

## Recent Trends and Advances in Berry Health Benefits Research<sup>†</sup>

Recent advances have been made in our scientific understanding of how berries promote human health and prevent chronic illnesses such as some cancers, heart disease, and neurodegenerative diseases. Cancer is rapidly overtaking heart disease as the number one killer disease in developed countries, and this phenomenon is coupled with a growing aging population and concomitant age-related diseases. Therefore, it is not surprising that consumers are turning toward foods with medicinal properties as promising dietary interventions for disease prevention and health maintenance. Among fruits, berries of all colors have emerged as champions with substantial research data supporting their abilities to positively affect multiple disease states. Apart from several essential dietary components found in berries, such as vitamins, minerals, and fiber, berries also contain numerous bioactives that provide health benefits that extend beyond basic nutrition. Berry bioactives encompass a wide diversity of phytochemicals (phytonutrients) ranging from fat-soluble/lipophilic to water-soluble/hydrophilic compounds. Recent research from laboratories across the globe has provided useful insights into the biological effects and underlying mechanisms of actions resulting from eating berries. The cluster of papers included here represents a cross section of topics discussed at the 2009 International Berry Health Benefits Symposium. Together, these papers provide valuable insight into recent research trends and advances made into evaluating the various health benefits that may result from the consumption of berries and their derived products.

### INTRODUCTION

It is now five years since the International Berry Health Benefits Symposium (BHBS), a series of biennial conferences organized to investigate and explore the latest scientific research related to berry consumption and human health, first met (1). This past summer (June 22–23, 2009), the National Berry Crop Initiative (NBCI), which consists of major North American berry organizations, joined together with scientists in Monterey, CA, to present the third conference featuring the latest research on berries and human health. The host sponsors of the 2009 BHBS included the NBCI, the California Strawberry Commission, the Cranberry Institute, the Oregon Raspberry and Blackberry Commission, the Oregon Strawberry Commission, the Washington Red Raspberry Commission, the Wild Blueberry Association of North America, the U.S. Highbush Blueberry Council, Driscoll's, Dole, and the North Carolina Research Campus. Additional sponsors include Well-Pict Berries, the U.S. Department of Agriculture—Agricultural Research Service (USDA-ARS), Naturipe Farms, California Giant Berry Farms, Nourse, Swardlick Marketing Group, Ocean Spray, SunBelle, the North American Raspberry and Blackberry Association, the Linus Pauling Institute, Youth Juice, and the North American Strawberry Growers Association. The 2009 BHBS showcased a combination of plenary oral and poster presentations presented over two days, bringing basic and clinical researchers together to share their work with their peers, the public, media representatives, health professionals, and representatives from the food, nutraceutical, and pharmaceutical industries. An international backdrop was provided by participants from around the globe including the United States and Canada, Asia, and Europe. This underscores the worldwide research interest in evaluating and understanding the effects of berries on human health, performance, and diseases.

Despite a growing body of research establishing the potential health benefits of several small fruits, including exotic tropical fruits such as açai, goji berry, mangosteen, and pomegranate, the primary focus of the 2009 BHBS (organized by the NBCI) was on small soft-fleshed edible berries grown commercially and regularly consumed in North America. These berries include blackberries, black raspberries, red raspberries, blueberries, cranberries, and strawberries. The impetus for forming the NBCI, the organization which represents these major U.S. berry growers, was the economic importance of these berries and the accumulation of scientific research supporting the role of these specialty berry crops in promoting human health. Goals of the NBCI include raising awareness of the health benefits of berries through science-based education and dissemination of this information to the public, communicating with government bodies and other relevant interest groups, and fostering collaborative relationships among researchers in berry health benefits research.

The cluster of papers presented here is taken from both oral and poster presentations/abstracts at the 2009 BHBS. Discussions included scientific reviews and recent progress made in berry health benefits research. There were 21 oral plenary lectures organized into five major sessions, chaired by the following researchers: session 1, *Berries and Heart Health*, chaired by *Jess Reed* from the University of Wisconsin, Madison; session 2, *Berries and Metabolism*, chaired by *Ronald Prior* from the USDA-ARS Arkansas Children's Nutrition Center; session 3, *Berries and Cancer*, chaired by *Gary Stoner*, from The Ohio State University; session 4, *Berries and Brain Aging*, chaired by *James Joseph* from the USDA-ARS Jean Mayer Center for Aging at Tufts University; and session 5, *Berry Compositional Chemistry and Biological/Health Effects*, chaired by *Navindra Seeram* from The University of Rhode Island College of Pharmacy. In addition, there were 24 posters in a session chaired by *Luke Howard* from the University of Arkansas.

<sup>†</sup>Part of the Berry Health Symposium 2009

**ORAL PLENARY PRESENTATIONS AT THE BHBS**

The first session on *Berries and Heart Health* had *Britt Burton Freeman* from the National Center for Food Safety and Toxicology, Illinois Institute of Technology, Chicago, IL, and the University of California, Davis, CA, presenting results from a recent human study investigating the effects of strawberry consumption on biomarkers of oxidative stress and inflammation. This was followed by a presentation by *Iris Erlund* from the National Public Health Institute, Helsinki, Finland, who presented data obtained from another human study evaluating the effects of berry fruit consumption on cardiovascular risk factors. The final speaker of the session was *Roger Corder* from the William Harvey Research Institute, London, U.K., who presented a paper on cardiovascular actions of procyanidin-rich foods and beverages.

In the second session on *Berries and Metabolism*, *Francisco Tomás-Barberán* from the Spanish Council for Scientific Research, CEBAS Institute, Murcia, Spain, presented a paper on the biological activities of berry ellagitannin metabolites. This was followed by *Alan Crozier* from the University of Glasgow, Scotland, who presented a paper on the bioavailability of berry flavonoids and phenolics. *Paul Milbury* from the Friedman School of Nutrition Science and Policy and the Jean Mayer USDA Human Nutrition Research Center on Aging at Tufts University, Boston, MA, then gave an overview of xenobiotic metabolism and berry flavonoid transport across the blood-brain barrier. The final paper of this session was presented by *Ronald Prior* from the USDA-ARS Arkansas Children Nutrition Center, who discussed anthocyanins and other berry components that may affect the development of obesity.

The third session on *Berries and Cancer* had four talks that included presentations from two researchers from The Ohio State University, namely, *Tatiana Oberyszyn* and *Gary Stoner*, with papers on the chemopreventive and chemotherapeutic effects of black raspberry on skin and colon cancers, respectively. The other talks in this session were by *Xiao-Ming Yin* from the University of Pittsburgh School of Medicine, Pittsburgh, PA, and *Peter Ferguson* from the University of Western Ontario, London, ON, Canada, presenting papers on the effects of cyanidin-3-rutinoside on leukemia cells and the anticancer effects of cranberry extracts, respectively.

The fourth session on *Berries and Brain Aging* had *Martha Clare Morris*, from the Rush Institute for Health Aging in Chicago, IL, who reviewed epidemiological evidence supporting the effects of antioxidant nutrients on brain health. This was followed by a presentation by *Thomas Kuhn* from the University of Fairbanks, Fairbanks, AK, with a paper on the effects of Alaskan wild blueberries on neuroinflammation and aging. The two remaining papers in this session were from *Barbara Shukitt-Hale* from the Neuroscience Laboratory, USDA-ARS Human Nutrition Research Center on Aging at Tufts University, Boston, MA, and *Robert Krikorian* from the University of Cincinnati College of Medicine, Cincinnati, OH, presenting papers on behavioral and cognitive effects of berries in various aging models.

The final session on *Berry Compositional Chemistry and Biological/Health Effects* had six speakers including *Jess Reed* from the University of Wisconsin, Madison, WI, who presented a paper on berry tannins and gut health, and *Luke Howard* from the University of Arkansas Department of Food Science, Fayetteville, AR, who presented data on effects of processing and storage on blueberry polyphenolics and their antioxidant capacity. *A. Venket Rao* from the University of Toronto School of Medicine, Toronto, ON, Canada, and *Amy Howell* from the Marucci Center for Blueberry and Cranberry Research at Rutgers University, Chatsworth, NJ, presented results from an ongoing human intervention study with raspberry and a review of the bacterial antiadhesive properties of

cranberries, respectively. The penultimate paper in this session was from *Wilhelmina Kalt* from Agriculture and Agri-Food, Canada, presenting results from a human study investigating the effects of blueberries on vision. The final paper of this session, concluding the symposium, was presented by *Mary Ann Lila* from the North Carolina Research Campus at Kannapolis, NC, with a talk titled "Berry Resources and Human Health under the Cloud of Change".

It should also be mentioned that *James Joseph*, Director of the Neuroscience Laboratory at the USDA-ARS Human Nutrition Research Center on Aging at Tufts University, Boston, MA, presented the keynote dinner speech on "Brainberries and Aging: Down with the Bad Signals and Up with the Good". His talk included data generated from his laboratory demonstrating that diets rich in antioxidants and anti-inflammatory compounds, such as those found in berries, may lower the risk of developing age-related neurodegenerative diseases, such as Alzheimer's and Parkinson's diseases.

**CONCLUDING REMARKS**

As previously discussed (see ref 1; Introduction for the 2007 BHBS symposium), although considerable progress continues in berry research, there are still important gaps that remain in our knowledge of the intricate roles and functions of berry components at the cellular, molecular, and systemic levels. Are all berries equal in their biological functions or are some berries "more equal" than others depending on the target disease? Are berries preventive or therapeutic in their actions or both? Should berries of all colors be eaten together or paired with other foods to get the maximum benefits and, if so, which ones? Should berry consumption be increased and, if so, are there specific populations/individuals who would gain the greatest benefit from berry fruit consumption? In conclusion, like many emerging and growing areas of scientific research, there were more questions regarding berries and human health than there were answers available. This underscores the importance of this thematic scientific conference with a very strong emphasis on the participation of a multi-disciplinary group including basic and clinical researchers and health care professionals. The BHBS has been successful and responsible in communicating recent research findings to the lay public, thus raising the public awareness of the health benefits of berry consumption through science-based education. Finally, I thank all of the participants of the 2009 BHBS symposium and the authors who have contributed to this cluster of papers reflecting recent research trends and advances in berry health benefits research.

**LITERATURE CITED**

- (1) Seeram, N. P. Berry Fruits: Compositional elements, biochemical activities and the impact of their intake on human health, performance and disease. *J. Agric. Food Chem.* **2008**, *56*, 627–629.

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