in part, due to their antioxidant capacity.

Using the latest national food consumption databases and the USDA flavonoid Database, Michigan State University researchers were able to differentiate tea drinkers from non-tea drinkers and analyze their diets, based on diet recalls, for flavonoid intake. “We found that just over 21 percent of U.S. adults drank tea and that the total flavonoid intake of tea consumers was more than 20 times higher than flavonoid consumption of non-tea drinkers,” explained lead researcher Won Song, Ph.D., R.D. Professor of Human Nutrition at Michigan State University.

Tea drinkers averaged nearly 700 mg flavonoids while non-tea drinkers averaged about 33 mg per day. A cup of tea contains approximately 125 mg flavonoids, which is more than most non-tea drinkers consume in an entire day.

### **A Glimpse at the Future of Tea and Health**

It's not surprising to many researchers who study plant-based foods that ongoing scientific studies into the health benefits of drinking tea has led to a robust body of literature that is very promising. Plants are known to have potent bioactive compounds, which is why diets rich in plant-based foods are known to support the body's fight against many chronic conditions associated with aging. Research continues to show that tea contains bioactive compounds that have biological roles within human cells.

“The data presented at this year's symposium extends the apparent benefits of tea beyond reducing the risk for cardiovascular disease and cancer to new facets of health. Preliminary studies suggesting an effect of tea on neurological function, inflammation, and weight maintenance add to the robust science already demonstrating that tea is a healthful beverage,” said Dr. Blumberg. New results from nutrigenomic research should help identify those individuals who will benefit the most from drinking tea. Experimental and clinical studies like these are continuing to expand our knowledge about tea and human health.

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