20th Annual OXFORD ICSB

March 28th - 31st 2022

at the Oxford Conference Center | 102 Ed Perry Blvd, Oxford, Mississippi

The Oxford International Conference on the Science of Botanicals is an annual meeting to discuss approaches for post market surveillance, risk and safety assessment, quality control and adverse event reporting (AER) for botanical dietary supplements (BDS) and natural products as well as regulatory aspects with perspectives from government, manufacturers and trade associations

Conference Agenda

- Daily Schedule
- Speaker Abstracts
- Speaker Bios

National Center for Natural Products Research
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March 28, 2022

Dear Friends,

On behalf of the Organizing Committee, I would like to invite you to present at the 20th Annual International Conference on the Science of Botanicals (ICSB) to be held March 28th – 31st, 2022 in Oxford, Mississippi. The ICSB is organized by the National Center for Natural Products Research (NCNPR), University of Mississippi, and a FDA Center of Excellence.

In addition, attendance at this event will enable you to hear from an outstanding line-up of world-renowned speakers, gain a perspective on developments in natural products and botanicals. Our meeting allows you to focus on the current trends including regulatory aspects find out about the latest research, Interact with researchers during the large poster session, and establish collaborations between universities and research institutes and industry.

Oxford is a town with a rich literary and artistic history and home of the University of Mississippi and the NCNPR. With the help of the Oxford Conference Center, we have put together a program of social and entertainment activities to run alongside our rich and informative scientific agenda. You can find additional information regarding this conference at www.oxfordICSB.org. A cooperative agreement between the NCNPR and the Center for Food Safety and Applied Nutrition (CFSAN) at the U.S. Food and Drug Administration (FDA) supports this conference. Our co-sponsors: the Shanghai Institute of Materia Medica/ CAS, China; the Council of Scientific and Industrial Research (CSIR - India); the Ministry of Indigenous Medicine, Sri Lanka; the American Society of Pharmacognosy (ASP); the Society for Medicinal Plant Research (GA); the Korean Society of Pharmacognosy (KSP) and the Japanese Society of Pharmacognosy (JSP).

We invite you to visit the website of the National Center for Natural Products Research at http://www.pharmacy.olemiss.edu/ncnpr to learn more about our research program. Oxford and the Ole Miss campus are a beautiful setting, and we hope you will get to explore them, especially if this is your first time to visit here. If there is anything, we can do to make your visit more enjoyable, please contact us.

Sincerely,

Ikhlas A. Khan, Ph.D.
Director, National Center for Natural Products Research
Director, FDA Center of Excellence
University of Mississippi

NOTES

DAY 1 (MONDAY, MARCH 28th)

8:00 – 9:00 Open onsite registration – Oxford Conference Center (OCC) Lobby
9:00-10:30 Opening Session - OCC Auditorium
Welcome and Introductory Remarks from Organizers
Ikhlas Khan, Director, National Center for Natural Products Research, University of Mississippi
Welcome on behalf of the University of Mississippi and the School of Pharmacy
Donna West-Strum, Dean and Executive Director, School of Pharmacy, University of Mississippi
Joseph Gladden, Vice Chancellor, Research & Sponsored Programs, University of Mississippi
Key Note Address **Tierona LowDog,** Integrative Medicine Concepts, LLC

*** Virtual Presentation**

10:30-11:00 **Break**

SESSION 1: ***"Tribute to Our Dear Friend and Colleague-Professor Hildebert Wagner"*** - OCC Auditorium
Moderator and Session Chair: ***Ikhlas Khan,*** *University of Mississippi*
11:00-11:50 **Mark Blumenthal,** American Botanical Council
***Geoffrey Cordell,** Natural Products Inc.
***Harry Fong,** University of Illinois Chicago
***Rudolf Bauer,** University of Graz

11:50-12:00 **Conference Photograph-**Meet at OCC side patio across from Cedar Room Dining Hall

12:00-1:00 **Lunch (**OCC Cedar)

SESSION 2: "*Dietary Supplement Use in Sport: Challenges in the Trenches"* - OCC Auditorium
Moderator and Session Chair: ***John Travis,*** *NSF International*
1:00-2:30

- **Shannon Singletary,** University of Mississippi
- **Melinda Valliant,** University of Mississippi
- **Oliver Catlin,** Banned Substances Control Group

2:30-3:00 **Break (30min)**

SESSION 3: ***"Clinical and Mechanistic Insights into Herbal and Dietary Supplement Induced Liver Injury"*** - - OCC Auditorium
Moderator and Session Chair: ***Victor Navarro,*** *Einstein Healthcare Network*
3:00-4:30

- **Victor Navarro,** Einstein Healthcare Network-DILIN Experience with Supplement Induced Liver Injury and Plan for the Future
- **Herbert Bonkovsky,** Wake Forest Baptist Health-Green Tea [GT], Garcinia, Polygonum species and the Liver—Strong Association with HLA-B* 35:01 Provides Evidence for Immune-Mediated Liver Injury in Genetically Susceptible Persons
- **Andrew Stolz,** Keck School of Medicine of USC-Appearance and Performance Enhancing Supplement Liver Injury: Clinical Feature and Possible Mechanisms
- **David Ostrov,** University of Florida College of Medicine-HLA Binding Sites and Liver Injury from Drugs and Dietary Supplements

SESSION 4: ***"1st Annual McChesney Lecture"*** - OCC Magnolia- OCC Auditorium
4:30-5:30

- **James McChesney,** Cloaked Therapeutics, LLC-TumorSelectTechnology® Enhancing Safety and Efficacy of Cytotoxic Chemotherapeutics

6:00-8:00 pm **Reception/Mixer** Award Presentation: Outstanding Contribution in Natural Products: OCC Cedar Room

DAY 2 (TUESDAY, MARCH 29)

SESSION 5: ***"Update and Future Perspectives from the FDA"*** - OCC Auditorium
Moderator and Session Chair: ***Larry Walker,*** *University of Mississippi*
8:30-10:15

- ***Cara Welch,** Food and Drug Administration, Center for Food Safety and Applied Nutrition-FDA's Dietary Supplement Program: Overview and Update
- ***Sara Handy,** Center for Food Safety & Applied Nutrition, Office of Regulatory Science, USDA-Using Genome-Scale Data to Ensure Authenticity and Safety of Botanicals
- ***Calvin Edwards,** Health Fraud Branch, FDA/ORA/OPOP/OSPOP/DE/HFB-Office of Regulatory Affairs Health Fraud Branch Program: Overview and Update
- ***Rahul Pawar,** Center for Food Safety and Applied Nutrition, U.S. Food and Drug Administration-What analytical methods tell us about the authenticity of selected Ginkgo biloba supplements

10:15-10:30	**Break**

SESSION 6: ***"How Should Cannabis Quality Be Defined?"*** - - OCC Auditorium
Moderators and Session Chairs: ***Nandakumara Sarma,*** *United States Pharmacopeia*
10:30-12:00

- **Holly Johnson,** American Herbal Products Association
- **Mahmoud A. ElSohly,** University of Mississippi
- **David Vaillencourt,** The GMP Collective
- ***Cassandra Taylor,** Office of Pharmaceutical Quality/CDER, FDA

12:00-1:00	**Lunch**

SESSION 7a: "*Changing Landscape for Cannabis Markets, Research and Regulation in the US"*** - OCC Auditorium
Moderator and Session Chair: ***Rick Kingston,*** *Safety Call*

1:00-1:25	***Cassandra Taylor,** Office of Pharmaceutical Quality/CDER, FDA-Cannabis and Cannabis-Derived Compounds: Quality Considerations for Clinical Research FDA Draft Guidance for Industry
1:25-1:50	**Lance Blundell,** Cbdmd Inc-Regulatory Landscape for Hemp-Derived Products
1:50-2:15	**Larry Walker**, University of Mississippi- State Medical Cannabis Programs: Wants and Needs

SESSION 7b: ***"Biological Evaluation of Botanicals"*** - OCC Magnolia
Moderators and Session Chairs: ***Xing-Cong Li,*** *University of Mississippi*

1:00-1:20	**Mohamed Ibrahim,** University of Mississippi-Identification of an Orally Bioavailable, Brain-Penetrant Compound with Selectivity for the Cannabinoid Type 2 Receptor
1:20-1:40	**Hayley Prescott,** University of Mississippi-Botanical Aphrodisiacs for Women's Health
1:40-2:00	**Yalda Shokoohinia,** Southwest College of Naturopathic Medicine & Health Sciences-Isolation of tens of compounds from Achillea wilhemsii including new sesquiterpenoids with metabolic syndrome management activities
2:00-2:20	**Heesung Chae,** University of Mississippi-PPARα and PPARγ agonistic effects and increase in glucose uptake by Aquilaria sinensis flower extract

2:20-3:00	**Break (30min)**

"Update on the Office of Dietary Supplements" - OCC Auditorium

2:30-2:45	**Joe Betz,** National Institutes of Health

SESSION 8a: ***"FDA Challenges & Opportunities: Hear From FDA Alumni on the Most Pressing Issues before the Agency"*** - OCC Auditorium
Moderators and Session Chairs: ***Ikhlas Khan,*** *University of Mississippi*
2:45-3:45

- **Dan Fabricant,** Natural Products Association National
- **Sybil Swift**, Cbdmd Inc
- **Robert Durkin,** Arnall Golden Gregory LLP

DAY 2 (TUESDAY, MARCH 29) Continued

SESSION 8b: *"Importance of Reference Materials"*- OCC Magnolia
Moderator and Session Chair: ***Adam Kuszak,*** *National Institutes of Health*

2:30-2:50	**Tara Lin Couch,** EAS Consulting Group-Raw Material Specifications The best way to ensure safety in dietary supplement products
2:50-3:10	**Sarah Aijaz,** Millipore Sigma-Development of certified reference materials for phytochemicals in ginger and kava
3:10-3:30	**Kiel Henderson,** Chromadex-Reference Standards and Considerations with Research and Development Projects
3:30-3:50	**Wilmer Perera,** CAMAG Scientific-Authentication and Quality Control of 'espinheira-santa' (Monteverdia ilicifolia) by Morpho-anatomy and High-Performance Thin-Layer Chromatography
3:50-4:10	**Wendy Applequist,** Missouri Botanical Gardens-Substitution and adulteration of Traditional Chinese Medicine seeds and small fruits in the U.S. market

5:30-8:00	**Poster Session Chair: Amar Chittiboyina, University of Mississippi (**OCC Oak)

6:00 – 8:00	**Dinner (**OCC Cedar)

DAY 3 (WEDNESDAY, MARCH 30)

SESSION 9: "Industry Perspective" - OCC Auditorium
Moderator and Session Chair: ***Loren Israelsen,*** *United Natural Products Alliance*

8:30-9:00	**Russ Osguthorpe,** doTerra-The Need for Purity, Consistency and Scientific Validation in the Essential Oil Marketplace
9:00-9:30	**Katie Banaszewski,** NOW Foods-Holding the line: Dietary Supplements Quality Control and the Regulatory Challenges
9:30-10:00	**Amit Chandra,** Amway-Significance Of Fit For Purpose Test Methods to Ensure Integrity of Botanicals in Dietary Supplements
10:00-10:30	**Break**

SESSION 10: *"Assessment of the Quality, Safety, and Efficacy of Essential Oils"* OCC Auditorium
Moderator and Session Chair: ***Ryan Yates,*** *University of Mississippi*

10:30-10:50	**Prabodh Satyal,** Aromatic Plant Research Center-Overcoming instrumental limitations in adulteration detection of essential oils and discovery of synthetic markers
10:50-11:10	**Nicole Stevens,** doTerra-Antidiabetic Potential of Volatile Cinnamon Oil: A Review and Exploration of Mechanisms Using in Silico Molecular Docking Simulations
11:10-11:30	**Stefan Gafner,** American Botanical Council-Analysis of Volatile Constituents in Commercial "Lavender" Products Linked To Premature Thelarche and Prepubertal Gynecomastia"
11:30-11:50	**Bill Gurley,** University of Mississippi-"So, you think you know the NCNPR": An update on facilities, research, and programs at the National Center for Natural Products Research

12:00-1:00	**Lunch (**OCC Cedar)

SESSION 11a: *"Sustainability and Plant Conservation"* – OCC Auditorium
Moderator and Session Chair: ***Mark Blumenthal,*** *American Botanical Council*

1:00-1:25	***Geoff Cordell,** Natural Products Inc. -Sustainability Considerations for Biologically Active Natural Products
1:25-1:50	**Kerry Hughes,** EthnoPharm-Biodiversity and Regenerative Agriculture
1:50-2:15	**Ed Fletcher,** Native Botanicals, Inc. -Sustainability and Plant Conservation

SESSION 11b: *"Analytical Approaches"* - OCC Magnolia
Moderator and Session Chair: ***Narendra Meruva,*** *Waters Corporation*

1:00-1:250	**Hui Zhao,** Agilent Technologies-Detection and Accurate Quantitation of 14 Water Soluble Vitamins and 14 Fat Soluble Vitamins in Supplement by LC-MS/MS Triple-Quadrupole
1:20-1:40	**Emily Britton,** Waters Corporation-Analytical Approaches for Characterizing Cannabinoids for Quality, Safety, and Research Applications

DAY 3 (WEDNESDAY, MARCH 30) Continued

1:40-2:00 **Adam Gilmore-**Rapid, Horiba Instruments Inc., -Accurate Quantification of Capsaicinoids in Various Chili Pepper Extracts with Absorbance-Transmittance fluorescence Excitation-Emission (A-TEEM) Spectroscopy.

2:00-2:20 **Cuiying Ma,** United States Pharmacopeia-Use of qNMR to determine HPLC relative response factors for botanical reference standards used in pharmacopeial monographs

3:30-5:00	**ICSB Yard Games and Crawfish Boil-OCC grounds**

6:00-9:00 Dinner **and Bowling and Arcade fun- Premier Lanes-**204 Commonwealth Boulevard, Oxford, MS 38655

DAY 4 (THURSDAY, MARCH 31)

SESSION 12: ***"Botanical Research and Development"***- OCC Auditorium
Moderator and Session Chair: Joe Betz, *National Institutes of Health*

8:30-9:00 ***Giulio Pasinetti,** Icahn School of Medicine at Mount Sinai-Microbiota metabolites modulate the T helper 17 to regulatory T cell (Th17/ Treg) imbalance promoting resilience to stress-induced anxiety- and depressive- like behaviors

9:00-9:30 **Nirmal Pugh,** University of Mississippi- Botanical Dietary Supplements Research Center: Arthrospira as a supplement for enhancing the host antiviral immune response.

9:30-10:00 **John Cort,** Pacific Northwest National Laboratory-NP-MRD: The Natural Products Magnetic Resonance Database

10:00-10:30	**Break**

SESSION 13: "*Botanical Safety Assessment: Updates From the BSC"*- OCC Auditorium
Moderator and Session Chair: ***Dan Marsman,*** *Procter & Gamble*
10:30-12:00

- **Holly Johnson,** American Herbal Products Association-Introduction to the Botanical Safety Consortium
- **Alkemist Lab-**HPTLC Comparisons for Ashwagandha Root Extract
- **Richard Van Breemen,** Oregon State University-Constituent Identification and Quantification talk
- **Cammi Thorton,** University of Mississippi-Method talk on Zebrafish embryos
- **Amy Roe,** The Procter & Gamble Company-ADME modeling and hepatoxicity
- **Hellen Oketch-Rabah,** United States Pharmacopeia & **Stefan Gafner**, American Botanical Council-HESI Botanical Safety Consortium & Kamuzu University of Health Sciences Initiatives

12:00-1:00	**Lunch**

SESSION 14: "*Traditional Uses/Clinical Studies"* -OCC Auditorium
Moderators and Session Chairs: ***Larry Walker,*** *University of Mississippi*

1:00-1:30 **Jon Wardle,** Southern Cross University, Traditional Claims for Herbal Medicines

1:30-2:00 **Gailen Marshall,** University of Mississippi Medical Center-Pragmatic Clinical Trials for Natural Products – Principles, Pitfalls and Potentials

SESSION 15: ***"The Contentious & Evolving Safety Story of Piper Methysticum: The Kava Paradox Revisited, Again"***- OCC Auditorium
Moderator and Session Chair: ***Bill Gurley,*** *University of Mississippi*
2:00-3:00

- **Holly Johnson,** American Herbal Products Association
- **Tyler Daniels,** Thorne
- **Bill Gurley,** University of Mississippi
- **Rick Kingston,** SafetyCall
  Chengguo Xing, University of Florida Health

6:30	**Closing Ceremony and Banquet (**OCC Cedar) Registration is required and is available online and onsite

"Key Note Address"

Tieraona (Ter-oh-nay) Low Dog, MD, began exploring natural medicine over 35 years ago and has since become an internationally recognized physician, educator, author, and expert. Dr. Low Dog is a founding member of the American Board of Integrative Medicine, she was appointed by President Bill Clinton to the White House Commission on Complementary and Alternative Medicine Policy, and has served as the Chair of the Dietary Supplements and Botanicals Admission Evaluation Sub-Committee from 2010-2020. Dr. Low Dog has spoken at over 600 medical conferences, and has authored 54 peer-reviewed articles, 24 medical textbook chapters, and five books of her own, including four with Natural Geographic: *Fortify Your Life, Healthy at Home*, *Life is Your Best Medicine,* and *Guide to Medicinal Herbs.*

NOTES

"Tribute to Our Dear Friend and Colleague-Professor Hildebert Wagner"

A Tribute to Professor Hildebert Wagner from Colleagues in Chicago

Harry H.S. Fong[1,2] and Geoffrey A. Cordell[3,4]

[1] Pharmacognosy Institute, College of Pharmacy, University of Illinois Chicago, Chicago, IL, USA
[2] RMIT University, Melbourne, Victoria, Australia
[3] Natural Products Inc., Evanston, IL, USA
[4] College of Pharmacy, University of Florida, Gainesville, FL, USA

Over the years, after Farnsworth spent a sabbatical leave in Munich in 1967, many close connections and outcomes for the pharmacognosy group at UIC arose from the special relationship between Prof. Norm Farnsworth and Prof. Bert Wagner. This presentation will highlight some aspects of those developments and initiatives as they evolved from the perspectives of Harry Fong and Geoff Cordell and how their careers were changed as a result.

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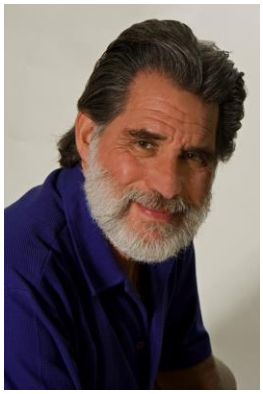

Mark Blumenthal is the Founder and Executive Director of the American Botanical Council (ABC), the leading independent, nonprofit organization dedicated to disseminating accurate, reliable, and responsible information on herbs and medicinal plants. He is the Editor/Publisher of HerbalGram, an international, peer-reviewed quarterly journal. For six years, he was an Adjunct Associate Professor of Medicinal Chemistry at the University of Texas at Austin, College of Pharmacy, teaching the course "Herbs and Phytomedicines in Today's Pharmacy." Mark is the Senior Editor of the English translation of The Complete German Commission E Monographs–Therapeutic Guide to Herbal Medicines (1998), Herbal Medicine: Expanded Commission E Monographs (2000), The ABC Clinical Guide to Herbs (2003), and co-author of Rational Phytotherapy, 5th edition (2004). He has appeared on over 400 radio and television shows and has written over 500 articles, reviews and book chapters for many major publications. In 2010, he was awarded the prestigious Tyler Prize in honor of the late Purdue Professor Varro E. Tyler from the American Society of Pharmacognosy. In 2008 he was awarded the “Natural Legacy” award from Natural Foods Merchandiser magazine and he has also been named to Natural Health Magazine’s Hall of Fame Award for “…opening America’s eye to the healing powers of herbs.” He has been a leader in the concerns for more rational regulations of herbal and natural product manufacturing, and education on plant-based medicines for over 36 years.

Professor Emeritus Geoffrey A. Cordell obtained his Ph.D. in indole alkaloid chemistry at the University of Manchester in 1970, and after two years at M.I.T. joined the College of Pharmacy, University of Illinois Chicago, holding several senior administrative positions at the College and Campus levels; he retired in 2007. He is the author of over 600 research publications, reviews, book chapters, two books on alkaloids, and the editor of 37 books, including 29 volumes in "The Alkaloids Chemistry and Biology" series. He is on the Editorial Advisory Board of 30 international scientific journals and has been a plenary speaker at over 190 international meetings. An Honorary Professor at universities in China, India, and the Philippines, he is also a Visiting Professor in Malaysia (at four universities), Japan, Thailand, Mexico, Brazil, Peru, and Colombia. He was named Outstanding International Ethnopharmacologist of the Year in 2015 by the International Society of Ethnopharmacology and received the Norman Farnsworth Research Achievement Award of the American Society of Pharmacognosy (ASP) in 2019, where he is one of thirteen Honorary Members and a former President. He presently assists governments and universities in the development of traditional medicines and their administrative and research resources, as well as providing lectures and workshops on traditional medicine quality control, the conduct of research programs, and grant and manuscript writing. His current interests include the chemistry, biological activity, and biosynthesis of alkaloids, cyberecoethnopharmacolomics, medicines security, ecopharmacognosy, and the role and new applications of natural products in the Fourth Industrial Revolution.

Harry H.S. Fong, Ph.D., Professor Emeritus of Pharmacognosy, Department of Medicinal Chemistry and Pharmacognosy at the University of Illinois at Chicago

Education: The Ohio State University Ph.D. (Pharmacognosy) 1961-1965; University of Pittsburgh M.S. (Pharmacognosy) 1959-1961; University of Pittsburgh B.S. (Pharmacy) 1955-1959

Research Interests: Major research interests are in the areas of collaborative drug discovery from higher plants, which include the acquisition of source materials through good agriculture and field collection practice (GACP) and the bioassay-directed phytochemical isolation and biology of potentially active antitumor, cancer chemo preventive, anti-malarial, and anti-TB agents; of qualitative and quantitative QA/QC of natural products and herbal medicine; of standardization of botanical dietary supplements and traditional herbal medicines; of basic and translational evidence-based traditional herbal medicine; and of monographing medicinal plants; of development of pharmacopoeia and standards for medicinal plants

Professional Organizations: American Society of Pharmacognosy (Honorary Member, 2004-present)

Honors: American Society of Pharmacognosy (Vice President 1977-1978; President 1978-1979); Society for Economic Botany (Treasurer, 1975-1977, Vice President 1980-1981, President 1981-1982), Adjunct Professor, RMIT University, Melbourne, Australia (2006-present); Honorary Visiting Research Fellow, Institute of Science and Technology, The Chinese University of Hong Kong (1977); Honorary Professor, Hong Kong Baptist University, Hong Kong, SAR, China; Visiting Professor, Guangzhou University of Traditional Chinese Medicine, Guangzhou, PRC (1993-2001); External examiner, School of Chinese Medicine, Chinese Univ. Hong Kong (2005-present); recipient of the Jack L. Beal Post Baccalaureate Alumnae Award, The Ohio State University 1997; the 2008 Natural Products Association, Burton Kallman Scientific Award; member of the WHO Expert Panel on Traditional Medicine (1997-present); member, International Advisory Board on Hong Kong Regulatory Standards for Chinese Medicinal Herbs (HKCMMS), Hong Kong, SAR, China (2001 - Present); member, Advisory Board of the Tang Center for Herbal Medicine Research, University of Chicago, 2003-present; member, Complementary and Alternative Medicine for Urological Symptoms Data and Safety Monitoring Board (NIH) (2003-presaent; Member, Expert Panel to Review the ODS Analytical Methods and Reference Materials (ODS, NIH). Served as consultant to the WHO/TRM, WHO Regional Office for the Western Pacific, WHO Eastern Mediterranean Regional Office, WHO South East Regional Office; and the World Bank, Department of Population, Health and Nutrition.

Editorial Duties: Journal of Natural Products (Associate Editor, 1993-1998); Member, Editorial Advisory Board of Oriental Pharmacy and Experimental Medicine (2002-2006); Member, Editorial Advisory Board of American Journal of Chinse Medicine, (2003-present); WHO Monograph on Selected Medicinal Plants, Vol. 1-4 (Co-writer, 1997-present)

Dr. Rudolf Bauer studied pharmacy 1976 1980 at University of Munich; 1984 graduation as Ph.D. at the Institute of Pharmaceutical Biology, University of Munich, under the supervision of Prof. Dr. H. Wagner; 1993 – 2002 Associate Professor at the Institute of Pharmaceutical Biology, University of Düsseldorf; since 2002 full professor of Pharmacognosy at University of Graz, Austria, and since 2004 Head of the Institute of Pharmaceutical Sciences at University of Graz. Together with Professor Litscher (Medical University of Graz), he is heading the TCM Research Center Graz. Besides, he is acting as a guest professor in several universities in China. He has long experience in natural product chemistry, analysis, and the bioassay-guided isolation of constituents from medicinal plants. He has published more than 300 research papers. He is recipient of the Egon-Stahl-Award of the Society for Natural Product and Medicinal Plant Research (GA), and in 2010, he has been awarded with the Norman R. Farnsworth Excellence in Botanical Research Award of the American Botanical Council. He is former president of GA, founding president of the Good Practice in TCM Research Association, and Editor of Planta Medica. Prof Bauer has been active in the development methods for quality control of Chinese herbs for more than 20 years. As a member of two expert groups on herbal drugs of the European Pharmacopoeia Commission, he is actively involved in the development of monographs for the European Pharmacopoeia.

"Dietary Supplement Use in Sport: Challenges in the Trenches"

Dietary supplement use is widely popular in competitive sport with surveys showing that 50-80% of competitive athletes use supplements, but this is not without risks. The dietary supplement category has proven to be attractive for those looking to thwart the regulations and sell prohibited substances, in some cases disguised as botanicals. Issues with quality control abound creating broader concerns about what athletes or consumers might be getting in their vitamins or protein powder. Environmental contamination has become a rising concern as some banned drugs can infiltrate dietary supplements, or other foods, through water contamination or other means. Explore with us the challenges we see in the trenches and the impacts on athletes and the larger natural product community.

Shannon Singletary joined Ole Miss Athletics in 2004 and currently serves as Executive Associate Athletics Director.

Singletary oversees the business office and academic services, in addition to directing the health and sports performance department.

His previous senior staff responsibilities include sport administration for cross country, track & field, softball and oversight of health & sports performance, which includes sports medicine, strength & conditioning, sport nutrition, sport psychology, and physical therapy.

He is responsible for the athletic department's Grill at 1810, which is a full-service dining facility and meeting space. In 2013, he also took on a lead role in an academic research partnership as co-director of the Center of Health & Sports Performance.

He has served on campus committees including the Chancellor's university standing committee on accessibility and the COVID task force. He serves as the liaison for athletics with several partnerships between athletics and various departments on campus such as Division of Student Life, Hospitality & Nutrition, and Exercise Science and Student & Employee Health. He holds an academic title of Adjunct Clinical Instructor in Health, Exercise Science and Recreation Management. Singletary currently serves by appointment of the Governor of Mississippi and serves on the Mississippi Board of Physical Therapy Licensure. His roles on the board have included two years as Chairman.

He previously held the title of Coordinator of Sports Medicine at the University of Mississippi Medical Center prior to arriving at Ole Miss in 2004. There he was responsible for sports medicine outreach services as well as serving patients of the medical center's physical therapy department. It is there that he published multiple articles and book chapters on topics such as sport rehabilitation and hand therapy. He has obtained other administrative and budget experience overseeing rehabilitation services for Nissan Motor Company in Canton, Mississippi in 2003.

Singletary's education includes a B.S. in Exercise Science, a B.S. in Physical Therapy, and a Doctorate in Physical Therapy all from the University of Mississippi. In 1991, he began working for the athletic department as a student athletic trainer serving during all four years of his undergraduate degree program.

He currently holds certifications and licensure in Athletic Training, Physical Therapy and Strength & Conditioning. He speaks at national conferences, state conferences and to civic groups and has found time to audit such classes as Sports Law within the University of Mississippi's School of Law.

Singletary and his wife, Molly, have three children, Shelby, Matthew and Jane Anne. Molly Singletary M.D is a pediatrician, where she is a partner in Oxford Pediatric Group in Oxford, MS.

Melinda Valliant PhD, RD, CSSD, LD received a Bachelor of Science in Nutrition, a Master of Science in Exercise Science and Doctor of Philosophy in Exercise Science from The University of Mississippi (UM). She has worked at a clinical dietitian, chief clinical dietitian, fitness center director, sports dietitian and is currently Professor and Department Chair of the Department of Nutrition and Hospitality Management and the Co-Director of the Center for Health and Sports Performance at UM. In these roles, she provides administrative oversight of the department, teaches graduate sports nutrition courses and oversees student research projects. She serves on the executive committee for the international sport and human performance nutrition practice group. She and her husband, Stephen have 3 children, Marty who is also an alumnus of UM and 16-year-old twins, Wells and Rebeka. She and her family enjoy traveling, outdoor activities and attending sporting events.

Oliver Catlin is the President and Co-founder of BSCG (Banned Substances Control Group), a leading international third-party certification and testing provider serving the nutrition and dietary supplement industry. Since 2004, Oliver has led the way in developing the BSCG brand, growing its sports testing menu and expanding its offerings. Under his leadership, BSCG has added testing for consumer protection, coverage for equines and canines, testing for contamination and label claims, GMP audits, and has expanded its coverage to include a range of products, from natural products to topical creams and CBD supplements. With a background in the administration of sports anti-doping analytical testing, he is widely regarded as a thought leader in the field of nutrition, dietary supplements and sport drug testing. His highly regarded opinion pieces often help companies and athletes navigate the difficult issues facing the industry, and have appeared in a number of publications, most recently Natural Products Insider. Oliver is a graduate of U.C. Berkeley's Haas School of Business with a minor in Conservation and Resource Sciences and more than 15 years of experience in the realm of anti-doping and nutrition.

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"Clinical and Mechanistic Insights into Herbal and Dietary Supplement Induced Liver Injury"

This session will comprise an overview from Investigators and Collaborators of the U.S. Drug Induced Liver injury Network (DILIN). The DILIN continues to enroll cases of drug induced liver injury, approximately 20% of which are attributable to herbal and dietary supplements. Dr. Navarro will review the current state of DILIN's findings and provide an overview of the network's research strategy to better understand liver injury from supplements, and to promote consumer safety. Dr. Bonkovsky will review liver injury from polyphenolic herbal products, including their clinical features and genetic susceptibility for injury. Dr. Stolz will review the DILIN's experience with liver injury from appearance and performance enhancing supplements, similarly, focusing on the clinical features as well as the possibility of genetic susceptibility. Finally, Dr. Ostrov will describe his exciting research on how HLA binding sites may be pivotal in the mechanism of liver injury.

Dr. Victor Navarro earned his Doctor of Medicine degree from the Pennsylvania State College of Medicine and completed medical residency followed by chief residency in Internal Medicine at Temple University. Thereafter, he obtained fellowship training in Gastroenterology, Hepatology, and Hepatobiliary Endoscopy at Yale University. In 1994, Dr. Navarro joined the faculty of the Yale University School of Medicine as an Assistant Professor of Medicine and Epidemiology and the Director of its Liver Failure and Transplantation service. He was also the Director of the State of Connecticut Emerging Infections Program Liver Study Unit. His scholarly work while at Yale focused on the population-based epidemiology of chronic liver disease.

In 2002, Dr. Navarro assumed a faculty position with Thomas Jefferson University, Philadelphia, as Chief of Hepatology and Medical Director for Liver Transplantation. While at Jefferson, he rose to the rank of Professor of Medicine, Pharmacology and Experimental Therapeutics. In 2012, he joined the Einstein Healthcare Network, Philadelphia, as Chairman of the Division of Hepatology, and Medical Director for Liver Transplantation, continuing his appointment at the Jefferson Medical College as Professor of Medicine. In 2016, Dr. Navarro became the founding medical chair of the Department of Digestive Disease and Transplantation for the Einstein Healthcare Network; in this position, he oversees Divisions of Hepatology, Gastroenterology, Transplant and Hepatobiliary Surgery.

As a mentor, Dr. Navarro has been directly responsible for the scholarly and clinical training of many young and mid-career health professionals and academicians. Dr. Navarro's chief sources of research funding are the National Institutes of Health as an investigator for the U.S. Drug Induced Liver Injury Network (DILIN), and the Patient Centered Outcomes Research Institute for his study of Palliative Care in Patients with End Stage Liver Disease.

Herbert L. Bonkovsky, M.D. FACP, FACG, FAGA, FAASLD, is a tenured Professor of Medicine and Molecular Medicine & Translational Science and Director of The Liver and Metabolic Disorders Laboratory at Atrium-Wake Forest University/NC Baptist Medical Center, Winston-Salem, NC. Dr. Bonkovsky also has academic appointments as Visiting Professor at Winston-Salem State University, Professor of Medicine at The University of CT Health Center, and Professor of Biology and Medicine at the University of North Carolina. Dr. Bonkovsky is known nationally and internationally as a clinical hepatologist, teacher, mentor, and clinical investigator. He is a valedictory graduate of Earlham College [Richmond, IN] and Case Western Reserve University School of Medicine [Cleveland, OH]. His Post-graduate training was at Duke University, Case Western Reserve University School of Medicine, The U.S. National Institutes of Health, Dartmouth Medical School, and Yale University.

Dr. Bonkovsky formerly served as Director of the Division of Digestive Disease and Nutrition at the University of Massachusetts Medical School and as Director of the Office of Clinical Research and the General Clinical Research Center and Director of the Liver-Biliary-Pancreatic Center at the University of Connecticut Health Center. He was recruited to Carolinas HealthCare System [now known as Atrium Health], Charlotte, NC, from U Conn in 2007 and, for 5 years, served as VP for Research at CHS. He joined the Department of Medicine, Section on Gastroenterology & Hepatology, of Wake Forest University School of Medicine in January, 2015. Dr. Bonkovsky has continued to maintain an active clinical practice, focused on liver disorders and metabolic disorders, especially disorders of copper, iron, porphyrin, and heme metabolism. His currently funded research is in porphyrin and heme metabolism, effects of heme and iron on gene expression and intermediary metabolism, and drug- and herbal supplement-induced liver injury.

Among Dr. Bonkovsky's seminal contributions to the study of disorders of porphyrin and heme metabolism were the first preparation and therapeutic use of heme [in the form of the hydroxide, hematin] for therapy of acute porphyrias and demonstration of defective activity of ferrochelatase as the underlying cause of erythropoietic protoporphyria. Hemin for human use was the first Orphan Drug ever developed, and its use for therapy of acute porphyric syndromes has stood the test of time. Still today, it is the treatment of choice for treatment of attacks of acute porphyria.

Dr. Bonkovsky also played a key role in establishing the programs in liver transplantation both at Emory University and at U Mass Medical Center. He also was a founding member of the Liver Center at Carolinas HealthCare System, Charlotte, NC, where he served for several years as VP and Director of Research. He was recruited to Wake Forest to continue with his funded research in drug-induced liver injury, disorders of porphyrin and heme metabolism, and auto-immune liver diseases, and to help build up subspecialty expertise and services in hepatology, with emphasis upon diseases of heme, porphyrin, and metal metabolism, such as hemochromatosis, hypoceruloplasminemia, Wilson's disease, and the porphyrias. The Liver Clinics at Wake Forest Baptist Medical Center also evaluate and manage patients with the more commonly occurring liver diseases, such as viral hepatitis, alcoholic and non-alcoholic fatty liver disease, and auto-immune liver disorders [such as autoimmune hepatitis, primary biliary cirrhosis, primary sclerosing cholangitis]. Dr. Bonkovsky also serves as chief of the Liver, Digestive, and Metabolic Disorders Laboratory of Wake Forest, which has competed successfully for external funding from NIH [NIDDK, NHLBI] and from several Foundations and Societies. In the past several years, Dr. Bonkovsky has filed five patent applications for new therapies and diagnostic tests for viral hepatitis and neuro-muscular diseases.

Dr. Bonkovsky is a member of many learned and professional societies: he is a Fellow of the American College of Gastroenterology, the American College of Physicians, the American Gastroenterological Association, and the American Association for the Study of Liver Diseases. He is also an elected member of the American Society of Clinical Investigation [The Young Turks] and the Association of American Physicians [The Old urks]. Continually since 1996, Dr. Bonkovsky has been selected by his peers as one of America's Top Doctors and Top Gastroenterologists and Hepatologists. Dr. Bonkovsky is author or co-author of more than 400 presented abstracts, 55 brief reports, 48 books or book chapters, and 460 original, peer-reviewed papers.

Dr. Andrew Stolz is a Professor of Medicine at the Keck School of Medicine in the Division of Gastrointestinal and Liver Diseases. Dr. Stolz received his Medical Degree from Albert Einstein College of Medicine, trained in Internal Medicine at Mt. Sinai Medical Center and went onto a 3-year GI Fellowship program at UCLA training in Dr. Neil Kaplowitz's laboratory. Dr. Stolz research interest initially started with the molecular characterization of cytosolic bile acid binding proteins, followed by their discovery that these were NADPH dependent oxidoreductases and members of the Aldo Keto Reductase (AKR) gene family. Further investigation of the human AKR gene family members lead to new research endeavor focusing on a pair of highly similar AKR1C family members to function as a pre-preceptor regulator of the Progesterone and Androgen Receptors by catalyzing reductive metabolism of Progesterone or Dihydrotestosterone to their weak ligands. In 2008, Dr. Stolz refocused his research interests into a more translational nature by participating as PI in various NIDDK supported UO-1 consortiums including being the PI of the USC-UCLA DILIN Clinical Center since 2008 and being the MPI with Dr. Terrault of the recently established NIH UO-1 supported Liver Cirrhosis Network that started last year.

Ostrov, David A. , Associate Professor

University of Colorado, Boulder, CO	BS	05/1986	Biology/Genetics
University of Washington, Seattle, WA	PhD	05/1988	Immunology
Albert Einstein College of Medicine, Bronx, NY	Fellow	12/2001	X-ray crystallography

My experience studying the structure of HLA molecules and small molecule drug interactions is expected to benefit the proposed effort to define green tea extract chemicals that induce liver injury. My lab was able to solve structures of HLA molecules associated with adverse drug reactions including HLA-B*57:01 and HLA-B*15:02. We solved crystal structures of the small molecule drug abacavir complexed to HLA-B*57:01 complexed to different peptide ligands. My lab has extensive experience using crystal structures as the basis for molecular docking to predict structural interactions to HLA molecules. We have experience screening drugs for HLA binding and validation experiments in vitro and in vivo. We identified an HLA-DQ8 binding drug currently in clinical trial to measure effects on autoimmune diabetes progression. Since our lab has experience expressing HLA allotypes, expression and purification of HLA-B*35:01 is expected to be routine. My lab has had productive collaborations with the Drug Induced Liver Injury Network, including publications, and is enthusiastic to work on this important and highly specialized problem.

Ongoing projects that I would like to highlight include:

R01DE028544
Nguyen (PI); Role: Co-Investigator
04/01/19-03/31/24
Mapping the T cell receptor/antigen complex and identifying the genetic-based treatment in Sjogren's syndrome

Positions and Scientific Appointments

2009 – Present	Associate Professor, Department of Pathology, Immunology and Laboratory Medicine and Department of Pediatrics, College of Medicine, University of Florida, Gainesville, FL
2002 – 2009	Assistant Professor, Department of Pathology, Immunology and Laboratory Medicine and Department of Pediatrics, College of Medicine, University of Florida, Gainesville, FL
2001 – Present	Member, American Crystallographic Association and American Association of Immunologists

Honors

2007	Junior Faculty Travel Award to Immunology 2007, 94th AAI Annual Meeting, American Association of Immunologists
2003	Travel Award to Proteomics in Diabetes workshop from NIDDK
2002	Travel Award to International Histocompatibility Congress from ASHI
2002	Howard Hughes Medical Institute Pilot Project Award
1994	University of Washington Dept. of Biological Structure, Chairman's Travel Grant Award

"1st Annual McChesney Lecture"

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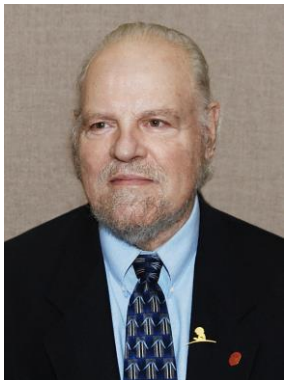
1st Annual McChesney Lecture

TumorSelectTechnology® Enhancing Safety and Efficacy of Cytotoxic Chemotherapeutics

James D. McChesney, PhD. Managing Director, Veiled Therapeutics, LLC;
CEO Cloaked Therapeutics, LLC

Veiled Therapeutics has developed an anticancer technology, TumorSelect® Technology, which combines proprietary anticancer prodrugs, nanotechnology, and knowledge of human physiology. Tumors have a voracious appetite for cholesterol which facilitates tumor growth and fuels their proliferation. We have transformed this need into a stealth delivery system to disguise and deliver anticancer drugs with the assistance of both the human body and the tumor cell. Veiled's designer prodrugs are assembled within pseudo-LDL nanoparticulates which carry them to tumor tissues where they are taken up, internalized and transformed into active drug and kill the cancer cells. This three-prong approach delivers the anticancer drug more selectively to the tumors and thereby avoids or reduces the severe side effect toxicities associated with current chemotherapy. Reduction of side effect toxicity of cancer therapy by our technology will improve patient quality of life, patient retention in treatment regimes, more rapid patient recovery post treatment, and overall patient benefit



James D. McChesney, Ph.D. has more than 55 years of research and development experience in natural products. He is Founder and Principal and serves as Chairman of Cloaked Therapeutics, LLC which was founded to clinically develop the TumorSelect technology discovered and patented by Veiled Therapeutics, LLC, a research and discovery company established by him to research and discover a means to significantly improve clinical therapy of cancer. Specifically, a strategy to enhance selectivity and reduce the toxic side-effect profile of cancer chemotherapeutics is under active development at Cloaked Therapeutics. Previously he established Ironstone Separations, Inc in Oxford, MS for the development of improved preparative chromatography methods to support commercial development of natural product compounds and served as Chief Scientific Officer of Natural Products for ChromaDex, Inc. Having received a B.S. in Chemical Technology from Iowa State University, M.A. in Botany, and Doctorate in Organic Chemistry focusing on Natural Products from Indiana University in Bloomington, Indiana, Dr. McChesney took a faculty position at the University of Kansas. He had a long, distinguished teaching career as professor of Botany and Medicinal Chemistry at the University of Kansas, and then as professor of Pharmacognosy at the University of Mississippi. He also served as an advisor to the World Health Organization on Traditional Medicines and anti-malarial drug development, and to UNESCO in Natural Products Chemistry. In 1985, he taught natural products chemistry in Brazil as a Fulbright Fellow. From 1978 to 1986, he chaired the Department of Pharmacognosy at Ole Miss. From 1986 to 1995 he was Director of the Research Institute of Pharmaceutical Sciences at Ole Miss and in that capacity he conceived and implemented the establishment of the National Center for Natural Products Research on the University of Mississippi Campus. The National Center is a state-of-the-art research and development facility of greater than 200,000 square feet for studying and supporting development of natural products. In 1986-87 he was President of the American Society of Pharmacognosy, the premier organization of natural products researchers in the world. In 1993 Dr. McChesney was named F.A.P. Barnard Distinguished Professor of Pharmaceutical Sciences at the University of Mississippi. In 1995 he was elected a Fellow of the American Association for the Advancement of Science for his contributions to the development of Artemisinin based anti-malarials. While at Ole Miss, Dr. McChesney discovered a new 8-aminoquinoline analog showing broad anti-infective activity against malaria, leishmania, and pneumocystis pneumonia without the usual attendant toxicity profile of the class. NPC 1161 is in final preclinical development and is slated to enter clinical trials in the near future. He retired from academia in 1996 to take a position as Vice President of Research and Development at NaPro Biotherapeutics, Inc., a natural product pharmaceutical company. In that role Jim developed an integrated strategy combining isolation and semi-synthesis for the economic production of paclitaxel from plantation grown Taxus biomass. In 2003 NaPro changed its name to Tapestry Pharmaceuticals and sold its development group to ChromaDex and Jim went along as CSO of the group while retaining his position as CSO of Natural Products Chemistry at Tapestry. As CSO of Tapestry, Jim designed a next generation taxane, TPI 287, overcoming many clinical limitations of the current clinically approved taxanes. TPI 287 is currently in Phase II clinical trials. During his career he has received numerous awards and accolades. In 2014, he was awarded the International Conference on the Science of Botanicals award “Outstanding Contribution in Natural Products Research”. In 2016 Jim was elected a Fellow of the American Society of Pharamacognosy. In 2018 he was selected by Marquis Who’s Who recognizing his life time achievements in Natural Products Research and Development. His research interests include the chemistry, metabolism, function and production of biologically active organic natural products, bioanalytical chemistry of natural products and drugs, chemotherapy of tropical diseases, and the control of plant growth and development. Most recently he has focused on development of biologically active natural products as pharmaceuticals, especially as anti-infectives and cancer chemotherapeutics. The establishment in 2011 of Veiled Therapeutics, LLC will facilitate these development efforts. In March of 2014 Cloaked Therapeutics, LLC was founded to clinically develop the TumorSelect technology discovered and patented by Veiled Therapeutics, LLC. Dr. McChesney has been a member of the American Chemical Society for more than 50 years. He has received more than $40 million of funding from the NIH, NSF, WHO, FDA, and USDA. As a recognized expert in medicinal plant and natural product development, he frequently lectures giving numerous regional, national, and international invited lectures, and has authored more than 225 peer-reviewed publications and more than 60 patents.

"Update and Future Perspectives from the FDA"

"FDA's Dietary Supplement Program: Overview and Update"

Cara Welch, Ph.D., is currently the Deputy Director for the Office of Dietary Supplement Programs (ODSP) in FDA's Center for Food Safety and Applied Nutrition (CFSAN). In this role, Dr. Welch leads the development of new policies and programs involving regulatory compliance and provides scientific expertise for emerging issues affecting the dietary supplement industry. She is also responsible for prioritization and execution of ODSP's research portfolio. Prior to returning to ODSP, she was on detail as a Special Assistant to the Deputy Commissioner for Policy, Legislation, and International Affairs in the Office of the Commissioner. In this role, she provided expertise on agency level food policy issues. Prior to joining FDA, Welch was the Senior Vice President of Scientific and Regulatory Affairs at the Natural Products Association. Welch earned her Ph.D. in Medicinal Chemistry from Rutgers University working with traditional medicinal African plants.

"Using Genome-Scale Data to Ensure Authenticity and Safety of Botanicals"

"Dr. Sara Handy is a Research Biologist in the Office of Regulatory Science within the Center for Food Safety and Applied Nutrition (CFSAN) at the United States Food and Drug Administration (FDA). Her work focuses on developing, evaluating, and validating genomic methods to identify plant and animal species in foods and dietary supplements. Prior to joining FDA she obtained a B.Sc. in Ecology and Evolutionary Biology at the University of Tennessee, Knoxville and her Ph.D. in Oceanography at the University of Delaware."

"Using Genome-Scale Data to Ensure Authenticity and Safety of Botanicals"

Calvin Edwards is the Director, Health Fraud Branch within the FDA's Office of Regulatory Affairs, Division of Enforcement. Prior to this assignment he served as an investigator with the Health Fraud Branch where he conducted investigations into a range of fraudulent products marketed to diagnose, treat, prevent, cure, or mitigate diseases and conditions including COVID-19, asthma, cancer, and diabetes and products claiming to promote weight loss, sexual enhancement, and body building.

He began his FDA career in 1996 with the Harrisburg, PA resident post where he was a low-acid canned food specialist through 2003 when he became the supervisory investigator in that post. He held that position through 2019 when he transferred to the Health Fraud Branch. During that time his unit brought successful cases in all the product commodity areas regulated by FDA including food, drugs, medical devices, biological products, and animal drugs.

As an active duty commissioned officer in the US Public Health Service Commissioned Corps assigned to the FDA, he led over 30 deployments to provide humanitarian medical aid in disaster situations including at Ground Zero immediately after 9/11, Hurricanes Katrina, Gustav, and Maria, the unaccompanied minor influx on the US-Mexico border, and led a team that stood up and operated an Ebola Treatment Unit in Monrovia, Liberia, West Africa during the Ebola epidemic in 2014. He retired from active duty in 2020 with 32 years of service.

He earned a BS in Health Physics from Thomas Edison State College, an MS in Safety Science from the Indiana University of Pennsylvania, and an MS in Organizational Dynamics from the University of Pennsylvania. He is a veteran of the US Navy's nuclear power program for over six years. He is a hobby beekeeper and backyard maple syruper. He lives with his wife of 36 years on a small farm in rural Pennsylvania.

"What analytical methods tell us about the authenticity of selected Ginkgo biloba supplements"

Rahul S. Pawar, Ph.D. was awarded PhD. in Natural Products from the National Institute of Pharmaceutical Education and Research (NIPER), India in 2003. He pursued postdoctoral research at the National Center for Natural Products Research (NCNPR) at the University of Mississippi from 2003-2007. Currently, Dr. Pawar is a Research Chemist in the Office of Regulatory Science at CFSAN-FDA in College Park, MD. He is the Office's Area Research Coordinator for dietary supplements. He is also the Office's subject matter expert and provides consultation to other offices within the CFSAN. He is an expert in the isolation and identification of botanical constituents of interest to the FDA. Currently, his research focuses on development of analytical methods for determination of dietary supplement quality. He has extensively published his work in peer-reviewed journals and presented talks at national and international meetings.

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"How Should Cannabis Quality be Defined?"

Jahan Marcu, Ph.D, Co-Founder, Marcu & Arora - MODERATOR
Holly Johnson, Ph.D, Chief Science Officer, American Herbal Products Association
Nandakumara Sarma, Ph.D., Director of Dietary Supplements and Herbal Medicines, US Pharmacopeia
Mahmoud A. ElSohly, Ph.D., Research Professor, National Center for Natural Products Research, University of Mississippi
David Vaillencourt, M.Sc., CEO of The GMP Collective and ASTM International representative
Casandra Taylor, Ph.D, Chemist, Center for Drug Evaluation and Research, Food & Drug Administration

The plant species Cannabis sativa L. includes several subspecies, cultivars (commonly referred to as "strains"), and chemotypes. Establishing specifications for cannabis identity, cannabinoid composition, and limit of contaminants would be beneficial in determining cannabis quality. Science-based quality specifications are important to protect public health from substandard and contaminated products, and to facilitate research. Historically, standards groups provide public standards and best practice guidelines with inputs from volunteer experts representing academic research, healthcare practice, regulators, and industry. These standards help industry in assessing quality and provide analytical tools. Regulatory bodies utilize a variety of standards to assist in regulating the industry. Globally recognized non-profit organizations, including US Pharmacopeia, ASTM International, and AOAC International, are actively engaged in providing analytical methods and guidelines to help ensure cannabis quality. In July 2020, US FDA published a Draft Guidance on quality considerations for clinical research using cannabis and cannabis-derived compounds. Representatives from these organizations will provide updates on the contributions and ongoing work related to cannabis and cannabis-derived compounds. The panel will also stimulate conversation on the current challenges and unmet needs related to cannabis quality and safety. Attendees will be able to participate in a discussion that will better their understanding of the possible solutions that exist, and how they can support the application of expertise and data in guiding research and use of quality standards.

Holly E. Johnson, Ph.D. is Chief Science Officer for the American Herbal Products Association, an alliance of over 400 member companies in the natural products industry. She previously served as Laboratory Director for Alkemist Labs, an ISO 17025 accredited natural product testing lab specializing in botanicals. Dr. Johnson took a B.S. in Botany and a Ph.D. in Pharmacognosy, and was awarded a National Institutes for Health (NIH) Fellowship at the University of Illinois-Chicago NIH Center for Botanical Dietary Supplements. Dr. Johnson is a member of the Editorial Board of the AOAC International Journal and contributes to standards setting work for dietary supplements and botanical materials, including service to AOAC in a variety of working groups and expert review panels. Holly is a member of the United States Pharmacopeia (USP) Expert Committee for Botanical Dietary Supplements & Herbal Medicines and the USP Cannabis Expert Panel; she serves on the steering committee for the Botanical Safety Consortium, and the Advisory Boards of the American Botanical Council and the American Herbal Pharmacopeia, among others. Holly has over 20 years' experience in botanicals research and spent many happy years giving courses at the University of Hawaii.

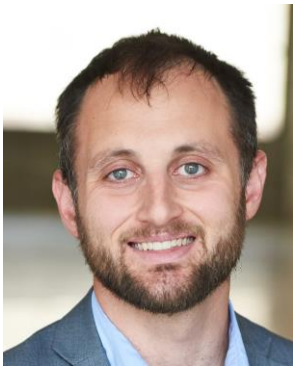
Mahmoud A. ElSohly, Ph.D., Research professor, National Center for Natural Products Research (NCNPR) and Professor of Pharmaceutics and Drug Delivery, School of Pharmacy, University of Mississippi (UM) obtained his Ph.D. from the University of Pittsburgh in 1975 with Masters and B.Sc., in Pharmacy from the University of Cairo.

Dr. ElSohly has been at UM since 1975 and in 1985; he started a private laboratory ElSohly Labs, Inc. (ELI) in Oxford, MS, which is an analytical laboratory specializing in providing drug testing services to the industry and a product development laboratory with a successful SBIR and STTR funding. In 2002, ELI received the National Tibbetts Award for of outstanding contributions to the SBIR Program.

Dr. ElSohly is board certified by the American Board of Forensic Examiners and the American Board of Forensic Medicine, and ELI is certified by (DHHS) and the College of American Pathologists since 1988.

Dr. ElSohly has been active in NIH funding over the years with over 1.5 million dollars/year. He authored or coauthored over 400 peer-reviewed publications and over 30 patents.

In 2011 Dr. ElSohly received the University of Pittsburgh's Legacy Laureate Award, in 2013 the UM Research and Creative Achievement Award and the (ICRS), Life time Achievement Award and in 2016 the Alexander O. Gettler Award from the (AAFS).



David Vaillencourt is an accomplished regulatory, policy, and standards expert dedicated to bringing credibility to the global cannabis and hemp marketplace. He is the CEO of The GMP Collective, which provides consulting services to cannabis producers across the supply chain. He holds a Master of Science degree and brings nearly 15 years of experience spanning quality assurance and quality control, education, and project management. He is recognized for his contributions and leadership in the cannabis industry, regularly speaking and writing for national and international outlets. In addition to speaking and writing on cannabis industry matters, David supports industry non-profits and policy-working groups, including his elected role as Vice-Chair on ASTM International's Committee D37 on Cannabis, supporting over 1,100 members across 30 countries develop consensus industry standards. When not enjoying the 3 L's of life, Leadership, Learning, and Listening, you can find him out in the mountains hiking, camping, and skiing with his dog.

Cassandra Taylor, Ph.D. is a Chemist at U.S. Food and Drug Administration within the Center for Drug Evaluation and Research (CDER) and is a member of the Botanical Review Team (BRT), which resides within the Office of Pharmaceutical Quality (OPQ). BRT collectively serves as an expert resource for CDER on all botanical issues. Dr. Taylor received her B.S. in Chemistry with a minor in Forensics from St. Francis University in Loretto, PA (2005), and her Ph.D. in Analytical Chemistry from the University of Maryland in College Park, MD (2014) under the guidance of Dr. Alice Mignerey. Dr. Taylor joined FDA in December 2014 as a primary BRT reviewer and has evaluated over 100 botanical drug submissions from all CDER's clinical divisions, with a focus on reviewing cannabis submissions. She serves as a cannabis subject matter expert (SME) for OPQ, CDER and across FDA, primarily concentrating on the botanical and quality aspects of cannabis. Dr. Taylor is the lead SME on the recently published draft FDA guidance for industry titled "*Cannabis and Cannabis-Derived Compounds: Quality Considerations for Clinical Research*." She leads and coordinates the internal CDER Cannabis working group and leads various cannabis initiatives within CDER and across the Agency. Dr. Taylor actively contributes as an SME to the internal FDA cross-agency cannabis-working group known as the Cannabis Products Committee (CPC). She also works collaboratively with colleagues across the agency to help close the substantial knowledge gaps about the science, safety, and quality of many of the cannabis products, including those containing cannabidiol. Dr. Taylor has presented at many forums internally and externally on the botanical drug review process and FDA's role in the regulation of cannabis products.

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"Cannabis and Cannabis-Derived Compounds: Quality Considerations for Clinical Research FDA Draft Guidance for Industry"

Taylor, Cassandra L.[1]

[1] Botanical Review Team, Office of New Drug Products, Office of Pharmaceutical Quality, Center for Drug Evaluation and Research, U.S. Food and Drug Administration

The new draft guidance, Cannabis and Cannabis-Derived Compounds: Quality Considerations for Clinical Research is intended to assist investigators conducting clinical research with cannabis or cannabis-derived compounds under an IND. Covers three topics: Sources of Cannabis, Resources for Information on Quality Considerations, and Percent Delta-9 THC Calculations.

This guidance outlines FDA's current thinking on several topics relevant to clinical research related to the development of drugs containing cannabis or cannabis-derived compounds. Cannabis and cannabis-derived compounds that may be used in drug manufacturing include botanical raw materials, extracts, and highly purified substances of botanical origin. This guidance does not address development of synthetic versions of substances that occur in cannabis, sometimes known as cannabis-related compounds, which are regulated like other synthetic drugs. This guidance is limited to the development of human drugs and does not cover other FDA-regulated products.

Presentation will highlight recommendations for sponsors or investigators wishing to conduct clinical research on cannabis or cannabis-derived compounds. The recommendations in this guidance are intended to provide clarity regarding a recent legislative change (i.e., 2018 Farm Bill) and to address certain questions raised in a recent public hearing. The guidance also introduces key FDA regulatory concepts to stakeholders who may be less familiar with FDA or our authorities than other drug developers.

Cassandra Taylor, Ph.D. is a Chemist at U.S. Food and Drug Administration within the Center for Drug Evaluation and Research (CDER) and is a member of the Botanical Review Team (BRT) which resides within the Office of Pharmaceutical Quality (OPQ). BRT collectively serves as an expert resource for CDER on all botanical issues. Dr. Taylor received her B.S. in Chemistry with a minor in Forensics from St. Francis University in Loretto, PA (2005), and her Ph.D. in Analytical Chemistry from the University of Maryland in College Park, MD (2014) under the guidance of Dr. Alice Mignerey. Dr. Taylor joined FDA in December 2014 as a primary BRT reviewer and has evaluated over 100 botanical drug submissions from all CDER's clinical divisions, with a focus on reviewing cannabis submissions. She serves as a cannabis subject matter expert (SME) for OPQ, CDER and across FDA, primarily concentrating on the botanical and quality aspects of cannabis. Dr. Taylor is the lead SME on the recently published draft FDA guidance for industry titled "*Cannabis and Cannabis-Derived Compounds: Quality Considerations for Clinical Research*." She leads and coordinates the internal CDER Cannabis working group and leads various cannabis initiatives within CDER and across the Agency. Dr. Taylor actively contributes as an SME to the internal FDA cross-agency cannabis-working group known as the Cannabis Products Committee (CPC). She also works collaboratively with colleagues across the agency to help close the substantial knowledge gaps about the science, safety, and quality of many of the cannabis products, including those containing cannabidiol. Dr. Taylor has presented at many forums internally and externally on the botanical drug review process and FDA's role in the regulation of cannabis products.

"Regulatory Landscape for Hemp-Derived Products"

***Lance M. Blundell, Esq*.** is the General Counsel for cbdMD and the co-chair of cbdMD Therapeutics. In this role, Mr. Blundell handles all contracting and licensing, advises and directs the highly nuanced domestic and international regulatory compliance activities, oversees the science and quality programs, manages the legal needs of multiple departments, manages litigation strategy, assists with business development, and develops the IP portfolio for the company's patents and trademarks. Prior to his role as General Counsel, Mr. Blundell served as outside counsel for the company and its predecessor since inception in 2017. Mr. Blundell has over 20 years of business experience serving as General Counsel or outside counsel for businesses in the internet services, consumer product manufacturing, electronic cigarettes, multi-state cannabis operators, entertainment and e-commerce sectors. Of note, Mr. Blundell served as counsel for Blu, an E-cigarette manufacturer founded in 2009 and subsequently sold to Lorillard Tobacco in 2012, and most recently W the Brand, a multi-state cannabis extraction and manufacturing company. Mr. Blundell received a Bachelor of Science degree in Business Administration/Marketing from the University of Colorado in 1994 and a Juris Doctor from the University of San Diego School of Law in 1997. He currently serves on the Board of Directors at the Natural Products Association (NPA).

"State Medical Cannabis Programs: Wants and Needs"

Dr. Larry Walker is Interim Director, National Center for Cannabis Research and Education Research Institute of Pharmaceutical Sciences, Director Emeritus of the National Center for Natural Products Research (NCNPR), and Professor in the Department of Pharmacology at the University of Mississippi. A native of Martin, Tennessee, his undergraduate pharmacy degree is from Mercer University (1975), and his doctorate in Pharmacology from Vanderbilt University School of Medicine in 1979, with emphasis in the areas of renal and cardiovascular pharmacology. He spent periods in postdoctoral research at the Bosch Institute for Clinical Pharmacology in Stuttgart, Germany and in the Department of Physiology at Dartmouth Medical School. He joined the faculty at the University of Mississippi as a Research Assistant Professor in 1981, and has worked for much of his career on research related to the pharmacology of natural products. In 1992, Dr. Walker assumed the role of Program Coordinator of the Drug Discovery and Development Program of the Research Institute of Pharmaceutical Sciences at the University of Mississippi. In 1995 was named Associate Director of the NCNPR. In 2001, he was named Interim Director, and selected as Director in 2002. The NCNPR has currently 85 full-time researchers in the natural products field, with programs in drug discovery, and in the chemistry and pharmacology of medicinal plants. In 2010, he also was appointed as Associate Director for Basic Science Research, Oxford campus, for the University of Mississippi Medical Center Cancer Institute.

Dr. Walker is a co-author of more than 175 papers in peer-reviewed journals in pharmacology, toxicology, and natural products discovery. He is a member of the American Society of Pharmacognosy, American Society of Pharmacology and Experimental Therapeutics, American Society of Microbiology, American Society of Tropical Medicine and Hygiene, American Association of Pharmaceutical Scientists, and the Society for Biomolecular Screening. He served as Editor-in-Chief of the Journal of Biomolecular Screening, and on the editorial boards of Phytotherapy Research and the J. of Pharmacology and Experimental Therapeutics, and has served on numerous grant review panels for the NIH and Dept. of Defense. In 2003, he received the UM School of Pharmacy's Researcher of the Year award, and in 2009 the University's Distinguished Research and Creative Achievement Award.

"Identification of an Orally Bioavailable, Brain-Penetrant Compound with Selectivity for the Cannabinoid Type 2 Receptor"

Ospanov M[1, 2], Sulochana SP[3], Paris JJ[3], Rimoldi JM [3], Ashpole N[3], Walker L[1], Ross SA [1, 3], Shilabin AG[4] & Ibrahim MA[1]
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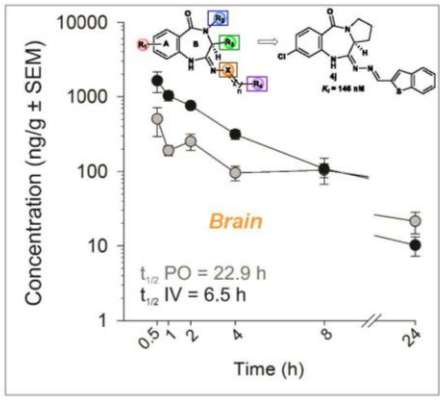
Modulation of the endocannabinoid system (ECS) is of great interest for its therapeutic relevance in several pathophysiological processes. The CB2 subtype is largely localized to immune effectors, including microglia within the central nervous system, where it promotes anti-inflammation. Recently, a rational drug design toward precise modulation of the CB2 active site revealed the novelty of Pyrrolo [2, 1-c] [1, 4] benzodiazepines tricyclic chemotype with a high conformational similarity in comparison to the existing leads. These compounds are structurally unique, confirming their chemotype novelty. In our continuing search for new chemotypes as selective CB2 regulatory molecules, following SAR approaches, a total of 17 selected (S,E)-11-[2-(arylmethylene)hydrazono]-PBD analogs were synthesized and tested for their ability to bind to the CB1 and CB2 receptor orthosteric sites. A competitive [^{3}H] CP-55,940 binding screen revealed five compounds that exhibited >60% displacement at 10 µM concentration. Further concentration-response analysis revealed two compounds, **4k** and **4q**, as potent and selective CB2 ligands with sub-micromolar activities (K_i = 146 nM and 137 nM, respectively). In order to support the potential efficacy and safety of the analogs, the oral and intravenous pharmacokinetic properties of compound **4k** were sought. Compound **4k** was orally bioavailable, reaching maximum brain concentrations of 602 ± 162 ng/g (p.o.) with an elimination half-life of 22.9 ± 3.73 h. Whether administered via the oral or intravenous route, the elimination half-lives ranged between 9.3 and 16.7 h in the liver and kidneys. These compounds represent novel chemotypes, which can be further optimized for improved affinity and selectivity toward the CB2 receptor.



The authors are thankful to the Neuropharmacology CORE (CORE-NPN) and the Chemistry and Drug Metabolism Pharmacokinetics (DMPK) CORE, School of Pharmacy, University of Mississippi for biological testing and PK analysis. The authors acknowledge the Department of Chemistry and The School of Graduate Studies at ETSU. This work is supported by the National Institute of General Medical Science of the National Institute of Health under Award Number P30GM122733. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health

Dr. Mohamed Ali Ibrahim's research interests are in the area of pharmacognosy with focus of studying complex natural products chemistry of leads acting on anticancer (WO 2020/056425 A1), infectious diseases (US8633166B2), and neurodegenerative disorders. He has blended the chemistry and biology of numerous natural products to generate several milestones in the field of natural products including the importance of endangered plants in natural products drug discovery (PNAS 110, 16832-16837, featured article in "University of Washington's Conservation Magazine" September 13, 2013, by Roberta Kwok; featured article recommended for teaching in "F1000Prime" October 11, 2013, by David Triggle), and the discovery of orally bioavailable, brain-penetrant compound with selectivity for the cannabinoid type 2 receptor. He has been an invited speaker at various esteemed universities and institutes and being the recipient of many prestigious awards such as 2019 John Faulkner Award and 2020 Algernon Sydney Sullivan Award. His main concept of drug discovery research is to be able to answer the "why" and "how" questions rationally.

"Botanical Aphrodisiacs for Women's Health"

Prescott H[1, 2], Ashpole NM[1, 3], & Khan IA[1, 2]

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Female Sexual Dysfunction (FSD) affects nearly 40% of women in the United States. While males have five FDA-approved drugs for erectile dysfunction, there is only one FDA-approved as-needed treatment for premenopausal women with acquired, generalized Hypoactive Sexual Desire Disorder (HSDD), the most prevalent FSD. The lack of approved drugs is largely due to the biopsychosocial complexity of HSDD; however, there are neurobiological underpinnings evident. Due to the lack of safe efficacious treatment options, we hypothesize that botanical species traditionally used, as aphrodisiacs may be promising leads, and exert their effects via activation of melanocortins, an excitatory circuit implicated in sexual function, specifically at MC4R. We conducted a review of the aphrodisiac products in the U.S. dietary supplement market to determine their levels of ethnobotanical and clinical evidence and narrow species selection. Utilizing market data, we found that 53 species were used for female-specific sexual complaints; concluding that there is little to no clinical evidence from the literature to substantiate their use. We selected five plants with reasonable evidence for further evaluation, *Corynanthe yohimbe, Labisia pumila, Asparagus racemosus, Tribulus terrestris,* and *Trigonella foenum-graecum*. Species were sequentially extracted, concentrated, dried, and tested to determine a NOAEL before subjection to an MC4R assay. Results showed four extracts demonstrated significant activation over control ($p < .05$). Further fractionation of one of the hits, *L. pumila* (H2O), resulted in a loss of activity. A large-scale isolation of *L. pumila* and preliminary analysis of fractions utilizing database services has resulted in multiple compounds of interest, and structure elucidation is ongoing. Additional experiments are being conducted to determine whether isolated specialized metabolites of those active extracts also activate the MC4R, and those that show activity will subsequently be tested for activity at the MC3R as there is a 75% similarity between these two receptor subtypes. To analyze any potential downstream effects of this binding, we will utilize the GT1-7 cell line that secretes Gonadotrophin Releasing Hormone in response to depolarization.

We are grateful to The Garden Club of America for providing funding through the Anne S. Chatham Fellowship in Medicinal Botany. We would also like to show our gratitude to Dr. Pamela L. Mellon for providing aliquots of the GT1-7 cell line.

Hayley N Prescott, Graduate Research Assistant, University of Mississippi

EDUCATION/TRAINING

- Bastyr University; Kenmore, WA B.Sc. 06/2016 Herbal Sciences
- The University of Mississippi; University, MS Ph.D. 2022 Pharmacognosy- Women's Health

My unique undergraduate training encompassed all aspects of herbal medicine, from taxonomy and microscopic analysis, to QA/QC for the dietary supplement industry. I finished my program with an overall working knowledge comprising 120 plants that are commonly used globally. While studying, I joined an ongoing ethnobotanical research project in order to develop a standardized Botanical Drug Substance (BDS) for future clinical trial work. This gave me the experience of taking a whole plant extract through the FDA process of specific laboratory requirements and GMP's for developing a BDS. As a graduate student, I garnered expertise in natural product research namely, extraction, fractionation, and structural elucidation from botanical species. While gaining expertise in natural products research I focused on botanicals for women's health, specifically in female sexual dysfunctions. My work started with the assessment of dietary supplements currently marketed towards women experiencing a low libido, and I was able to succinctly review the plants for both traditional and clinical evidence. I also gained knowledge of cell cultivation and the application of botanicals in cell-based screening assays. I was able to successfully apply for The Anne S. Chatham Fellowship in Medicinal Botany, which afforded me the opportunity to expand my mechanistic research downstream from the receptor of interest. My unique perspective in natural products research allows for a wholly interdisciplinary and progressive approach and understanding to my work and future global impact. I believe my work will continue to push the innovation of discovering natural products drugs for development in the field of women's health.

B. Positions, Scientific Appointments, and Honors

2014-2016	American Herbalists Guild Member
2018-Present	Graduate Student Researcher
2018-Present	BioMolecular Sciences Student Advocate Member, 1 yr. Executive Committee Service
2020-Present	Rho Chi Society Member
2020-Present	The American Society of Pharmacognosy Member
2021	Anne S. Chatham Fellowship in Medicinal Botany
2021	Charles D. Hufford Outstanding Pharmacognosy Graduate Student

"Isolation of tens of compounds from Achillea wilhemsii including new sesquiterpenoids with metabolic syndrome management activities"

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Metabolic syndrome affects more than thirty percent of Americans according to the CDC. Current pharmacotherapies for prevention and treatment of metabolic disorders have severe adverse effects, high costs and insufficient accessibility, which make them less effective. To help resolve this medical dilemma, Yarrow (Achillea wilhelmsii C. Koch) a member of the Asteraceae family is explored for its unique properties in the prevention and treatment of metabolic syndrome. Yarrow has been traditionally used in Persian and Native American medicine predominantly for GI related disorders. Phytochemical analysis of Achillea wilhelmsii led to the isolation of 17 pure secondary metabolites belonging to the classes of sesquiterpenoids and phenolics. Two of these compounds, named wilhemsin (7) and wilhelmsolide (9), are new sesquiterpenoids, and the first shows undescribed structural features. Their structures were elucidated through extensive spectroscopic analysis, mainly based on 1D and 2D NMR, and chemical derivatization. Starting from plant traditional use and previous reports on the activity of the plant extracts, all the pure compounds were evaluated on endpoints related to the treatment of metabolic syndrome. The sesquiterpene hanphyllin (8) showed a selective cholesterol-lowering activity (−12.7% at 30 µM), santoflavone (13) stimulated glucose uptake via the GLUT transporter (+16.2% at 30 µM), while the trimethoxylated flavone salvigenin (14) showed a dual activity in decreasing lipid levels (−22.5% palmitic acid biosynthesis at 30 µM) and stimulating mitochondrial functionality (+15.4% at 30 µM). This study further confirms that, in addition to the antioxidants vitexin, isovitexin, and isoschaftoside, A. wilhelmsii extracts contain molecules that can act at different levels on the metabolic syndrome symptoms.

The authors would like to acknowledge the support of Southwest College of Naturopathic Medicine, University of Naples Federico II, and Kermanshah University of Medical Sciences

Dr. Yalda Shokoohinia is currently a Principal Scientist at Ric Sclazo Institute for Botanical Research and a Professor of Pharmacognosy and Phytochemistry at Southwest College of Naturopathic Medicine (SCNM). She directs the phytochemistry labs at SCNM and teaches Pharmacology and Research to Naturopathic medical students. Dr. Shokoohinia received her Professional doctorate in Pharmacy, Pharm D, and Ph.D. in Pharmacognosy besides fellowships in Phytochemistry and Medicinal Plants Analysis. Over the last seventeen years, she has served in various research, teaching, Pharmacist, and leadership roles. She was a researcher, faculty member, the chair of the Department of Pharmacognosy & Biotechnology, the head of the School of Pharmacy, the Director of Pharmaceutical Sciences Research center, and the Head of Continuous Medical Education. She also serves as AHP, UNPA and AHPA advisor/ committee member. Her research areas are phytochemistry, natural product chemistry, and multidimensional chromatography.

"PPARα and PPARγ agonistic effects and increase in glucose uptake by Aquilaria sinensis flower extract"

Chae H-S[1], Dale O[1], Mir TM[1], Avula B[1], Zhao J[1], Khan IA[1,2] & Khan SI[1,2,]*

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Aquilaria sinensis (Lour.) Spreng. is known for its resinous secretion (agarwood). The resin of A. sinensis is highly valuable due to its use in therapeutic perfumes, traditional medicines, and aromatic food ingredients. The leaf and stem of A.sinensis have been extensively studied earlier but the flower has not been explored for its pharmacological effects. We investigated the effects of A. sinensis flower extract (AF) on peroxisome proliferator-activated receptors alpha and gamma (PPARα and PPARγ), liver X receptor (LXR), glucose uptake, and lipid accumulation (adipogenesis). At a concentration of 50 µg/mL, AF caused 11-fold activation of PPARα and 5-fold activation of PPARγ, while the activation of LXR was only 1.82-fold. AF inhibited (28%) the adipogenic effect induced by rosiglitazone in adipocytes and increased glucose uptake by1.6-fold in muscle cells at 50 µg/mL. It was concluded that AF acted as a PPARα/γ dual agonist without the undesired effect of adipogenesis and retained the property of enhancing glucose uptake. This is the first report to reveal the PPARα/γ dual agonistic action and glucose uptake enhancing property of A. sinensis flower extract (AF) along with its antiadipogenic effect indicating its potential in preventing the symptoms of metabolic disorder.

This work was supported in part by the United States Department of Agriculture, ARS, Specific Cooperative Agreement No. 58-6060-6-015.

Dr. Hee-sung Chae is a Postdoctoral Research Associate at the National Center for Natural Products Research (NCNPR), School of Pharmacy, University of Mississippi. He received her Ph.D. (Korea traditional pharmacy), M.Sc. (Korea traditional pharmacy) and B.S. (Korea traditional pharmacy) from the Wonkwang University, South Korea. He received postdoctoral trainings from department of biological sciences, Korea research institute of bioscience and biotechnology, South Korea. He began his career as an invited research professor at college of pharmacy and integrated research institute for drug development, Dongguk University in 2013. And He was moved to Senior Researcher at research institute of pharmaceutical sciences, Seoul National University, Seoul, Republic of Korea. in 2020. Dr. Chae has a special interest in target discovery of natural products using RNA sequencing. His research interest also includes pharmacological properties of natural products in relation to inflammation and metabolic disorder. He has published more than 100 papers in peer-reviewed journals in the areas of natural products drug discovery, and ethnopharmacology.

"Update on the Office of Dietary Supplements"

Joseph M. Betz, PH.D., was appointed Acting Director of the Office of Dietary Supplements (ODS) in June of 2018. Dr. Betz joined ODS in 2002 as the first director of the Analytical Methods and Reference Materials (AMRM) program. As AMRM director, he oversaw several large intra- and extra-governmental initiatives with the goal of providing stakeholders with rugged, validated analytical methods and reference materials for measuring natural products in research, industrial, and regulatory settings.

Prior to joining ODS, Dr. Betz was vice president for scientific and technical affairs at the American Herbal Products Association (AHPA). Before serving at AHPA, Dr. Betz worked for 12 years as a research chemist in the Division of Natural Products at FDA's Center for Food Safety and Applied Nutrition.

Dr. Betz is an adjunct associate professor at the Georgetown University School of Medicine and, the Philadelphia College of Pharmacy and Science (now called the University of the Sciences, USciences). He is a member of the Board of Visitors of the Misher College of Arts and Sciences in the USciences. He is a member of the American Society of Pharmacognosy and a fellow of AOAC International. He also is chair of the Editorial Board for the Journal of AOAC International; a member of the United States Pharmacopeia's Expert Committee on Dietary Supplements and serves on expert scientific advisory committees for the governments of Canada and Hong Kong.

The author or co-author of over 100 peer-reviewed publications, Dr. Betz is the recipient of the American Botanical Council's first Norman R. Farnsworth Award, the American Herbal Product Association's Herbal Insight Award, AOAC International's Technical Division on Reference Materials (TDRM) Reference Material Achievement Award, and the American Society of Pharmacognosy's Varro E. Tyler. He was recognized by the NIH Office of the Director with an Honor Award for his contributions to the establishment and development of the ODS Vitamin D Standardization Program.

A native of Philadelphia Dr. Betz earned a B.Sc. degree in Biology at USciences and a M.Sc. in Marine and Environmental Science at C.W. Post/Long Island University. Dr. Betz earned a Ph.D. in Pharmacognosy at USciences.

NOTES

"FDA Challenges & Opportunities: Hear From FDA Alumni on the Most Pressing Issues before the Agency"

FDA Challenges & Opportunities: The group will consider the FDA's current authorities and candidly discuss their progress towards fully utilizing them to date. The group will share insights as former regulators regarding how FDA should use current authorities effectively to ensure consumer safety.

Daniel Fabricant, Ph.D. is CEO and President of the Natural Products Association (NPA), the nation's largest and oldest trade organization representing the natural products industry, including dietary supplements, foods, personal care products and more. Most recently, Dr. Fabricant served as the Director of the Division of Dietary Supplement Programs at the U.S. Food and Drug Administration (FDA), where he directed agency policy, public affairs and regulatory action regarding regulation of the dietary supplement industry for more than three years. While with the agency, he successfully navigated the large, heavily-matrixed government organizational structure to bring life to a regulatory function that was non-existent for almost 20 years. Dr. Fabricant carried his interest in natural products into the classroom, earning a Ph.D. in Pharmacognosy from the University of Illinois at Chicago, where he has served as an adjunct professor in the Department of Medicinal Chemistry and Pharmacognosy since 2009. He has also published extensively and is internationally recognized for his regulatory and governmental public health expertise and natural products research.

Sibyl Swift, Ph.D. is the Vice President for Scientific & Regulatory Affairs for cbdMD and the co-chair of cbdMD Therapeutics. As VP for cbdMD, she directs the company's research partnerships, clinical trials, advises on regulatory matters and provides guidance on good manufacturing practices. Prior to joining cbdMD, Dr. Swift was the Senior Vice President for Scientific & Regulatory Affairs at the Natural Products Association (NPA). In that role, Dr. Swift was responsible for the development and implementation of the association's education, regulatory, and compliance programs and effort, such as the Supplement Safety and Compliance Initiative (SSCI), the NPA Natural Standard, and others. She represented the association on Codex Alimentarius (an international standards organization) and provided guidance on claims reviews, substantiation, and regulatory policy. Before joining NPA, Dr. Swift was the Associate Director for Research and Strategy within the U.S. Food and Drug Administration's (FDA) Office of Dietary Supplement Programs. As Associate Director, Dr. Swift directed the office's research portfolio and was responsible for ensuring alignment between its science, research, compliance, enforcement, and policy initiatives. Dr. Swift was also the co-chair of the Botanical Safety Consortium, a collaboration between scientists from government agencies, academia and industry. Dr. Swift earned her Ph.D. in nutrition and M.S. in exercise physiology at Texas A&M University. She is currently a member of the American Society for Nutrition and the Science and Regulatory Affairs Committee for the Council for Federal Cannabis Regulation.

Bob Durkin joins AGG as of counsel in the firm's FDA and Healthcare practices, and is a member of the Dietary Supplements industry team. As a former acting Director and Deputy Director of the Office of Dietary Supplement Programs (ODSP) in the FDA's Center for Food Safety and Applied Nutrition (CFSAN), he brings a wealth of knowledge and insight to his legal practice. In working with AGG clients, Bob will draw from the extensive experience he gained at the FDA where he was responsible for performing policy analysis and evaluations related to all aspects of the agency's dietary supplement programs while also providing skillful advice on compliance and enforcement issues (such as Warning Letters, seizures, injunctions, import detention/refusal, etc.). During this time, he was active in a variety of agency working groups, including Agency-wide Marijuana Working Group, Agency-wide CBD Policy Working Group, and the Agency-wide Investigational New Drug (IND) Policy Working Group. While helping to lead ODSP, Bob also successfully led the Office through multiple GAO investigations.

Just prior to joining ODSP, Bob was the acting Director of CFSAN's Food Defense Staff. In this role, Bob led a dedicated group of professionals whose duty it was to determine the best regulatory strategies to help protect our nation's food supply from intentional contamination. The Food Defense staff's work includes the implantation of the Food Safety and Modernization Act's Rule for Mitigation Strategies to Protect Food against Intentional Adulteration and determining the best ways to educate, and then regulate, industry relative to the Rule.

Bob has also served in both the Commissioner's office and the Center for Drug Evaluation and Research (CDER). While in the Commissioner's Office, Bob managed a staff of Emergency Response Coordinators whose focus was on coordinating an over-all Agency approach to mitigate and respond to urgent health concerns related to FDA regulated commodities. While at CDER, Bob worked in the areas of health fraud, over the counter drugs, and pharmacy compounding.

"Raw Material Specifications The best way to ensure safety in dietary supplement products"

Tara Lin Couch, Ph.D., Senior Director, Dietary Supplement and Tobacco Services, EAS Consulting Group, Alexandria VA

Dietary supplement products are intended to promote the health of the consumer and should never do the opposite by posing a health or safety risk. Unfortunately, there are numerous adverse events related to the consumption of dietary supplements each year, many of which can be traced back to the raw materials (dietary ingredients and components) that the products are formulated with. Ensuring the quality of dietary supplement raw materials is accomplished by establishing an appropriate, scientifically sound Raw Material Specification that addresses the materials' identity, purity, strength, composition, and limits of potential contaminants; and then determining if this specification is met via testing with every single receipt of incoming material. These requirements are dictated in Subpart E – Requirement to Establish a Production and Process Control System of 21 CFR 111, *Current Good Manufacturing Practice in Manufacturing, Packaging, Labeling, or Holding Operations for Dietary Supplements,* and particularly 21 CFR 111.70 and 111.75, respectively. This is more important now than ever before because of the increased demand in dietary supplement products coinciding with significant supply chain challenges during the COVID-19 pandemic. Testing laboratories are finding more quality issues with raw materials including the prevalence of intention adulterants and other contaminants, subpotent material, and even the identity of material altogether. The development and use of a Raw Material Specification that will ensure the material is unequivocally identified, meets its' strength requirements, and does not contain adulterants or contaminants is vital to all dietary supplement product manufacturers and brand owners.

Learning Objectives:

1. How to develop and implement a controlled system for the establishment of Raw Material Specifications.
2. Practical definitions of identity, purity, strength, composition, and potential contaminants.
3. Resources to gather information about raw materials.
4. Strategies to ensure the quality of incoming raw materials.
5. What to do when an established Raw Material Specification is not met.

Tara Lin Couch, Ph.D. is an analytical/organic chemist with exceptional analytical abilities and more than 30 years of diverse laboratory and regulatory experience in academic, field, contract and manufacturing environments. She is a sought-after expert on issues pertaining to quality in pharmaceutical, dietary supplement, and tobacco manufacturing. Dr. Couch assists clients with the development, improvement and implementation of quality systems that are scientifically sound, efficient, practical and compliant with FDA regulations. She also performs mock FDA inspections, gap analyses, and contractor and laboratory audits. She provides GMP (Good Manufacturing Practice) and laboratory trainings via seminar, webinar and on-site presentations.

Kiel Henderson
Chromadex, Longmont, CO 80503 USA

ChromaDex has been dedicated to the development of novel standards and solutions for the natural products industry for more than two decades. This talk will focus on the newest areas of reference standard commercialization. From the constituents of ashwagandha, curcumin and turmeric to unique isolates of the cannabinoid and terpene families, as well as emerging components of interest in the mushroom/fungi arena, there are plenty of new materials to explore.

In 2009, **Mr. Kiel Henderson** obtained his B.S. in Chemistry with an emphasis in Analytical Chemistry from the University of Colorado at Colorado Springs. Upon earning his degree, he worked as an analytical chemist in the petrochemical industry. After his stint at SGS North America, he moved onto DCG Partnership LLC; where he was heavily involved in new testing methods for detailed hydrocarbon analysis, Sulfur & Nitrogen speciated testing, and helped to implement the first ISO 17025/guide 34 accreditation for the reference standards business unit.

After 3 years, family obligations led Kiel closer to home in Colorado where he began working for ChromaDex Analytics as a Method Development GC Chemist in 2014. He then transferred to the R&D division. This is where Kiel focused on numerous customer projects and support in the testing of the eventual flagship ingredient Nicotinamide Riboside Chloride (Tru-Niagen). While in this role, Kiel began mentoring new hires and his fascination with the use of botanicals as alternative forms of medicine & potential novel drug development came to light. He now works as a Product Manager in the Reference Standards Business Unit within ChromaDex connecting with the leaders in the industry and gaining insight into the next big developments.

Outside of work Kiel enjoys his time in the mountains away from the bustle of town, in the form of hiking, backpacking, camping, and snowboarding. He also gets a few games of sand volleyball in from time to time.

"Authentication and Quality Control of 'espinheira-santa' (Monteverdia ilicifolia) by Morpho-anatomy and High-Performance Thin-Layer Chromatography"

*Antunes KA[1], Almeida VP[1], Monteiro LM[1], **Perera WH[2]**, Howard C[2], Reich E[3], Heiden G[4], Guarino EG[4], Raman V[5], Santos VLP[6], Manfron J[1]*

[1]Postgraduate in Pharmaceutical Sciences, State University of Ponta Grossa, Paraná, Brazil; [2]CAMAG Scientific, Inc, Wilmington, NC, USA. [3]CAMAG, Muttenz, Switzerland; [4]Embrapa, Rio Grande do Sul, Brazil; [5]National Center for Natural Products Research, School of Pharmacy, University of Mississippi, University, USA; [6]Escola Superior de Saúde, Biociências, Meio Ambiente e Humanidades, Centro Universitário Internacional Uninter, Curitiba, Paraná, Brazil.

Monteverdia ilicifolia (Mart. ex Reissek) Biral (syn. *Maytenus ilicifolia*), commonly known as "espinheira-santa", are widely used in South American folk medicines to treat gastritis and ulcers. Several herbal products containing the leaves of *M. ilicifolia* are sold on the market. Many other species with similar leaf morphology are also called espinheira-santa and used for the same purpose. The most common adulterants that show morphological similarities to *M. ilicifolia* are *Monteverdia aquifolia* (Mart.) Biral [Celastraceae], *Sorocea bonplandii* (Baill.) W.C.Burger, Lanj. & Wess.Boer, [Moraceae], *Zollernia ilicifolia* Vogel [Fabaceae], *Jodina rhombifolia* (Hook & Arn.) Reissek (recognized as espinheira-de-três-pontas) [Santalaceae], and *Citronella gongonha* (Mart) R.A.Howard [Cardiopteridaceae]. This study aimed to differentiate *M. ilicifolia* from its adulterants by morphological, microscopic and HPTLC techniques. The morpho-anatomical studies of the leaves and stems of *M. ilicifolia* and its adulterant species have revealed noteworthy features that can help species identification. In addition, the comprehensive HPTLC analysis enables unambiguous identification of *M. ilicifolia* and quality control of commercial espinheira-santa.

Acknowledgements: This research was funded in part by CAPES–Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (scholarship number 88887.634818/2021-00), UEPG–Universidade Estadual de Ponta Grossa, and Araucária Foundation, Brazil.

Wilmer Perera, PhD. is a natural products chemist, and he is currently the laboratory manager at CAMAG Scientific, Inc., CAMAG's sister company, and the world leader in planar chromatography. Wilmer oversees HPTLC analyses and projects in Wilmington, NC and provides advanced HPTLC trainings and short courses to customers from United States of America and Canada. Dr. Perera is also the secretary general of the North America Chapter of the International Association for the Advancement of High-Performance Thin-Layer Chromatography (HPTLC Association) and collaborates in the HPTLC Atlas for the identification of herbal drugs and in the scientific HPTLC PRO network.

Prior to join CAMAG Scientific, Inc. in 2019, his research was focused on the development of analytical and preparative techniques to identify, quantify and purify bioactive compounds from complex mixtures. He worked with different natural sources: plant species from different botanical families, fungi, and parotoid gland secretions from toads, and identified multiple minor compounds with diverse structures and biological activities. He has published 35 papers in peer-reviewed journals and has served as a peer reviewer for various scientific journals.

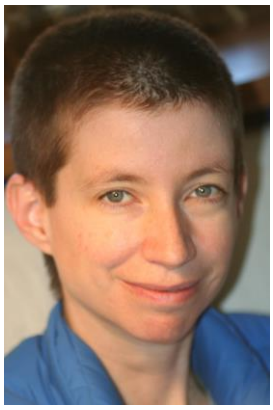
"Substitution and adulteration of Traditional Chinese Medicine seeds and small fruits in the U.S. market"

Applequist WL[1] & van der Valk JMA[2]

[1]William L. Brown Center, Missouri Botanical Garden, St. Louis, MO, USA. [2]Department of South Asian, Tibetan and Buddhist Studies, University of Vienna, Vienna, Austria.

Macroscopic authentication by van der Valk et al. (2017) of 23 Chinese Materia Medica seed and small fruit species purchased in the U.K. in 2012 determined that 9.5% of samples were sourced from unofficial species as defined by the 2010 Chinese Pharmacopoeia. Substitution, adulteration, or major contamination were absent in most species, but frequent in a few. It was of interest to determine whether material currently marketed in the U.S. displayed the same patterns. Over 250 samples of the same species were purchased in 2020. All of the most common plant and mineral substitutes, adulterants and contaminants reported by van der Valk et al. were observed, though their frequency was usually lower. Multiple possible reasons for improved quality in recent U.S. samples exist. Use of water-soluble dye to conceal substitution of less colorful *Schisandra* species for fruits of *S. chinensis* (Wu Wei Zi) was not observed. Contrarily, some adulterants not previously reported were observed; these include three unrelated seeds sold as *Plantago* (Che Qian Zi) and three seeds sold as *Phyllolobium chinense* (Sha Yuan Zi), in both cases usually mixed. Suan Zao Ren (*Ziziphus spinosa* or an unofficial substitute) often includes small fragments of an unidentified endocarp, also reported by van der Valk et al. As its content is usually not great enough to substantially increase weight, its persistence as a widespread contaminant in otherwise clean seed may reflect some other cause or perceived utility; further investigation would be desirable.

We thank the U.S. Food and Drug Administration for support from RFA-FD-16-014 and Christine Leon for helpful information.



Wendy Applequist is a plant taxonomist who has worked at the Missouri Botanical Garden's William L. Brown Center since 2000. Her research interests include the identification and quality control of medicinal plants, taxonomy of the flora of Madagascar, and plant nomenclature; she is the author of a book on morphological authentication of botanicals in commerce.

Russell J. Osguthorpe MD
CMO doTERRA International
Associate Professor of Pediatrics
University of Utah Dept. of Pediatrics

Essential Oils (EO) have been in use for hundreds of years but have recently increased in popularity worldwide. Market size has increased rapidly in the last fifteen years and continues to grow. Unfortunately, due to financial pressures and lack of regulation, EO's are often adulterated and subject to contamination. Further, EO's are inherently difficult to produce with consistent chemistry even when pure, due to natural variation in multiple stages of the product life cycle. These realities make safety of EO's difficult to evaluate. For EO's to withstand scientific and regulatory scrutiny, purity, consistency and scientific validation of health claims, are necessary. Data will be presented on the amount of adulteration and level of chemical consistency in lavender essential oil. Further data will be presented discussing chemical consistency between batches of multiple EO's and year-to-year variation levels will be discussed in relation to ISO standards. doTERRA is currently conducting clinical trials on several essential oils for efficacy and these will be briefly discussed. It is hoped this will become a template and new standard for EO purity and consistency in the marketplace.

Dr. Russell J. Osguthorpe currently serves as the Chief Medical Officer of doTERRA International. He is establishing a virtual healthcare delivery platform focused on prevention of metabolic disease through integrative, evidence-based medical practices. His work at doTERRA also revolves around directing research on the use of essential oils in healthcare settings. Prior to doTERRA he developed mixed matrix models of delivering pediatric subspecialty care at distance from the traditional Children's Hospital. Dr. Osguthorpe received his medical degree from the McGill University School of Medicine, completed his residency at the Children's Hospital in Denver, Colorado, and Pediatric Infectious Diseases Fellowship at Washington University School of Medicine. He and his wife Mary, have five children and two beautiful grandchildren.

"Holding the line: Dietary Supplements Quality Control and the Regulatory Challenges"

Katie Banaszewski

NOW Foods, Bloomingdale, IL

With the growing emphasis on wellness and customer focus on prevention rather than treatment of misalignments, the interest in dietary supplements rapidly increased in recent years. The global market is projected to reach $278 billion in 2024 and just in the United States; dietary supplements are used by more than 80% of adults. The increased use of dietary supplements raises public health concerns about their safety and efficacy both, short and long term. Although the federal government has an interest in ensuring the supplements Americans consume are high quality, free from contaminants and properly labelled, the lack of global consensus on regulation of dietary supplements is particularly challenging. While many manufacturers strive to remain compliant and provide their customers with high quality product, some take advantage of the loose global regulations. The customer concerns about quality problems and the growing supplement use prompt the development and application of state-of-the art scientific methods to address supplement quality issues. The analytical assessment of dietary supplements requires accurate, precise and reliable methods, development of which is challenging when considering the complexity of the dietary ingredients. Nevertheless, science is vital in setting regulatory framework and should be strongly considered when considering approaches focusing on public health.

Katie Banaszewski is a Director of Quality at NOW Foods, who strongly believes great things are never done by one person, but a team of people. Driven by curiosity and her passion for science, she joined NOW in 2013 with a plan to transform the analytical capabilities of their labs. During her tenure at NOW, she has led the development and implementation of a routine pesticide residue monitoring program and plays an integral role in growing the company's analytical capabilities. Katie focuses on exploring new scientific approaches to analytical challenges and her areas of expertise are mass spectrometry and elemental analysis. In her current role, Katie focuses on recent issues within the dietary supplement industry and ensures NOW remains the industry leader in holding high quality standards. Prior to joining NOW, Katie spent 5 years at the Institute for Food Safety and Health, working in collaboration with the academia, industry and the FDA. Katie authored and co-authored multiple journal articles and is actively involved with the scientific community, learning and sharing her knowledge with others. Katie holds degrees in Biotechnology and Chemistry form William Paterson University of New Jersey.

"Significance of Fit for Purpose Test Methods to Ensure Integrity of Botanicals in Dietary Supplements"

Amit Chandra, Ph.D

Fellow Botanical Innovation, Amway R&D.

Traceability of botanical ingredients in health and beauty products is a mandate. However, compliance with it alone cannot guarantee the "integrity" of the botanical during its life cycle from seed to shelf. A combination of fit for purpose specification aligned with fit for purpose analytical method is required to assure that. This presentation will 1) Recap the hits and misses on quality during traceability process, 2) Provide recommendations to maintain botanical integrity in traceability process with emphasis on quality before quantity. The presentation will also show examples of specifications that are vulnerable to botanical adulteration. The focus is to ensure botanical integrity in current and post COVID times, when supply chain is short and demand is high.

Dr. Amit Chandra is the Distinguished Scientist and Fellow of Botanical Innovation Amway R&D, Amway Corporation. He is a world-class subject matter expert in the area of botanicals, dietary supplements, nutraceuticals and cosmeceuticals. Dr. Chandra is a pharmacognosist / Phyto-chemist with a doctorate in Medicinal Plant Chemistry. He has over 34 years of experience in academia and industry in this area. Amit's area of focus at Amway- Nutrilite is directed towards innovation, discovery and development of health and beauty products (dietary supplements, food and beverage, cosmetics, skin and personal care). His research has gained him 82 peer-reviewed publications and over 80 invited presentations in international journals and scientific societies. He also has 18 patents in his career so far. He is very focused and active on the scientific areas that relate to deliver authentic, safe and efficacious botanicals as part of dietary supplements and traditional medicine. Amit's passion is to evolve the traditional botanical medicine that has already proven to work based on ethnobotany and folklore using current technology that addresses consistency in quality and authenticity. Mantra: Let ancient wisdom meet modern science.

Dr. Chandra participates and serves as a subject matter expert in international scientific societies and organizations such as AOAC (International Association of Analytical Communities), ASP (American Society of Pharmacognosy), ABC (American Botanical Council), AHPA (American Herbal Products Association), NCNPR (National center for Natural Products Research) to name a few. In 2019 he was also conferred the lifetime achievement award of "Fellow of AOAC International" for his meritorious service to the organization.

"Overcoming instrumental limitations in adulteration detection of essential oils and discovery of synthetic markers"

Prabodh Satyal[1], Aaron Sorensen[1]
Aromatic Plant Research Center, 230N 1200E, Suite 100, Lehi, UT 84043

Considering on the concerns with side effects of synthetically derived medicines, many people are trying to transform their lifestyles through naturopathy. Unfortunately, due to a lack of complete instrumental techniques and strict government regulation, adulteration of natural products is rampant globally. About 80% of commercially available, so-called "pure and natural" essential oils are adulterated for economic profit. Not only does this create concerns for the end user, this also negatively impacts hardworking farmers and their ability to make a reliable income.

According to the *Merriam-Webster Dictionary*, to adulterate something means, "to corrupt, debase, or make impure by the addition of an inferior substance or element, especially to prepare for sale by replacing more valuable with less valuable or inert ingredients." Typically, adulteration of essential oils occurs through the addition of synthetic and natural compounds, those related and unrelated to the oil's composition, in order to increase profits or meet some established requirements such as ISO. There are many analytical instruments and methods that can detect certain types of adulteration in essential oils. The most commonly used analytical instruments are Gas Chromatography Isotope-Ratio Mass Spectrometry (GC-IRMS), Site-Specific Natural Isotope Fractionation NMR (SNIF-NMR), Enantioselective GC-MS, and components ratio quantitation [Lawrence, 2007]. GC-IR-MS is often used to detect the authenticity of the EO's origin via the isotopic ratio measurement. However, this technique has several limitations. The first limitation is that the 14C activity of essential oil can be manipulated with the addition of ^{14}C-labeled compounds. Second, synthetic methods that are undetected by GC-IRMS can transform naturally obtained compounds into other compounds. Thus, GC-IRMS is not a completely reliable source of essential oil authentication [Culp & Noakes, 1990]. Enantioselective GC-MS also has specific limitations, as it is only applicable to chiral molecules and the enantiomeric ratio of chiral compounds varies from origin to origin. SNIF-NMR is only useful for small molecules (such as monoterpenes) to authenticate their origin via the Deuterium ratio, but essential oils are also composed of sesquiterpenes and diterpenes. Likewise, this method requires pure isolated compounds [Lawrence, 2007].

Minor components and their quantities with respect to major components can also indicate adulteration in essential oil. Every adulterant has some kind of marker or impurity. Identifying this marker is a more effective way of detecting EO adulteration [Burfield, 2008 and Frey, 1986]. The identification of those markers in the essential oil can provide the best solution for detecting adulteration through ordinary GC-MS.

Markers are basically of two types: one is naturally originated which comes from the addition of similar oils (for example globulol as a marker of *Eucalyptus globulus* addition, Coumarin is a natural marker of cassia bark addition and isopulegol as a marker of Cornmint addition) and the other is synthetically originated marker which is always unique the synthesis of the desired compound (for example Phenylpentadienal cis and trans as the marker of synthetic cinnamaldehyde in cinnamon bark or cassia EOs). In some cases, if you use principle of biosynthetic pathways you can also trace the expected natural markers. Most of the natural products follow three pathways (MVA, MEP, Shikimic acid pathway). For synthetic markers, it is possible to predict the reaction mechanism of synthetic products. For example, Cinnamaldehyde is produced by crossed aldol condensation of benzaldehyde and acetaldehyde, but unfortunately, produced cinnamaldehyde further undergoes crossed aldol condensation to phenylpentadienal as a trace synthetic marker in synthetic trans-cinnamaldehyde. We conducted a quality survey of several market lavender samples, we found varieties of adulteration types, in total, and more than 80% of lavenders were adulterated. An interesting form of lavender adulteration is the addition of acetylated ho-wood oil. When fractionated linalool from Ho-wood is acetylated, the process also produces unavoidable synthetic markers called linalool oxide acetate cis, trans furanoids which make it possible to determine when acetylated ho wood has been added to lavender essential oil.

Similarly, there is a challenge associated with carrier oil-based adulteration. Most of the carrier oils have fatty acids or heavier components having a high boiling point and they are colorless and odorless. In an ordinary GCMS method, they are difficult to detect. Adulterators know this and are taking advantage of these instrumental limitations. Therefore, my presentation will focus on sophisticated adulteration (undetected by ordinary lab and chemists).

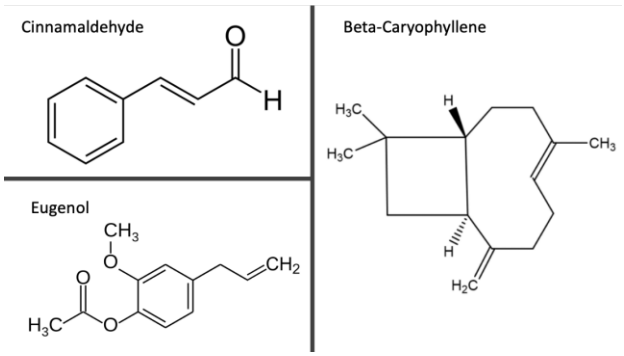
Prabodh Satyal, PhD is the Chief Scientific Officer of Aromatic Plant Research Center (APRC) and Head of EOScience at doTerra. He is originally from Nepal and moved to the United States to pursue research in essential oils at the University of Alabama, where he received his MS, PhD and post-doctoral studies in essential oil research. He has studied the chemical composition of more than thirty thousand essential oils from various parts of the world, has published more than ten dozens research articles in peer-reviewed journals, and has been quality analyst (serving in several positions) for nearly ten years. He is an editorial member of several journals. Dr. S has a special interest in essential oil adulteration detection using marker-based analysis and has created the only known mass spectral library of synthetic markers. He has played a significant role in establishing several essential oil databases and has spoken at dozens of reputable international conferences. He also has research collaboration on worlds renowned several universities for EO research and currently supervising PhD, MPhil and Masters level student on their research. He is currently developing the first ever fully automated adulteration analysis software for GCMS that will identify the percentage of purity, origin, and mixed sources in essential oils.

"Antidiabetic Potential of Volatile Cinnamon Oil: A Review and Exploration of Mechanisms Using In Silico Molecular Docking Simulations"

Stevens N[1-2], Allred K[1-2]

[1]dōTERRA International, Department of Clinical Research, Pleasant Grove, UT 84062, USA. [2]Prime Meridian Health, Department of Clinical Research, Pleasant Grove, UT 84062, USA.

Cinnamon has been used as a flavoring and medicinal agent for centuries. Much research has focused on cinnamon bark powder, which contains antioxidants, flavonoids, carotenoids, vitamins, minerals, fiber, and small amounts of essential oil. However, isolated and concentrated cinnamon essential oil may also have important medicinal qualities, particularly in antidiabetic therapy. Some of the most common essential oil constituents identified in the literature include cinnamaldehyde, eugenol, and beta-caryophyllene. Due to their high concentration in cinnamon essential oil, these constituents are hypothesized to have the most significant physiological activity. We present a brief review of literature on cinnamon oil and its constituents as they relate to glucose metabolism and diabetic pathogenesis. We also introduce molecular docking simulations of these cinnamon essential oil constituents (cinnamaldehyde, eugenol, beta-caryophyllene) that suggest interaction with several key enzymes in glucometabolic pathways.



We gratefully acknowledge Dr. Brian Lawrence for his expertise in cinnamon botany and constituent chemistry, and Dr. Russell Osguthorpe for his support of this project.

Nicole Stevens has been conducting research with essential oils for more than 20 years. She has worked in quality control laboratories in the nutraceutical industry as well as academic research laboratories at the University of Utah and the University of Nevada Las Vegas Cancer Research Institute. In addition to research, she has taught courses in chemistry and biochemistry at Brigham Young University – Idaho and University of Nevada Las Vegas. Nicole has served as a scientific consultant for dōTERRA International since the company formed in 2008 and joined the corporate team in 2015 as an essential oil formulator and researcher. Currently she serves as Director of Clinical Research at dōTERRA. Her main field of research is essential oil biochemistry relating to human therapeutic application, along with many other aspects of essential oil science.

Nicole holds a Bachelor of Arts degree in Technical Writing and a Master of Science degree in Botany, both from Brigham Young University. She earned her doctorate degree in Biochemistry and Molecular Biology from the University of Miami Miller School of Medicine. She is currently working on a second master's degree in Public Health from Purdue University. Nicole holds a Certified Principal Investigator (CPI) accreditation with the Association of Clinical Research Professionals, and a Certified Clinical Research Professional (CCRP) endorsement with the Society of Clinical Research Associates. She is also a Certified Phlebotomy Technician (CPT) with IV specialization, a Certified Electrocardiography Technician (CET) and a Certified Clinical Medical Assistant (CCMA).

"Analysis of Volatile Constituents in Commercial "Lavender" Products Linked To Premature Thelarche and Prepubertal Gynecomastia"

Satyal P[1], Sorensen A[1], Bascoul C[1], Embry MR[2], Gafner S[3].

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A number of case reports have associated exposure to the essential oil of lavender (*Lavandula angustifolia*, Lamiaceae) to the occurrence of breast enhancement (prepubertal gynecomastia) in 7-11 year old boys, or premature breast development (premature thelarche) in 1-8 year old girls.[1-4] The link was established based on in vitro estrogenic activities of lavender oil and its main constituents, linalool and linalyl acetate.[1, 2]

The actual presence of lavender in the products allegedly casing these symptoms was not confirmed in any of the case reports, but the most recent publication[2] listed three commercial products as source of lavender exposure: Crusellas Violet Water Cologne, Mi Tesoro Agua de Violetas, and Baby Magic Calming Baby Bath. Headspace GC-MS analysis of the three products revealed the presence of ionones (6-methyl-α-ionone, isomethyl-α-ionone, *t*-α-ionone, and *t*-β-ionone) in all three products, although at vastly differing relative concentrations. Substantial concentrations of linalool and linalyl acetate were detected only in the Baby Magic Calming Baby Bath, however, other characteristic lavender constituents were absent in this product. The data show that none of these products contained any lavender but are composed mainly of isolates obtained from natural sources or by chemical synthesis. Therefore, the association between exposure to lavender oil and abnormal breast enlargement in children based on these case reports cannot be supported.

References

1. Henley DV, Lipson N, Korach KS, Bloch CA. Prepubertal gynecomastia linked to lavender and tea tree oils. *New Engl J Med.* 2007; 356(5):479-485.
2. Ramsey JT, Li Y, Arao Y, et al. Lavender products associated with premature thelarche and prepubertal gynecomastia: Case reports and endocrine-disrupting chemical activities. *J Clin Endocrinol Metabol.* 2019; 104(11):5393-5405.
3. Linklater A, Hewitt JK. Premature thelarche in the setting of high lavender oil exposure. *J Pediatr Child Health.* 2015; 51(2):235-235.
4. Diaz A, Luque L, Badar Z, Kornic S, Danon M. Prepubertal gynecomastia and chronic lavender exposure: report of three cases. *J Pediatr Endocrinol Metabol.* Vol 292016:103.

Stefan Gafner, PhD, American Botanical Council, the organization's first-ever Chief Science Officer. For more than a decade, Dr. Gafner has served as a research scientist and director of analytical chemistry in the research and product development department of Tom's of Maine, a leading manufacturer of natural oral and personal care products. Among other products, he researched and developed at Tom's, Dr. Gafner co-developed a breath-freshening licorice (*Glycyrrhiza glabra*, Fabaceae) extract that is a component of Tom's bestselling Wicked Fresh® toothpaste.

Dr. Gafner received his degree in pharmacy at the University of Bern School of Pharmacy in Bern, Switzerland. He earned his doctorate in pharmaceutical sciences — with a focus on phytochemistry (the chemistry of plants) — at the University of Lausanne in Switzerland, from the internationally respected phytochemist Professor Kurt Hostettmann. His doctoral thesis focused on the search for new antibacterial and antifungal compounds from African medicinal plants in three plant families (Asteraceae, Bignoniaceae, and Myricaceae). Dr. Gafner conducted his postdoctoral research at the University of Illinois – Chicago, in the College of Pharmacy's highly regarded Department of Medicinal Chemistry and Pharmacognosy (the study of medicines from plants and other natural sources).

Highlights of Dr. Gafner's impressive career include the discovery of dozens of new natural products, the development of more than 40 methods for the identification and authentication of herbal extracts, and the validation of methods for more than 20 over-the-counter drug ingredients for consumer products.

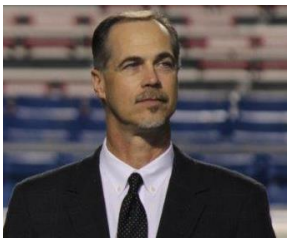
He has participated as an expert peer reviewer for many respected scientific journals including *Phytochemistry*, *Planta Medica*, *Journal of AOAC INTERNATIONAL*, *Journal of Agricultural and Food Chemistry*, and the *Journal of Natural Products*, and he co-chaired the organization of the American Society of Pharmacognosy's 48th annual meeting.

"So, you think you know the NCNPR": An update on facilities, research, and programs at the National Center for Natural Products Research"

Gurley BJ, [1] *Yates CR*, [1] *& Khan IA*[1]

[1] *National Center for Natural Products Research, School of Pharmacy, the University of Mississippi, PO Box 1848, University, MS, 38677, USA.*

The internationally renowned National Center for Natural Products Research (NCNPR) was founded in 1995 to research, develop, and commercialize potentially useful natural products. Based at the University of Mississippi School of Pharmacy, NCNPR collaborates with academia, government and the pharmaceutical and agrochemical industries to create natural products that can be used to improve human health and agriculture as crops, pharmaceuticals, dietary supplements and agrochemicals. Funding for the NCNPR stems from grants and contracts received from the NIH, dietary supplement and agrochemical industries, and the State of Mississippi, as well as through cooperative research agreements with both the FDA and USDA. The NCNPR is well known for its long-time leadership in the world of *Cannabis* horticulture and research, its extensive botanical repository (~15,000 specimens), active herb garden, and expertise in natural product chemistry and characterization. Perhaps one of its most recognized and respected features is hosting the annual International Conference on the Science of Botanicals (ICSB) meeting. Recently, however, several new developments, programs, and research facilities have been established to further expand the reach of the NCNPR into areas not typically associated with the Center's mission. A few of these new advancements and their role in fostering additional research relationships with industry, academia, and regulatory agencies will be presented.



Bill J. Gurley, Ph.D., is Principal Scientist and a director of the Clinical Research Facility within the National Center for Natural Products Research (NCNPR) at the University of Mississippi. Prior to joining the NCNPR in 2019, Gurley was Professor of Pharmaceutical Sciences at the University of Arkansas for Medical Sciences (UAMS) College of Pharmacy, Vice-Chair of the UAMS Department of Pharmaceutical Sciences, and Chair of the UAMS Institutional Animal Care and Use Committee. He is a member of the American Association of Pharmaceutical Scientists, American Society of Clinical Pharmacology and Therapeutics as well as the USP's Expert Panel on Dietary Supplements. Gurley also serves on the editorial boards of *Clinical Pharmacology & Therapeutics*, and *Phytomedicine* as well as the advisory board of the American Botanical Council. He has authored more than 200 peer-reviewed publications, abstracts, and book chapters in the areas of pharmacokinetics, analytical method development, therapeutic drug monitoring, herbal dietary supplements, dietary supplement safety, and herb-drug interactions. His research interests include mechanisms of herb-drug interactions, toxicity of multiple-component herbal dietary supplements, phytochemical modulation of human drug metabolizing enzymes and transport proteins, human phytochemical disposition, botanical supplement use in special populations, and Civil War medicine, particularly botanical remedies used by the Confederacy. Gurley received a B.S. in chemistry from Tennessee Technological University and a B.S. in pharmacy and Ph.D. in pharmaceutical sciences from the University of Tennessee Health Science Center in Memphis, TN.

"Sustainability Considerations for Biologically Active Natural Products"

Geoffrey A. Cordell

Natural Products Inc., Evanston, IL, 60202, U.S.A. and Department of Pharmaceutics, College of Pharmacy, University of Florida, Gainesville, FL 32610, U.S.A.

Sustainability is a wisdom. Frequently viewed only in terms of the availability of a particular plant in a certain location to respond to the human need for a biological agent, it is a profound and personal ethical issue in response to the contemporary question "What is my responsibility for the quality of the lives of those who will follow?" This presentation will illustrate in the world of Gaia how the "sustainability" of the resources for biologically active natural products has diverse, interwoven implications for society, now, and more pertinently for the future. The discussion will focus on the importance of putting people first to assure a healthy planet and enhanced global health care based on the 4IR, the Quintuple Helix, climate change, ecopharmacognosy, cyberecoethnopharmacolomics, medicines security, and education. Some of the philosophical and practical responses required to ameliorate the untoward impacts of devastating resource losses and unethical practices will be indicated.

Professor Emeritus Geoffrey A. Cordell obtained his Ph.D. in indole alkaloid chemistry at the University of Manchester in 1970, and after two years at M.I.T. joined the College of Pharmacy, University of Illinois Chicago, holding several senior administrative positions at the College and Campus levels; he retired in 2007. He is the author of over 600 research publications, reviews, book chapters, two books on alkaloids, and the editor of 37 books, including 29 volumes in "The Alkaloids Chemistry and Biology" series. He is on the Editorial Advisory Board of 30 international scientific journals and has been a plenary speaker at over 190 international meetings. An Honorary Professor at universities in China, India, and the Philippines, he is also a Visiting Professor in Malaysia (at four universities), Japan, Thailand, Mexico, Brazil, Peru, and Colombia. He was named Outstanding International Ethnopharmacologist of the Year in 2015 by the International Society of Ethnopharmacology and received the Norman Farnsworth Research Achievement Award of the American Society of Pharmacognosy (ASP) in 2019, where he is one of thirteen Honorary Members and a former President. He presently assists governments and universities in the development of traditional medicines and their administrative and research resources, as well as providing lectures and workshops on traditional medicine quality control, the conduct of research programs, and grant and manuscript writing. His current interests include the chemistry, biological activity, and biosynthesis of alkaloids, cyberecoethnopharmacolomics, medicines security, ecopharmacognosy, and the role and new applications of natural products in the Fourth Industrial Revolution.

"Biodiversity and Regenerative Agriculture"

Regeneration is the buzzword today because the conversation is not just about "sustainability" anymore and how to make a "sustainable system". We can't sustain what we have, as many lands and soils are too degraded by our past activities, what we need now is Regeneration. At the root of all approaches to regenerative agriculture is soil health, with emphasis on soil carbon sequestration. This means developing soil health and organic matter for the important function of taking carbon out of the atmosphere and storing it in the soil. Additionally, new approaches, such as the newly launching Certified Regenerative by A Greener World (AGW) program, see biodiversity as a key indicator that needs to be tracked on the journey to regeneration. Regenerative agriculture certification is an important tool in developing quality botanical supply as it ensures traceability and transparency, protects biodiversity, fosters self-sufficiency and social responsibility and can be applied in wild harvested systems.

Kerry Hughes is an Ethnobotanist, Herbalist and Author who works at the nexus of market opportunity identification, innovative product formulation, and global biodiversity development. Through her work in both the public and private sectors, Kerry is driven by a tenacious fascination with the potential health-enhancing role plants can play and bringing about products and solutions that not only heal people but also protect our threatened global biodiversity.

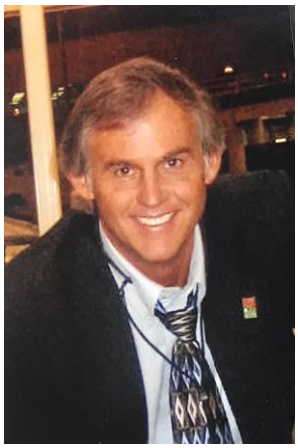
Kerry serves as an Advisor for *Certified Regenerative by AGW*, a program of the non-profit certifier, A Greener World (AGW). Kerry is also an independent formulator and product developer through Ethnopharm LLC (www.Ethnopharm.com) consulting. Kerry played a key role in the development and establishment of the Fair for Life Social & Fair Trade Programme through The Institute for Market Ecology (IMO), and today is continuing her work developing meaningful sustainability solutions through the launch of the new *Certified Regenerative by AGW* program, a whole-farm assurance of regeneration, measuring benefits for soil, water, air, biodiversity, infrastructure, animal welfare and social responsibility.

Kerry's love of natural products has compelled her to write and speak frequently on a variety of subjects. Her writing includes the recently published *Botanicals With Benefits: Establish a New Relationship with your garden* (2020), as well as these in-depth text books: *Understanding Socio-Ecological Systems through Decoloniality: Convergence of Indigenous and Western Knowledge* (Springer; in press); *The Incense Bible*, Taylor & Francis (2007), one of the first scientific reviews & examinations of incense; *The Health Professionals Guide to Dietary Supplements*, Lippincott, Williams & Wilkins (2006), a peer-reviewed guide to herbs and nutritional supplements; and *Botanical Medicines: The Desk Reference for Major Herbal Supplements*, Haworth Press (2002) an in-depth text-book on the medical aspects of many of our top supplements. Additionally, she has authored over a dozen articles in peer-reviewed scientific journals on various natural product topics.

Kerry also serves on the Scientific & Medical Advisory Boards for Amare Global, Good Pharma and Hilma, a Judge for Global Food Forums and on the Editorial Board for Ethnopharmacology, a peer-reviewed scientific journal. She has acted as a consultant to the United Nations through the International Trade Centre (ITC) for international development projects involving botanicals and authored essential oil and organic reports for the Market News Service (MNS).

Kerry has a background in Ethnobotany and Biochemistry, with a Bachelor of Science degree in Biochemistry, and a Master of Science degree in Agriculture with an emphasis in Ethnobotany and Soil Science from California Polytechnic State University, San Luis Obispo, California. She is also a certified Clinical Herbalist by the Berkeley Herbal Center.

"Herbal Ingenuity-Sustainability and Plant Conservation"



Edward J. Fletcher is the Director of Quality & Sustainability at Native Botanicals, Inc. He has been in the botanical business and made his livelihood with plants for all his adult life. Therefore, he understands sustainability supports livelihoods in many ways.

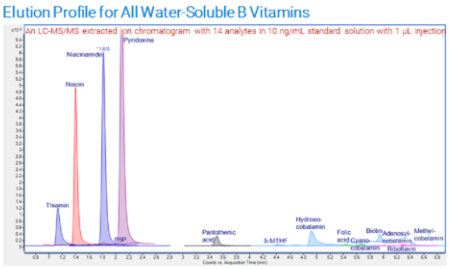
The part of his job he enjoys the most is working with farmers, growers and suppliers around the world to educate and assist them in producing the best possible crop they can. He addresses all aspects of the process from propagation, cultivation, harvesting and post-harvest handling techniques for the chosen crop to achieve this. He has conducted research on different crops to improve their yields, marker constituents and overall quality through different techniques including Regulated Irrigation Deficit, Light Percentage Variances and Nutritional Input Impact Studies.

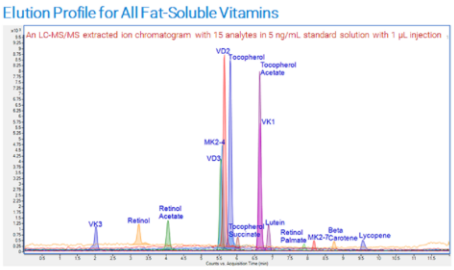
He is an active member of the American Herbal Products Associations (AHPA) and serves on the Board of Trustees as well as the current Chair of the Botanical Raw Materials Committee and a member of the Sustainability Committee. He sits on the Dietary Supplement General Chapters Expert Committee of the United States Pharmacopeia, other advisory panels, enjoys speaking and presenting at numerous Industry gatherings, and is always more than happy to discuss any botanical questions you may have.

"Detection and Accurate Quantitation of 14 Water Soluble Vitamins and 14 Fat Soluble Vitamins in Supplement by LC-MS/MS Triple-Quadrupole"

Hui Zhao, Ph.D.
Agilent, 2850 Centerville Rd, Wilmington, DE, USA

The water-soluble B vitamins and the fat-soluble vitamins are essential nutrients for human health. Accurate quantitative measurements for water-soluble B vitamins and fat-soluble vitamins are required to ensure product quality and regulatory compliance. Two fast and sensitive LC-MS/MS methods were developed respectively for the simultaneous determination of 14 water-soluble vitamins and 14 fat-soluble vitamins on Agilent 1290 Infinity II LC coupled to an Agilent 6470 triple quadrupole LC/MS system in positive electrospray ionization mode. The approaches of improving the accuracy of mass spectrometry quantitation results including matrix matched standard/standard addition were introduced. Method criteria for data acceptance were established. The water-soluble B vitamins include Vitamin B1 (Thiamine), Vitamin B2 (Riboflavin), Vitamin B3 (Nicotinic Acid and Nicotinamide), Vitamin B5 (Pantothenic Acid), Vitamin B6 (Pyridoxine and Pyridoxal-5-Phosphate), Vitamin B7 (Biotin), Vitamin B9 (Folic Acid and 5-Methyltetrahydrofolate) and Vitamin B 12 (Cyanocobalamin, Adenosylcobalamin, Methylcobalamin and Hydroxocobalamin). The fat-soluble vitamins include Vitamin A (Retinol, Retinyl Acetate and Retinyl Palmitate), Vitamin D (Cholecalciferol (D2) and Ergocalciferol (D3)), Vitamin E (Alpha-Tocopherol, Alpha-Tocopherol Acetate and Alpha-Tocopherol Succinate), Vitamin K (Phytonadione (K1), Menaquinone (K2-4) and Menaquinone (K2-7)) and selected carotenoids include β-Carotene, Lutein and Lycopene. The methods were applied to quantify the water-soluble B vitamins and fat-soluble vitamins in a highly complex multivitamin tablets matrix. All tested water-soluble vitamins and fat-soluble vitamins met the claims. It was concluded that the methods can be utilized for quality control and establishment of the nutrition labels for water-soluble vitamins/fat-soluble vitamins-containing supplement products.





Hui Zhao, Ph. D., Agilent LCMS Application Scientist, has 15 years of industry experience developing and validating analytical methods for food/feed nutrition, food safety, dietary supplements and botanicals testing, using a variety of analytical techniques including LC-TQ, LC-QTOF, LC-DAD and GC-MS and a breadth of sample preparation methodologies. She has worked as a Research Scientist at Monsanto, EPL-Bioanalytical Services, Tate & Lyle, Inc. and Lead Staff Scientist at Covance Food Solutions. She holds a Master of Science degree in Analytical Chemistry from Lanzhou University in China and a Ph.D. in Analytical Chemistry from the University of Missouri. Hui currently works as an LCMS application scientist in Agilent.

"Analytical Approaches for Characterizing Cannabinoids for Quality, Safety, and Research Applications"

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Decriminalization and legalization of cannabis in many regions of the world has led to rapid market growth and research expansion. Cannabinoids remain in the spotlight due to their proven and potential health benefits, indicated by the number of new products, newly popularized cannabinoids, and steadily increasing list of peer reviewed publications. Understanding and annotating cannabinoid content is a foundational need for those who are growing, processing, testing, and researching cannabis, and there are a variety of analytical tools that can accomplish this task. This presentation will highlight fit-for-purpose analytical tools (targeted and non-targeted) to enable scientists to quantify cannabinoids for raw material characterization, formulation and finished product testing, to better understand the complexity of new cannabinoid production methods, and to uncover new insights for research and development.

Emily Rose Britton, PhD is the Senior Marketing Manager for Natural Products and Food in the United States with Waters Corporation. Emily has been with Waters since 2018, following her graduate studies at the University of North Carolina Greensboro where she used mass spectrometry to study synergy in plant medicines. She brings strong analytical expertise in food, dietary supplements, and natural products and has a passion for facilitating collaboration. Emily is an active member of AOAC International, the American Society of Pharmacognosy, the United Natural Products Alliance, the American Herbal Products Association and Females in Mass Spectrometry, and can be found promoting Waters and science communication on LinkedIn and Twitter (@ChEmilyBritton).

"Accurate Quantification of Capsaicinoids in Various Chili Pepper Extracts with Absorbance-Transmittance fluorescence Excitation-Emission (A-TEEM) Spectroscopy"

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Chili peppers, largely believed to be derived from *Capsicum annuum* in the United States, are valuable for many types of food preparations due to their heat compounds known as capsaicinoids. Conventional analysis of capsaicinoids usually involves liquid chromatography (LC) with UV, photodiode-array, fluorescence and/or mass spectrometry detection. Hence, analyses in the field and lab can be prohibitive with respect to cost and levels of expertise needed to operate and maintain the equipment. Here we investigated the quantification of the three major capsaicinoids, capsaicin (Cp), dihydro-capsaicin (DHCp), and nordihydro-capsaicin (NDHCp). Methanolic extracts were prepared from dried, pulverized chilis from eight different commercial extracts each analyzed in triplicate. The total capsaicinoid content (Cp+DHCp+NDHCp) of the final A-TEEM sample dilutions determined by LC varied 255 fold, ranging from 0.028 to 7.158 mg/L. Importantly, the A-TEEM method's automatic inner-filter-effect (IFE) correction facilitates linear fluorescence instrument responses over a wide concentration range. The A-TEEM scans included 240-700 nm for excitation and 250-800 nm for emission both with 2 nm increments. While all capsaicinoid' s fluorescence was contained to the UV region (<400 nm) other widely variable compounds in the extract including carotenoids, xanthophylls, chlorophyll and their degradation products exhibited strong absorbance from the deep UV to >650 nm; hence IFE correction was important to correct for interferences from these compounds. Two sensitivity ranges were applied for the A-TEEM scans differing only in the total integration time where samples with <0.110 mg/L used 220 s and samples >0.110 mg/L used only 25 s per A-TEEM acquisition; A-TEEM data were intensity normalized using water Raman Scattering units to account for the integration time. Simple linear regression of the unfolded A-TEEM fluorescence data yielded accurate single ex/em coordinate variable predictions for all three capsaicinoids and their total with the R^2 >0.994 and relative error of prediction (REP) significantly less than 1%. We conclude that the A-TEEM with IFE correction can serve as a simple, rapid tool for measuring capsaicinoid content over a wide range in a variety of commercial chili products.

Adam Gilmore, Ph.D., is the Aqualog Product Manager at HORIBA Instruments Inc. He received his Ph.D. in 1992 from the University of Hawaii at Manoa in the Department of Plant Molecular Physiology. His Dissertation centered on the first simultaneous absorbance and fluorescence measurements to define a causal relationship between xanthophyll-cycle carotenoids and photoprotective nonradiative dissipation of excess energy in Photosystem II, measured by chlorophyll fluorescence. He pursued the physiological significance of this subject during his first postdoctoral tenure at the Carnegie Institution of Washington's Department of Plant Biology and its biophysical mechanism during his second postdoctoral tenure at the University of Illinois at Urbana Champaign's Laboratory for Fluorescence Dynamics. He worked for 7 years at the Australian National University as a Research Fellow and Fellow followed by a one-year sabbatical at UC Berkeley's Lawrence Berkeley National Laboratory before joining HORIBA in 2004. At HORIBA, he has developed and patented application-specific instruments and software methods with primary foci on nanotechnology, water treatment monitoring and molecular fingerprinting applications. The most significant developments have included simultaneous absorbance-fluorescence instruments utilizing multichannel detectors, which have been implemented globally in a wide variety of research institutions and industrial QA/QC applications.

"Use of qNMR to determine HPLC relative response factors for botanical reference standards used in pharmacopeial monographs"

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In modern botanical pharmacopeial monographs, one measurement of content is the quantitation of relevant constituents as marker compounds. The use of suitable reference standards (RSs) to quantify multiple compounds by HPLC is recommended in the U.S. Pharmacopeial (USP) botanical monographs. However, these substances may be expensive and difficult to develop into an RS. Surrogate RSs could be used instead of the actual constituents, provided that the relative response factors (RRFs) of each analyte to the selected surrogate RS are known. USP monographs of both Sichuan Lovage Rhizome and Dong Quai Root recognize *Z*-ligustilide as a major characteristic marker compound, making quantitation of *Z*-ligustilide and its analog(s) relevant for quality control. However, because *Z*-ligustilide is unstable, it is difficult to develop it into a quantitative RS. Instead, oxybenzone was selected as a surrogate external quantitative RS because of its similar chromatographic behavior to *Z*-ligustilide, its stability, and affordable cost. The RRF determination of *Z*-ligustilide to oxybenzone by the conventional HPLC procedure is challenging due to both the instability of the purified *Z*-ligustilide at ambient temperature and the difficulty of determining its purity. Therefore, a qNMR method was used to overcome these challenges as it enables to directly measure the mass ratio of *Z*-ligustilide to oxybenzone in the stock solution without the need for weighing and purity information. In the present study, RRF values of 1.01, 0.46, and 0.89 for *Z*-ligustilide, senkyunolide A, and ferulic acid relative to oxybenzone, respectively, were determined using the qNMR-based methodology.

Virginia S. Goldman from Science, Dietary Supplements and Herbal Medicines, USP, supported the project and contributed to editing. John T. Simpson and Jennifer L. Belsky from Global Laboratory and Technical Operation, Analytical Development Laboratory, USP, contributed to the project review and organization.

Cuiying (Macy) Ma, Ph.D., is a principal scientist at U.S. Pharmacopeial Convention (USP) responsible for monograph development of botanical dietary supplements and traditional herbal medicines. Dr. Ma joined USP in 2006 as a scientist doing reference standards development and evaluation until 2013. Before joining USP, Dr. Ma conducted her postdoctoral research in College of Pharmacy, the University of Illinois at Chicago, performed research on bioassay-guided isolation, structure elucidation of bioactive compounds from plants. She worked for eight years in the National Institute for the Control of Pharmaceutical and Biological Products (NICPBP, current name is NIFDC), Beijing, China, focused on quality control methods development for Traditional Chinese Medicines (TCM). Dr. Ma holds a Ph.D. degree in natural products chemistry from the Hong Kong University of Science and Technology; a M.S. degree in analytical chemistry; and a B.S. degree in pharmacy (TCM) from the Beijing University of Chinese Medicine and Pharmacology.

"Microbiota metabolites modulate the T helper 17 to regulatory T cell (Th17/ Treg) imbalance promoting resilience to stress-induced anxiety- and depressive- like behaviors"

Chronic stress disrupts immune homeostasis while gut microbiota-derived metabolites attenuate inflammation, thus promoting resilience to stress-induced immune and behavioral abnormalities. There are both peripheral and brain region-specific maladaptations of the immune response to chronic stress that produce interrelated mechanistic considerations required for the design of novel therapeutic strategies for prevention of stress-induced psychological impairment. This study shows that a combination of probiotics and polyphenol-rich prebiotics, a synbiotic, attenuates the chronic-stress induced inflammatory responses in the ileum and the prefrontal cortex promoting resilience to the consequent depressive- and anxiety-like behaviors in male mice. Pharmacokinetic studies revealed that this effect may be attributed to specific synbiotic-produced metabolites including 4- hydroxyphenylpropionic, 4-hydroxyphenylacetic acid and caffeic acid. Using a model of chronic unpredictable stress, behavioral abnormalities were associated to strong immune cell activation and recruitment in the ileum while inflammasome pathways were implicated in the prefrontal cortex and hippocampus. Chronic stress also upregulated the ratio of activated proinflammatory T helper 17 (Th17) to regulatory T cells (Treg) in the liver and ileum and it was predicted with ingenuity pathway analysis that the aryl hydrocarbon receptor (AHR) could be driving the synbiotic's effect on the ileum's inflammatory response to stress. Synbiotic treatment indiscriminately attenuated the stress-induced immune and behavioral aberrations in both the ileum and the brain while in a gut-immune co-culture model, the synbiotic-specific metabolites promoted anti-inflammatory activity through the AHR. Overall, this study characterizes a novel synbiotic treatment for chronic-stress induced behavioral impairments while defining a putative mechanism of gut-microbiota host interaction for modulating the peripheral and brain immune systems.

Dr. Giulio Pasinetti is the Saunders Family Chair and Professor of Neurology, and Chief of the Neurodiagnostics and Neurotherapeutics division of the Friedman Brain Institute at The Icahn School of Medicine at Mount Sinai. He is also the Director of Basic and Biomedical Research and Training Program at GRECC of the James J. Peters Veterans Affairs Medical Center, Bronx, NY. He has a strong record of successful and productive research endeavors exploring the mechanisms associated with mood disorders and neurodegenerative conditions. The emphasis of his research in the last 30 years has been to develop model systems of brain disorders to better understand and clarify their underlying mechanisms. These studies have allowed him to develop preventative and therapeutic approaches for neurological disorders including exploring how polyphenol metabolites interact with multiple neuropathological features in Alzheimer's disease.

"Botanical Dietary Supplements Research Center: Arthrospira as a supplement for enhancing the host antiviral immune response"

Pugh ND [a], Khan IA [a, b], Chittiboyina AG [a], Tan C [c], Marshall GD [d], Ashfaq MK [a], Khan SI [a].

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The University of Mississippi Botanical Dietary Supplements Research Center is focused on research directed towards generating sufficient data to optimally design future human intervention studies to evaluate the utility of an *Arthrospira*-derived oral supplement (Immulina™) in promoting resilience against respiratory viral infections such as influenza. The use of an *Arthrospira*-derived oral supplement may provide an important complementary approach to currently available antiviral therapies that is inexpensive, safe and readily available to the public. Our overall mechanistic hypothesis is that the principal bioactive compounds in Immulina™ are Braun-type lipoproteins, which upon oral administration will target immune cells in the small intestines that result in a cascade of events to alter the host antiviral immune response. The Botanical Core ensures product integrity and has established a chemico-biological approach to standardization. Fatty acid profile of product material has been identified as a statistically significant predictor of immune-enhancing activity (Toll-like receptor (TLR) 2/TLR1-dependent activation by Braun-type lipoproteins). Research Project 1 is investigating product formulation, identification of *in vivo* biomarkers and molecular mechanism of action. Research Project 2 is evaluating oral administration of Immulina™ in three non-lethal mouse models of resilience against influenza A virus infection (prophylaxis, prodrome and recovery). Human clinical studies will establish optimal parameters for administration (dosage and duration needed for a therapeutic-related biomarker effect) in normal and elderly (immune comprised) subjects.

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Dr. Nirmal Pugh received his PhD in Pharmacognosy from the University of Mississippi with a research emphasis on natural products that enhance immune function. For the past two decades he has worked at the National Center for Natural Products Research and is currently a Principal Scientist overseeing the research program on the immunomodulatory properties of botanicals and dietary supplements. He has worked on collaborative projects and built multidisciplinary teams for NIH-funded botanical research. Funded research on *Echinacea* resulted in the formulation of the novel theory, that components derived from the naturally occurring bacterial communities (plant microbiome) of this botanical, are principal contributors to its immune-enhancing activity. He currently serves as Associate Director of a NIH Botanical Dietary Supplements Research Center grant focused on investigating the use of *Arthrospira* in promoting resilience against influenza viral infection. Dr. Pugh has also worked on development of botanical products and is an inventor on two that have been commercialized - Immulina™ (an immune-enhancing extract from *Arthrospira*) and the Sustainable Youth® skincare product line (based on an *Aloe vera*-derived ingredient).

"NP-MRD: The Natural Products Magnetic Resonance Database"

NMR spectroscopy is essential to natural products and specialized metabolite research: for example, in novel structure determination, characterization of functions and interactions, or analysis of mixtures. However, progress in the field has been greatly hindered by poor accessibility to NMR data for known natural products. Currently, chemical shift assignments are scattered throughout decades of published scientific literature and a few valuable, but incomplete, chemical shift databases. Furthermore, nearly all raw data (FIDs) used to determine structures of natural products is not archived and is likely unrecoverable. To address such inadequacies, the Natural Products Magnetic Resonance Database (NP-MRD, np-mrd.org) has been established with a goal to become a comprehensive, searchable, connected, and open database and repository for all natural products NMR data. The mission of NP-MRD is to benefit research through engagement and partnership with the worldwide natural products community. With derived (e.g. chemical shift assignments), raw (FID), and simulated NMR data, as wells as tools and links to other databases, NP-MRD can facilitate dereplication, support correction of erroneous or missing chemical shift assignments, and enable structure validation or structure revision. Furthermore, NP-MRD can create opportunities for developing new artificial intelligence-based approaches for structure determination and chemical shift or spectral prediction, among other presently unforeseen applications of such a database resource.

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Dr. John R. Cort is a staff scientist in the Biological Sciences Division at Pacific Northwest National Laboratory (PNNL). He received a B.A. in Chemistry in 1991 from Williams College and a Ph.D. in Organic Chemistry in 1997 from the University of Washington. Dr. Cort was an American Cancer Society postdoctoral fellow at PNNL from 1998-2000, and has been a PNNL staff member since 2001. Dr. Cort is also a joint faculty appointee in the Institute of Biological Chemistry at Washington State University.

Dr. Cort's research is centered around the application of NMR spectroscopy and mass spectrometry to problems in organic and biomolecular structure and function. He is the author or coauthor of dozens of structure depositions in the Protein Data Bank, many solved within the NIH Protein Structure Initiative. Current areas of interest include phenylpropanoid and lignin biosynthesis, structure-property relationships in bio-oils and other complex mixtures derived from biomass, comparability determination in heterogeneous macromolecular pharmaceuticals, and characterization of proteins and peptides of unknown function. Dr. Cort is the director of the Natural Products Magnetic Resonance Database (www.np-mrd.org), an NIH-supported project to establish a database and repository for NMR data of natural products and specialized metabolites. He has also helped establish a role for NMR spectroscopy in chemical forensic analysis of highly toxic organic compounds and biomolecular toxins for source attribution and sample matching, and has co-organized several symposia on chemical forensics and attribution for the ANYL division of the American Chemical Society.

"Botanical Safety Assessment: Updates from the BSC"

The Botanical Safety Consortium (BSC) was officially convened in November 2019 as a public-private partnership aimed at enhancing the botanical safety toolkit and bringing clarity to botanical dietary ingredient safety assessments. This partnership is the result of a Memorandum of Understanding (MOU) between the US Food and Drug Administration (FDA), the National Institute of Health's National Institute of Environmental Health Sciences (NIEHS), and the Health and Environmental Sciences Institute (HESI). The BSC serves as a forum for global scientists from government, academia, consumer health groups, industry, and non-profit organizations to work collaboratively to generate a sound scientific basis for integrating existing data and the latest toxicology tools to evaluate the safety of botanical dietary supplements. The objectives of the BSC are to identify pragmatic, fit-for-purpose, *in vitro & in silico* assays to evaluate botanical safety; establish the appropriate levels of chemical characterization for complex botanical products; evaluate the application of these tools via comparison to the currently available safety information; and integrate these tools and approaches into a framework that can facilitate robust evaluation of botanical substances. Initial endpoints of focus are chemical analysis, genotoxicity, hepatotoxicity & ADME, developmental & reproductive toxicity, and systemic toxicity. This presentation will provide a brief overview of the BSC goals and strategies, and its ongoing work.

"Introduction to the Botanical Safety Consortium"

Holly E. Johnson, Ph.D. is Chief Science Officer for the American Herbal Products Association, an alliance of over 400 member companies in the natural products industry. She previously served as Laboratory Director for Alkemist Labs, an ISO 17025 accredited natural product testing lab specializing in botanicals. Dr. Johnson took a B.S. in Botany and a Ph.D. in Pharmacognosy, and was awarded a National Institutes for Health (NIH) Fellowship at the University of Illinois-Chicago NIH Center for Botanical Dietary Supplements. Dr. Johnson is a member of the Editorial Board of the AOAC International Journal and contributes to standards setting work for dietary supplements and botanical materials, including service to AOAC in a variety of working groups and expert review panels. Holly is a member of the United States Pharmacopeia (USP) Expert Committee for Botanical Dietary Supplements & Herbal Medicines and the USP Cannabis Expert Panel; she serves on the steering committee for the Botanical Safety Consortium, and the Advisory Boards of the American Botanical Council and the American Herbal Pharmacopeia, among others. Holly has over 20 years' experience in botanicals research and spent many happy years giving courses at the University of Hawaii.

"Constituent Identification and Quantification talk"

Richard B. van Breemen received his B.A. in chemistry from Oberlin College and Ph.D. in Pharmacology and Experimental Therapeutics from the Johns Hopkins University (with Prof. Catherine Fenselau). He carried out post-doctoral research in laser desorption mass spectrometry at Johns Hopkins with Prof. Robert Cotter. Since 2000, he has been professor of Medicinal Chemistry and Pharmacognosy at the University of Illinois College of Pharmacy. Prof. van Breemen is director of the UIC/NIH Center for Botanical Dietary Supplements Research and of the University of Illinois Cancer Center Mass Spectrometry, Metabolomics and Proteomics Facility. From 1996 until 2010, he was Editor-in-Chief of *Combinatorial Chemistry & High Throughput Screening* and is currently on the editorial boards of *Biomedical Chromatography* and *Assay and Drug Development Technologies.* He received a University Scholar faculty award from the University of Illinois, a 2010 Expert Methods Panel award from the AOAC International for his work on analytical methods for dietary supplements, and the 2008 Harvey W. Wiley Award from the AOAC International. The research of Prof. van Breemen concerns the discovery and development of natural products as chemoprevention agents and the investigation of botanical dietary supplements as alternatives to conventional estrogen replacement therapy. In over 270 papers, he has reported on the use of mass spectrometry for drug discovery from natural product sources, and he has carried out translational research culminating of phase I and phase II clinical trials of lycopene for the prevention of prostate cancer in men and studies of the safety and efficacy of botanical dietary supplements for the management of menopausal symptoms in women.

"Method talk on Zebrafish embryos"

Cammi Thornton, B.S., is a principal R&D chemist in the BioMolecular Sciences Department at the University of Mississippi. She is a native Mississippian and received her B.S.degree in forensic chemistry at the University of Mississippi. Upon completion of her B.S. degree, she began working in the BioMolecular Sciences Department at the University of Mississippi studying environmental contaminants using fish as a model for the last 15 years. Recently, she also began using the zebrafish model to identify novel antiepileptic drugs. She has co-authored 26 research articles in peer-reviewed journals.

"ADME modeling and hepatoxicity"

Dr. Amy Roe has 22+ years of experience as a practicing toxicologist in government, pharmaceutical and consumer product industries, through positions at both the FDA and The Procter & Gamble Company. Her professional experience is in general, descriptive and regulatory toxicology as well as specialized expertise in drug/xenobiotic metabolism and pharmacokinetics. Her industry experience is quite broad and includes toxicology support of drugs, medical devices, herbal/dietary supplements, foods, and water filtration devices. As a project leader, she has led multi-disciplinary drug development teams. Dr. Roe is a board-certified toxicologist (DABT) and a Fellow of the Academy of Toxicological Sciences (ATS). She is well recognized externally in her field as evidenced by her service on a number of professional boards and committees including USP Dietary Supplement Admission Evaluation & Labeling Expert Committees and Probiotic Expert Panel, SOT Regulatory & Safety Evaluation Specialty Section (Past-President), Food Safety Specialty Section (Vice-President Elect) and an NIH/NCCIH Expert Advisory Panel related to natural product-drug interactions. Dr. Roe is currently serving as co-chair of the hepatotoxicity/ADME sub-committee of the HESI Botanical Safety Consortium. She also serves on the Editorial Board of *Applied in Vitro Toxicology*.

"HESI Botanical Safety Consortium & Kamuzu University of Health Sciences Initiatives"

Hellen Oketch-Rabah, PhD is currently the Senior Manager & Senior Scientific Lead in the Department of Dietary Supplements (DS) and Herbal Medicines at the United States Pharmacopeia (USP). She leads the front end of dietary supplements monograph development activities including the nomenclature of DS articles and admission of dietary ingredients for monograph development, which is based on safety evaluation among other considerations.

Stefan Gafner, PhD, American Botanical Council, the organization's first-ever Chief Science Officer. For more than a decade, Dr. Gafner has served as a research scientist and director of analytical chemistry in the research and product development department of Tom's of Maine, a leading manufacturer of natural oral and personal care products. Among other products, he researched and developed at Tom's, Dr. Gafner co-developed a breath-freshening licorice (*Glycyrrhiza glabra*, Fabaceae) extract that is a component of Tom's bestselling Wicked Fresh® toothpaste.

Dr. Gafner received his degree in pharmacy at the University of Bern School of Pharmacy in Bern, Switzerland. He earned his doctorate in pharmaceutical sciences — with a focus on phytochemistry (the chemistry of plants) — at the University of Lausanne in Switzerland, from the internationally respected phytochemist Professor Kurt Hostettmann. His doctoral thesis focused on the search for new antibacterial and antifungal compounds from African medicinal plants in three plant families (Asteraceae, Bignoniaceae, and Myricaceae). Dr. Gafner conducted his postdoctoral research at the University of Illinois – Chicago, in the College of Pharmacy's highly regarded Department of Medicinal Chemistry and Pharmacognosy (the study of medicines from plants and other natural sources).

Highlights of Dr. Gafner's impressive career include the discovery of dozens of new natural products, the development of more than 40 methods for the identification and authentication of herbal extracts, and the validation of methods for more than 20 over-the-counter drug ingredients for consumer products.

He has participated as an expert peer reviewer for many respected scientific journals including *Phytochemistry*, *Planta Medica*, *Journal of AOAC INTERNATIONAL*, *Journal of Agricultural and Food Chemistry*, and the *Journal of Natural Products*, and he co-chaired the organization of the American Society of Pharmacognosy's 48th annual meeting.

NOTES

"Traditional Claims for Herbal Medicines"

International regulatory and legislative developments are increasingly acknowledging traditional knowledge for medicinal health claims. Evidence based principles guiding policy development rely not only on scientific methods but on longstanding traditions of use. This momentum is being seen in policy development, case law and legislation and regulation in many countries, and the World Health Organization has a committed strategy to support appropriate integration of TCIM. The Astana Declaration on Primary Health Care – an update to the Alma-Ata Declaration and the new guiding document for global health policy and primary health care moving forward not only supported the role of TCIM in achieving global health aims, but actively expanded it, overtly supports the inclusivity of traditional knowledge and health products, and the incorporation of appropriate TCIM technologies, products and practices. These developments are having real policy impact – from examples such as increased recognition of TCIM claims in Australian and Canadian medicines regulations, among others. Yet despite this momentum and in-principle support, there remain many barriers to practical implementation and integration, including significant issues around defining what constitutes valid traditional health knowledge and appropriate acknowledgement of traditional owners of that knowledge. This presentation examines some of the issues in balancing remaining authentic to traditional knowledge with increased quality assurance, safety and evidence requirements for natural health products.

Jon Wardle is Professor of Public Health, Maurice Blackmore Chair of Naturopathic Medicine and Director of the National Centre for Naturopathic Medicine at Southern Cross University. In addition to clinical qualifications in nursing and naturopathic medicine, Jon has postgraduate qualifications in public health, law and health economics and holds visiting positions at Boston University, Chinese University of Hong Kong and Oxford University. Jon has published over 200 research publications, has leadership positions in the *Public Health Association of Australia* and *American Public Health Association* in relation to traditional and complementary medicine policy, and leads several *World Federation of Public Health Associations* and *World Health Organization* initiatives in traditional, complementary and integrative medicine, health policy, primary health care and developing health research capacity in developing countries. Jon and currently serves as Deputy-Chair of the Australian government's *National Health and Medical Research Council*'s Natural Therapies Advisory Committee. Jon works on traditional, complementary and integrative medicine, Indigenous health perspectives, public health and primary health care policy with numerous governments, non-government organisations and international bodies.

"Pragmatic Clinical Trials for Natural Products – Principles, Pitfalls and Potentials"

Gailen D. Marshall, Professor of Medicine and Pediatrics, Vice Chair for Research, Division Director

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- University of Tennessee, Memphis, TN, Resident, 06/1988, Internal Medicine
- University of Tennessee, Memphis, TN, Training, 06/1989, Allergy-Immunology Fellowship

I have spent the past 45 years training for and studying immune regulation and the consequences of its imbalance in human inflammatory diseases. I am a triple board-certified clinical immunologist with 30+ yrs of experience caring for patients with dysfunctional immune systems and providing care aimed at repairing and optimizing their immune responses. For the last 25 years, our group has been studying the effects of psychological stress on the immune system in health and disease. Once thought to be purely immunosuppressive, current work from our group and others has shown a significant effect of stress on immunoregulatory networks associated with inflammatory disease such as allergic sensitization. We have been particularly interested in the role of psychosocial factors such as obesity and smoking as well as internal environmental factors such as family history (genetics), learned behaviors such as stress and anxiety responses on the development of various allergic diseases. This background will allow me to be centrally involved in this U19 establishment and function of a Botanical Dietary Supplements Research Center at the University of Mississippi National Center for Natural Products Research. This exciting opportunity will combine world-class basic scientists in botanicals from Oxford with highly experienced Clinical and Translational Immunologists at UMMC in Jackson to address important science questions with clinical implications. I will participate as a member of the internal steering committee and also oversee the conduct of study 2, which will look to establish animal models, and further investigate the immunomodulatory potential of Immulina as a botanical derived agent that may increase host resilience against viral infections such as influenza. To address the human question, we will search for Immulina- induced changes in biomarkers associated with host resilience to viral infections as a basis for future efficacy trials. I will also serve as advisor/mentor for students, postdoctoral fellows and junior faculty (both clinical and basic science) who wish to develop their career toward discovering, establishing and optimizing the use of various botanical products to improve immune health and resilience against infectious, allergic, autoimmune and malignant diseases which are all characterized by having dysfunction components to their immune systems.

Honors: 2018 The Bela Schick Lectureship, ACAAI; 2017 Gold Headed Cane Award, ACAAI; 2012 The R. Faser Triplett, Sr., MD Chair of Allergy and Immunology, UMMC; 2010 Distinguished Alumnus Award, Graduate School of Biomedical Sciences, UTMB; 2009 Distinguished Fellow Award, ACAAI; 2008 The Bernard Berman Memorial Lectureship, ACAAI; 2007 Distinguished Service Award, ACAAI; 2006 The Jaros Memorial Lectureship, ACAAI; 2004 The Daniel Goodman Lectureship, ACAAI; 2003 The Jean A. Chapman Lectureship, American College of Allergy, Asthma and Immunology (ACAAI); 1991 Excellence in Teaching Award 1991-2004, UTHSC; 1985 NIH Postdoctoral Training Fellowship, University of Iowa; 1979 James W. McLaughlin Postdoctoral Fellowship, UTMB

"The Contentious & Evolving Safety Story of Piper Methysticum: The Kava Paradox Revisited, Again"

Holly E. Johnson, Ph.D., Chief Science Officer, American Herbal Products Association, Maryland, USA
Tyler Daniels, Senior Scientist, Thorne Research, SC, USA
Bill Gurley, Ph.D., Professor and Principal Scientist, National Center for Natural Products Research, School of Pharmacy, University of Mississippi
Rick Kingston, Ph.D., Clinical Professor, Division of Professional Education & Department of Experimental and Clinical Pharmacology, College of Pharmacy, University of Minnesota
Chengguo (CX) Xing, Ph.D., Professor and Associate Chair, Department of Medicinal Chemistry, College of Pharmacy, University of Florida

The traditional kava beverage prepared from water-macerated roots and rhizomes of *Piper methysticum* L. has been celebrated for centuries by peoples of Oceania for its neuropharmacological benefits and has been generally considered safe based on a long history of traditional use and very little evidence of harm. More recently, tablet and capsule kava products in the US, Australia, and Europe prepared from ethanolic or acetonic extracts have a more tumultuous safety record. In the late 1990s and early 2000s, rare but severe hepatotoxicity cases were reported among users, mostly in Europe where kava was used as an anxiolytic drug. Based on these reports, the FDA Center for Food Safety and Applied Nutrition issued a safety alert on March 25th, 2002, advising healthcare professionals and consumers to be vigilant of the potential risk of severe liver injury associated with the use of kava-containing dietary supplements; several countries in Europe outright banned the sale of kava, and in Australia the Therapeutic Goods Association issued a practitioner alert, consumer advice, and voluntary recall. While these measures have mostly been repealed and kava is again consumed routinely in various forms within the US, Europe, and Australia, an explanation for the inconsistency of safety profiles between traditional kava beverage and western medicinal preparations has not yet achieved consensus among experts.

In this panel, the toxicological history of kava is revisited and likely mechanisms for the problems seen outside of the Pacific region are explored. In particular, the hepatic risk from cytochrome P450 inhibition by constituents of kava preparations are reviewed, including the pharmacogenomics considerations with individuals that may be particularly susceptible to perturbed metabolism of substances co-administered with kava. Novel pharmacokinetics data will be presented, permitting an updated quantitative perspective on bioavailability and translational relationships between human data and influential safety studies that have been previously conducted. Framework for a modern safety study designed to capture the health and safety risks is included. Together, these data and review of the literature provide the basis for a discussion of a renewed understanding of the safety profile of all types of kava preparations.

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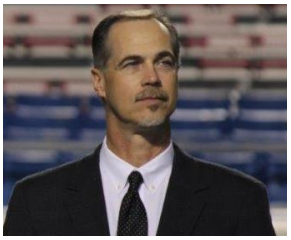
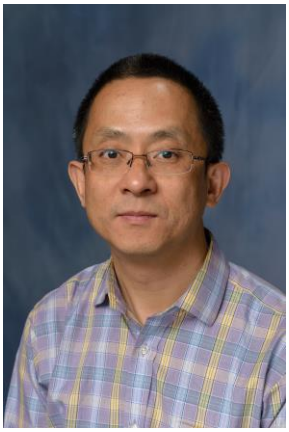
Holly E. Johnson, Ph.D. is Chief Science Officer for the American Herbal Products Association, an alliance of over 400 member companies in the natural products industry. She previously served as Laboratory Director for Alkemist Labs, an ISO 17025 accredited natural product testing lab specializing in botanicals. Dr. Johnson took a B.S. in Botany and a Ph.D. in Pharmacognosy, and was awarded a National Institutes for Health (NIH) Fellowship at the University of Illinois-Chicago NIH Center for Botanical Dietary Supplements. Dr. Johnson is a member of the Editorial Board of the AOAC International Journal and contributes to standards setting work for dietary supplements and botanical materials, including service to AOAC in a variety of working groups and expert review panels. Holly is a member of the United States Pharmacopeia (USP) Expert Committee for Botanical Dietary Supplements & Herbal Medicines and the USP Cannabis Expert Panel; she serves on the steering committee for the Botanical Safety Consortium, and the Advisory Boards of the American Botanical Council and the American Herbal Pharmacopeia, among others. Holly has over 20 years' experience in botanicals research and spent many happy years giving courses at the University of Hawaii.

Tyler Daniels MS has been with Thorne for over 10 years, starting with Quality and later moving to Research and Development. With R&D he seeks expertise in the global herbal marketplace while sourcing and creating dietary ingredients that offer both transparency and agricultural best practices, as well as meaningful analytical characteristics. Searching for phytotherapies for discovery and clinical research while also finding novel insights offered by multi-omics biotechnology are also focuses for Thorne and affiliated companies.



Bill J. Gurley, Ph.D., is Principal Scientist and a director of the Clinical Research Facility within the National Center for Natural Products Research (NCNPR) at the University of Mississippi. Prior to joining the NCNPR in 2019, Gurley was Professor of Pharmaceutical Sciences at the University of Arkansas for Medical Sciences (UAMS) College of Pharmacy, Vice-Chair of the UAMS Department of Pharmaceutical Sciences, and Chair of the UAMS Institutional Animal Care and Use Committee. He is a member of the American Association of Pharmaceutical Scientists, American Society of Clinical Pharmacology and Therapeutics as well as the USP's Expert Panel on Dietary Supplements. Gurley also serves on the editorial boards of *Clinical Pharmacology & Therapeutics*, and *Phytomedicine* as well as the advisory board of the American Botanical Council. He has authored more than 200 peer-reviewed publications, abstracts, and book chapters in the areas of pharmacokinetics, analytical method development, therapeutic drug monitoring, herbal dietary supplements, dietary supplement safety, and herb-drug interactions. His research interests include mechanisms of herb-drug interactions, toxicity of multiple-component herbal dietary supplements, phytochemical modulation of human drug metabolizing enzymes and transport proteins, human phytochemical disposition, botanical supplement use in special populations, and Civil War medicine, particularly botanical remedies used by the Confederacy. Gurley received a B.S. in chemistry from Tennessee Technological University and a B.S. in pharmacy and Ph.D. in pharmaceutical sciences from the University of Tennessee Health Science Center in Memphis, TN.

Rick Kingston, PharmD, is the President, Regulatory and Scientific Affairs and Sr. Clinical Toxicologist at SafetyCall International P.L.L.C., a multidisciplinary healthcare firm of nationally recognized experts focused on providing manufacturers an outsourced option for postmarket medical surveillance, product safety assessment and evaluation, and regulatory reporting support for adverse events. His academic career spans more than 30 years at the University of Minnesota where he attained the rank of full Professor in the Department of Experimental and Clinical Pharmacology and currently serves as Clinical Professor, in the College of Pharmacy. Dr. Kingston earned his B.S in Pharmacy at the University of New Mexico, his Doctorate in Clinical Pharmacy at the University of Minnesota and completed a Post-Doctoral Fellowship in clinical toxicology and pharmacokinetics at St. Paul-Ramsey Regional Trauma Center and the University of Minnesota. He was the co-founder and Director of the Minnesota Poison Control System and its Regional Poison Control Center where he served for 18 years. He has authored more than 100 peer reviewed scientific abstracts, publications, confidential technical white papers and textbook chapters. He is co-editor of the recently published Herbal Products Toxicology and Clinical Pharmacology Second Edition published by Humana Press. He serves on numerous scientific panels, advisory boards and non-profit professional organization scientific committees advising on issues of product stewardship, science and safety. He also serves on the advisory board of the American Botanical Council as the resident expert on botanical safety. His professional experience includes a focus in the areas of clinical toxicology and pharmacology, poison control, product post-market safety surveillance, regulatory policy, drug and dietary supplement safety, and academic medicine.



Chengguo Xing, Professor

EDUCATION:

Dalian University of Technology	B.S.	1996	Chemical Engineering
Arizona State University	Ph.D.	2001	Organic Chemistry
Harvard University	2003	Postdoctoral Fellow	

Dr. Xing, as a medicinal chemist, has built research expertise in medicinal chemistry, pharmacology, molecular and cellular biology, bioanalytical chemistry, various in vivo animal models, and recently has gained clinical trial experience. His independent research focuses on developing natural and synthetic small-molecule agents for the prevention of lung cancer and elucidating their corresponding mechanisms. During the last sixteen years, Dr. Xing has led his colleagues to characterize the composition of a dietary supplement kava and demonstrated kava with DHM as the active ingredient as a promising lung cancer chemopreventive agent with a unique mechanism of action using the A/J mouse lung tumorigenesis model. Dr. Xing and his colleagues have also developed a number of mechanism-based biomarkers to facilitate prevention clinical evaluation, and successfully accomplished a pilot human trial of a dietary supplement form of kava among addicted smokers. The promising results were published in Cancer Prevention Research and featured as the journal cover in May 2020. Through these activities, Xing's group has built expertise in DHM pharmacology, mechanism of actions, various lung carcinogenesis animal models, bioanalytical research and developed rigorous LC-MS/MS methods to quantify metabolite-based mechanistic biomarkers of key signaling pathways in various body fluids. Dr. Xing has also established efficient synthetic routes for kavalactones synthesis with extensive structure-activity relationship characterized. These results have led to over 50 peer-reviewed publications in kava-related research.

Positions and Scientific Appointments

7/2018-present	Associate Department Chair
8/2016-present	Professor, University of Florida, Gainesville, FL
7/2014-7/2016	Professor, University of Minnesota, Minneapolis, MN
7/2009-7/2014	Associate Professor, University of Minnesota, Minneapolis, MN
7/2003-7/2009	Assistant Professor, University of Minnesota, Minneapolis, MN
2/2001-7/2003	Postdoctoral Research Fellow, Harvard University, Cambridge, MA

Other Experiences and Professional Memberships

2016-present	UF Cancer Center
2013-present	Society of Toxicology
22004-present	American Association of Cancer Research
2003-present	American Association of College of Pharmacy
1996-present	American Chemical Society

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