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2017 Cannabis Science Conference Final Program & Exhibitor Guide



August 28–30, 2017
Portland, Oregon

Bridging the Gaps Between Cannabis, Science, and Medicine



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Montel Williams

founder of LenitivLabs

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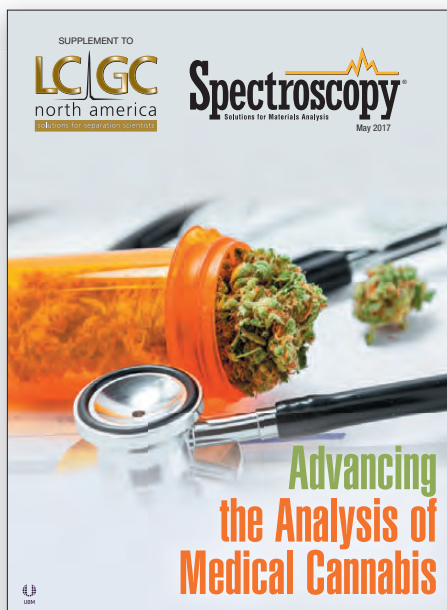
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2017

Cannabis Science Conference

Final Program & Exhibitor Guide

August 28–30, 2017
Portland, Oregon



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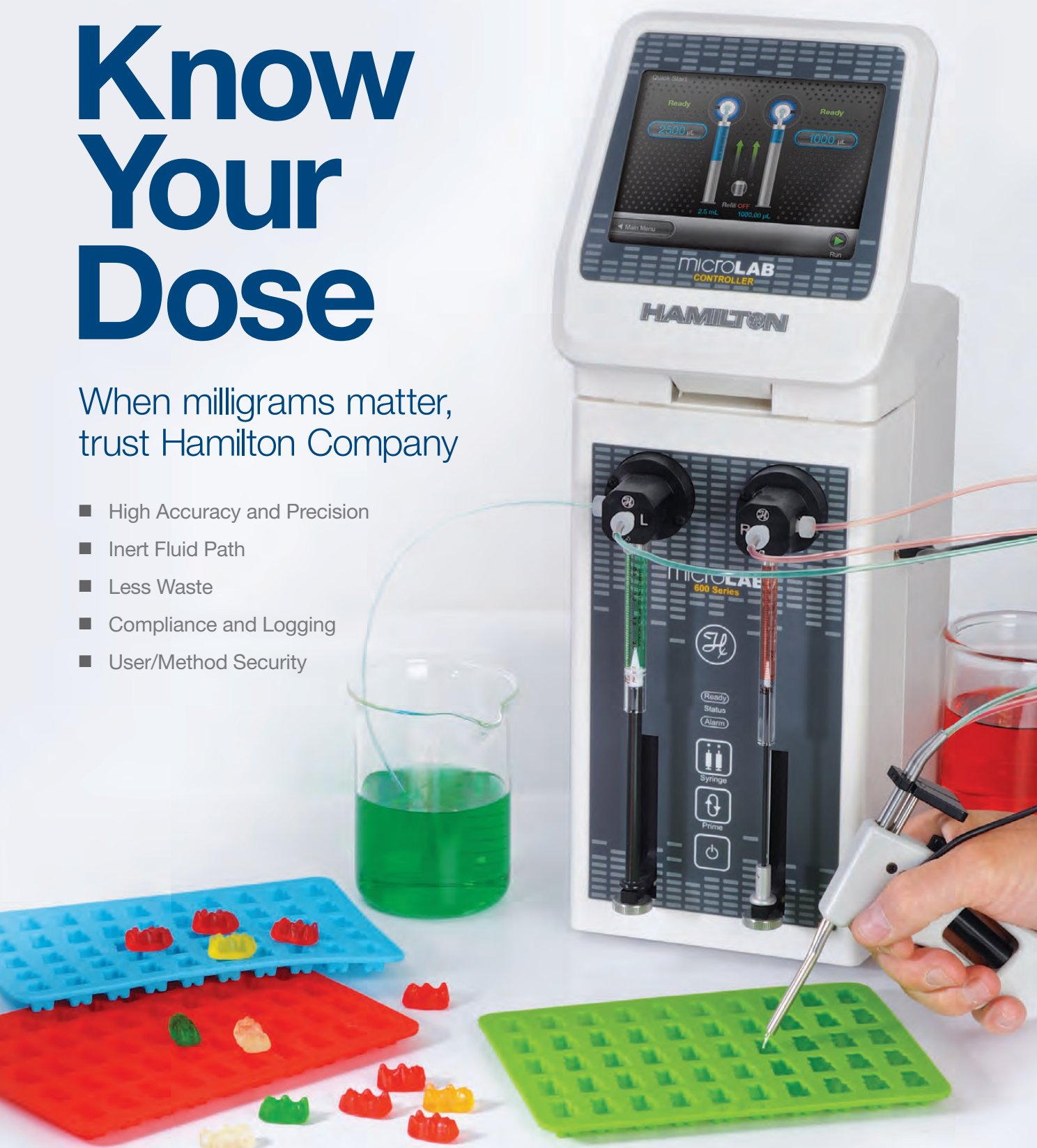
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Cannabis + Science



Laura Bush
Editorial Director of
LCGC and *Spectroscopy*

All of us at *LCGC* and *Spectroscopy* magazines are excited to have partnered with Joshua Crossney and jCanna to produce this official conference program and exhibitor guide for the 2017 Cannabis Science Conference.

Given the recent acceleration in the acceptance of cannabis as a valuable medical treatment and a safe product for recreational use, the industry is now at a critical juncture. Medical testing, long desired and long thwarted, must advance, so that the anecdotal evidence of cannabis's effectiveness for various conditions can be backed up by hard science, and so that the increasing numbers of patients who are gaining access to cannabis can get the most effective use of it (see the interviews with Sue Sisley on page 18 and longtime advocate Montel Williams on page 12).

Similarly, as more consumers and patients use cannabis, it is more important than ever that product safety be ensured through proper analytical testing, not just for potency but also for contaminants like pesticides, mycotoxins, and heavy metals. Proper testing also requires the establishment, acceptance, and implementation of standardized analytical methods.

Also, as legalization threatens to cause product commoditization, the industry needs to take measures to ensure brand legitimacy. Research into strain characterization can enable a strain authentication system (see the interview with Cindy Orser on page 40), which can help ensure consumer confidence in premium-priced products. Likewise, analytical techniques used in fields like forensics can enable product fingerprinting and protection of intellectual property (see the interview with Brett Tipple on page 58).

In this situation, information and collaboration are essential. The Cannabis Science Conference fills an important void in this regard, as a conference devoted to advancing the science of cannabis. It brings together analytical chemists, researchers, cannabis industry experts, medical doctors (and patients), and technology companies to learn, share expertise, and collaborate.

At *LCGC* and *Spectroscopy*, our mission is to help scientists advance analytical methods. Our readers, who conduct both fundamental research as well as applications-focused work in a range of industries, rely on us to stay up to date on the latest methods, brush up on analytical science fundamentals, learn about best practices, get troubleshooting tips, and more. In the last two years, we have begun to connect our community of analytical scientists with the cannabis community. We started that last year, with an e-book developed in collaboration with the Cannabis Science Conference (1), and have continued this year with a print and online special issue devoted to methods for cannabis analysis (2).

Now, as we collaborate with jCanna to publish this conference program and as we participate in the 2017 event, we are taking another important step to connect the scientific world we know well with the cannabis industry we are starting to get to know. We are excited to explore where these steps will take us, and to see what the cannabis industry will achieve as science becomes more and more integrated into the everyday workings of the industry.

A handwritten signature in black ink that reads "Laura Bush". The signature is fluid and cursive, with a long horizontal line extending from the end.

References

- (1) *Advancing the Science of Medical Cannabis Analysis*, *LCGC* **e4**(9), September 2016 (ebook). Available at http://www.chromatographyonline.com/LCGC_Cannabis2016.
- (2) *Advancing the Analysis of Medical Cannabis*, supplement to *LCGC* and *Spectroscopy*, **35**(s5), May 2017. Available at http://www.chromatographyonline.com/LCGC_Cannabis2017.

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Software:

- MicroLab PC

Liquid and Gas Chromatography

Instrumentation:

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- 7890 Series GC with FID
- 1260 Infinity II Diode Array Detector

Software:

- MassHunter

POTENCY



Molecular Spectroscopy

Instrumentation:

- Cary 630 FTIR

Software:

- MicroLab PC

Liquid and Gas Chromatography

Instrumentation:

- Intuvo 9000 GC
- 5977B GC/MSD
- 1290 Infinity II LC
- 1290 Infinity II 2D-LC Solution
- 1260 Infinity II SFC System

Software:

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- ICP-MS Expert

Instrumentation:

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- 7800/7900 ICP-MS
- 8900 Triple Quadrupole ICP-MS

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The Cannabis Science Conference Grows to New Levels



Joshua Crossney,
President
and Founder,
jCanna, Inc. and
Cannabis Science
Conference

As I look around today, there is certainly no shortage of cannabis-related conferences and trade shows. Most of these shows, however, have a very similar look and feel, catering to a wide variety of cannabis businesses: everything from LED lighting companies and

cannabidiol (CBD)-infused product providers to marketing businesses and cannabis security companies. These trade shows are a diverse mix of “everything cannabis,” and the oral presentations are just as eclectic.

Last year jCanna, Inc., hosted one of the “must attend” cannabis events, the Cannabis Science Conference in Portland, Oregon, and we broke the stereotypical cannabis conference mold. jCanna, Inc., a Maryland-based 501(c)3 devoted to advancing the science of cannabis, brought together analytical chemists, cannabis industry experts, medical doctors (and patients), and a superstar line-up of advanced technology companies. The seeds for this dream were planted more than three years ago when we set out to bridge the gaps between analytical science, medicine, and cannabis. In September 2016, those seeds not only began to grow, but also blossomed into one of the most inspiring and educational cannabis events of the year.

It is impossible to describe how the inaugural Cannabis Science Conference became the epicenter of an incredible synergy among all those passionate about advancing cannabis science. On the opening day of the Cannabis Science Conference, a scientific journey that started more than 8000 years ago

and was abruptly halted about 70 years ago began to see a new light. Cannabis science, unjustifiably suppressed for seven decades, was the topic of discussion everywhere from the keynote presentations, roundtables, and panel discussions to the energetic exhibit hall and networking sessions. There was an air of enthusiasm and accomplishment as discussions turned from shared ideas into collaboration projects. Analytical chemists were learning from cannabis cultivators, processors, and dispensers, and vice versa. A century of stigma and misinformation suddenly shifted toward an alliance and affirmation of medical-analytical cannabis support. Cheers rang out from the audience in support of one medical doctor, Dr. Uma Dhanabalan of Uplifting Health and Wellness (Natick, Massachusetts), who set out to “educate, embrace, and empower” Cannabis Science Conference attendees. In short, the cannabis scientific revolution had begun.

From the sold-out, full day, hands-on “Canna Boot Camp” workshop that covered everything—cultivation, processing, sample preparation, edibles manufacturing, and quality control (QC) lab testing—to the exceptional lecture by Dr. Dedi Meiri of the Technion Israel Institution of Technology and educational keynotes by Tracy Ryan of CannaKids (Los Angeles, California) and Gordon Fagras of Trace Analytics (Spokane, Washington), it was clear that the goals of bridging gaps and advancing cannabis science were being realized. Partnerships, collaborations, and friendships were created at the 2016 Cannabis Science Conference.

This year we have not stopped innovating. For the 2017 Cannabis Science Conference, we have made impressive changes. We moved the event to the Oregon Convention Center, with more than 50,000 square-feet of meeting space for presentations and a 60,000-square-foot exhibition hall

to accommodate more attendees and exhibitors. Our Canna Boot Camp has sold out for the second straight year, with more than 90 participants. Our team is working to expand the 2018 Canna Boot Camp to accommodate even more participants, since this workshop has been so popular. The scientific program has more than doubled to two parallel tracks—medical and analytical—along with technical poster sessions.

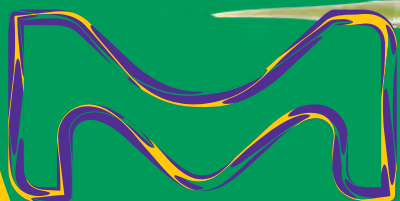
With a brief look at the agenda, one sees unique sessions and panel discussions, such as “The Doc and the Jocks Panel” in which Dr. Dhanabalan returns to moderate a medical discussion with several former professional athletes, including ex-NFL superstars. This year, television personality Montel Williams will provide a plenary address. We also created a “Cannabis Standards Panel,” a gathering of representatives from organizations that are actively working on standard methods for cannabis testing, including the American Oil Chemists’ Society (AOCS), the Association of Official Analytical Chemists (AOAC), the American Council of Independent Laboratories (ACIL), and the American Society for Testing and Materials (ASTM). Also added for 2017 is an “International Medical Cannabis Updates Panel” where panelists will discuss medical cannabis advances (and obstacles) around the world.

I am always quick to point out that while the level of technical presentations has definitely increased, we have also added many sessions where cannabis novices, and even curious patients, can learn about cannabis applications ranging from personalized nutrition and pediatric illnesses to pain in aged care and cancer. For more information on how the Cannabis Science Conference continues to grow and innovate, please visit our website, www.CannabisScienceConference.com.

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Montel Williams: Speaking for Patients

Montel Williams has had many successful careers, all in one lifetime. His first career was in the United States military, where, over 22 years, he earned three Meritorious Service Medals, two Navy Commendation Medals, and two Navy Achievement Medals. His second career was as an award-winning television personality. His most recent career turn stems from a medical diagnosis: In 1999, at the height of his television career, Williams began suffering from neuropathic pain caused by multiple sclerosis. Pharmaceuticals proved ineffective, so his doctor recommended medical cannabis as part of his treatment. That personal experience led to his becoming an advocate for access to medical cannabis. Last year, Williams founded Lenitiv Scientific, LLC, and the LenitivLabs brand of medical cannabis products, moving from patient and advocate to cannabis entrepreneur. Williams spoke to LCGC about what needs to be done in the field of medical cannabis.

You have been an advocate for the medical use of marijuana for a long time. What prompted you to found a cannabis company?

As the industry sets its sights on adult use, we have to make sure that patients still have access to cannabis that meets their medical needs and that's why I started LenitivLabs. Our products are formulated with patients' needs in mind, and we're never going to lose sight of that.

What role do you feel you can play, as an advocate or as an entrepreneur, in helping the cannabis industry establish a more scientific approach to quality and dosing?

I think on the business side, we're going to do everything we can to help educate patients on issues like dosing. On the advocacy side, we all need to be open to the kind of common sense regulation and standards that need to be in place to help reluctant states get to yes.

Do you plan to get involved in research on cannabinoids and terpenes?

Absolutely. One of my goals in founding Lenitiv was to be in a position to fund meaningful cannabis research and we very much intend to do that, likely outside the United States, in the not too distant future.

I also plan on continuing to press the U.S. government to remove the administrative barriers it has placed on cannabis research. It's important to appreciate the irony: On the one hand, the government says more research is needed before changing cannabis policy, while on the other hand it works hard to prevent meaningful cannabis research.

In your view, what steps should the industry take to advance clinical research on cannabis?

We need to start taking "yes" for an answer. To get federal law changed, which will greatly advance research, we need to step back and realize the states we haven't been successful in yet aren't Northern California. The industry then needs to step up and use the billions of dollars it generates to support top-notch research.

Interest by pharmaceutical companies in cannabis is increasing. Do you see this as a boon or a threat to the cannabis industry or patients?

It's hard to say yet. Quite frankly, pharma is set up to produce x medication for y condition. The last time pharma tried to develop a marijuana-based drug it gave us Marinol, which in my experience, and in that of so many other patients, is useless. Just making one marijuana-based medicine won't work, and cannabis isn't ideally suited to pharma's business model.

You have long been an advocate for military veterans to legally gain access to medical cannabis without losing benefits. After the failure last year to pass the Veterans Equal Access Amendment—which would have allowed Veterans Affairs (VA) doctors to recommend medical cannabis to patients—what is the next step in this fight? Are you hopeful that this situation will improve in the near future?

This is one of those things you can't blame on the VA. You can't have doctors employed by the federal government breaking federal law. This problem is Congress's to solve and while it's nice to see incremental progress using the power of the purse, the fact remains that the law itself needs changing. I think it's critical that patients continue to make themselves heard on Capitol Hill. As more and more states, especially conservative states, reform their laws, it stands to reason that Congress will see the light. It's truly a frustrating problem as many members of Congress on both sides have told me if they could vote by secret ballot on descheduling cannabis it would get done very quickly.



Montel Williams is the founder of Lenitiv Scientific, LLC, and the LenitivLabs brand. He will deliver his plenary address titled "A Patient's Perspective on the Endocannabinoid System" at the 2017 Cannabis Science Conference on Tuesday, August 29, at 12:00 p.m. in the Exhibit Hall. ■

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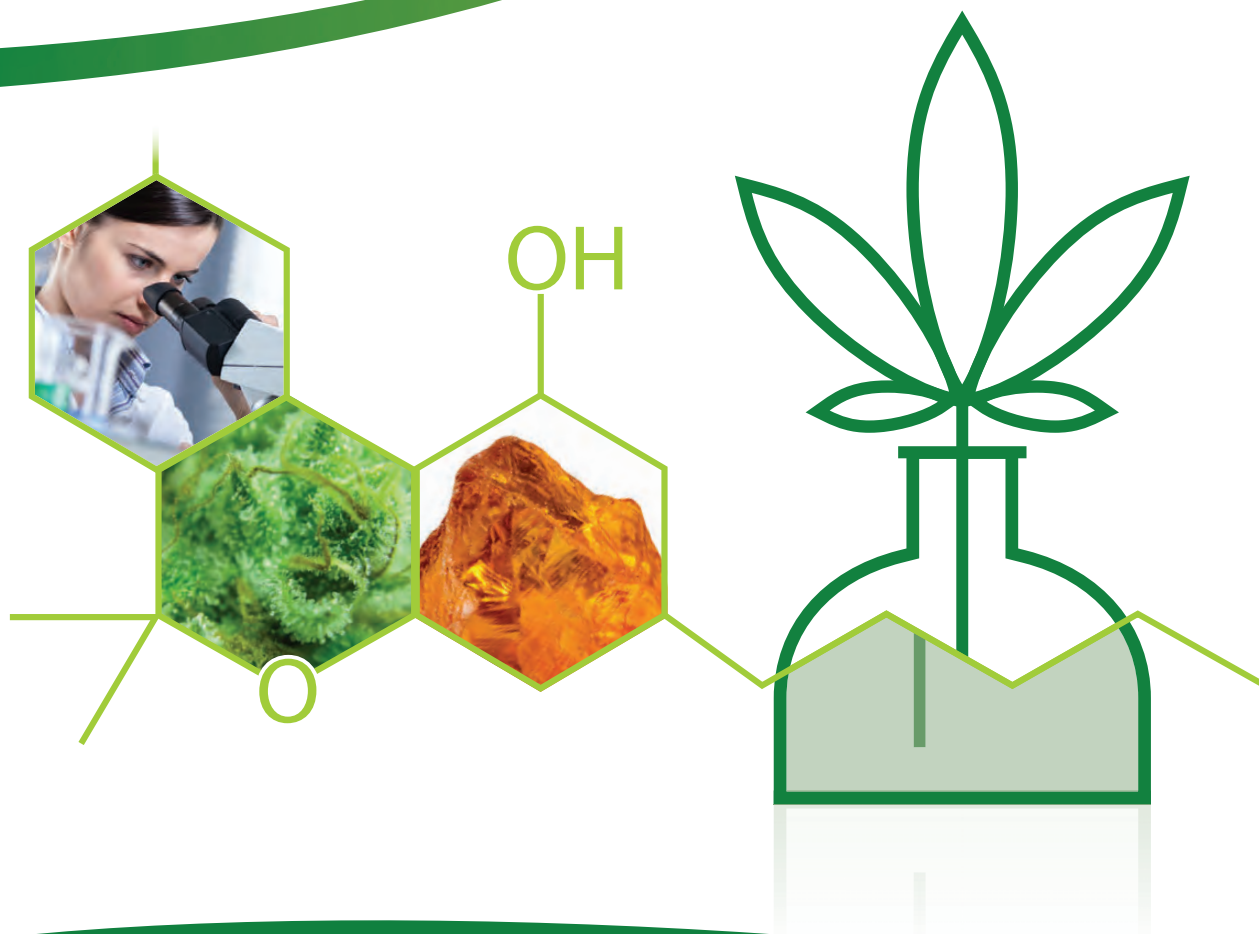
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CONFERENCE PROGRAM OVERVIEW

Analytical Cannabis Track

Tuesday, August 29, 2017

Exhibit Hall B

- 7:00 Registration opens
- 8:00 Networking & Coffee in Exhibit Hall A/A1
- 8:55 Welcome Address by Joshua Crossney, President & Founder, jCanna & Cannabis Science Conference and Jenifer Murray, Cofounder, GENIFER M and Former CEO, CannLabs

Cultivation Panel

Chair: Autumn Karcey, President, Cultivo, Inc.

9:00 Maximize Yield Through Proper Facility Design, Operating Procedures, and Environmental Monitoring

Panelists: **Autumn Karcey**, President, Cultivo, Inc.,
Peter Maguire, Vice President System Applications, Lighthouse Worldwide Solutions, and **Skye Hanke**, Cofounder and Business Development Officer, SmartBee Controllers

- 9:40 Q&A
- 9:50 Break

Genomics

9:55 Technology to Enable High Throughput Analysis of the Entire Cannabis Supply Chain

Dr. Michael Hogan, CSO, Pathogen Dx

- 10:25 Break

KEYNOTE ADDRESS

10:30 Beyond the Mountains of THC and CBD, the Future of Cannabis Research

David (Dedi) Meiri, PhD, Associate Professor, Technion Israel Institute of Technology

- 11:10 Q&A

- 11:20 Break/Lunch
Exhibit Hall A/A1, Networking
Poster Presentations

Cannabis Testing Session

Chair: Julie Kowalski, PhD, Trace Analytics Laboratory

1:00 Quality Control Testing in Regulated Markets and Lessons Learned from a Decade in the Cannabis Testing Industry

Josh Wurzer, President, SC Laboratories

1:20 The Problem with Cannabinoids: Investigation of Various Sample Preparation Approaches to Remove Cannabinoids for Trace Level Pesticide Analysis

Julie Kowalski, PhD, Trace Analytics Laboratory

1:40 Standardization in the Cannabis Industry

Cindy Orser, PhD, CSO, Digipath Labs

2:00 Association of Cannabinoid and Pesticide Concentration Effects in Extracts

Jason Strull, MS, Cofounder and Lab Director, 374 Labs, LLC

- 2:20 Q&A
- 2:35 Break

Medical Cannabis Track

Tuesday, August 29, 2017

Meeting Rooms B113–B116

- 7:00 Registration opens
- 8:00 Networking & Coffee in Exhibit Hall A/A1
- 8:55 Welcome Address by Tracy Ryan, CEO & Founder, CannaKids & SavingSophie.org

Medical Cannabis Session I

Chair: Tracy Ryan, CEO & Founder CannaKids & SavingSophie.org

9:00 KEYNOTE ADDRESS

Researching Medical Cannabis: Navigating Barriers to Efficacy Research

Dr. Sue Sisley, Arizona-based physician practicing internal medicine and psychiatry & the site PI for only FDA-approved cannabis trial for veterans with PTSD

- 9:40 Q&A

9:50 Pediatric Cannabis Panel

Moderator: Tracy Ryan

Cannabis for Pediatric Disease:

A Parent's Journey to Find a Cure

Panelists: **Moriah Barnhart**, Cofounder, CannaMoms & Publisher, Sensi Magazine FL, **Sebastien Cotte**, National Business/Education Director & Board Member, Flowering Hope Foundation, **Janie Maedler**, COO, Rylie's Smile Foundation, CannaKids ASD Consultant, CEO, Rylie's Sunshine, and **Tracy Ryan**, CannaKids & SavingSophie.org

- 10:30 Q&A

10:40 Cannabis in Personalized Nutrition—Bringing Disparate Ideas into Uniform Practice

Curtis Phinney, CNS, LDN, former reference standards scientist and scientific liaison, U.S. Pharmacopeia

11:00 Patient Testimony: Challenges and Hurdles of Being a Medical Marijuana Patient

Pete Tranchemontagne, Co-owner, Green Gold, Inc.

- 11:20 Break/Lunch
Exhibit Hall A/A1, Networking
Poster Presentations

Medical Cannabis Session II

Chair: Nurse Heather Manus, RN, Cannabis Nurses Network

1:00 Compounding with Cannabis Oil

Carla Kay, Founder, Specialized Formulations

1:30 Making eCS Connections: The Future of Nursing

Heather Manus, RN, Cofounder, Cannabis Nurses Network

2:00 Cannabis as Immune Therapy and Stem Cell Therapy

Judy Mikovits, PhD, Vice President, Mikovits and Ruscetti Consulting

- 2:30 Q&A

2:45 Cannabis Nurses Network Panel

Moderator: Ken Sobel, Esq.

Bridging the Gap Between Cannabis and Western Medicine Through Nursing

Panelists: **Lisa Buchanan**, RN, OCN,

CONFERENCE PROGRAM OVERVIEW

Cannabis Standards Panel

2:40 Moderator: *Susan Audino*

Panelists: **Susan Audino**, PhD, Chair of the Cannabis Advisory Panel and Chair of the Cannabis Working Group, AOAC International, **Joe Konschnik**, ACIL, **Robert Morgan**, Director, Technical Committee Operations, ASTM, and **Doug Rennie**, Technical Services Project Manager, AOCS

3:20 Q&A

Poster Sessions & Networking

3:30 Poster sessions and networking in Expo Hall A/A1

Industry Session

Chair: *Laura Bush*, Editorial Director, LCGC and Spectroscopy

4:30 **Using Solid Phase Microextraction for Cannabis Testing**

Katherine Stenerson, Principal Scientist, MilliporeSigma

4:50 **Analysis of Cannabis for Pesticide Residues by GC-Q-TOF and GC-MS/MS**

Phillip Wylie, Senior Research Scientist, Agilent Technologies

5:10 **Analysis of Heavy Metals in Cannabis via ICP-MS**

Andrew Fornadel, Senior Product Specialist, Elemental Spectroscopy, Shimadzu Scientific Instruments

5:30 **The Use of Orthogonal Methods to Monitor the Major Degradation Products of Cannabidiol (CBD)**

Catharine Layton, Senior Applications Chemist, Waters Corporation

5:50 Q&A

Marcie Cooper, RN, MSN, ADS, AHN-BC, **Heather Manus**, RN, Cofounder, Cannabis Nurses Network, and **Juhlzie Monteiro**, RN, BSK

Poster Sessions & Networking

3:30 Poster sessions and networking in Expo Hall A/A1

Medical Cannabis Session III

Chair: *Leah Bisiani*, RN, MHLthSc, Director of Clinical Research, Leafcann

4:30 **PTSD & CBD: What You Need to Know**

Dr. Philip Blair, Elixinol

4:50 **Understanding Pain in Aged Care: Exploring the Nature and Treatment of Chronic Pain in the Australian Aged Care Setting**

Leah Bisaini, RN, MHLthSc, Director of Clinical Research, Leafcann

5:10 Q&A

5:20 **International Medical Cannabis Panel**

Moderator: *Sharlene Mavor*, Director, Medical Cannabis Research Australia

International Medical Cannabis Updates

Panelists: **Paul Mavor**, B.Pharm, Director, Health House International (AU), **Dedi Meiri**, PhD, Assistant Professor at the Faculty of Biology, Technion Israel Institute of Technology (Israel), and **Bibiana Rojas**, Chief Strategic Officer, Colombian Cannabis (Colombia)

6:00–8:00 Mixer in Exhibit Hall A/A1
Sponsored by Shimadzu Scientific Instruments

Analytical Cannabis Track, continued

Wednesday, August 30, 2017

Exhibit Hall B

7:00 Registration opens

8:00 Networking & Coffee in Exhibit Hall A/A1

8:55 Welcome Address by Joshua Crossney

Extraction Session

Chair: *AC Braddock*, CEO, Eden Labs

9:00 **Extraction Technology Was the Catalyst for Rapid Legalization and the Growth of the Industry. What Will Secure the Cannabis Industry's Future Growth?**

AC Braddock, CEO, Eden Labs

9:30 **The Science and Economics of CO₂ Extraction and Oil Manufacturing**

Dr. Markus Roggen, Director of Science & Technology, OutCo

Medical Cannabis Track, continued

Wednesday, August 30, 2017

Meeting Rooms B113–B116

7:00 Registration opens

8:00 Networking & Coffee in Exhibit Hall A/A1

8:55 Welcome Address by Tracy Ryan

Medical Cannabis Session IV

Chair: *Tracy Ryan*, CEO & Founder CannaKids & SavingSophie.org

9:00 **KEYNOTE ADDRESS**

Cannabis: The Exit Drug

Dr. Uma Dhanabalan, MD, MPH, FAAFP, Founder, Uplifting Health & Wellness

9:40 Q&A

9:50 **Pediatric Cannabis Therapy...Leaving No Stone Unturned**

Janie Maedler, COO, Rylie's Smile Foundation,

CONFERENCE PROGRAM OVERVIEW

10:00 **Extraction and Refinement in Colorado:
A 5,280-Foot View**

Christian Sweeney, Director of Science & Technology, Cannabistry Labs

KEYNOTE ADDRESS

10:30 **Analysis of Cannabis-Related Samples for Composition via LC–MS Employing a Compact Mass Spectrometer**

Professor Jack Henion, PhD, Cofounder, CSO, Advion

11:10 Q&A

11:20 Break/Lunch
Exhibit Hall A/A1, Networking
Poster Presentations

PLENARY ADDRESS

12:00 **A Patient's Perspective on the Endocannabinoid System**
Special Plenary Address by **Montel Williams** in Exhibit Hall

Cannabis Research Session

Chair: Scott Kuzdzal, PhD, Shimadzu

1:00 **Comprehensive Analysis of Cannabis sativa from Cannabinoids to Terpenes Using Multiple Reaction Monitoring (MRM) Gas Chromatography–Triple Quadrupole-Mass Spectrometry**

Allegra Leghisa, Analytical Chemistry Graduate Student, University of Texas at Arlington

1:20 **Stable Isotopes of Cannabis—A Powerful New Analytical Tool**

Brett J. Tipple, PhD, Research Assistant Professor, Department of Biology, University of Utah, and James R. Ehleringer, PhD, Distinguished Professor of Biology, Department of Biology, University of Utah

1:40 **How Normal Are You? Why Cannabis Will Determine Who Wins the Battle Between One-Size-Fits-All Medical Treatment and Personalized Medicine**

Jeff Ullman, CMO/Founder, Only You Genetics, and Jahan Marcu, PhD, Medical Cannabis Science Director, Only You Genetics & CSO, Americans for Safe Access

2:00 **Efficacy and Safety of a Standardized Oromucosal Formulation of Cannabis Oil for the Management of Chronic Non-Cancer Pain (CNCP)**

Dr. Kenton Crowley, Palliative Care Corp.

2:20 Q&A

2:30 **Lab Information Management (LIMS) for Cannabis Quality Assurance**

Alan Vaughn, Lab Informatics Advocate, Laboratory Informatics Institute

2:50 **LIMS: A Critical Tool for the Cannabis Industry**
Dr. Christine Paszko, Accelerated Technologies

10:35 CannaKids ASD Consultant, CEO, Rylie's Sunshine
Computational Toxicology of Pesticide Exposure in Cannabis Products

Maxwell C.K. Leung, PhD, Associate Toxicologist, California EPA

11:05 Q&A

11:20 Break/Lunch
Exhibit Hall A/A1, Networking
Poster Presentations

PLENARY ADDRESS

12:00 **A Patient's Perspective on the Endocannabinoid System**
Special Plenary Address by **Montel Williams** in Exhibit Hall

Medical Cannabis Session V

Chair: Tracy Ryan, CEO & Founder CannaKids & SavingSophie.org

1:00 **Cannabis Medicine Translational Panel**

Moderator: Tracy Ryan

The Future of Clinical Research Exposed

Panelists: **Rob Davidson**, CEO, CURE Pharmaceuticals, **Dedi Meiri**, PhD, Associate Professor, Technion Israel Institute of Technology, **Karen Roellich**, RN, Mayo Clinic Nurse, Patient Dosing Consultant, CannaKids, **Jessica Rousset**, Chief Business Officer, Cure Pharmaceuticals, and **Tracy Ryan**, CEO & Founder, CannaKids & SavingSophie.org

1:45 Q&A

1:55 **An Integral Exploration of Doctor–Patient Experiences**

Dr. Regina Nelson, The eCS Therapy Center

2:15 **A Case for Cannabis**

Dr. Debra Kimless, MD, ForwardGro

2:35 **Personalized Cannabis Therapy Pathways**

Dr. Igor Kovalchuk, CEO, Pathway Rx

2:55 **Understanding the ECS & Organic Minimalist Gardening**

James Schwartz, RN, BSN, LNC, CEO, Cascade High

3:15 Q&A

3:20 **The Doc & The Jocks Panel**

Dr. Uma Dhanabalan and former NFL players Marvin Washington and Jim McMahon



CONFERENCE PROGRAM OVERVIEW

Special Presentations

3:10 **Rapid, Accurate, and Automated Residual Solvent, Terpene, and Total Potency Analysis Using a Compact Ultrafast GC Analyzer with FID and High Pressure Mass Based Detection**

Graham Shelver, Commercial Lead, Applied Markets, 908 Devices Inc.

3:30 Q&A

3:40 **A Public-Private Collaboration for Cannabis Testing Success Story—Could This Work in Other States?**

Joe Konschnik, Business Development Manager, Restek, and Heather Krug, MS, Colorado State Marijuana Laboratory Sciences Program Manager



4:00–6:00 Closing Mixer in Exhibit Hall A/A1
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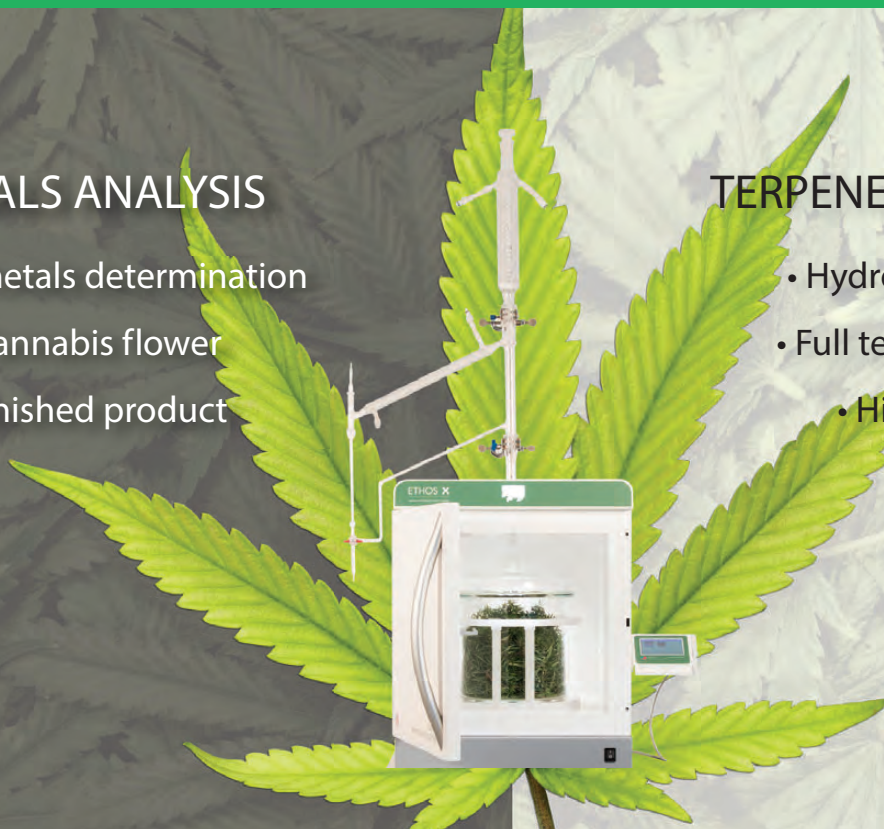
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PTSD Study Advances Medical Cannabis Research

The lack of controlled clinical studies on the effectiveness of cannabis to treat medical conditions has been a major concern for the industry. In January 2017, the nonprofit organization Multidisciplinary Association for Psychedelic Studies (MAPS) began a clinical study of the use of smoked whole-plant marijuana to treat symptoms of post-traumatic stress disorder (PTSD) in U.S. veterans. The study, now ongoing at the Scottsdale Research Institute in Phoenix, Arizona, has been approved by the Public Health Service, the Food and Drug Administration, the Drug Enforcement Agency (DEA), and institutional review boards, and is funded by a \$2.1 million grant to MAPS from the Colorado Department of Public Health and Environment. Sue Sisley, MD, is the site principal investigator on the study, and Marcel Bonn-Miller, PhD, is the coordinating principal investigator. Sisley spoke to LCGC about the study and the overall environment for medical cannabis research in the United States.

You are now enrolling patients for a clinical trial of smoked marijuana for PTSD in U.S. veterans. First, why did you choose to study smoked marijuana specifically? Would you consider conducting studies that did not use the whole plant?

We chose to study smoked marijuana because of the many veterans and others who already report using smoked marijuana to successfully treat their PTSD symptoms. There is already a great deal of well-funded research into using isolated or synthetic cannabinoids and nonsmoking delivery systems for therapeutic purposes, but ours is the very first clinical trial to look at the safety and effectiveness of the smoked marijuana plant. The marijuana plant cannot be patented, so there has been no private investment or government funding into developing it into a federally legal prescription medicine. That's why it fell to MAPS, the nonprofit study sponsor, and our team of researchers, to start research into the whole plant.

How did you determine which strains to use in the study?

We're investigating the safety and efficacy of four types of smoked marijuana to manage chronic, treatment-resistant PTSD symptoms. The doses of marijuana (excluding placebo) in this study were chosen because they contain a range of tetrahydrocannabinol (THC) and cannabidiol (CBD) ratios and potencies generalizable to what many veterans are currently using to manage PTSD symptoms in nonclinical settings in states with legalized medical marijuana. The marijuana that we're using in the study came from the National Institute on Drug Abuse (NIDA), the sole provider of marijuana for research in the United States. The four potencies we're using are placebo (<1% CBD/<1% THC), high THC (<1% CBD/12% THC), high CBD (12% CBD/<1% THC), and balanced (9% CBD/9% THC). These different potencies are not "strains," but rather material that has been processed from several

strains to create blended marijuana with precise CBD and THC ratios. Unfortunately, we had to use a lower balanced ratio (9% CBD/9% THC) than what we were originally approved to use (12% CBD/12% THC) because that's all that NIDA had available.

The restrictions for sourcing cannabis for medical research in the United States have been a significant concern. What do you think the future holds on this issue?

MAPS is currently working with Professor Lyle Craker, PhD, of the University of Massachusetts-Amherst to end the NIDA monopoly on marijuana for research by obtaining a license from the U.S. DEA for a license to grow marijuana for research. The DEA announced its intention to grant licenses to additional marijuana growers for research in August 2016, and it has received at least 25 applications, but neither Craker's nor any of the other applications have been approved. We're hoping that Attorney General Jeff Sessions and the Trump administration will soon end the obstructive NIDA monopoly, encourage independent marijuana research, and take action by granting Craker's license.

In the current legal and political environment, and given the withdrawal of Johns Hopkins from the study, how significant are the barriers to patient enrollment in the study?

The withdrawal of Johns Hopkins from the study didn't have much impact, if any, on enrollment. We've already enrolled nearly one-third of the participants we'll need at our Scottsdale Research Institute study site in Phoenix. We would like to see faster enrollment, but we're confident that we'll be able to enroll all 76 veterans in Phoenix.

Do you think your study will pave the way for more FDA-approved studies of the medical use of cannabis?

FEATURED INTERVIEW: SUE SISLEY

As scientists, we don't know yet what the results will be, so it's impossible to say whether we'll have very encouraging results, somewhat encouraging results, or just more questions. Either way, this trial has absolutely been the spearhead of a nationwide effort from researchers and clinicians to finally look at smoked, whole-plant medical marijuana from a scientific perspective. So, I'd have to say that regardless of the results, in that sense this study has already been a success: It will be easier for researchers to study medical marijuana in the United States from now on.

Given the challenges of conducting these studies in the United States, have you considered working with partners in other countries?

Yes, and in fact our friends at Tilray Pharmaceuticals in Canada have just started their own clinical trial of marijuana for symptoms of PTSD. We've shared our research protocol with them (and in fact it's available

online at maps.org) and they're doing almost the same trial, with the exceptions that they're using vaporized instead of smoked cannabis, and that they are looking at PTSD in anyone who suffers from it, such as police, firefighters, ambulance workers, and rape victims, whereas we are only looking at PTSD in military veterans. We're excited to compare our results.



Sue Sisley, MD, is an Arizona-based physician practicing Internal Medicine and Psychiatry. Her keynote address at the 2017 Cannabis Science Conference is titled "Researching Medical Cannabis: Navigating Barriers to Efficacy Research," and will kick off the Medical Cannabis Track on Tuesday, August 29, at 9:00 a.m. in Meeting Rooms B113–B116. ■

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CONFERENCE ABSTRACTS: ANALYTICAL CANNABIS TRACK

Analytical Cannabis Track

Tuesday, August 29, 2017

Exhibit Hall B

Cultivation Panel

9:00

Maximize Yield Through Proper Facility Design, Operating Procedures, and Environmental Monitoring

Panelists: Autumn Karcey, President, Cultivo, Inc., Peter Maguire, Vice President System Applications, Lighthouse Worldwide Solutions, and Skye Hanke, Cofounder and Business Development Officer, SmartBee Controllers

This panel will cover the key points of proper facility design, standard operating procedures (SOPs), and environmental monitoring that will lead to increased product yield and thus increased profitability. Overview:

- Key building design and construction concepts
- Sources of contamination
- Standard operating procedures to stop contamination
- Grow room monitoring for proper environmental control

Genomics

9:55

Technology to Enable High Throughput Analysis of The Entire Cannabis Supply Chain

Michael Hogan, Rick Eggers, Melissa May, Carl Yamashiro, and Kevin O'Brien, PathogenDx

PathogenDx developed a rapid, low-cost microarray technology to detect and quantify dozens of pathogens (bacteria, fungi) in parallel. Most steps in the analysis can be performed at room temperature with simple off-the-shelf lab equipment, with the capacity to process several hundred samples per day without automation. PathogenDx developed four "game changing" attributes of this technology to advance microbial testing in cannabis and, more broadly, in food and agriculture:

1. bypass microbial incubation and enrichment,
2. raw sample genotyping (RSG) to bypass DNA extraction and quantitation,
3. scalable, low-cost microarray technology to analyze dozens of microbes in parallel, and
4. simplified testing protocols that can be done at lab ambient temperature with inexpensive test equipment and with minimal lab personnel training.

Here, we describe a new phase to deploy this technology platform at the state and national scale. Rather than focusing on the testing of cannabis specimens to accommodate state regulation, we now envision extending the core technology for "preventative screening" of the entire cannabis supply chain via coupling of the core microarray technology to additional key components such as swab-based collection of specimens from surfaces at a grower, processor, or dispensary, smart-phone-based tracking of swab collection parameters such as time, location, and company, centralized, automated microarray analysis of 1000 swabs/day, 30 pathogens each, cloud-based analysis of pathogen profiling and linked product processing data, secure, role-based data retrieval and analysis, and analytics to predict trends. The bottom line is real-time profiling (and prediction) of the site and time dependence of pathogen contamination.

KEYNOTE ADDRESS

10:30

Beyond the Mountains of THC and CBD, the Future of Cannabis Research

David (Dedi) Meiri, PhD, Associate Professor, Technion Israel Institute of Technology

Recently, there has been a rapidly increased use of cannabis for various therapeutic and medical purposes. To date, there have been more than 500 different compounds reported to be found within the cannabis plant, of which at least 140 were classified as phytocannabinoids. Despite the vast number of phytocannabinoids, cannabis is prescribed today mainly on the ratio of two phytocannabinoids, THC and CBD. In the present study, we analyzed the full spectrum of cannabinoids in the cannabis plant. Using cancer and epilepsy models, we demonstrated how critical it is to understand the therapeutic potential of cannabis because each strain of the plant contains a different chemical composition.

Cannabis Testing Session

1:00

Quality Control Testing in Regulated Markets and Lessons Learned from a Decade in the Cannabis Testing Industry

Josh Wurzer, President, SC Laboratories

Until recently, the medical cannabis market in the United States has been essentially unregulated with respect to quality control since California passed proposition 215 in 1996. Testing for levels of active ingredients, pesticide residues, microbiological contamination, heavy metals, and other potentially harmful chemical constituents was not possible until the first laboratories willing to service the cannabis market began appearing in 2009. Until then, medical cannabis patients, caregivers, producers, and attending physicians had very little analytical data available when making decisions on dosage and even less information about potential adulterants and contaminants. With the legalization of recreational cannabis first in Colorado and Washington then Oregon and Alaska, as well as new legislation legalizing medical cannabis in states like Hawaii, New York, and Illinois, laws requiring quality control testing have begun to take effect. Additionally, trade groups like the American Herbal Pharmacopeia, the American Herbal Products Association, the American Chemical Society, and others have issued recommendations for best practices, recommended tolerances for contaminants, and guidance with respect to acceptable analytical methods. However, very little reliable data has been published regarding the state of the current cannabis supply. Since 2010, SC Laboratories has tested nearly 300,000 unique samples of cannabis, cannabis extracts, and cannabis-infused products from the California market for a range of potential contaminants including pesticides, plant growth regulators, microbiological contaminants, and residual solvents. Based on this analysis, it is clear that pesticide use is rampant, as high as 80%. There are no pesticides or plant growth regulators approved for use on cannabis and the health impacts are unknown when consumed via inhalation. Their use is illegal in most states. Microbiological and residual solvent contamination appears to be less of an issue with a smaller portion of the cannabis supply failing to meet recommended safety levels recommended by the trade associations mentioned above.

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1:20

The Problem with Cannabinoids: Investigation of Various Sample Preparation Approaches to Remove Cannabinoids for Trace Level Pesticide Analysis

Julie Kowalski, PhD, Trace Analytics Laboratory

Viable pesticide residue analysis methods have been demonstrated, but difficulties with this analysis still exist. Overwhelming amounts of cannabinoids often remain in popular methods based on the QuEChERS (quick, easy, cheap, effective, rugged, and safe) approach. Methods typically do not use enough sorbent capacity to significantly reduce cannabinoids content. This causes major ion suppression affecting detectability of trace-level pesticides. Other complications include solubility issues when matching high aqueous LC mobile phases and increased instrument fouling.

This work explores various sample preparation approaches to determine cannabinoids removal. Pesticide recovery is determined for the most promising approaches. A common method using modified QuEChERS and a zirconia-coated silica dispersive solid phase extraction (dSPE) cleanup is used for comparison. Several techniques were used including sequential dSPE cleanup, enhanced matrix removal cleanup materials, and SPE pass through with various sorbents. Cleanup was assessed by gravimetric analysis, cannabinoid analysis, and pesticide recovery.

1:40

Standardization in the Cannabis Industry

Cindy Orser, PhD, CSO, Digipath Labs

Regulating the cannabis industry on a state-by-state basis has demonstrated the absence of the federal government in providing oversight and enforcement of standardized guidance as enjoyed by the agricultural, food, and pharmaceutical markets. In the absence of federal oversight, state-mandated cannabis programs should make every effort to ensure the safety and reliability of cannabis and cannabis-based products on the dispensary shelves. The gatekeepers in the state-led effort are the independent cannabis testing labs. It is paramount that testing labs be held to a higher standard of excellence to ensure that quality and safety tests are indeed being run using properly calibrated analytical instruments and validated protocols. One effective assurance is through requiring International Organization for Standardization (ISO) accreditation with bi-yearly proficiency testing and incorporating random testing by the state throughout the year.

Reputable cannabis testing labs are key as the cannabis industry evolves towards evidence-based medicine where chemical profiles are correlated with their pharmacological activities. The high-volume testing data for cannabis flower samples is of value in revealing both the complexity, simplicity, and breadth of cannabis chemometric data. Testing labs are the path toward strain authentication, combining chemometric data with genotyping. Ultimately, only through the adoption of strain authentication will there be true quality control and truth in advertising at the consumer or patient level.

Modern medicinal cannabis requires a quality-assured, highly-reproducible product ensuring batch-to-batch consistency for dosing from whole plant extracts and to avoid unknown long-term health impacts from inhaling, dabbing, or vaping adulterating chemicals.

2:00

Association of Cannabinoid and Pesticide Concentration Effects in Extracts

Jason Strull, MS, Cofounder and Lab Director, 374 Labs, LLC

Significant diversity in pesticide tolerances exists among the nearly 30 states that have approved medical or recreational cannabis, mirroring both uncertainties in tolerance-setting processes and the variety of approaches cultivators have selected to control ongoing pest issues. Pesticide failures are a common industry problem, yet a number of states permit cultivators to extract problematic flower or trim in spite of research highlighting the potential of both butane and supercritical CO₂ extraction to concentrate certain classes of pesticides, resulting in residue levels exceeding most tolerances applying to flower and trim. The absence of pesticide tolerances for concentrates in Nevada and other states is problematic in light of prevailing public perception of high-purity extracts—often billed as “the clear”—as free of potentially harmful contaminants. Though previous research has demonstrated high levels of pesticides in concentrates, the quantitative association of cannabinoid and pesticide fold-increase from flower-trim to concentrate following either CO₂ or butane extraction is poorly understood. To investigate this relationship, we spiked a cannabis flower (deemed

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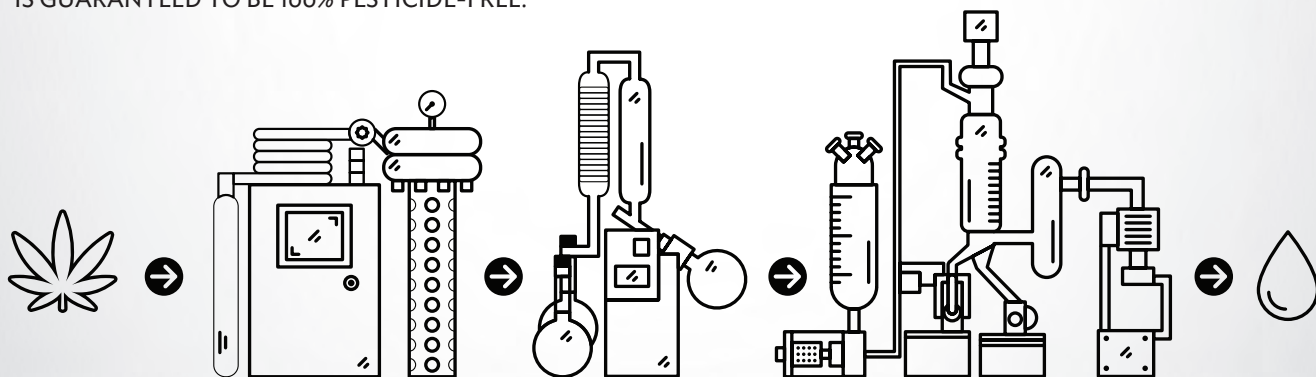
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free of pesticides by liquid chromatography–tandem mass spectrometry [LC–MS/MS] with log₁₀ levels of selected pesticides, extracted the flower via open blasting butane extraction, and manufactured “clear” through short-path fractional distillation; the levels of pesticides and cannabinoids in both the spiked starting materials and the extraction products were then quantified via high performance liquid chromatography–ultraviolet (HPLC–UV) and LC–MS/MS, and regressions of both starting and finishing material concentrations were compared. Results of this work will be discussed in the context of using cannabinoid concentration as an “informational proxy” for the estimation of pesticide concentration following butane extraction.

Cannabis Standards Panel

2:40

Panelists: *Susan Audino, PhD, Chair of the Cannabis Advisory Panel & Chair of the Cannabis Working Group (AOAC International), Robert Morgan, Director, Technical Committee Operations (ASTM), Joe Konschnik (ACIL), and Doug Rennie, Technical Services Project Manager (AOCS).*

For the first time ever, representatives from AOAC International, the American Society for Testing and Materials (ASTM), the American Council of Independent Laboratories (ACIL), and the American Oil Chemists' Society (AOCS), will come together on a panel to discuss the current state of cannabis standard method development. Join us for a closer look at what is being done today to standardize cannabis testing. This interactive panel was designed to update Cannabis Science Conference attendees on advances in standardization, as well as allow attendees to ask questions to these organization representatives.

Industry Session

4:30

Using Solid Phase Microextraction for Cannabis Testing

Katherine K. Stenerson, Jennifer E. Claus, and Michael Halpenny, MilliporeSigma

In the realm of cannabis testing, two specific applications—residual solvents and terpene analyses—are amenable to determination using headspace gas chromatography (GC). Solid-phase microextraction (SPME) is an inexpensive, fast, and easy to perform extraction technique that can be used for the headspace analyses of both of these classes of compounds. It utilizes a coated fiber to extract and concentrate analytes from a sample. The fiber is then desorbed directly into a GC system for analysis. The SPME device is reusable and can be manipulated manually for extractions or easily automated using a standard X-Y-Z “rail-style” autosampler. It has been used in both environmental and food testing labs for headspace analysis of both solvents and terpenes. This makes it a good candidate for use in the cannabis testing laboratory. In this presentation, we will demonstrate the use of SPME combined with GC–mass spectrometry (MS) for the determination of residual solvents in oily extracts, and terpenes from cannabis plant material. The quantitative analysis of a panel of residual solvents was achieved from hemp extract using headspace SPME in combination with GC–MS analysis. In the analysis of terpenes, SPME was used to determine the terpene profile of a dried cannabis sample. It was then applied to the quantitative analysis of selected terpenes, and the results compared directly to those obtained using a conventional solvent extraction of the plant material followed by GC–flame ionization detection (FID) analysis.

4:50

Analysis of Cannabis for Pesticide Residues by GC–Q-TOF and GC–MS/MS

Philip L. Wylie, Mei Wang†, Mahmoud A. ElSohly‡,†, Ikhlas Khan†, Chandrani Gor§, and Mohamed Radwan§, *Agilent Technologies, †National Center for Natural Products Research, ‡Department of Pharmaceutics and Drug Delivery, School of Pharmacy, University of Mississippi, and §ElSohly Laboratory Inc.*

As of the November 2016 election, 29 states approved the use of medical cannabis and eight states, representing 65 million people, approved recreational use by adults. Canada allows medical use and is on a path to full legalization. Because the United States government still classifies cannabis as a Schedule 1 drug, all legislation controlling the growing, testing, and use of cannabis products is done at the state level. There is no uniformity in the regulations and their enforcement. Pesticide use on cannabis plants is very controversial, but is loosely regulated in most states. It is clear that pesticide residue testing is important for a product that may be eaten or inhaled. This presentation describes the analysis of cannabis extracts for pesticide residues using accurate mass high resolution gas chromatography–quadrupole time-of-flight (GC–Q-TOF). Chromatograms are analyzed by applying a “find by fragments” approach using a personal compound database and library (PCDL) containing about 850 pesticide and contaminant exact mass spectra. Sixteen confiscated marijuana samples were analyzed and



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found to have an average of more than six contaminants in each. These included 22 different pesticides, three polycyclic aromatic hydrocarbons (PAHs), and two fire retardants.

5:10

Analysis of Heavy Metals in Cannabis via ICP-MS

Andrew Fornadel, Senior Product Specialist, Elemental Spectroscopy, Shimadzu Scientific Instruments

The recent evolution of legislation in the United States and other countries has opened up the cultivation and sale of cannabis and related products for medical and recreation use in a variety of states and municipalities. With the availability of cannabis as a commercial product comes the need for analysis and regulation of potency, pesticides, biological contaminants, and heavy metals, among others.

The concentration of heavy metals in plants that are intended for consumption is of concern because of the potentially hazardous effects of these metals related to their toxicity. As they grow, plants can bioaccumulate metals in their tissues that originate from the soil and water in which they are grown. These metals may originate naturally in soils and water as a result of the mineral content of the soil or source of the water, or they may be artificially introduced in the form of fertilizers, pesticides, herbicides, and fungicides commonly applied to increase crop yields.

Some of these metals contained in plants have beneficial metabolic uses, such as iron in beans and leafy greens, whereas others, such as lead, can have deleterious effects including toxicity and carcinogenicity. Here, we explore and discuss the applicability of inductively coupled plasma-mass spectrometry (ICP-MS) to the detection of the "Big Four" heavy metals (that is, As, Cd, Hg, and Pb) in digested cannabis flower samples for compliance with local and state regulations.

5:30

The Use of Orthogonal Methods to Monitor the Major Degradation Products of Cannabidiol (CBD)

Catharine Layton, Senior Applications Chemist, Waters Corporation

The debate surrounding the use of cannabinoids for medicinal purposes has been in the news for several years. Although there are at least 85 active substances identified in cannabis, many people associate the bio-botanical with the psychoactive compound tetrahydrocannabinol (THC). Recent attention has shifted to the nonpsychoactive compound cannabidiol (CBD), as evidence of the medical benefits continue to grow.

Some CBD preparations are marketed as dietary supplements and claim efficacy against a range of medical conditions. For manufacturers of these preparations, it is important to monitor product stability. A change in this parameter risks consumer health and safety when toxic or unexpected degradation products form over time resulting in the delivery of a different CBD dose than expected.

Extracts prepared from cannabis products can pose a significant challenge to chromatographers because of the vast number of naturally occurring isomeric cannabinoid structural isomers. When analyzing complex mixtures, it is beneficial to use multiple strategies and utilize various analytical tools to provide a more comprehensive understanding of the components within the mixture. For example, when applying different modes of separation, one

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may gain additional knowledge of both the compounds present and their structural composition.

Through a preliminary forced degradation study of crystalline CBD, we demonstrate how reversed-phase and convergence chromatography can be applied collectively to monitor solution stability. When these techniques are coupled with photodiode array (PDA) detection and mass spectrometry (MS), the chemical and structural identity of important CBD degradation products is determined.

Analytical Cannabis Track, continued Wednesday, August 30, 2017 Exhibit Hall B

Extractions Session

9:00

Extraction Technology Was the Catalyst for Rapid Legalization and the Growth of the Industry. What Will Secure the Cannabis Industry's Future Growth?

AC Braddock, CEO, Eden Labs

This dive into the future of the cannabis industry will cover the differing paths the industry could or should take via extraction technology and how we move forward for expansive and secure growth. Pharmaceutical? Nutraceutical? Recreational? Where is the industry headed and do we have any control over it? What are the demographics of a growing industry and how important is the science of extraction in effecting the development of this

market? These questions cover standardization, labeling, and the ethics of the modern business culture.

Modern business culture directly reflects the swell of awareness of how human consumables are grown and processed, as well as the intention of the company behind these products. We are well down the road in rejecting pirateering corporations whose only focus is the bottom line and who seriously injure their own consumers with reckless abandon. This industry has an immense responsibility to stick to its current path driven by social responsibility and a dedication to health and wellbeing through plant medicine and the use of separation technology with intention. The science of extraction and the products developed with it could alter our entire medical system by directly treating endocannabinoid deficiencies, addiction, and specific illnesses. In addition, we can do it with a greater understanding of how terpenoids, cannabinoids, and the combinations therein to create health or we could undermine decades of research, past and future, by ignoring a modern approach to treating illness and just fold under the weight of business as usual, which will greatly diminish the science of the plant and those who have built an industry around it.

9:30

The Science and Economics of CO₂ Extraction and Oil Manufacturing

Dr. Markus Roggen, Director of Science & Technology, OutCo

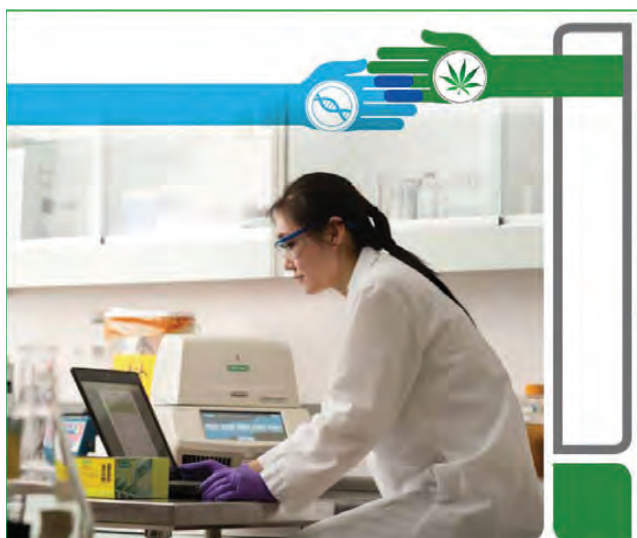
With legalization comes a change in consumer demands and economical pressure on manufacturers. Marijuana extract manufacturing has long been viewed as an art form. However, now is the time to think of extraction as a scientific and economical task. Supercritical fluid extraction (SFE) with CO₂ offers precisely modulated extraction conditions to target specific oil compositions. From an economical view, efficiency numbers and turnover rate can be optimized for the highest yield per week. This session will focus on modulating extraction conditions—such as temperature, pressure, flow, and particle size—to optimize for all required results. This session will be based on scientific data and methods, from solubility numbers of different cannabinoids in supercritical CO₂ to the concept of design-of-experiment and life-cycle costs analysis.

10:00

Extraction and Refinement in Colorado: A 5,280-Foot View

Christian Sweeney, Director of Science & Technology, Cannabistry Labs

In Colorado, and many other legal states, a number of techniques have been adopted for extraction and refinement of cannabis. Much like traditional botanical extractions, the aim of these techniques is to provide the desirable qualities of cannabis in a more readily usable form for the delivery method of choice. Ideally, these techniques minimize the loss of bioactive and flavor compounds while removing undesirable components. The most commonly applied extraction and refinement techniques in the industry will be discussed and reviewed for these attributes. Techniques discussed will include supercritical fluid extraction, light hydrocarbon (butane-propane) extraction, organic solvent



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extraction, aqueous extraction, expression, distillation, and chromatography. The core principles of each technique will be discussed as well as their strengths and weaknesses at achieving the goals of extraction. In addition to covering the basics of each technique, their current uses will be discussed and their fit for various applications will be reviewed. Lastly, the potential hazards to both consumers and operators will be discussed for each technique, as well as basic strategies for hazard mitigation.

KEYNOTE ADDRESS

10:30

Analysis of Cannabis-Related Samples for Composition via LC–MS Employing a Compact Mass Spectrometer

Jack Henion, Nigel Sousou, Changtong Hao, Daniel Eikel, and Simon Prosser, Advion Inc., and Danielle Mackowsky, Brian Kinsella, and Mike Telepchak, United Chemical Technologies

Chemical screening analyses by mass spectrometry (MS) are considered among the “gold standards” for samples with uncertain chemical composition. This includes determining the level of important expected constituents such as THC and CBD as well as possible toxins such as pesticides. The current rapidly growing aspects of the cannabis industry raise many medical, legal, social, and analytical questions. Because of the often chemically complex nature of representative samples, including the

presence of isobaric cannabis analogs, chromatography coupled with sensitive and selective detectors is often beneficial. Although high performance triple quadrupoles, quadrupole time-of-flight (QTOF) systems, and orbital ion traps are “in vogue” for these applications, this presentation will describe how often some important questions can be quickly answered by simpler and cheaper approaches. In this presentation, we will describe how the determination of cannabis-related compounds and pesticides may be determined utilizing a novel compact mass spectrometer coupled to ultrahigh-pressure liquid chromatography (UHPLC) or even thin layer chromatography (TLC). A comparison of results with selected reaction monitoring (SRM) LC–MS will also be shown.

The described compact, transportable single quadrupole mass spectrometer may be coupled with sophisticated on-line UHPLC sample analysis (UHPLC–MS) or with simple TLC plates (TLC–MS) following a preliminary sample cleanup step. Utilization of a QuEChERS (quick, easy, cheap, effective, rugged, and safe) extraction procedure allows for the removal of unwanted matrix components and provides clean extracts for analysis on the LC–MS. In addition, a variety of simple ambient ionization techniques including atmospheric solids analysis probe (ASAP) and the open port probe (OPP) inlet system recently reported by Oak Ridge National Labs (ORNL) may be used. These latter

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techniques often require no prior sample preparation or chromatographic separations for the qualitative determination of targeted compounds.

Examples presented will focus on the development of simple, routine, and economical LC–MS methods for the multiresidue quantitative determination of cannabinoids and pesticides in cannabis plant extracts.

PLENARY ADDRESS

12:00

A Patient's Perspective on the Endocannabinoid System

Montel Williams, Exhibit Hall

Montel Williams will discuss what he's learned during his 17-year journey with cannabis from a patient's perspective. In no small part, his journey has been about harnessing his endocannabinoid system to mitigate his multiple sclerosis (MS) symptoms. Williams believes it's critically important for providers to arm potential medical cannabis patients with the information they need to have the best chance at achieving symptom relief.

Cannabis Research Session

1:00

Comprehensive Analysis of *Cannabis Sativa* from Cannabinoids to Terpenes Using Multiple Reaction Monitoring (MRM) Gas Chromatography-Triple Quadrupole-Mass Spectrometry

Allegra Leghissa*, Zacariah L. Hildenbrand†, and Kevin A.

Schug*, *Department of Chemistry and Biochemistry, The University of Texas at Arlington and †Inform Environmental, LLC *Cannabis sativa* cultivars have two main bioactive components, including cannabinoids, which confer the main medicinal effects to the plant, and terpenes, which are the primary aromatic principles and are believed to provide synergistic medical benefits. In this research, we developed a new sensitive and specific method for the analysis of these components, based on the use of multiple reaction monitoring (MRM) mode in gas chromatography coupled with triple-quadrupole mass spectrometry (GC–QqQ-MS). Different benefits were found by using this method, among which the fast and efficient analysis of *C. sativa* because of the ability to differentiate between the isomeric structures of cannabinoids. Furthermore, it is possible to detect and quantify lower concentrations of analytes by focusing on specific transitions created by the analytes of interest, overcoming the matrix effect of the plant. On the other hand, the highly labile carboxyl group in the acidic cannabinoids leads to their decarboxylation at the temperatures of the GC system, therefore, requiring a silylation reaction for their protection. Even though the analysis via GC–MS required prior sample preparation, it allowed us to obtain a baseline chromatographic resolution, because of the different silylation adducts that were created from the cannabinoids that were not obtainable with the natural ones.

1:20

Stable Isotopes of Cannabis—A Powerful New Analytical Tool

Brett J. Tipple, PhD, Research Assistant Professor, Department of Biology, University of Utah and James R. Ehleringer, PhD, Distinguished Professor of Biology, Department of Biology, University of Utah

The naturally occurring isotopes of carbon, nitrogen, oxygen, and hydrogen within cannabis act as nature's chemical "barcodes." This natural chemistry present in all cannabis plants permanently records cultivation conditions, fertilizer type, and geographic source information. Measurements of the stable isotopes of cannabis and cannabinoids provide a powerful technique to determine, certify, verify, and protect the origin and label claims of a cannabis product. For example, stable isotope analysis can be used to determine that a medical cannabinoid oil was extracted from natural cannabis as opposed to synthesized, certify that a cannabis product was produced organically, verify that a cannabis plant was cultivated within a specific region, and fingerprint proprietary cannabis strains to protect the grower's intellectual property. The stable isotope signal is permanently retained from cultivation through distribution and sale and within any final product form. Attendees will gain specific knowledge on basic stable isotope chemistry and the applications of stable isotope analysis for cannabis testing and regulations. Attendees will also acquire an understanding of the uses of stable isotope analysis that are of specific interest to growers, processors, regulators, and law enforcement.

1:40

How Normal Are You? Why Cannabis Will Determine Who Wins the Battle Between One-Size-Fits-All Medical Treatment and Personalized Medicine

Jeff Ullman, CMO/Founder, OnlyYou Genetics, and



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Jahan Marcu, PhD, Medical Cannabis Science Director,
OnlyYou Genetics & CSO, Americans for Safe Access

The evidence we've been waiting for to prove cannabis's medical effectiveness is finally here: The science of pharmacogenetics ("PGx")—accepted by every leading medical institution as a proven, healthcare support tool—reveals which cannabinoids and prescription pharmaceuticals work from best to worst, thus providing a far superior treatment method than our current one-size-fits-all method. PGx also helps avoid the 100,000+ deaths every year as a result of people taking the wrong medicine. Because only 7% of the world responds normally to all medicines, pharmacogenetics identifies how our unique genetics respond to medicines, thus helping replace our one-size-fits-all treatment with a truly personalized medicine approach.

Attendees will learn how a do-it-yourself, 1-minute, at-home, and once in your lifetime saliva test will enlighten and empower them to take greater control over their own health. Consumers receive their personalized report in just one week, and once they see the evidence about their metabolic responses to different cannabis and prescription drugs, their lives will instantly change for the better because they are now educated and empowered with the evidence to become their most-informed patient advocate.

Because OnlyYou Genetics is a lab, we must remain agnostic about treatment plans, choice of products, and dosing. In light of this breakthrough evidence for cannabis, it's likely to be the single biggest opportunity to increase patient health

and ganjapreneurial wealth: patients can get well faster, avoid most side effects, and save money on medications. Innovative companies and healthcare professionals now have the scientific evidence they, and the entire medical marijuana industry, need to create and offer services and products best-suited to each person's unique genetics.

2:00

Efficacy and Safety of a Standardized Oromucosal Formulation of Cannabis Oil for the Management of Chronic Non-Cancer Pain (CNCP)

Dr. Kenton Crowley, Palliative Care Corp, Huntington Beach, CA, and Guillermo Moreno-Sanz, PhD, Abagune Research, Vitoria-Gasteiz, Basque Country, Spain

Pain management is the most commonly reported reason for seeking medical cannabis, which is associated with 64% lower opioid use, fewer medication side effects, and better quality of life in patients with chronic pain. However, therapeutic use of cannabinoids is often limited by their low bioavailability and undesirable psychoactivity. The aim of this study is to assess the efficacy and safety of an oromucosal formulation of cannabis oil for the management of chronic non-cancer pain (CNCP).

An observational, longitudinal study was conducted over 12 weeks and completed by 49 participants. A numeric analog scale (NAS) was used to determine self-reported pain, before and after daily treatment for 4, 8, or 12 weeks. Additional observations included reduction of opioid medication and

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occurrence of adverse reactions. Formulations containing Δ^9 -tetrahydrocannabinol (THC), cannabidiol (CBD), and Δ^9 -tetrahydrocannabinolic acid A (THCA) were available to participants throughout the study to meet the desired pain management goals. Key takeaways:

- A 68% reduction in pain score was observed, with all participants reporting some degree of improvement.
- Various concentrations of THC, CBD and THCA were used, alone or in combination, with comparable results.
- Duration of treatment beyond the first week did not increase the reduction in pain score.
- More than 80% of participants taking opioid medication reduced or discontinued it.
- None withdrew from the study due to intolerable side effects.

These results seem to indicate that our oromucosal formulation of cannabis oil represents an effective and safe approach to manage chronic noncancer pain. However, a randomized, placebo-controlled, double blind study will be required to further characterize its efficacy and bioavailability.

2:30

Lab Information Management (LIMS) for Cannabis Quality Assurance

*Alan Vaughn, Lab Informatics Advocate,
Laboratory Informatics Institute*

In the burgeoning cannabis industry, quality testing is taking on increased importance as the dangerous consequences of inaccurately labeled or contaminated products grows clearer

and standards and certifications are beginning to be seen as a competitive edge in the market. Good science and accurate informatics (data management and reporting) are therefore becoming indispensable. This presentation takes a close look at exactly what that means for today's cannabis testing labs—whether starting up or adding to existing services. Areas of discussion include:

- The industry from a lab perspective
- Informatics for the cannabis industry
- The cannabis lab
- How to start a cannabis lab
- Regulatory compliance aspects
- Features and functions of cannabis testing LIMS solutions
- Evaluation and implementation processes

2:50

LIMS: A Critical Tool for the Cannabis Industry

Dr. Christine Paszko, Accelerated Technology Laboratories

The cannabis industry is growing steadily as more states continue to relax their laws for medicinal and recreational use. As more states sign on, the demand for cannabis testing services increases as well. With concerns over rapidly changing testing regulations on potency, pathogens, and pesticides, cannabis testing laboratories are looking for guidance on every aspect of their operation including laboratory automation.

A critical component in today's automated cannabis lab should include a laboratory information management system (LIMS) that will manage many aspects of the testing process including sample management, quality assurance (QA) and quality control (QC), comprehensive reporting, and full traceability. Other LIMS capabilities that are important to the laboratory would be client access to test results, 24/7 availability, and integration with other business applications (for example, QuickBooks). Along with having a comprehensive, flexible, and secure LIMS, automation should also include instrument integration and bar coding because these are productivity boosters that help increase data quality. Finally, the advent of cloud-based LIMS means that even small laboratory operations can afford to implement a cloud-hosted LIMS solution without a significant upfront capital outlay.

This presentation will be a primer for cannabis testing laboratories who are looking for guidance on why they should implement a LIMS, how to do it, and what benefits they'll realize that will pay dividends immediately and into the future. One takeaway from this session will be a 28-page workbook entitled "Roadmap to LIMS Success Guide," which will help walk an organization through the LIMS implementation process from defining scope to final deployment.

Special Presentations

3:10

Rapid, Accurate, and Automated Residual Solvent, Terpene, and Total Potency Analysis Using a Compact Ultrafast GC Analyzer with FID and High Pressure Mass Based Detection

*Graham Shelper, Commercial Lead,
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automated sample injection, was used to identify and quantify residual solvents, terpenes, and cannabinoids. A resistively heated capillary column module containing a mid-polarity mixed mode stationary phase was used to separate residual solvents and terpenes while a high aromatic content stationary phase capillary column module separated neutral cannabinoid species. In addition to standard FID, high-pressure MS, a new mass based detection system that requires 1000-fold less vacuum than conventional MS, was used to confirm the identity of compounds in complex sample matrices. Together automated sample injection and resistively heated column technology resulted in highly reproducible residual solvent and terpene component retention times that were significantly shorter than those associated with conventional GC separations while the combination of high-pressure MS and FID provided excellent mass-based compound identification and quantitation. Separation of neutral cannabinoids for total potency determination by FID was also shown to be rapid and highly reproducible on this system.

3:40

A Public-Private Collaboration for Cannabis Testing Success Story—Could This Work in Other States?

Joseph D. Konschnik^{}, Heather Krug[†], Eric Petty[‡], Shawn Kassner[§], Julie Kowalski^{||}, Jack Cochran^{||}, Jeff Lowry[#]*

^{}Restek Corporation, [†]Colorado Department of Public Health & Environment (CDPHE), [‡]Neptune and Company, Inc., [§]Trace Analytics, ^{||}VUV Analytics, Inc., [#]Lowry Consulting*
The discovery of nonregistered pesticides contamination in cannabis plant material in Colorado prompted the need to set mandatory reporting limits (MRLs) for these pesticides in Colorado to ensure public safety. Since then, the Colorado Department of Public Health and Environment (CDPHE) undertook the responsibility for setting such MRLs. Colorado's novel approach to determine the proper levels for each pesticide involved forming a working group with its in-state laboratories and expert volunteers to agree on an analytical procedure to determine method detection limits (MDLs) using an industry-standard approach. The authors will tell the story of how this approach formed a collaborative public-private partnership where the state government worked side-by-side with labs to establish procedures and complete a multilaboratory study to report MDLs for 13 pesticides in cannabis flowers using QuEChERS (quick, easy, cheap, effective, rugged, and safe) extraction with dispersive solid-phase extraction (dSPE) cleanup and analysis by liquid chromatography–tandem mass spectrometry (LC–MS/MS). The authors will share the procedures used in this approach and an overview of the data generated by the participating labs as well as the outcome of the study.

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Medical Cannabis Track

Tuesday, August 29, 2017
Meeting Rooms B113–B116

Medical Cannabis Session I

KEYNOTE ADDRESS

9:00

Researching Medical Cannabis: Navigating Barriers to Efficacy Research

Dr. Sue Sisley, Arizona-based Physician Practicing Internal Medicine and Psychiatry & the Site PI for Only FDA Approved Cannabis Trial for Veterans with PTSD

Dr. Sisley will discuss hypothesized mechanisms of action for the use of medical marijuana in treatment of military-related post-traumatic stress disorder (PTSD). Learn about the design of the first ever triple-blind randomized controlled trial evaluating the use of marijuana for military-related PTSD and the regulatory obstacles in conducting this scientific study for developing medical marijuana into a United States Food and Drug Administration (FDA) approved medicine. In addition, you will learn about the existing and current state of both anecdotal and observational data.

Pediatric Cannabis Panel

9:50

Cannabis for Pediatric Disease: A Parent's Journey to Find a Cure

Panelists: *Moriah Barnhart, Cofounder, CannaMoms &*

Publisher, Sensi Magazine FL, Sebastien Cotte, National Business/Education Director & Board Member, Flowering Hope Foundation, Janie Maedler, COO, Rylie's Smile Foundation, CannaKids ASD Consultant, CEO, Rylie's Sunshine, and Tracy Ryan, CEO & Founder, CannaKids & SavingSophie.org

Come face to face with four of the industry's most powerful parent advocates who have worked to shape legislation, change laws, and save thousands of lives—all while caring for their very sick children. From marching on Washington, D.C., to planning pediatric human trials and building their own well-known brands for pediatric focused nonprofit foundations, hear first-hand accounts of how these “CannaWarriors” have fought the good fight and are winning.

Learn more about each of the panelists' journeys that began with the news every parent fears, and how they took their dark clouds and found the silver linings. Experience the emotion, cheer on the successes, and learn what to do should you ever be faced with these same circumstances.

10:40

Cannabis in Personalized Nutrition: Bringing Disparate Ideas into Uniform Practice

Curtis Phinney, CNS, LDN, former reference standards scientist and scientific liaison, U.S. Pharmacopeia

The primary facet of personalized nutrition is embracing client individuality. Individuality facilitates the development of solutions for individual wellness. Individuals actively participate in their own wellness goals and recovery from chronic conditions. The personalized nutrition paradigm is poised to facilitate the narrative of cannabis in nutrition and the methodologies we use in its implementation.

Clinicians and paraprofessionals prepare themselves to evaluate clients in the nutritional intervention arena using a multitiered system of support, that is, core instruction, intervention, and evaluation. Evaluations of nutritional interventions using cannabis are hindered by a lack of standard clinical testing methodology, analytical techniques, and methods.

Cannabis and its components exist in the nutrition mosaic as functional foods, premium ingredients, and preparations for clinical intervention and therapy. Personalized nutritional product strategies can be based on non- or mildly psychoactive components. Tuning the abundance of physiologically active compounds can be accomplished by manipulating strain selection, extraction techniques, and concentrate profiles.

Cannabis has some unique barriers to clinical implementation, such as the dearth of information from formal clinical studies. Other concerns are common to dietary supplements and functional foods. For example, adulteration, contamination by filth, chemicals, or noxious weeds, and misidentification of the plant or plant materials. Specifications, limits, and methodology are developing in a state-by-state patchwork, at best. Nongovernmental organization such as AOAC International, American Herbal Products Association (AHPA), and United States Pharmacopeia (USP) are

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developing stakeholder driven consensus testing methods. These standard methods facilitate traceability to higher level methodology and reference materials.

Stakeholder guided development of uniform approaches to using cannabis in nutrition gives our community an opportunity to profoundly influence the public health and to provide stewardship to the emerging cannabis consumer base.

11:00

Patient Testimony: Challenges and Hurdles of Being a Medical Marijuana Patient

Pete Tranchemontagne, Co-Owner, Green Gold, Inc.

So, you are a legal medical marijuana patient. Now what? The challenges and hurdles of being a medical marijuana patient will be addressed in this patient testimonial from Peter "Uncle Pete" Tranchemontagne. Let Pete educate you about his experiences in medicating daily with THC.

Medical Cannabis Session II

1:00

Compounding with Cannabis Oil

Carla Kay, Founder, Specialized Formulations

As a founding member of Skunk Pharm Research, Specialized Formulations and Box Extracts, I provided medications for cancer patients and others. I understand, use, and can explain the relevance between cannabis disciplines. My primary motivation into cannabis research was my mother, who was diagnosed with Alzheimer's in 2002 though her initial symptoms were obvious in 1998.

I started her with cannabis when she came to live with me in 2007. Her conditions and associated medication list was long. It was difficult to tell the difference between symptoms and side effects of pharmaceuticals and over the counter medications (OTCs). Her primary care physician began removing traditional medications with good results. Either the conditions were instigated by combined pharmaceuticals, the symptoms were resolved by cannabis, or a combination of both.

Experimentation compounding with cannabis lead to a better understanding of the effects that growing parameters, extraction techniques, and compounding have on the efficacy of the final product. Its efficacy is a continuum, the more parameters chosen with intent, the higher the product quality. For example, the best night medication uses flowers with high a CBN-THC ratio for sedation and CBD for relaxation. A fully matured flower with golden trichomes will offer the most attractive components for the desired end result. A long, warmer cure encourages trichome maturation. Warmer temperatures with longer processing time produce higher CBN-THC ratios, which provide more sedation.

I speak to the grower, extractor, processor, and, most importantly, the end consumer, on using this information to aid in the selection of cannabis to grow and produce the final product with the intent to optimize daily life.

1:30

Making eCS Connections: The Future of Nursing

Heather Manus, RN, Cofounder, Cannabis Nurses Network

This lecture will be a collision that embraces endocannabinoid science with holistic nursing by bridging

the gap between cannabis and holistic medicine as participants learn to integrate a more holistic approach of education into their health and wellness. The lecture will include, but is not limited to, the endocannabinoid system's (eCS) function and purpose as well as answering what is a cannabinoid, the phytocannabinoids, endocannabinoids, and an introduction to ethnobotany. This talk embraces nurses and medical professionals alike and looks briefly into the future of where we are headed. Come learn from one of the top leading cannabis nursing experts, Nurse Heather Manus, RN, who will guide you on a journey that is creating positive change across the globe.

2:00

Cannabis as Immune Therapy and Stem Cell Therapy

Judy Mikovits, PhD, Mikovits and Ruscetti Consulting

It has only been in the last 20 years that we, the scientific and medical communities, have appreciated the role of the endogenous cannabinoid system (ECS) in maintaining a healthy immune system and brain. More recently, we recognized that the ECS is critical for stem cell development and homeostasis. The phytocannabinoid, THC, is a modulator of hematopoietic stem cells (HSC). It acts in part via stimulation of TGF beta production. The modulation of TGF beta, HSC, and the NFkB by other natural product immunotherapy via some of the same pathways as THC suggest opportunities for synergy

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and decreasing psychoactive effects. Evidence is accumulating that THC actually reduces opioid addiction by modulating endogenous opioids. Endogenous opioids are peptides derived from food that can also modulate immune cells including hematopoietic stem cells and be valuable therapeutics against HIV/AIDS and cancer. Our collaborator, Candace Pert, demonstrated this in the 1980s when we developed peptide T as an AIDS and cancer therapeutic (see the book *Molecules of Emotion*). Endocannabinoids, phytocannabinoids, and opioids modulate the immune system as well as hematopoietic and mesenchymal stem cells, and they may also modulate the opioid pathways to reduce addiction.

Cannabis Nurses Network Panel

2:45

Bridging the Gap Between Cannabis and Western Medicine Through Nursing

Moderator: *Ken Sobel, Esq.*

Panelists: *Lisa Buchanan, RN, OCN, Marcie Cooper, RN, MSN, ADS, AHN-BC, Heather Manus, RN, Cofounder, Cannabis Nurses Network, and Juhlzie Monteiro, RN, BSK*

Now that the majority of the states across the nation have approved medical cannabis or recreational adult use, it is more important than ever to have cannabis integrated and accepted into health and wellness. As nurses, we believe all cannabis consumers, no matter its label, are patients. Period. The importance of this now is bridging the gap between cannabis and Western medicine in allowing its use—without prejudice—

and nurses are leading the way. We will discuss what nurses are doing today to create positive acceptance of this medicine into our communities across the nation.

Medical Cannabis Session III

4:30

PTSD & CBD: What You Need to Know

Dr. Philip Blair, Elixinol

Post-traumatic stress disorder (PTSD) is a vexing problem affecting more than 3.5 million Americans, not just service veterans. This disorder is frequently associated with other debilitating problems including chronic pain, anxiety, addictions, and suicide.

Current therapies can be effective, but they have frequent dropouts and side effects. On the other hand, CBD from nonpsychoactive hemp has been shown to be as effective as the best psychiatry medicines with no significant side effects. Numerous clinical studies have suggested the potential of CBD for many conditions. In addition, current evidence and experience suggests cannabidiol could be highly effective in many of the associated PTSD conditions including traumatic brain injury.

Dr. Blair will elaborate on the current science and clinical experience in using CBD. He is particularly appealing to veterans to attend and participate in CBD research.

4:50

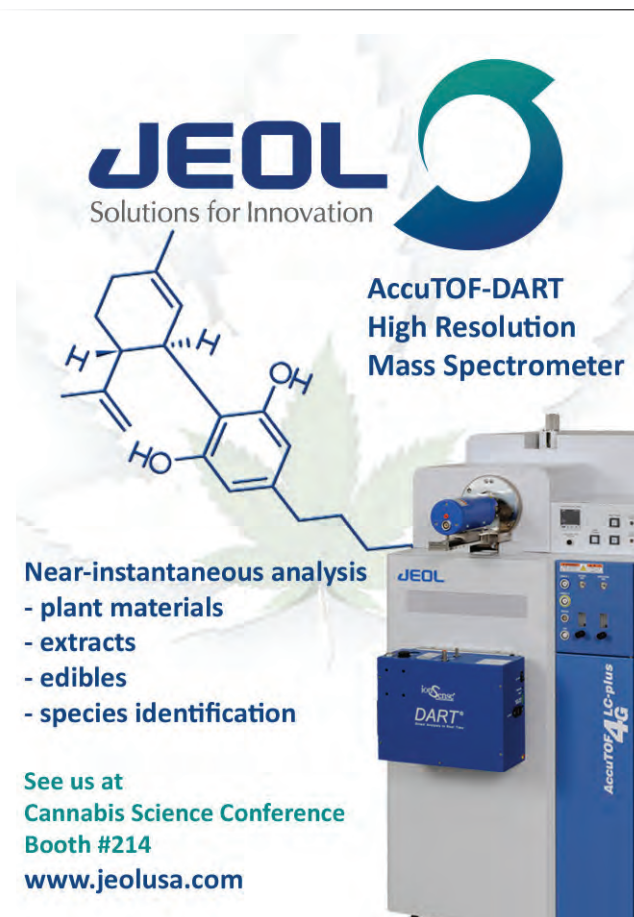
Understanding Pain in Aged Care: Exploring the Nature and Treatment of Chronic Pain in the Australian Aged Care Setting

Leah Bisiani, RN, MHLthSc, Director of Clinical Research, Leafcann

Potent opioid analgesics are widely prescribed within the aged care sector, yet these agents are associated with the highest degree of drug-related harm. This major research initiative examined current practices of pain management in the Australian aged care sector, exploring scope for the potential positive and significant impact based on the utilization of medicinal cannabinoids as an alternative to current pain management regimes. This research, initiated by the partnership of GreenC Medical and Ward Medication Management is the first large-scale, comprehensive examination of pain management investigating in detail the characteristics of medication use amongst a large cohort of older Australians living in residential aged care.

The study categorized the detailed features of unmanaged pain management in aged care, with extensive examination of medication usage characteristics in context, identifying the extent to which dose escalation occurs, and the extent to which this engenders potential prescribing cascades in response to treatment-emergent adverse effects. All medications (prescription, nonprescription, and complementary-alternative medicines) that are included in the active order documented on the medication chart, were recorded, and the dosage, route, and frequency of administration documented. In addition, the profile records detailed all medical morbidities, demographic information such as age, gender, and facility location, and the subsequent results of other relevant investigations.

This research provides evidence of widespread use of analgesia and adjuvant medicines for the management of chronic pain amongst older people living in aged care



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The advertisement features a chemical structure of a cannabinoid (THC) on the left, a photograph of the JEOL AccuTOF-DART mass spectrometer on the right, and a green leaf in the background. The text is arranged in a clean, professional layout with bold headings and bullet points.

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facilities. The findings illustrate the scope for the use of medicinal cannabis as a beneficial alternative approach to enhancing quality of life and maximizing comfort.

International Medical Cannabis Updates Panel

5:20

Moderator: *Sharlene Mavor, Director, Medical Cannabis Research Australia (Australia)*

Panelists: *Paul Mavor, B. Pharm, Director, Health House International (AU), Dedi Meiri, PhD, Assistant Professor at the Faculty of Biology, Technion Israel Institute of Technology (Israel), Bibiana Rojas, Chief Strategic Officer, Colombian Cannabis (Colombia)*

The Cannabis Science Conference has attendees from more than 14 countries worldwide. This year, join us for an international update on cannabis science and medicine as representatives from Israel, Australia, and Colombia explain advances and challenges in their respective countries.

Medical Cannabis Track, continued

Wednesday, August 30, 2017

Meeting Rooms B113–B116

Medical Cannabis Session IV

KEYNOTE ADDRESS

9:00

Cannabis: The Exit Drug

Dr. Uma Dhanabalan, MD, MPH, FAAFP, Founder, Uplifting Health & Wellness

Cannabis is a plant that has been used for thousands

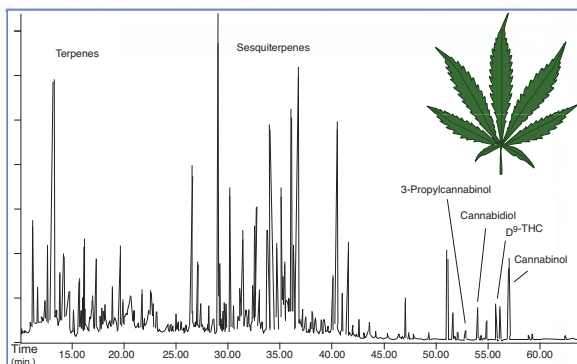
of years throughout the world. It has multiple purposes from medicine to industrial products. Cannabis has been listed as a Schedule 1 drug along with heroin, LSD, and ecstasy since 1970. Cannabis works with our bodies endocannabinoid system for homeostasis that most people and healthcare providers are not aware of or taught about. The positive impact of cannabis on human health and mankind has been limited because of prohibition, politics, and the stigma surrounding it.

This presentation by a cannabis therapeutics specialist trained in family medicine and occupational and environmental medicine draws from more than 30 years experience in both research and patient care to Dr. Uma's TotalHealthCareTHC™. She will cover the history of cannabis, the endocannabinoid system, delivery methods, and its applications.

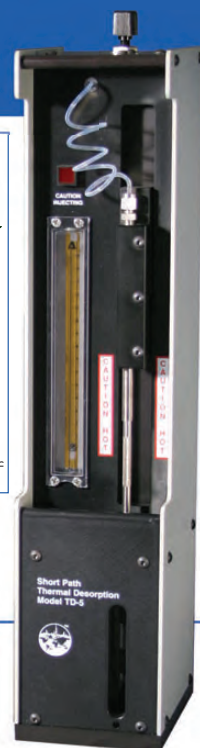
It is time to move beyond the misconceptions and misinformation associated with this healing plant. It is time to "open your hearts and open your minds," improve quality of life, and learn more about the healing properties of cannabinoids. We are facing an opioid epidemic: The United States of America has about 5% of the world's population, yet they consume about 80% of the world's pain medication. One American dies from a prescription drug overdose every 19 minutes. Deaths from medication abuse outnumber motor vehicle accident deaths. "Cannabis is not for everyone, yet it should be a first line option not the last resort," said Dr. Dhanabalan. "Cannabis is not an entrance drug, it is an exit from pharmaceuticals and narcotics."

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CONFERENCE ABSTRACTS: MEDICAL CANNABIS TRACK

9:50

Pediatric Cannabis Therapy...Leaving No Stone Unturned

Janie Maedler, COO, Rylie's Smile Foundation, CannaKids ASD Consultant, CEO, Rylie's Sunshine

When our children face extreme odds, we will do anything to find an effective medicine. Follow Janie Maedler's journey of helping her young daughter, Rylie, who was diagnosed in 2013 with rare, aggressive bone tumors find treatment with cannabis in an illegal medical marijuana state. After finding success for Rylie she then turned around to help others. She not only successfully changed the laws in her state to allow access for pediatrics, named Rylie's Law, but continued to change additional laws needed to accommodate pediatric patients. Through individualized consulting, sharing pediatric dosing tips, and speaking internationally on her experiences Janie has helped remove the stigma of pediatric cannabis therapy and encouraged parents to turn every stone over when it comes to their child's health. Her daughter, Rylie, having witnessed what "could have been" by watching what happened to other children created a 501c3 nonprofit, Rylie's Smile Foundation, in 2015 to help children find an "escape" while being stuck in the hospital. Then in 2017, with a team of scientist having more than 125 years of combined experience in tumor biology, immunobiology of retroviral-associated inflammatory diseases, cancer, stem cell biology, hematopoiesis, and drug development, Janie and Rylie created Rylie's Sunshine LLC to make sure that all families facing extreme odds have the option of cannabis therapy.

10:35

Computational Toxicology of Pesticide Exposure in Cannabis Products

Maxwell C.K. Leung, Marilyn Silva, Amanda Palumbo, Peter Lohstroh, Svetlana Koshlukova, and Shelley DuTeaux, California Environmental Protection Agency

There is a general lack of awareness of pesticide safety by both cannabis growers and users. The presence of pesticide residues on cannabis and in manufactured cannabis products can potentially pose both acute and long-term health risks for users. One particular concern is the ability for some pesticides to bind at the same location as the psychoactive components in cannabis (the endocannabinoid receptors). Laboratory animal studies have shown an association between disruption of the endocannabinoid system and developmental effects in offspring after in utero or neonatal exposure to a combination of cannabis and organophosphate (OP) pesticides. As a proof of concept, we constructed an adverse outcome pathway (AOP) of prenatal exposure to OPs and cannabis by curating the key events at the molecular, cellular, and tissue levels. The key events that follow OP contaminated cannabis exposure may result in developmental neurotoxicity through a multitude of pathways, including disruption of the cholinergic system, endocannabinoid metabolism, and retrograde post-synaptic signaling. Using this AOP and the United States Environmental Protection Agency (EPA) ToxCast high-throughput screening data, we developed a Toxicological Priority Index (ToxPI) to predict the developmental neurotoxicity of OPs that have been detected in cannabis products. The ToxPI scores were highest for chlorpyrifos (8.15), followed by malaoxon (2.25). Further studies will validate the results from in vivo toxicity studies and assess the risk of cumulative pesticide exposures in cannabis users.

PLENARY ADDRESS

12:00

A Patient's Perspective on the Endocannabinoid System

Montel Williams, Exhibit Hall

Montel Williams will discuss what he's learned on his 17-year journey with cannabis from a patient's perspective. In no small part, his journey has been about harnessing his endocannabinoid system to mitigate his multiple sclerosis (MS) symptoms. Williams believes it's critically important for providers to arm potential medical cannabis patients with the information they need to have the best chance at achieving symptom relief.

Medical Cannabis Session V

1:00

Cannabis Medicine Translational Panel The Future of Clinical Research Exposed

Moderator: *Tracy Ryan, CEO & Founder, CannaKids & SavingSophie.org*

Panelists: *Rob Davidson, CURE Pharmaceutical, Dedi Meiri, Technion Institute in Israel, Karen Roellich, CannaKids' and Mayo Clinic, Jessica Rousset, CURE Pharmaceutical*
In this groundbreaking panel, we'll have an open discussion with some of the world's leading pioneers in clinical research. Moderated by CannaKids' CEO Tracy Ryan, who successfully forged a partnership with Rob

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CONFERENCE ABSTRACTS: MEDICAL CANNABIS TRACK

Davidson from CURE Pharmaceutical and Dedi Meiri from the Technion Institute in Israel. Discussions between these panelists will bring insight and understanding as to how they plan to shape the way this plant is studied, what research is now underway, and what paths they'll travel to get U.S. Food and Drug Administration (FDA) approved drugs to market.

Davidson and Meiri will be joined by CannaKids' expert dosing professional and Mayo Clinic nurse, Karen Roellich, and CURE's Chief Business Officer Jessica Rousset who spent the last 10 years of her life at a top five pediatric hospital, Children's Hospital Los Angeles, as the Head of Innovative Medicine.

1:55

An Integral Exploration of Doctor-Patient Experiences

Dr. Regina Nelson, The eCS Therapy Center

This presentation shares data from Nelson's dissertation study that aid in understanding the experiences of doctors and patients as participants in medical cannabis compassionate care programs by means of the medical cannabis recommendation process. An improved understanding of experiences related to the medical cannabis recommendation process expand scholarly knowledge pertinent to future research in healthcare, leadership, public policy, and other academic applications. In the United States, when engaging with compassionate care programs, physicians and patients must both contend with the polarities of state policies that conflict with the federal Controlled Substances Act, which bleed into other life experiences. An integral methodology was applied to a narrative inquiry of 32 physician and patient participants. By assessing common and differing narratives through an integral lens (Wilber, 2000a), while grounding experiences in the All-Quadrants, All-Levels (AQAL) theoretical frame, a developed understanding emerges. Participants describe how the interobjectified public and institutional policies (lower right quadrant) affect the cultural (lower left quadrant), relational (upper right quadrant), and subjective consciousness (upper left quadrant). These findings will help guide future research, educational initiatives, and assist with normalizing the use of cannabis.

2:15

A Case for Cannabis

Dr. Debra Kimless, MD, ForwardGro

The use of medical cannabis for the treatment of many disease processes and conditions dates back thousands of years. The mechanisms of action are multifactorial including immunomodulation, anti-inflammation, interacting with pain pathways, and programmed cell death.

The objective of this presentation is to report the results of the treatment of patients with brain cancer, either metastatic or primary, patients with prostate cancer, patients with peripheral neuropathic pain conditions, and patients with other conditions using low dose, whole plant cannabis oil extract or topical cannabis applications alone or in conjunction with other traditional therapies along with a strict diet change to non-processed plant-based food.

All patients were given a whole food plant-based diet.

They were instructed to monitor urinary pH. Every patient was then treated with medical cannabis either with a sublingual oil extract or with topical applications.

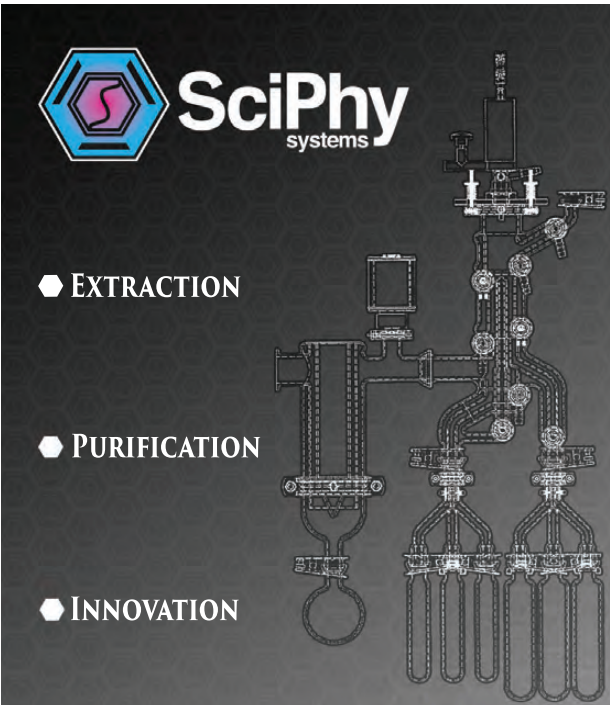
Cannabis has been reported to help with the treatment of many medical conditions through various mechanisms of action, as well as to help with the symptoms that result from conventional therapy such as anorexia, nausea and vomiting, anxiety, and insomnia. Cannabis has also been shown to be a successful adjunct as treatment in combination with other traditional therapeutic modalities. In these case reports, some patients were not being treated with traditional medical therapies when they received a significant response with cannabis. Other patients experienced improvement with a combination of conventional medicine and cannabis. There were no reports of adverse side effects from the cannabis treatment.

2:35

Personalized Cannabis Therapy Pathways

Dr. Igor Kovalchuk, CEO, Pathway Rx

Just as no two people are alike, no two diseases develop alike and yet diseases have to be treated similarly. Treatments should include individual approaches—personalized medicine. Pathway Rx Inc., is the research and development company offering a personalized approach to diagnostics and cannabis-based treatment of various conditions associated with acute and chronic pain, such as rheumatoid arthritis, multiple sclerosis, and traumatic brain injury, among others.



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CONFERENCE ABSTRACTS: MEDICAL CANNABIS TRACK

Pathway Rx uses a deep machine learning approach to develop modules for diagnostics and treatment of specific pain-associated conditions. Pathway Rx uses liquid biopsy (blood, saliva, and urine samples), followed by transcriptome-metabolome profiling and its algorithms for diagnostics of disease state and selection of individual therapeutic approach.

Pathway Rx uses PathSelect, a unique platform that utilizes a variety of original algorithms to detect intricate interplay of core intracellular signaling pathways occurring in response to a disease, and matches them to the best available cannabis treatment. The algorithm allows us to detect individual response to various combinations of cannabinoids-terpenoids and their interaction with various molecular pathways altered in specific diseases. Pathway Rx works with individuals and organizations, including medical practitioners, diagnostic companies, legal growers, and manufacturers. In this presentation, we will describe our approach to personalized cannabis treatments.

2:55

Understanding the ECS & Organic Minimalist Gardening

James Schwartz, RN, BSN, LNC, CEO, Cascade High

As an emergency room and intensive care unit registered nurse (RN) for almost 20 years and a cannabis cultivator for almost as long, I have seen the effects of cannabis on my own health and the health of others. Along the way, I have also been a part of or have studied multiple treatment modalities for diseases and injuries. I have critically read the information available about the endocannabinoid system, its role on health, and its importance on the body. As a cultivator, I have observed and discussed with multiple scientists the effect of glyphosate and mineral salt fertilizers on both the body

and planet. I have grown cannabis using Monsanto's chemicals, organic nutrients, and now a water-only method. This vast experience in both health and agriculture science has led me to the conclusion that to cultivate the most complete cannabinoid profile cannabis, an organic minimalist methodology is what is best for the plant and the consumer. I have observed terpene profiles expand and broaden as I moved away from supplemental nutrients. Terpenes as the building blocks to complex chemical cannabinoid compounds have created more robust and complete whole plant products. Now as an Oregon Liquor Control Commission (OLCC) Licensed Cultivator in the state of Oregon, I continue to get amazing feedback both from the healing as well as the wellness and pleasurable effects of the cannabis produced on my farm. The message of organic minimalist cultivation is one that must be shared with the cannabis community especially as large-scale commercial farming and profits take center stage as a business model.

3:20

The Doc & The Jocks Panel

Dr. Uma Dhanabalan, and former NFL players Marvin Washington and Jim McMahon

Join the "Doc," Dr. Uma Dhanabalan of Uplifting Health & Wellness, as she discusses medical cannabis with the "Jocks"—former NFL players Jim McMahon and Marvin Washington. We will take a closer look at the opportunities for, and opposition to, cannabis in professional sports. This panel discussion was designed to share inside perspectives into the applications of medical cannabis in professional sports. The discussion will combine these shared perspectives and larger than life personalities along with opportunities for audience interaction. This is the "do not miss event" of this year's conference!





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The Call for Mandatory Cannabis Strain Authentication

As science comes to the cannabis industry, it brings with it a focus on standardization and repeatability. One area where standardization is lacking in the cannabis industry is in the naming conventions used for strains. Cindy Orser, PhD, the chief scientific officer of DigiPath Labs, talked to LCGC about why a system for cannabis strain authentication and classification matters, and what would be involved in creating such a system—and making it mandatory.

You have called for mandatory cannabis strain authentication. What should that authentication include?

Cannabis has emerged from the black market with a lack of horticultural or agronomic standardized naming conventions. Instead, the use of acronyms and nonstandard abbreviations has made it increasingly difficult to have confidence about what is on the market and to make effective comparisons and has created additional uncertainty over the ability to trademark or patent strains.

The first step toward authenticating cannabis cultivation would be to throw out the tradition of “strain” naming and replace it with the agronomic and horticultural convention of “cultivar” names. While plant varieties often occur in nature and breed true, cultivars are selected and cultivated by humans and usually must be propagated vegetatively for true-to-type clones. For example, the strain Blue Dream would become the cultivar *Cannabis sativa* cv. Blue Dream.

The second step would be to associate a referenced chemotype and genotype with *Cannabis sativa* cv. Blue Dream. The combination of the Blue Dream cultivar name with its chemotype and referenced genotype would authenticate it.

Coming in line with agronomic standards would help promote the legitimacy of the cannabis industry. In addition, consumers are willing to pay a premium for genotyped, authenticated flowers.

Do we currently have enough information about cannabis strains or cultivars to implement a classification system? If not, what additional information is needed?

Various efforts have been underway toward classification schemes based on chemotypic data for cannabis that are currently being practiced, for example by Leafly (strain tiles), David Schacter (Cannabiscopes), and Ethan Russo and Mark Lewis (PhytoFacts). The classification scheme developed by Ethan Russo and Mark Lewis describes three major “chemovar” superclasses based on phytocannabinoid and terpene content to enable patients to easily visually distinguish particular attributes

for optimal therapeutic impact. And genotypic-centric efforts at cannabis phylogeny are also underway by several groups including Phylos Galaxy, Medicinal Genomics’ Kannapaedia, and various academic groups including those of Johnathan Page and Nolan Kane. Both approaches—chemotypic and genotypic—are aimed to give cannabis consumers more confidence in what they are purchasing.

What is now on the horizon is a classification approach using both chemoprofiling and genoprofiling tied down to a formal registry of cannabis cultivars. Because of federal restrictions, the cultivar registry would have to be managed on a state-by-state basis.

Who should be involved in establishing a uniform strain classification system?

All stakeholders should participate, from growers to state departments of agriculture to scientists actively working in this area. State regulatory agencies will need to be active participants in creating cannabis cultivar registration systems. There are hopeful signs from the Association of Official Seed Certifying Agencies (AOSCA) with their interest in forming a varietal hemp working group.

What are the barriers to developing such a system? What are the barriers to making it mandatory? How can such barriers be overcome?

The main barrier will be changing human behavior, given that cannabis variants have been introduced, named, and hybridized at will until now. I think the motivating event for adoption of a new nomenclature will occur in California, where recreational cannabis comes online in 2018. California will be the largest cannabis recreational market in the biggest agricultural economy in the United States. Cannabis cultivation will mature rapidly and a cannabis registry will be one important part of that process as the industry rapidly evolves toward big agriculture versus boutique cannabis growers; in both instances, cannabis cultivar authentication will be the key to success and keeping market share.

Research into cannabinoids and terpenes is ongoing. How can a cannabis strain authentication system

FEATURED INTERVIEW: CINDY ORSER

avoid becoming outdated as research advances?

We can look to established agricultural commodity industries as models to see how new research findings, such as elucidating terpene pathways in the case of cannabis, or introduction of pest-resistance in the case of wheat, can easily be incorporated, lead to registration of a new cultivar, and only strengthen the intellectual property position of specific cultivars. Marketing and branding will require a more reliable experience or therapeutic outcome, and, therefore, tighter controls on authenticating what is actually being grown and processed.

Where do we stand in terms of our knowledge about the correlation between chemical and genotypic profiles of cannabis strains and their pharmacological activities? How would a strain classification system relate to studies aimed at advancing this knowledge?

We do not have a complete assemblage of the genes involved in what we believe are the pertinent pathways that contribute to the pharmacological activities of cannabis, nor do we have a complete picture of the human genetic variants that contribute to a therapeutic outcome.

Although a lot of information has been gathered by various cannabis labs and groups, because of the lack

of standardization in analytical methods used to collect chemoprofile data, one can never be fully confident with cross analyses. Likewise, because of nonstandardized sequencing approaches in genotyping, not all genetic sequence data are comparable.

The reality is that a cultivar classification system or registry could serve as a framework or point of reference so that Blue Dream grown in Boston could be compared to Blue Dream grown in California. Cannabis cultivar registration would ideally require full sequencing and chemoprofile data for the given cultivation technique. The registry would also serve the purpose of preventing the re-use of an already registered cultivar name.



Cindy Orser, PhD, is the chief scientific officer of DigiPath Labs. Her talk at the 2017 Cannabis Science Conference is titled "Standardization in the Cannabis Industry," and will be held on Tuesday, August 29, at 1:40 p.m. in Exhibit Hall B, as part of the Cannabis Testing session. ■

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SPEAKER BIOS



Susan Audino

Analytical Cannabis Track

Tuesday, August 29, 2017, 2:40

Cannabis Standards Panel

Susan Audino, PhD, is an analytical chemist and chemometrician. She consults for laboratories and regulatory bodies, is lead assessor and instructor for A2LA, and is BOD member for Center

for Research on Environmental Medicine. Dr. Audino chairs the AOAC Cannabis Advisory Panel and Working Group and is an Executive Committee member of ASTM Cannabis Division.



Moriah Barnhart

Medical Cannabis Track

Tuesday, August 29, 2017, 9:50

Pediatric Cannabis Panel

Moriah Barnhart publishes Sensi Mag FL and is cofounder of CannaMoms, a federal nonprofit dedicated to helping families of critically ill children. She also created Dahlia's Botanicals, an organic

hemp and cannabis line named for her daughter, who was diagnosed with brain cancer at the age of two.



Leah Bisiani

Medical Cannabis Track

Tuesday, August 29, 2017, 4:30

Medical Cannabis Session III (chair)

Medical Cannabis Track

Tuesday, August 29, 2017, 4:50

Understanding Pain in Aged Care: Exploring the Nature and Treatment of Chronic Pain in the Australian Aged Care Setting

Leah Bisiani is an RN, dementia consultant, and MHthSc who revolutionizes inspiring change and maximizes life quality for humanity. Her innovative, published research, and pioneering work has placed her at the forefront of the aged care and dementia industry. Leah is initiating evidence-based research regarding the introduction of medicinal cannabinoids as an alternative to ineffective, traditional pain relief approaches.



Philip Blair

Medical Cannabis Track

Tuesday, August 29, 2017, 4:30

PTSD & CBD:

What You Need to Know

Philip Blair, MD (Colonel US Army), graduated from West Point in 1972, trained in family medicine, served as a combat physician in the Gulf War,

and retired after 29 years in uniform. He manages complex diseases for worker insurance programs, and since 2014 he has been treating, consulting, and lecturing on the nonpsychoactive cannabidiol.



AC Braddock

Analytical Cannabis Track

Wednesday, August 30, 2017, 9:00

Extraction Session (chair)

Extraction Technology Was the Catalyst for Rapid Legalization and the Growth of the Industry. What Will Secure the Cannabis Industry's Future Growth?

In 2009, AC Braddock, Eden Lab's new CEO, envisioned and initiated a pathway for significant expansion of the cannabis industry through national promotion and further product development of safe extraction technology, ensuring pure consumable products for medical applications and legalization. Eden is now an internationally recognized and distributed brand with an impeccable reputation for innovation and leadership.



Lisa Buchanan

Medical Cannabis Track

Tuesday, August 29, 2017, 2:45

Cannabis Nurses Network Panel: Bridging the Gap Between Cannabis and Western Medicine Through Nursing

Lisa Buchanan is a registered nurse in Washington state. She is an oncology

certified nurse (OCN) who has worked with the seriously ill and dying for more than 20 years. She is a member of the Oncology Nurses Society (ONS), American Cannabis Nurses Association (ACNA), and the Washington State Nurses Association (WSNA). She has earned certificates in the Core Curriculum for Cannabis Nursing and the Advanced Curriculum for Cannabis Nursing.



Laura Bush

Analytical Cannabis Track

Tuesday, August 29, 2017, 4:30

Industry Session (chair)

Laura Bush is the editorial director of *LGC* and *Spectroscopy*, two peer-reviewed publications that provide practical technical information to analytical chemists and spectroscopists

working in fields such as biopharmaceutical, food, and environmental analysis. In previous roles, Laura was an editor for *BioPharm International* and *Pharmaceutical Technology*, and a project manager in the pharmaceutical industry.



Marcie Cooper

Medical Cannabis Track

Tuesday, August 29, 2017, 2:45

Cannabis Nurses Network Panel: Bridging the Gap Between Cannabis and Western Medicine Through Nursing

Marcie Cooper, MSN, RN, AHN-BC, is board certified as an Advanced Holistic

Nurse and is working to build a bridge between conventional healthcare and holistic nursing care including cannabis therapeutics. She obtained education, certifications, and

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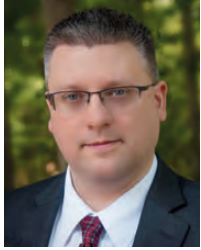
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SPEAKER BIOS

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Sebastien Cotte

Medical Cannabis Track

Tuesday, August 29, 2017, 9:50

Pediatric Cannabis Panel

**Cannabis for Pediatric Disease:
A Parent's Journey to Find a Cure**

Sebastien Cotte became actively involved in the field of medical marijuana in 2013 while seeking alternative treatments for his son Jagger's rare terminal mitochondrial disease. Sebastien is the national business/education director and a board member for the Flowering Hope Foundation (a 501c not for profit that provides education and patient support for Haleigh's Hope-Cannatol products). He is also on the board of advisors of MDherb, a cannabis education website, and he is the Georgia action group leader for Americans with Safe Access and the VP of the "Talk to the 6630507 hand" campaign, which is aimed at descheduling cannabis.



Kenton Crowley

Analytical Cannabis Track

Wednesday, August 30, 2017, 2:00

Efficacy and Safety of a Standardized Oromucosal Formulation of Cannabis Oil for the Management of Chronic Non-Cancer Pain (CNCP)

Kent Crowley, Pharm.D., is a board-certified Pharm.D. through the American Academy of Anti-Aging Medicine. He is the director of R&D at Silver State Trading, Sparks, Nevada, a 40,000-sq.-ft. clean green cultivation and production facility; he is also CMO for the Palliative Care Corporation in Huntington Beach, California, working with patients and physicians incorporating cannabis in disease-state treatment and symptoms management. He also serves on the research subcommittee for the Society of Cannabis Clinicians.



Robert Davidson

Medical Cannabis Track

Wednesday, August 30, 2017, 1:00

Cannabis Medicine Translational Panel: The Future of Clinical Research Exposed

Robert Davidson is the CEO and Chairman of the Board of Directors at CURE Pharmaceutical. Prior to his current role, Davidson served as President and Chief Executive Officer of InnoZen Inc., Chief Executive Officer of Gel Tech LLC, and Chief Executive Officer of Bio Delivery Technologies Inc., and he has served on multiple corporate boards.



Uma Dhanabalan

Medical Cannabis Track

Wednesday, August 30, 2017, 9:00

KEYNOTE ADDRESS:

Cannabis: The Exit Drug

Wednesday, August 30, 2017, 3:20

The Doc & The Jocks Panel

Dr. Uma Dhanabalan, MD, MPH, FAAFP, is a highly respected physician trained in Family Medicine and Occupational & Environmental Medicine, a Fellow of the American Academy of Family Physicians, and a Diplomate Certified in Cannabinoid Medicine. She is the Founder/CEO for Global Health & Hygiene Solutions, LLC, established in 2006 with a mission to promote wellness and prevent illness. She practices TotalHealthCareTHC at Uplifting Health and Wellness, in Natick, Massachusetts, where she "Educates Embraces Empowers" her patients and promotes cannabis as a treatment option.

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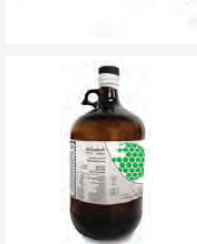
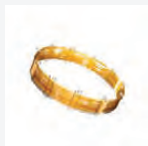
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SPEAKER BIOS



James R. Ehleringer
Analytical Cannabis Track
Stable Isotopes of Cannabis—A Powerful New Analytical Tool

Wednesday, August 30, 2017, 1:20

James (“Jim”) Ehleringer is a Distinguished Professor of Biology at the University of Utah and cofounder of

IsoAnalytics. Jim’s research focuses on developing stable isotope technologies for ecologic, forensic, and health applications. Jim is a member of the National Academy of Sciences and a Fellow of the Ecological Society of America.



Andrew Fornadel
Analytical Cannabis Track
Analysis of Heavy Metals in Cannabis via ICP-MS

Tuesday, August 29, 2017, 5:10

Andrew Fornadel, PhD, is a senior product specialist for elemental spectroscopy at Shimadzu Scientific Instruments. Throughout his education

and career, he has focused on elemental analysis in various media via ICP-MS, ICP-OES, and X-ray techniques. He received a PhD from Iowa State University in 2014.



Skye Hanke
Analytical Cannabis Track
Cultivation Panel: Maximize Yield Through Proper Facility Design, Operating Procedures, and Environmental Monitoring

Tuesday, August 29, 2017, 9:00

Skye Hanke is a third-generation grower, and over the past 15 years he

has worked with many companies in the indoor gardening industry doing brand development and product design with a special focus on new technology development. He is a cofounder and Business Development Officer for SmartBee Controllers.



Jack Henion
Analytical Cannabis Track
KEYNOTE ADDRESS: Analysis of Cannabis-Related Samples for Composition via LC-MS Employing a Compact Mass Spectrometer

Wednesday, August 30, 2017, 10:30

Dr. Jack Henion is an internationally recognized leader in the field of MS and

LC-MS. He is credited with nine patents and has published more than 200 peer-reviewed papers in scientific journals. In addition to his work at Advion, Dr. Henion managed a major research laboratory at Cornell University, where he served as a professor of toxicology for more than 24 years and is now Emeritus Professor of Analytical Toxicology.



Michael Hogan
Analytical Cannabis Track
Technology to Enable High Throughput Analysis of The Entire Cannabis Supply Chain

Tuesday, August 29, 2017, 9:55

Dr. Michael Hogan is CSO of PathogenDx. Based on his expertise in the area of physical chemistry,

biosample processing, and genetic testing, he is leading multiple programs in technology development at PDx, with special emphasis on building its proprietary DNA microarray technology into the cannabis, food safety, and agricultural markets.



Autumn Karcey
Analytical Cannabis Track
Cultivation Panel: Maximize Yield Through Proper Facility Design, Operating Procedures, and Environmental Monitoring

Tuesday, August 29, 2017, 9:00

Autumn Karcey, the president of Cultivo, Inc., takes a logical, consistent, and

scientific approach when she designs cultivation facilities. She combines the use of modern clean-room technology, state-of-the-art agricultural equipment, along with custom fabricated equipment, specialized irrigation, high-end security, and sensor systems to create world class facilities of enduring value.



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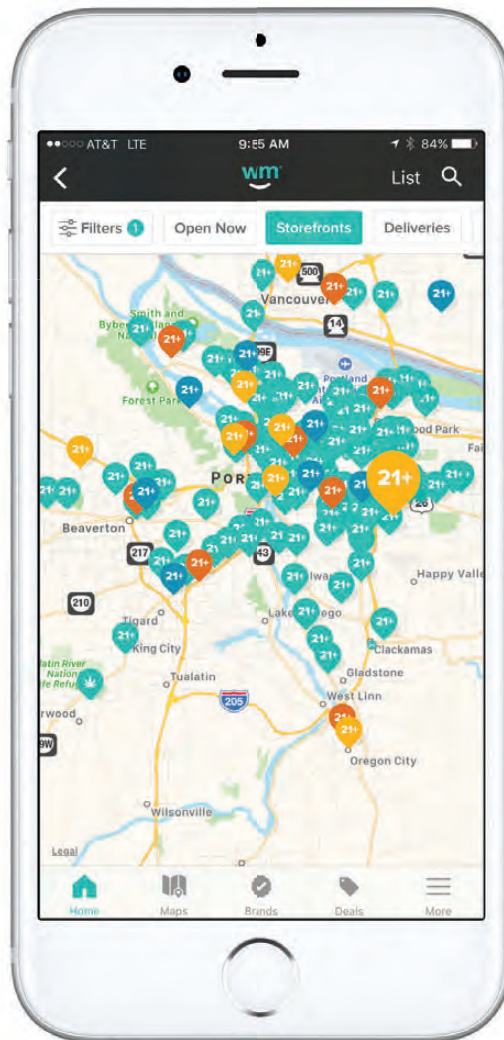
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SPEAKER BIOS



Carla Kay

Medical Cannabis Track

Tuesday, August 29, 2017, 1:00

Compounding with Cannabis Oil

Carla Kay is the founder of Specialized Formulations. In 1983, she graduated from UWec as a single parent. She worked for Honeywell before owning several businesses, then took a five year

break to care for her mom as she declined. Carla cofounded Skunk Pharm Research, LLC, and founded Specialized Formulations and Box Extracts, which provide training, consultation, and patient services.



Debra Kimless

Medical Cannabis Track

Wednesday, August 30, 2017, 2:15

A Case for Cannabis

Debra Kimless, MD, is a board-certified Anesthesiologist and ForwardGro's medical director. She consults pro bono with patients to help guide them with cannabis medicine

treatment. She shares patient results by presenting the case studies at national and international conferences to destigmatize cannabis and promote it as a safe and effective therapeutic option.



Joe Konschnik

Analytical Cannabis Track

Tuesday, August 29, 2017, 2:40

Cannabis Standards Panel

Wednesday, August 29, 2017, 3:40

A Public-Private Collaboration for Cannabis Testing Success Story— Could This Work in Other States?

Joe Konschnik is the Business

Development Manager for the Food and Agriculture market at Restek. The first 19 years of his career he was as an environmental analytical chemist and joined Restek nearly 16 years ago as an employee-owner. Joe volunteers in leadership roles with nonprofit organizations such as the American Council of Independent Laboratories (ACIL), the International Law Institute (ILI), and the American Industrial Hygiene Association (AIHA).



Igor Kovalchuk

Medical Cannabis Track

Wednesday, August 30, 2017, 2:35

Personalized Cannabis

Therapy Pathways

Dr. Igor Kovalchuk is an MD/PhD with training in genetics and epigenetics and expertise in molecular biology and genetic engineering. Since 2001 he has

been a professor at the University of Lethbridge in Alberta, Canada. He is also a cofounder and CEO of Pathway Rx.



Julie Kowalski

Analytical Cannabis Track

Tuesday, August 29, 2017, 1:20

The Problem with Cannabinoids: Investigation of Various Sample Preparation Approaches to Remove Cannabinoids for Trace Level Pesticide Analysis

Julie Kowalski is the Director of

Science and Research at Trace Analytics. She earned her graduate degree in Analytical Chemistry from Pennsylvania State University. Her professional experience includes troubleshooting and method development for GC, GC-MS, GCxGC, LC, and LC-MS/MS in addition to pesticide residue analysis and chromatography method development.



Heather Krug

Analytical Cannabis Track

Wednesday, August 30, 2017, 3:40

A Public-Private Collaboration for Cannabis Testing Success Story— Could This Work in Other States?

Heather Krug is the State Marijuana Laboratory Sciences Program Manager for the Colorado Department of

Public Health and Environment. She oversees inspections of Colorado retail-medical marijuana laboratories for compliance-suitability for certification, and is responsible for the state Marijuana Reference Laboratory. Heather holds a Bachelor of Science degree in Biomedical Sciences and a Master of Science degree in Forensic Toxicology.

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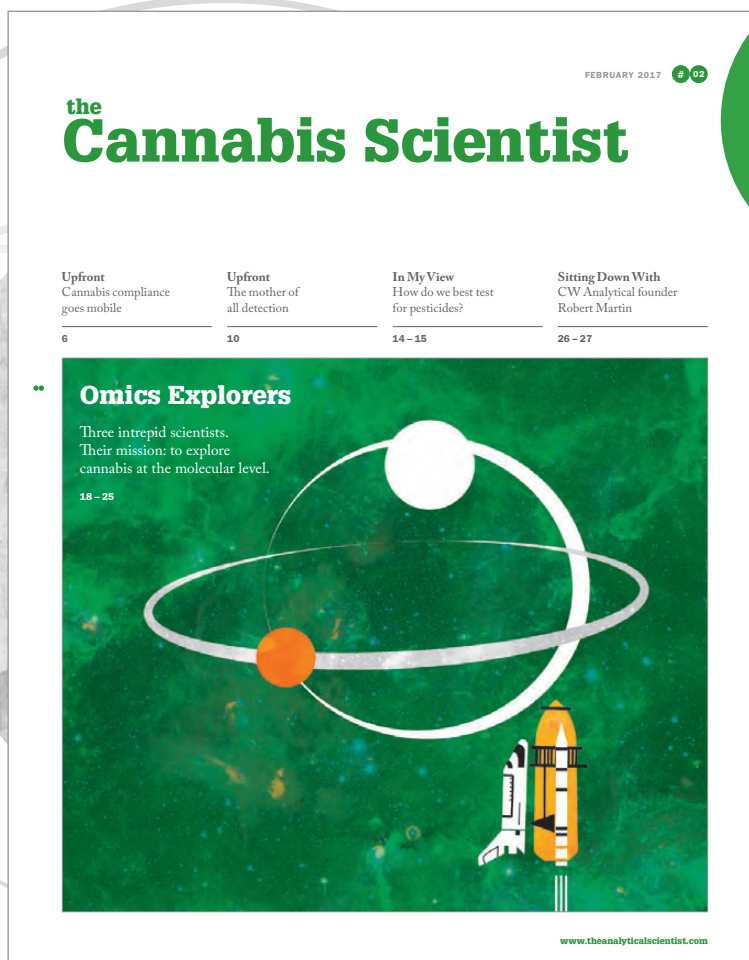
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SPEAKER BIOS



Scott A. Kuzdzal

Analytical Cannabis Track

Wednesday, August 30, 2017, 1:00

Cannabis Research Session (chair)

Scott A. Kuzdzal, PhD, received his PhD in analytical chemistry from the University of California at Riverside. Scott has a strong clinical chemistry background and has directed toxicology and therapeutic

drug monitoring labs at Johns Hopkins Medical Institutions. Scott currently serves as the Director of Marketing for Shimadzu Scientific Instruments (www.GrowYourLab.com).



Catharine Layton

Analytical Cannabis Track

Tuesday, August 29, 2017, 5:30

The Use of Orthogonal Methods to Monitor the Major Degradation Products of Cannabidiol (CBD)

Catharine Layton received her undergraduate degrees in Biological Science and Chemistry at the University

of North Carolina at Chapel Hill and her master's degree at Western Connecticut State University. She has worked as a laboratory chemist for companies including Covance Biotechnology, Diosynth Biotechnologies, Boehringer Ingelheim, and PerkinElmer. She is a senior technical application chemist at Waters Corporation.



Allegra Leghissa

Analytical Cannabis Track

Wednesday, August 30, 2017, 1:00

Comprehensive Analysis of Cannabis sativa from Cannabinoids to Terpenes Using Multiple Reaction Monitoring (MRM) Gas Chromatography–Triple Quadrupole–Mass Spectrometry

Allegra Leghissa is a PhD-seeking

analytical chemistry graduate student at the University of Texas at Arlington, working under the direction of Professor Kevin A. Schug. She was born and raised in Bologna, Italy. She left Italy in August 2014, after completing an undergraduate chemistry degree at the University of Bologna.



Maxwell C.K. Leung

Medical Cannabis Track

Wednesday, August 30, 2017, 10:35

Computational Toxicology of Pesticide Exposure in Cannabis Products

Dr. Maxwell C.K. Leung is an associate toxicologist in the

Department of Pesticide Regulation at the California Environmental Protection Agency (EPA). He has M.Sc. and PhD degrees in Food and Environmental Toxicology from the University of Guelph (2007) and Duke University (2012), respectively. He completed his postdoctoral fellowship at the United States EPA National Center for Computational Toxicology.



Janie Maedler

Medical Cannabis Track

Tuesday, August 29, 2017, 9:50

Pediatric Cannabis Panel

Cannabis for Pediatric Disease:

A Parent's Journey to Find a Cure

Wednesday, August 30, 2017, 9:50

Pediatric Cannabis Therapy...Leaving No Stone Unturned

Janie Maedler is the COO of Rylie's Smile foundation, a Cannakids ASD Consultant, and CEO of Rylie's Sunshine. Janie helps give families life-saving options they may not have had before. She has been actively involved in getting several medical marijuana laws passed. She currently advocates for continued improvements in medical cannabis and is a pediatric cannabis consultant.



Peter Maguire

Analytical Cannabis Track

Tuesday, August 29, 2017, 9:00

Cultivation Panel: Maximize Yield Through Proper Facility Design, Operating Procedures, and Environmental Monitoring

Peter Maguire is the Vice President System Applications at Lighthouse

Worldwide Solutions. Peter has been involved in the cannabis industry for 5 years as a cultivator, consultant, speaker, and writer of standards. Since 2014 he has headed up the Cultivation Committee for the Foundation of Cannabis Unified Standards (FOCUS).



Heather Manus

Medical Cannabis Track

Tuesday, August 29, 2017, 1:00

Medical Cannabis Session II (chair)

Tuesday, August 29, 2017, 1:30

Making eCS Connections:

The Future of Nursing

Tuesday, August 29, 2017, 2:45

Cannabis Nurses Network Panel:

Bridging the Gap Between Cannabis and Western Medicine Through Nursing

Heather Manus, RN, specializes in all aspects of medical cannabis care. As founder of the Arizona Cannabis Nurses Association, Heather was responsible for the addition of PTSD listed as a debilitating condition under Arizona's medical marijuana act. In 2015, she received the CannAwards "Best Charitable/Community Outreach Program" award and Cannabis Business Awards "Activist of the Year" award.

SPEAKER BIOS



Jahan Marcu

Analytical Cannabis Track

Wednesday, August 30, 2017, 1:40

How Normal Are You? Why Cannabis Will Determine Who Wins the Battle Between One-Size-Fits-All Medical Treatment and Personalized Medicine

Jahan Marcu, PhD, is the medical cannabis science director for OnlyYOU

Genetics. He received a doctorate for significant contributions to the study of the structure and function of cannabinoid receptors. Marcu is an author of the American Herbal Pharmacopoeia's Cannabis Inflorescence Monograph, which has set the current US federal standards of identity, analysis, and quality control for cannabis products.



Paul Mavor

Medical Cannabis Track

Tuesday, August 29, 2017, 5:20

International Medical Cannabis Updates Panel

Paul Mavor, B.Pharm, is the director for Health House International. His company was granted the first medicinal cannabis import license in Australia and he is

currently distributing medicinal cannabis products to eligible patients. Paul has a wealth of knowledge from his hands-on research in the United States, Canada, and Israel.



Sharlene Mavor

Medical Cannabis Track

Tuesday, August 29, 2017, 5:30

International Medical Cannabis Updates Panel (moderator)

Sharlene Mavor is a Medical Scientist and director of Medical Cannabis Research Australia who has been researching how medical cannabis can treat an increasing

array of disorders. She's traveled to the United States, Canada, and Israel to hear from leading researchers in this new medical field, particularly on medicinal cannabis production methods and purity and potency testing.



Jim McMahon

Medical Cannabis Track

Wednesday, August 30, 2017, 3:20

The Doc & The Jocks Panel

Jim McMahon played professional football in the NFL for 15 years. He has earned two Super Bowl rings, one in 1985 with the Chicago Bears and the other in 1996 with the Green

Bay Packers. Jim also played professionally with the San Diego Chargers, Philadelphia Eagles, Minnesota Vikings, Arizona Cardinals, and Cleveland Browns. He is now working extensively in the cannabis industry as a patient, advocate, and public speaker.

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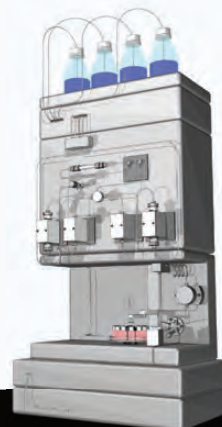
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SPEAKER BIOS



David (Dedi) Meiri
Analytical Cannabis Track
 Tuesday, August 29, 2017, 10:30
KEYNOTE ADDRESS: Beyond the Mountains of THC and CBD, the Future of Cannabis Research
Medical Cannabis Track
 Tuesday, August 29, 2017, 5:20
International Medical Cannabis Updates Panel

Medical Cannabis Track

Wednesday, August 30, 2017, 1:00

Cannabis Medicine Translational Panel: The Future of Clinical Research Exposed

David (Dedi) Meiri, PhD, is Assistant Professor at the Faculty of Biology and heads the Laboratory of Cancer Biology and Cannabinoid Research at the Technion Israel Institute of Technology. He is a member of the Technion Integrated Cancer Center. He holds an MSc in Biochemistry and a PhD in plant biotechnology from Tel Aviv University. Dr. Meiri conducted his postdoctoral fellowship at the Ontario Cancer Institute where he focused on the role of the GEF-H1 protein in tumor invasion and metastasis. Presently, his lab is investigating the therapeutic potential of phytocannabinoids.



Judy A. Mikovits
Medical Cannabis Track
 Tuesday, August 29, 2017, 2:00
Cannabis as Immune Therapy and Stem Cell Therapy

Judy A. Mikovits, PhD, Vice President, Mikovits and Ruscetti Consulting, earned her BA in chemistry from the University of Virginia and a PhD in biochemistry and molecular biology from George Washington University. In her 35-year quest to understand and treat chronic diseases, she has coauthored seminal papers culminating at least a decade of research in each of four fields: immunology, natural products chemistry, epigenetics, and AIDS and cancer drug development. Since 2011, Dr. Mikovits has been translating knowledge of the endocannabinoid system in immunity into phytocannabinoid therapies for cancer, AIDS, neuroimmune and autoimmune disease.



Juhlzie Monteiro
Medical Cannabis Track
 Tuesday, August 29, 2017, 2:45
Cannabis Nurses Network Panel: Bridging the Gap Between Cannabis and Western Medicine Through Nursing

Juhlzie Monteiro, RN, BSK, is a Registered Nurse in Nevada. She has worked more than 20 years in medicine specializing in many fields, such as internal medicine, orthopedics, and pain management. She is known in the Las Vegas community as "Ask Nurse Juhlzie" and educates people on cannabis therapeutics and the science behind the plant.



Robert J. Morgan
Analytical Cannabis Track
 Tuesday, August 29, 2017, 2:40
Cannabis Standards Panel

Robert J. Morgan is the Director of Technical Committee Operations at ASTM International. Bob has worked with multiple industries during his career, bringing stakeholders together to develop consensus standards that improve the quality of products and services, while protecting the consumer and the environment. His latest technical committee assignment is Committee D37 on Cannabis.



Genifer Murray
Analytical Cannabis Track
 Tuesday, August 29, 2017, 8:55
Welcome Address with Joshua Crossney

Genifer Murray is a champion of cannabis health and safety and an established expert on cannabis science and business. Genifer cofounded a premium cannabis jewelry line, GENIFER M, with her father who has been in the jewelry business for more than 30 years. Before that, she founded Carbon Blue Consulting, which provides results-driven science, health and safety, laboratory setup, training, and education intelligence to new and existing cannabis companies.



Regina Nelson
Medical Cannabis Track
 Wednesday, August 30, 2017, 1:55
An Integral Exploration of Doctor-Patient Experiences

Regina Nelson earned her PhD in ethical and creative leadership in 2016. Her doctoral studies concentrated on issues within the medical cannabis arena. Dr. Nelson is a founding officer of The eCS Therapy Center a 501(c)(3) Integral organization that is a national champion of community-based education and research projects.



Cindy Orser
Analytical Cannabis Track
 Tuesday, August 29, 2017, 1:40
Standardization in the Cannabis Industry

Cindy Orser, PhD, CSO, Digipath Labs, has had a scientific career that spanned across many disciplines from understanding how microorganisms control the phase transition of liquid to solid H₂O, to how a misfolded protein can transmit disease states and how cannabinoids can kill cancer cells. Her recent work focuses on biosensor design, data analytics, and standardization of protocols while ensuring public health.



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SPEAKER BIOS



Christine Paszko

Analytical Cannabis Track

Wednesday, August 30, 2017, 2:50

LIMS: A Critical Tool for the Cannabis Industry

Christine Paszko, PhD, currently serves as the Vice President of Sales and Marketing at Accelerated Technology Laboratories. Christine received her

BS in medical technology with a minor in microbiology from the State University of New York at Buffalo. She received her PhD in microbiology infectious diseases with a minor in biochemistry from the University of Maryland.



Curtis S. Phinney

Medical Cannabis Track

Tuesday, August 29, 2017, 10:40

Cannabis in Personalized Nutrition

Curtis S. Phinney, CNS, LDN, brings analytical, food, and pharmaceutical science expertise to cannabis and nutrition. He helps his clients develop, formulate, and validate cannabis

products for human and animal health. He is a Working Group member on methods committees for cannabis plant material, concentrates, and chocolates.



Doug Rennie

Analytical Cannabis Track

Tuesday, August 29, 2017, 2:40

Cannabis Standards Panel

Doug Rennie is a molecular biologist with expertise in regulatory compliance, safety compliance, and laboratory management. Doug joined the American Oil Chemists' Society (AOCS) in 2016

as a Technical Services Project Manager, with a focus on national standardization efforts of testing methods as well as helping to expand the National Laboratory Proficiency Program for cannabis testing.



Karen Roellich

Medical Cannabis Track

Wednesday, August 30, 2017, 1:00

Cannabis Medicine Translational Panel: The Future of Clinical Research Exposed

Karen Roellich, RN, began her nursing career with the Mayo Clinic more than 10 years ago. In 2014, she transitioned to

the cannabis industry at Vireo Health, which holds cannabis dispensing and cultivation licenses in multiple states. At Vireo, Karen was director of patient services and worked with challenging medical cannabis patients.

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Markus Roggen

Analytical Cannabis Track

Wednesday, August 30, 2017, 9:30

The Science and Economics of CO₂ Extraction and Oil Manufacturing

Markus Roggen, PhD, is the Vice President of Extraction at OutCo. An organic chemist by training, Markus started in the cannabis world by

establishing a testing laboratory. He also built an extraction facility for large-volume supercritical CO₂ extraction. He is interested in the molecular properties of the plant, including testing, extracting, and the transformation of active ingredients.



Bibiana Rojas

Medical Cannabis Track

Tuesday, August 29, 2017, 5:20

International Medical Cannabis Updates Panel

Bibiana Rojas is the cofounder and CSO of Colombian Cannabis and the founder of the EduCannabis Foundation. Prior to entering the cannabis industry,

Bibiana worked for the Boston Consulting Group, Kimberly-Clark, Siemens, and Morgan Stanley. She holds an MBA from the Wharton School, University of Pennsylvania and a BS in Finance from the University of Central Florida.

SPEAKER BIOS



Jessica Rousset

Medical Cannabis Track

Wednesday, August 30, 2017, 1:00

Cannabis Medicine

Translational Panel: The Future of Clinical Research Exposed

Jessica Rousset currently serves as the Chief Business Officer of Cure Pharmaceutical, a drug delivery

company that is redefining how medicines and health products are delivered and experienced. She is responsible for driving Cure's strategy and growth by bridging corporate, academic, and governmental interests toward the common goal of improving patients' lives.



Tracy Ryan

Medical Cannabis Track

Tuesday, August 29, 2017, 8:55

Welcome Address

Tuesday, August 29, 2017, 9:00

Medical Cannabis Session I (chair)

Tuesday, August 29, 2017, 9:50

Pediatric Cannabis Panel (moderator)

Cannabis for Pediatric Disease:

A Parent's Journey to Find a Cure

Wednesday, August 30, 2017, 8:55

Welcome Address

Wednesday, August 30, 2017, 9:00

Medical Cannabis Session IV (chair)

Wednesday, August 30, 2017, 1:00

Medical Cannabis Session V (chair)

Wednesday, August 30, 2017, 1:00

Cannabis Medicine Translational Panel (moderator):

The Future of Clinical Research Exposed

Tracy Ryan is the CEO of CanaKids, a California cooperative specializing in medical cannabis oil for serious illness and disease. With sights now set on clinical research, Tracy and her team are in the planning phases to start human trials on pediatrics with a top children's hospital in the United States.



James Schwartz

Medical Cannabis Track

Wednesday, August 30, 2017, 2:55

Understanding the ECS & Organic Minimalist Gardening

James Schwartz, RN, BSN, LNC, is the President and CEO of CascadeHigh and a critical care, emergency nurse with a successful business in medical legal consulting. He has more than

18 years of experience cultivating cannabis. Since June 2016, he has been an Oregon Liquor Control Commission licensed cultivator.



Graham Shelver

Analytical Cannabis Track

Wednesday, August 30, 2017, 3:20

Rapid, Accurate, and Automated Residual Solvent, Terpene, and Total Potency Analysis Using a Compact Ultrafast GC Analyzer with FID and High Pressure Mass Based Detection

Graham Shelver, PhD, is the Commercial Leader – Applied Markets at 908 Devices Inc. Prior to joining 908 Devices in 2015, Graham worked for Waters and has held product development positions at Varian Instruments, S-Matrix, and Bruker. His areas of expertise include pharmaceutical, chemical manufacturing, and oil and gas sectors.



Sue Sisley

Medical Cannabis Track

Tuesday, August 29, 2017, 9:00

KEYNOTE ADDRESS: Researching Medical Cannabis: Navigating Barriers to Efficacy Research

Sue Sisley, MD, is an Arizona-based physician practicing internal medicine and psychiatry. She works as a medical

director for medical cannabis license holders in 11 different states or territories from Hawaii to Puerto Rico and New York. Sue serves as Site Principal Investigator for the only

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SPEAKER BIOS

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Ken Sobel Esq.

Medical Cannabis Track

Tuesday, August 29, 2017, 2:45

Cannabis Nurses Network Panel (moderator): Bridging the Gap Between Cannabis and Western Medicine Through Nursing

Ken Sobel is an attorney, consultant, and medical marijuana advocate. He

was the founding member and board member for the three major dispensary advocacy groups in Arizona, including one that helped to defeat the Legislature's effort in 2013 to repeal or weaken the Arizona Medical Marijuana Act. Ken founded The Green Halo, LLC, the third dispensary to open in Arizona, and cofounded The Heavenly Harvest, Arizona's first cannabis extraction and infusion producer, with Nurse Heather Manus of New Mexico.



Katherine Stenerson

Analytical Cannabis Track

Tuesday, August 29, 2017, 4:30

Using Solid Phase Microextraction for Cannabis Testing

Kathy Stenerson is a principal scientist in Workflow Development at the life science business of Merck KGaA in Darmstadt, Germany, which operates as MilliporeSigma in the U.S. and Canada. Her current work involves developing workflow solutions for extraction and analysis to address problems related to analytical testing, with a focus on the areas of food and beverage and environmental analysis.



Jason Strull

Analytical Cannabis Track

Tuesday, August 29, 2017, 2:00

Association of Cannabinoid and Pesticide Concentration Effects in Extracts

Jason Strull is a cofounder, managing partner, and laboratory director for 374 Labs, a Nevada state-licensed medical marijuana independent testing laboratory. He holds a master's degree in chemical engineering from the University of Nevada. Jason is state certified as a clinical laboratory manager in chemistry and toxicology and with the National Registry of Certified Chemists as a toxicological chemist.



Christian Sweeney

Analytical Cannabis Track

Wednesday, August 30, 2017, 10:00

Extraction and Refinement in Colorado: A 5,280-Foot View

Christian Sweeney, the Director of Science and Technology at Cannabistry Labs, is a scientist focused on the extraction of natural ingredients for both their bioactive and organoleptic properties. His mission is to maintain the nutritive and sensorial attributes of horticultural products while converting them into functional ingredients. He leads a multifunctional research team focused on cannabinoid analytics, extraction technologies, and cannabinoid delivery improvement.



Brett J. Tipple

Analytical Cannabis Track

Wednesday, August 30, 2017, 1:20

Stable Isotopes of Cannabis—A Powerful New Analytical Tool

Brett J. Tipple, PhD, is a research assistant professor within the Department of Biology at the University of Utah. Brett is a cofounder of IsoAnalytics where he develops stable isotope tools for issues in the cannabis industry. He holds a BS and PhD from Indiana University and Yale University, respectively.

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SPEAKER BIOS



Pete Tranchemontagne
Medical Cannabis Track

Tuesday, August 29, 2017, 11:00

Patient Testimony: Challenges and Hurdles of Being a Medical Marijuana Patient

Peter Tranchemontagne, also known as “Uncle Pete,” is a medical marijuana patient and a licensed caregiver since 2011. He is President of Uncle Pete’s Re-Leaf, and co-owner of Green Gold, Inc., with his wife, son, and daughter-in-law. He is an active member of Legalize Maine, assisted with “Yes on 1” for a successful adult recreational campaign in 2016, and introduced the LD 764 Organ Exclusion Bill.



Jeff Ullman
Analytical Cannabis Track
How Normal Are You? Why Cannabis Will Determine Who Wins the Battle Between One-Size-Fits-All Medical Treatment and Personalized Medicine

Jeffrey Ullman is a personalized medicine health and wealth matchmaker

and investor, and the CMO and founder of OnlyYOU Genetics. He is also a chairperson for YPO Cannabis Industry Wealth & Health group, a founder of GoodFOR Health Cannabis & Nutraceuticals, a founder and CEO of Great Expectations Video Dating (the largest global singles brand), a founder of Twoology.com (the largest global relationship couples resource), and a co-creator and executive producer of “Love Connection” and “Taidaters.”



Alan Vaughn
Analytical Cannabis Track
Lab Information Management (LIMS) for Cannabis Quality Assurance

Alan Vaughan has a BSc in mass communications and broadcast journalism from Virginia Commonwealth University. He has been a member of the

laboratory informatics community for more than 11 years, and is a founding member of the Laboratory Informatics Institute. He is the author of the e-book *Lab Information Management (LIMS) for Cannabis Quality Assurance*.



Marvin Washington
Medical Cannabis Track
The Doc & The Jocks Panel

Marvin Washington is a retired NFL player who played for 10 years with three teams: the New York Jets, Denver Broncos, and San Francisco 49ers. He was a member of the Denver Broncos

1998 Super Bowl winning team. An advocate for all-natural, nonhabit forming cannabis, Washington speaks out on the topic of using cannabinoids as neuroprotectants and as an avenue to alleviate the nation’s #1 health epidemic: prescription opioid abuse and addiction.



Montel Williams
Analytical & Medical Cannabis Tracks
PLENARY ADDRESS

Wednesday, August 30, 2017, 12:00

A Patient’s Perspective on the Endocannabinoid System

Montel Williams is one of the highest profile advocates for medical cannabis in the country. He has used medical cannabis products to effectively manage the symptoms of his multiple sclerosis (MS) since his diagnosis with the disease in 1999. As the founder of Lenitiv Scientific, LLC, and the LenitivLabs brand, Williams remains dedicated to delivering high-quality and consistent products to patients, like himself, who rely on cannabis as medicine. Williams earned his media celebrity status as an Emmy Award-winning television personality whom Americans invited into their homes for more than 17 years. Alongside his TV career, he’s become an international speaker, author, entrepreneur, and advocate for patients worldwide.



Josh Wurzer
Analytical Cannabis Track

Tuesday, August 29, 2017, 1:00

Quality Control Testing in Regulated Markets and Lessons Learned from a Decade in the Cannabis Testing Industry

Josh Wurzer has seven years of experience testing cannabis and cannabis products. He is the President and cofounder of SC Laboratories, an analytical laboratory specializing in quality control for the cannabis industry. With laboratories in Northern and Southern California as well as Portland, Oregon, SC Labs is one of the largest analytical laboratories servicing the cannabis industry. He also serves on the board of directors of Envirocann, an organization that provides compliance and quality certifications for cannabis producers and manufacturers.



Phillip Wylie
Analytical Cannabis Track

Tuesday, August 29, 2017, 4:50

Analysis of Cannabis for Pesticide Residues by GC–Q-TOF and GC–MS/MS

Philip Wylie is a senior research scientist for Agilent Technologies in Wilmington, Delaware, where he specializes in developing GC, GC–MS, GC–MS/MS, and GC–Q-TOF techniques for food safety and environmental analysis. Recently, Dr. Wylie has focused on developing methods for the analysis of pesticide residues in food, environmental, and marijuana samples.

Analytical Tool Enables Tracking Origin of Cannabis—and Brand Protection

As scientists bring their expertise to the cannabis industry, new opportunities emerge. One example arises from the work of Brett J. Tipple of the University of Utah. Tipple studies how stable isotopes can be used to trace the origins, and even growing conditions, of agricultural products. In this interview, he explains how this works and how it can benefit the cannabis industry.

You have shown that the carbon and nitrogen isotopes in cannabis can be used to trace where a particular plant was grown and whether it was grown indoors or out. First, can you explain briefly what isotopes are, and why they vary from plant to plant?

Isotopes are different forms of an element that contain a different number of neutrons, and thus have different atomic masses. Carbon, for example, has three isotopes, two of which are stable, carbon-12 (^{12}C) and carbon-13 (^{13}C), and one that is radioactive, carbon-14 (^{14}C). Each isotope of carbon has six protons and either six, seven, or eight neutrons, respectively. For our current research on cannabis, we use stable isotopes of carbon, nitrogen, oxygen, and hydrogen and measure the abundances of these isotopes using a specialized piece of equipment called a *gas-source isotope ratio mass spectrometer*.

As you mentioned, the stable isotopes of plants record the environment in which the plant was grown. Variations in the carbon isotopes of cannabis largely relate to the quality and quantity of carbon dioxide the plant has access to during cultivation. When cannabis plants are grown indoors, carbon dioxide levels are often elevated to stimulate growth, and the elevated levels leave a telltale isotopic signature within the cannabis tissues. When cannabis is cultivated outdoors, it also has a unique carbon isotope signature. On the other hand, nitrogen isotopes of cannabis relate to the type of fertilizer used to nourish the plant during cultivation. The nitrogen isotope values of cannabis cultivated using organic fertilizers are quite distinct from those that would exist if that same plant had been grown using conventional synthetic fertilizers. Finally, oxygen and hydrogen isotopes of cannabis record a plant's geographical location during growth. There are measureable differences in water isotope values across North America, and these differences are recorded in cannabis tissues and compounds. As a result, we can use the oxygen and hydrogen isotopes to determine where a plant was grown.

What are some of the ways that isotopes can be used in connection with law enforcement concerns related to cannabis?

We have worked with state and federal law enforcement agencies to help them identify where illicit cannabis material may have originated. In the past few years we have seen an uptick in interest from law enforcement agencies in both states with legal cannabis and states that border states with recreational marijuana statutes. In a recent case, a large bundle of marijuana was found floating off the U.S. coast and investigators wanted to know if the marijuana was foreign or domestically produced. Using isotope analysis, we were able to provide the investigators information

they would not otherwise be able to determine. Previously, my colleague Jim Ehleringer led a project in collaboration with federal law enforcement that used stable isotopes to uncover trade patterns of illicit cannabis movement into the United States from north and south of the border. Stable isotopes are a great tool to provide actionable information regarding the origin of an unknown material. These are a few of the ways stable isotopes can help law enforcement with illicit cannabis.

Are there ways that isotope analysis can be beneficial to people in the cannabis industry?

Yes, absolutely, and here is where there are great opportunities that should be of interest to the entire cannabis industry. We are very excited by the potential value and many uses of stable isotope analysis to growers, processors, and consumers. Specifically, we have spoken with numerous growers about how isotope analysis could help them protect their product and intellectual property. Given the current legal gray area of commercial cannabis, there is a lack of means for growers to protect their intellectual property (IP) for specific proprietary cannabis strains—that is, their brands. Stable isotopes offer growers a new way to authenticate or “fingerprint” high-value cannabis products, completely independent of genetics. The isotopic fingerprinting technique can be used to certify a product's authenticity and protect the grower's brand and IP. In effect, growers have a fingerprint recorded in the chemistry of their cannabis plants and extracts that relates back to the cultivation facility. The isotopic fingerprinting technique is widely used, particularly in Europe, to protect high-value products such as specific cheeses and wines. Cannabis processors could also benefit from stable isotope analysis because they could chemically verify the cultivation conditions of a batch of cannabis plants, independent of barcodes, before processing and establish if the entire batch were grown according to their state's regulation. Stable isotope analysis can be performed on bulk plant materials as well as processed materials, such as extracts and oils. Thus, the processor could independently verify that a batch of plants or processed product meets specific regulations. Finally, these examples illustrate how stable isotope analysis would help protect customers' health and safety by ensuring product authenticity as well as guaranteeing that purity requirements are met.

You have studied how cultivation setting—indoor versus outdoor—can affect the waxes that occur in cannabis flowers. What have you found?

In our research, we have confirmed that individual compounds from cannabis (such as waxes and cannabinoids) record the environment the plant was cultivated in. This step is important

FEATURED INTERVIEW: BRETT J. TIPPLE

for the increased application of stable isotope analysis in the cannabis industry given the rapid rise in extract-based products, such as edibles, oils, and vape liquids. This discovery opens the door for anyone in the cannabis industry to have an analytical tool to certify the origin of a product, independent of a barcode. This finding allows the industry to detect illicit or adulterated materials anywhere in the supply chain, from bulk plant material to refined final products.

How can this information be useful to the cannabis industry?

As the cannabis industry continues to develop and becomes more established, there will likely be a growth in the consumer's interest in product quality and purity. As an example, in the past decade we have seen exponential growth in consumers choosing organic foods as well as more sustainable, locally produced foodstuffs over conventionally produced foods. Thus, it is likely that increased numbers of consumers will seek out cannabis products that are certified as being of exceptional quality or as having been produced regionally or organically. In terms of commercial development and associated regulations, we all benefit from analytical tools that allow for the safe and effective growth of this industry, protecting both the growers and consumers. Stable isotope analysis fills an analytical gap to independently verify and certify these qualities of high-value cannabis products.

Further, at some point when interstate sales and transport of cannabis and cannabis products become legal, law enforcement will need tools to detect illicit cannabis entering the supply chain and gray-market cannabis leaving the legal

marketplace. Stable isotope analysis has long been a valuable tool in diversion control for illicit drugs and monitoring supplies and production processes of pharmaceutical drugs. These techniques will likely become increasingly utilized in law enforcement applications regarding cannabis.

What are your next steps in this work?

We continue to be excited about the introduction of this reliable and quantitative technique for the cannabis industry. Our research group currently offers stable isotope analysis of cannabis flowers, leaf materials, and extracts. This technique has a modest cost and requires less than 0.01 gram for bulk flower analysis and even less for compound specific analysis.

The next research discoveries will likely be made through applying these scientific tools to edibles using state-of-the-art extraction methods. We are continuing to promote the applicability of this technique for the cannabis industry, as well as to the health, public safety, and agricultural agencies involved in cannabis regulation. We are also working to increase the availability of stable isotope instrumentation within analytical testing facilities across the United States.

Brett J. Tipple, PhD, is a research assistant professor in the Department of Biology at the University of Utah. His talk at the 2017 Cannabis Science Conference is titled, "Stable Isotopes of Cannabis—A Powerful New Analytical Tool," and will be held on Wednesday, August 30, at 1:20 p.m. in Exhibit Hall B, as part of the Cannabis Research session. ■

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Optimizing Cannabis Extraction Yield by Precision Milling

Markus Roggen and Blake Grauerholz, OutCo

The Fritsch Pulverisette 19 is utilized to finely mill cannabis plant material in preparation for SFE processes. The efficient and precise reduction in particle size optimizes oil output and formulation.

The fast-growing field of cannabis extraction still holds many process inefficiencies, that can be easily overcome. A bottleneck often encountered is the packing density, or lack thereof, of cannabis plant material in the extraction vessel. Low packing density leads to a decrease in extraction efficiency and increase in output variability. Non-milled cannabis plant material generally experiences packing densities of 100–125 g/L, whereas milled material packs at 225–250 g/L.

The Fritsch Pulverisette 19 is an efficient tool to quickly comminute large volumes of cannabis plant material to a precise particle size. Plant material is fed into the Pulverisette 19 through large funnel for fast throughput. The negative pressure in the milling system ensures a continuous flow through the cutting rotor and the selected sieve cassette for precise particle sizing, and prevents any system clogging. The high throughput of up to 60 L/h is supported by large collection vessels of up to 10 L. Fast processing is further supported by unrestricted accessibility of the cutting chamber, quickly removable cutting rotor and sieve cassette, and generally easy-to-clean grinding chamber.

In this application note, we describe the general process employed at OutCo for sample preparation in their SFE production operation. This will include particle size distribution data and experimental data on extraction yield increases due to particle size reduction.

After testing (Figure 1), we chose the 2 mm screen size, as it allows for a high packing density, increased extraction speed, and optimized oil constitution, while allowing the operator to constantly feed material into the mill itself, thus increasing work efficiency. The blade speed of 300 rpm was found to be optimal for narrow particle size distribution.

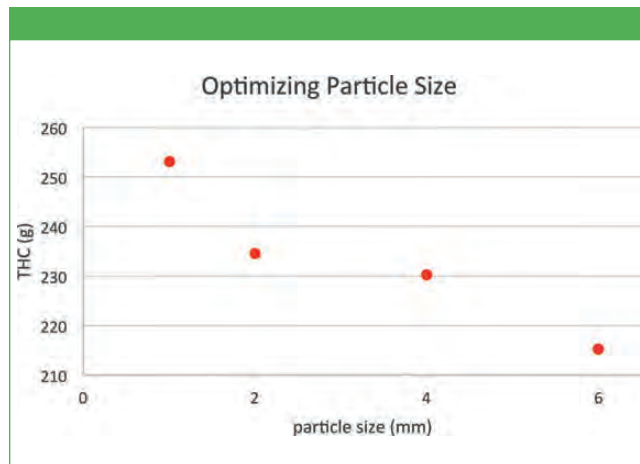


Figure 1: Extraction efficiency for different particle sizes. All other inputs are identical, for example, type of material, weight of material (2.0 kg), and extraction parameters, like temperature (34 °C), pressure (124 bar), and run time (6 h).

Furthermore, this low blade speed avoids thermal damage and loss of volatiles for the sample. It is important that the moisture content of the material being milled is dry, below 15%, as the milling sieve will clog in the presence of moisture. One full extraction load of 4.5 kg can be milled before stopping the machine to clean the sieve and behind the milling wheel to prevent buildup of chlorophyll and cannabis residue. If there is not enough of a single cultivar to facilitate a full extraction run, a blend of strains can be homogenized using the Fritsch mill. Strains selected for a blend should have complementary flavor profiles and can also be chosen to enhance therapeutic effects.

Other applications OutCo uses the mill for is sample preparation for rosin pressing and milling of flower for pre-roll production. It was found that different particle sizes optimize draw behavior or item stability.

Conclusion

The Fritsch Pulverisette 19 critically supports OutCo's extraction operations by providing fast milling of powders with precise particle size distribution and minimal degradation of raw material.



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High-Sensitivity Potency Testing in Cannabis Extracts

Craig Young, Shimadzu Scientific Instruments

Cannabis testing laboratories typically analyze for 5 to 10 of the most common cannabinoids. This method targets 11 cannabinoids, including THCV, with an instrument cycle time of less than 10 min. The high efficiency chromatography produces sharp chromatographic peaks for the best overall sensitivity.

Medical marijuana is often characterized by higher levels of CBD and lower levels of THC. The therapeutic CBD is desirable for medicinal effect but the psychoactive THC may be unnecessary and even undesirable for some patients. Pain mitigation, reduced severity of nausea, and seizures are some of the therapeutic benefits reported by medical cannabis patients. This THC/CBD ratio information is of primary importance to the medical personnel prescribing cannabis for medicinal purposes. The 10 primary cannabinoids of interest are THCA, d9-THC, d8-THC, CBD, CBDA, CBDV, CBC, CBN, CBG, and CBGA. However, many laboratories also want to analyze for THCV (a difficult-to-resolve target) because, while it is a relatively minor component, its role may be pronounced. The turnkey Cannabis Analyzer for Potency allows quantitative analysis of these 11 components in less than 10 min.

Experimental Conditions

- Column Particle Characteristics: SPP, 2.7 μ m
- Column Format: 150 $\times$ 4.6 mm
- Column Chemistry: C18
- Mobile Phase A: 0.085% phosphoric acid in water
- Mobile Phase B: 0.085% phosphoric acid in acetonitrile
- Pump Elution Mode: Gradient
- Detector Wavelength: 220 nm
- Cycle Time: 10 min

Table I: Quantitative Result of Flower Sample

#	Compounds	Conc (mg/L)	wt %
1	THCV	0.28	0.05
2	CBD	0.491	0.09
3	CBG	0.53	0.11
4	CBDA	0.715	0.14
5	CBGA	0.816	0.16
6	CBN	1.501	0.3
7	D9-THC	11.894	2.38
8	D8-THC	ND	ND
9	CBC	0.65	0.13
10	THCA	18.915	3.78
11	CBDV	ND	ND
Potency			5.70%

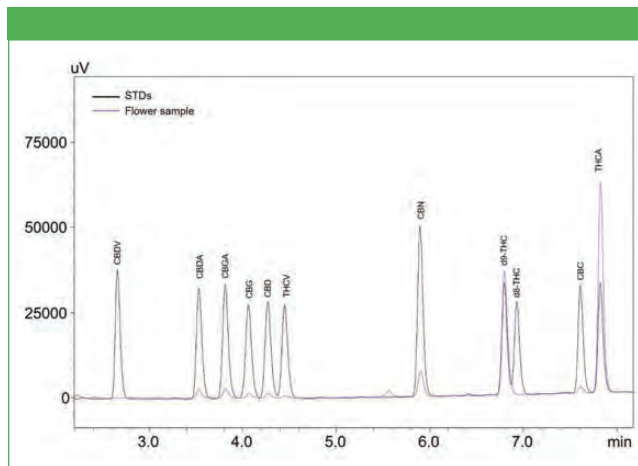


Figure 1: Overlay of THC-rich flower extract and 10 mg/L standard mixture.

Results and Discussion

The purpose of this analysis represents a compromise between sample throughput and resolving power. Quantitative analysis of THCV is mandatory. A superficially porous particle (SPP) column with 2.7 μ m particle size was chosen for increased efficiency, yet with greatly reduced back pressure. This provided reduced run times, narrow peaks, high repeatability, high reproducibility, and method ruggedness.

Conclusion

There are various analysis goals when analyzing for cannabis potency. This application illustrates a high-sensitivity method designed to detect THCV. Modifications to methods can be made for higher throughput or resolution. In each case, the analyst must compromise on questions of sample throughput and resolution of target peaks while ensuring accurate quantitation.



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Analysis of Plant Materials for Toxic and Nutritional Elements with the NexION 350 ICP-MS

Ewa Pruszkowski and Cynthia Bosnak, PerkinElmer, Inc.

Plants primarily serve as a food substance, being an important source of nutrients. However, toxic elements can also be found in plants, primarily through uptake from the soil, water, and fertilizer. Therefore, it is important to measure both the nutritional and toxic elemental content of plants and plant materials.

Several challenges arise in the elemental analysis of plants. First, because both toxic and nutritional elements must be measured, a wide dynamic range is required. Plants are complex biological entities which require sample preparation, usually consisting of homogenization followed by digestion in order to break down the complex matrix and extract the elements. Despite these steps, matrix-induced spectral interferences still persist which could cause false readings, especially for the toxic elements. Therefore, collision or reaction cell technology has to be used to remove the interferences.

One plant species that is gaining considerable interest in the United States is cannabis (that is, marijuana) since its use has been legalized in several states, both for recreational and medicinal purposes through inhalation and consumption in food products. With its increased use, interest in the toxic and mineral element content has also risen.

An additional challenge of cannabis analysis in the U.S. is legally attaining samples, since it is illegal in some states. However, hops are a generally accepted surrogate for cannabis due to its similar chemical and physical properties.

This work discusses the analysis of hops (as a surrogate for cannabis) for both toxic and nutritional elements with ICP-MS.

Experimental

Sample Preparation

Hops were purchased from a commercial store and chopped into small pieces, both to homogenize the sample and expose more surface area for increased digestion efficiency. The Titan MPS™ microwave sample preparation system with the standard 75 mL PTFE vessels was used for digestion digestion, following the program in Table I. Each vessel contained 0.25 g of plant material, 5.0 mL of concentrated nitric acid, 5.0 mL water, and 3.0 mL of 30% hydrogen peroxide. After digestion, the samples were diluted to 50 mL

Step	Target Temp (°C)	Pressure, Max (bar)	Ramp Time (min)	Hold Time (min)	Power
1	150	30	5	5	60
2	200	30	5	20	90
3	50	30	1	10	0

Table II: Elements and Analysis Mode

Element	Mass	Mode
Beryllium (Be)	9	Standard
Boron (B)	11	Standard
Sodium (Na)	23	Collision
Magnesium (Mg)	24	Collision
Aluminum (Al)	27	Collision
Phosphorus (P)	31	Collision
Sulfur (S)	34	Collision
Potassium (K)	39	Collision
Calcium (Ca)	44	Collision
Vanadium (V)	51	Collision
Chromium (Cr)	52	Collision
Manganese (Mn)	55	Collision
Iron (Fe)	56	Collision
Cobalt (Co)	59	Collision
Nickel (Ni)	60	Collision
Copper (Cu)	63	Collision
Zinc (Zn)	66	Collision
Arsenic (As)	75	Collision
Selenium (Se)	78	Collision
Strontium (Sr)	88	Collision
Molybdenum (Mo)	95	Collision
Cadmium (Cd)	111	Collision
Tin (Sn)	118	Standard
Antimony (Sb)	121	Standard
Barium (Ba)	137	Standard
Mercury (Hg)	202	Standard
Thallium (Tl)	205	Standard
Lead (Pb)	208	Standard
Thorium (Th)	232	Standard
Uranium (U)	238	Standard

with deionized water, along with the addition of gold (Au) to stabilize mercury (200 µg/L Au in the final solution).

Instrumental Conditions

All analyses were performed on a PerkinElmer NexION® 350 ICP-MS with the standard sample introduction components and conditions. The elements and analysis mode used are shown in Table II. The internal standards were added on-line via a mixing tee. The final concentration introduced to the instrument were 10 mg/L Sc, 5 mg/L Ge, and 0.1 mg/L Rh, In, Tb in 10% methanol and 1% nitric acid. Using both standard and collision modes, the analysis time was 100 s per sample.

Results and Discussion

Table III shows the average results for two digestions of hops. To test the accuracy, pre-digestion spikes were added for those elements present at less than 50 mg/kg. The spike levels were 20 mg/L for all elements, except Hg, which was spiked at 2 mg/L. All spike recoveries were within 15% of the added amounts, further validating the methodology.

Table III: Results for Analysis of Hops

Element	Experimental (mg/kg)	% Recovery
Be	0.00	86
B	27.7	106
Na	13.2	113
Mg	3617	---
Al	10.8	108
P	6580	---
S	2001	---
S	34358	---
Ca	10936	---
V	0.04	101
Cr	0.23	96
Mn	17.3	113
Fe	58.6	---
Co	1.33	105
Ni	2.27	107
Cu	6.27	90
Zn	31.8	122
As	0.03	100
Se	0.20	102
Sr	17.9	99
Mo	0.93	102
Cd	0.02	97
Sn	0.28	96
Sb	0.01	96
Ba	18.1	94
Hg	0.04	97
Tl	0.00	88
Pb	0.65	87
Th	0.00	95
U	0.00	95

Conclusions

This work has demonstrated the ability of the NexION 350 ICP-MS, combined with a Titan MPS microwave, to effectively analyze hops (as a surrogate for cannabis) for both nutritional and toxic elements. Analyses are accomplished in both collision and standard modes and require only 100 s per sample. The accuracy of the applied method was previously validated by analyzing a variety of NIST™ plant materials (1).

Reference

- (1) C. Bosnak and E. Pruszkowski, "The Determination of Toxic, Essential, and Nutritional Elements in Food Matrices Using the NexION 300/350 ICP-MS," PerkinElmer Application Note.



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High-Throughput Filtration Using the [MPE]² for Cannabinoid Analysis

Anthony Torres* and Ryan M. Ravenelle†, *Steep Hill Labs, †Hamilton Robotics

An increasing number of jurisdictions within the United States have legalized the use of medicinal marijuana, along with several states that have also legalized it for recreational sale. As with any consumer product, quality control methods are necessary to ensure product safety; additionally, properly characterized cannabinoid profiles give consumers confidence in purchasing products with the desired dose and physiological response. While several methods are used to evaluate these compounds of interest, it is important to keep in mind that scalability and throughput are crucial factors to consider as laboratories will need to accommodate increased analytical requests. One difficulty with cannabis and cannabis infused products is the amount of manual labor in the sample preparation procedures, including separation and filtration of extraction solutions. After extracting the compounds of interest with a solvent, the mixtures are typically either centrifuged or manually separated with syringe filters or other tedious manual methods. In this study, an automated high-throughput filtration method, using the [MPE]²—Monitored Multi-flow, Positive Pressure Evaporative Extraction module—from Hamilton Robotics, was evaluated for cannabinoid analysis in multiple matrices.

Materials and Methods

For flower and concentrate samples, two extractions of 500 mg of sample (for flower) and 100 mg of sample (for concentrate) were prepared in a conical tube with the addition of 10 mL acetone. For edible samples, two extractions of 2000 mg were prepared in a glass VOA vial with the addition of 10 mL cyclohexane. For each extraction, the mixture was homogenized and sonicated. The two mixtures of each respective sample were then subjected to two separate filtration methods (Figure 1). In the manual filtration method, the mixture was transferred to a syringe with a 0.2- μ m luer lock syringe filter attached (Phenomenex®) and pushed through the filter by hand. For the automated method, the mixture was transferred to an individual well of a 0.2- μ m regenerated cellulose 96-well filter plate (Chrom Tech, Inc.®

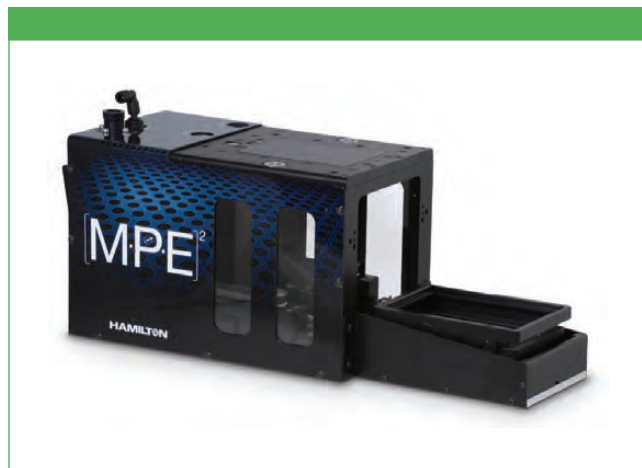


Figure 2: [MPE]² from Hamilton Robotics is an automated positive pressure extraction module.

P/N: 96F-RC020) then loaded into the [MPE]² (Figure 2) and pushed through the filter plate into a collection plate according to a predefined pressure and hold profile (40 psi, 30 s hold). All filtrates were then diluted into an LC vial with the addition of an internal standard.

Samples were analyzed by LC-DAD (Agilent 1100 Series HPLC system) equipped with a Restek® Raptor ARC-18 HPLC column. Five dilutions of each sample were run for repeatability. Quantitation was performed against an 11-point calibration curve prepared from commercially available analytical grade standards for THC-A (Restek), THC (Restek), CBD-A (Cerilliant®), and CBD (Restek) at 1000 μ g/mL down to 0.56 μ g/mL.

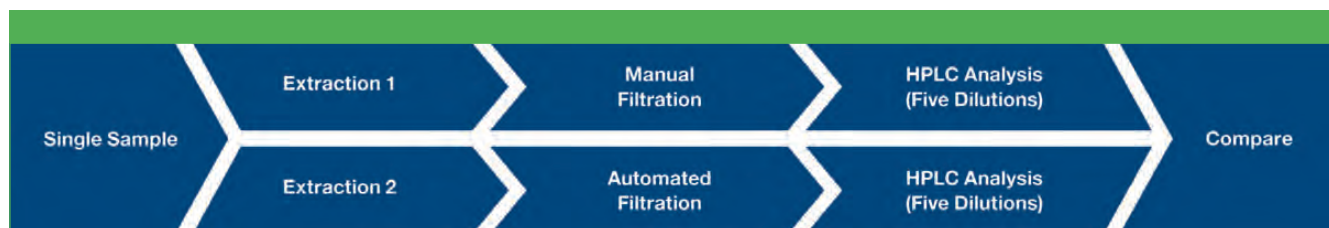


Figure 1: Extraction, filtration, and analysis workflow.

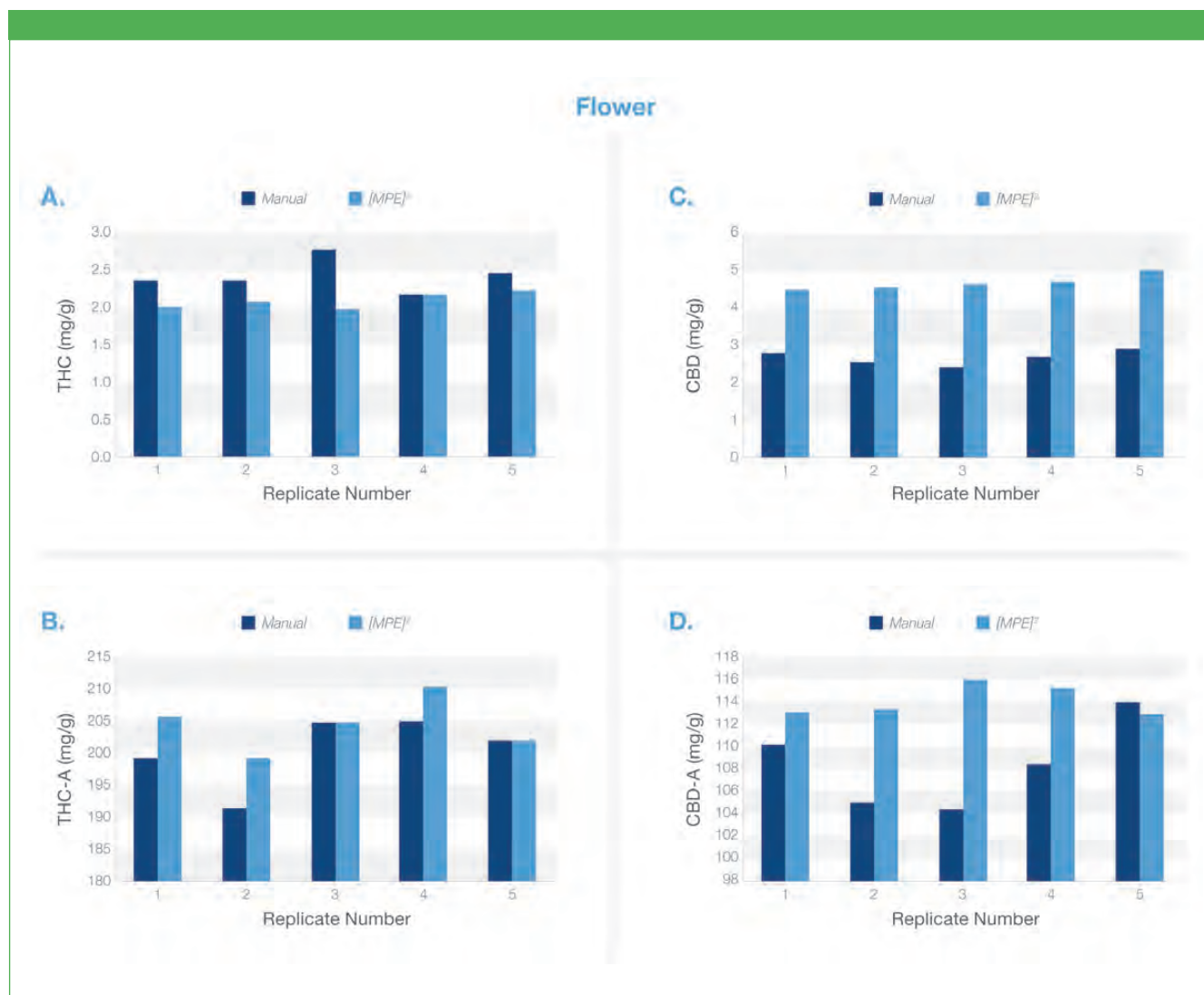


Figure 3: Measured concentrations of A. THC, B. THC-A, C. CBD, and D. CBD-A in flower samples.

Table I: Statistical Measures of Samples Measured by Both Methods

		Mean (mg/g)		Std. Dev. (mg/g)		Std. Dev. (as % of mean)	
		Manual	[MPE] ²	Manual	[MPE] ²	Manual	[MPE] ²
Flower	THC	2.44	2.11	0.22	0.11	8.97%	5.10%
	THC-A	200.54	204.51	5.58	4.24	2.78%	2.07%
	CBD	2.71	4.71	0.20	0.20	7.23%	4.26%
	CBD-A	108.47	114.19	3.94	1.39	3.63%	1.22%
Edible	THC	0.72	0.77	0.03	0.02	3.55%	3.09%
Concentrates	Sample 1 CBD	1003.56	1021.01	47.15	20.93	4.70%	2.05%
	Sample 2 CBD	264.20	270.06	10.57	5.10	4.00%	1.89%

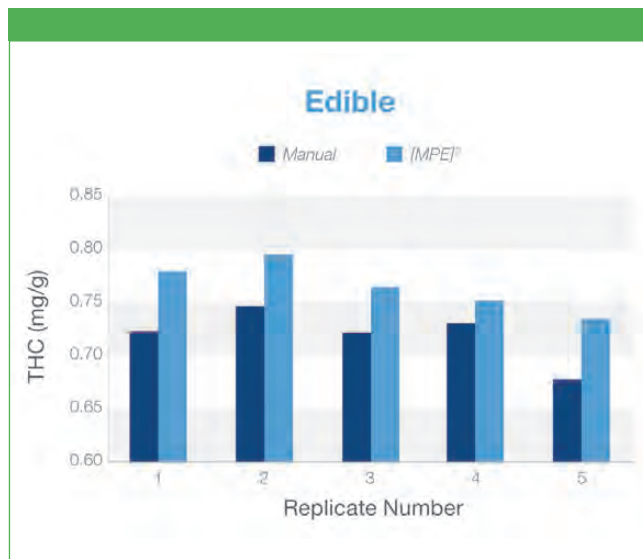


Figure 4: Measured concentrations of THC in edible samples.

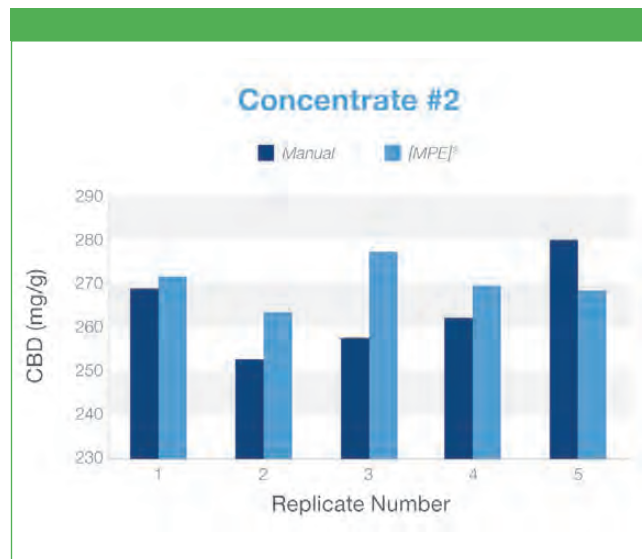


Figure 6: Measured concentrations of CBD in concentrate #2 sample.

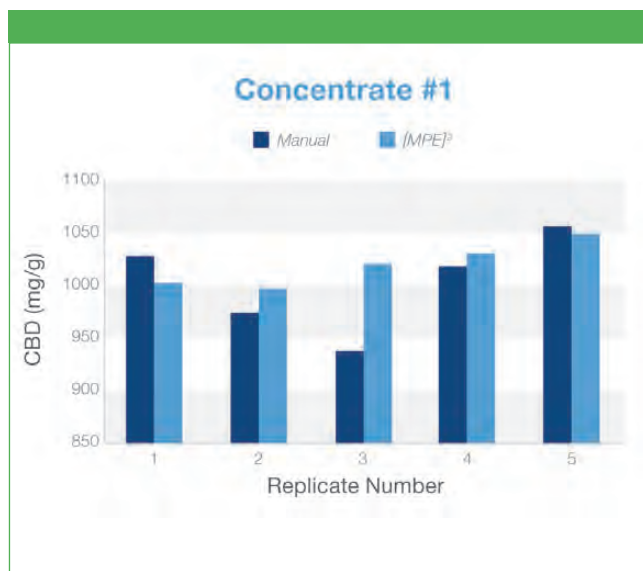


Figure 5: Measured concentrations of CBD in concentrate #1 sample.

Results and Discussion

The efficacy of the automated filtration method can be illustrated by a direct comparison of filtrates from the manual method. As previously mentioned, five dilutions of each sample filtrate were analyzed on the LC for reproducibility. The results for THC, THC-A, CBD, and CBD-A in flower are given in Figures 3A–3D. With the exception of THC, the mean values of all cannabinoids were higher when filtered with the [MPE]² compared to the manual method (Table I). The most notable difference was for CBD, where the mean value measured after filtration with the [MPE]² was 1.7 times higher than that via the manual syringe

filter method. It is also interesting to note that smaller relative standard deviations were observed for all compounds in flower when using the [MPE]² and filter plate.

For the measured THC values in edible, the manual filtration yielded values from 0.68 to 0.75 mg/g, while those for the automated method were between 0.74 and 0.80 mg/g (Figure 4), and the resulting average value was about 7% higher for the automated method. Similar results were observed for CBD in both concentrates, where the mean values were higher utilizing the [MPE]². There was also a notable decrease in measured standard deviations in the dilution sets of the samples filtered with the [MPE]² (Figures 5 and 6). When comparing the average values obtained for all sample types, measured cannabinoid concentrations were consistently higher when processed with the [MPE]² compared to the manual method (Table I). It is unclear if this is just an artifact or a result of more efficient filtering (for example, less analyte binding to membrane) in the case of using filter plates and the [MPE]². In terms of reproducibility, all analytes had standard deviations within 5.1% or less of the mean values (Table I) using the [MPE]², while standard deviations of up to 9.0% of the mean were observed for the manually filtered samples. Currently, it is unclear why the standard deviations with the filtrates from the [MPE]² were smaller; however, the results were consistent across all data sets. Future work will focus on identifying the cause. It is also interesting to note that THC in flower exhibited the highest standard deviation of both methods. Further testing is necessary to elucidate whether THC itself is generally just more difficult to measure consistently in flower compared to the other cannabinoids. In addition to comparing measured concentrations obtained via both methods, it is also important to note the savings in time and materials. By utilizing the 96-well

plate and the [MPE]², the tedious and time consuming syringe filter method is avoided. A sample typically takes ~30 s to filter via a syringe; therefore, laboratories could realize around 45 min of time savings filtering a full plate of samples. The automated method also reduces strain and potential injury to technicians by avoiding strenuous forcing of fluid through luer lock filters. Based on available products prices, it is estimated that the filter plate method costs up to 40% less per sample than using luer lock syringe filters, and also significantly cuts down on waste.

Conclusion

In this study, two methods of sample filtration for cannabinoid analysis are compared. Specifically, three sample types (flower, edible, and concentrate) are filtered through both a manual syringe filter and a 96-well filter plate with an automated positive pressure extraction unit and then analyzed for cannabinoids. It was demonstrated that filtration with the [MPE]² typically gave higher yields of cannabinoids and also significantly increased reproducibility compared to the manual syringe filters. Additionally, savings in time and consumables cost make the automated method attractive for high-throughput sample handling.

Acknowledgements

The authors would like to acknowledge lab ware and materials supplied by Chrom Tech, Inc. for these efforts.

The logo for Hamilton Company, featuring the word "HAMILTON" in a bold, blue, sans-serif font, followed by a circular emblem containing a stylized "H" and the word "Company" in a smaller, blue, sans-serif font.

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EXHIBITOR PROFILES

908 Devices

Booth #139

908 Devices, a pioneer of ridiculously small and elegantly simple analytical devices, recently introduced the G908 3-in-1 Cannabis Analyzer. G908 combines award-winning high-pressure mass spectrometry™ (HPMS) with the separating power of ballistic gas chromatography (GC), enabling users to perform three tests on one device: total potency, terpenes, and residual solvents.



A2LA

Booth #141

A2LA is a nonprofit, multidiscipline accreditation body with almost 40 years of experience providing internationally-recognized accreditation services and quality training. A2LA's accreditation services encompass testing and calibration laboratories, clinical testing laboratories, inspection bodies, proficiency testing providers, reference material producers, and product certification bodies.



Accelerated Technology Laboratories

Booth #349

Accelerated Technology Laboratories (ATL), a leading provider of laboratory information management systems (LIMS), offers customers a comprehensive solution to cannabis testing laboratories. From assessment, to planning, implementation, and training and support services, ATL has you covered. Result Point® is a secure web reporting portal for clients.

Visit us at www.atlab.com.



ACE Glass

Booth #248

Ace Glass has been a leader and innovator of scientific glassware and lab equipment for over 80 years. We provide a wide variety of quality US manufactured standard glass apparatus and custom glassware, including distillation and extraction equipment, and reactors designed to customers' specific applications from 100 mL through 200 L.



ACIL

Booth #512

Founded in 1937, the American Council of Independent Laboratories (ACIL) represents both large and smaller, family-owned, independent, commercial scientific and testing laboratories. ACIL's mission is to enhance members' success by providing advocacy, education, service, and mutual support, as well as promoting quality, ethics, independence, objectivity, and free enterprise.



ACS/C&EN

Booth #405

Chemical & Engineering News, published by the American Chemical Society, is the academic and industry-approved voice of record in the chemical industry that partners directly with marketers to activate more than 25 million researchers - lab directors, R&D professionals, and policy influencers.



Advanced Nutrients **Booth #459 & #461**

Advanced Nutrients, founded by Michael "BigMike" Straumietis, is the number 1 marijuana fertilizer and supplement company in the world, with sales in 95 countries.

Advanced Nutrients' laboratories boast 25 PhD's, tirelessly perfecting cannabis formulas. That's why its products have been used to repeatedly win every major cannabis grow competition in the world.



Advion **Booth #430**

Advion is a leader in MS and synthesis solutions. The expression CMS is a high performance, compact, affordable single-quad mass spectrometer. Its compact size allows it to fit in space-limited labs for direct access and immediate results for chemists requiring mass confirmation, reaction monitoring, QC, and purity analysis. www.advion.com



Ag Energy Solutions **Booth #409**

Carbon Logic products are natural soil amendments that provide a wide range of benefits for plant growth, including increased yields in both soil and soilless media. Two formulations for cannabis have demonstrated over a 50% increase in yield. Find out how Carbon Logic can help you build bigger, better buds.



Agilent **Booth #137 & #236**

Agilent Technologies is a worldwide provider of GC, LC, MS, and spectroscopy instruments, technologies, related consumables, support, services, and workflow solutions that enable labs to analyze, confirm, and quantify substances of interest with confidence while maintaining the most stringent laboratory practices, from sample preparation to final report. Learn more: www.agilent.com.



American Laboratory/Labcompare **Booth #161**

Sign up for your free subscription today!
www.americanlaboratory.com

For laboratory managers and researchers utilizing analytical chemistry and seeking knowledge on new technologies, methods, applications, and products, the American Laboratory® publication platform provides comprehensive technology coverage for laboratory professionals at all stages of their careers.



Americans for Safe Access **Booth #113**

The mission of Americans for Safe Access is to ensure safe and legal access to cannabis for therapeutic use and research. Founded in 2002, ASA works to overcome political, social, and legal barriers by creating policies that improve access to medical cannabis for patients and researchers.



Analytical Instrument Management

Booth #305

Analytical Instrument Management is a leading supplier of refurbished analytical laboratory instrumentation for the cannabis testing industry. We provide application specific chromatography systems for cannabis potency testing, residual solvents in cannabis concentrates, terpenes analysis, and basic pesticide profiling. All of our equipment is completely refurbished, tested with warranty. Installation and training available.



Anton Paar USA

Booth #115

Anton Paar produces high-quality measuring and analysis instruments for laboratory, research, and industrial applications. In the fields of density and concentration measurement, we are the established world leader. Our product portfolio also includes viscometers, rheometers, polarimeters, refractometers, microwave synthesis, microwave decomposition, and instruments for X-ray structure analysis.



Aokin

Booth #219

The Aokin poetry system offers a rapid, simple-to-use system for testing plant, food, or liquid samples for THC, CBD, and mycotoxins. Aokin automated system offers HPLC sensitivity and accuracy. Designed for rapid testing on-site or in areas ranging from incoming goods control to routine analysis.



Bio-Rad Laboratories

Booth #413

Bio-Rad Laboratories has played a leading role with advancing science for 65 years. We offer fast, easy, and complete solutions for pathogenic bacterial testing. Certified analytical test methods for *Salmonella*, *E.coli*O157:H7, STEC, and more. RAPID[®]Chromogenics or iQ-Check[®] real-time PCR; Bio-Rad manufactures, supports, and partners with you for your safety success.



Biotage

Booth #352

Biotage offers solutions, knowledge, and experience in the areas of analytical chemistry, separation, and purification of cannabis extracts. Our customers include companies within the cannabis industry, pharmaceutical and biotech companies, companies within the food industry, and leading academic institutes. Check out the Extrahera[™] automation, the Isolera[™] Dalton, Mass Detection, and the Isolera[™] Spektra.



Buchi Corporation

Booth #444

We are experts in laboratory and industrial solutions for the marijuana market. Buchi offers solutions for extraction, concentration, solvent recycling, chromatography, formulation of products, and analysis.

Our solutions include: rotary evaporation, spray drying, freeze drying, melting point, preparative chromatography, extraction, distillation and digestion, and NIR (near infrared spectroscopy).



Cannabis Club TV**Booth #257**

Cannabis Club TV is the first broadcasting network devoted to the cannabis industry certified by Tommy Chong! The rapidly-growing network produces and publishes the latest cannabis-related news, entertainment, and business content straight into dispensaries' waiting rooms and sales floors across the nation while simultaneously helping to facilitate a marketing and branding reach for businesses like never before.

**Cannabis Industry Journal****Booth #147**

CannabisIndustryJournal.com is a B2B, online trade journal serving the global cannabis marketplace. We publish news, technology, trends, regulations, and expert opinions on cannabis business, safety, quality, and sustainability, aiding in the advancement of an informed and safe market for the global cannabis industry.

**Cannabis Life
Radio/Green Roads****Booth #107 & #109**

Green Roads (est. 2013) is one of the world's leading suppliers of cannabidiol/hemp derived CBD products, with over 5,000 wholesale clients and over one million end users. Green Roads products are formulated by a compounding licensed pharmacist in an ISO6 clean room to ensure the highest quality finished products.

We believe, "THERE'S ALWAYS A NATURAL ALTERNATIVE"

**Cannabis Medical Network, Booth #220**

Cannabis Lifestyle Network, and sister network, Cannabis Medical Network are the latest Digital Signage network launches of CMN Holdings, Inc. Both help to educate cannabis clients while they wait, CMN at the POC (doctors) and CLN, POS (dispensaries). Free equipment, install, service, and content with subscription—zero-cost placement. "It's ALL about the content!"

**Cannabis Nurses Network****Booth #210**

Cannabis Nurses Network is a global network to empower nurses through education, opportunity, recognition, and advocacy. Their affiliate organizations, *Cannabis Nurses Magazine* and *Nature Nurse™* are leading the way through education and a natural product line that's rooted in ancient plant wisdom; expanded upon through science. Synergistically they are guiding nurses and their patients through health and wellness around the globe.

**Cannabis Scientific****Booth #339**

Cannabis Scientific is a subsidiary of a fourth generation, 120 million dollar scientific supplier, created to support the MMJ community. Our partnership with over 1,500 suppliers allows us to provide the top brands, supplying the complete portfolio of products needed as well as the value of full support and industry knowledge.



CANNAHEALTH**Booth #157**

CANNAHEALTH is a digital magazine to empower healthcare providers and caregivers through knowledge, supplies resources for safe access, and opportunities for advocacy.

It is FREE, monthly. It's loaded with clinical and scientific articles from various healthcare disciplines (such as physicians, registered nurses, pharmacists), profiles of cannabis clinics and organizations, "how to" articles, and patient success stories.

**CannaKids/Leafhead****Booth #261**

Leafhead is a technology platform serving the legal cannabis and industrial hemp industry by providing network building, educational, and marketing tools to promote brand success in a niche market.

Browse our catalogs to find suppliers and service providers or join the community and start building your network today!

**Cannaline****Booth #259**

Since 2009, Cannaline has been supplying the recreational and medical cannabis industry with the highest quality marijuana packaging for flower, edibles, and concentrates. We take pride in securing brand packaging that stands out, while protecting your margins. Our staff has extensive industry knowledge that helps make choosing the right packaging option easy.

**Chalice Farms**

Chalice Farms is a seed to sale, lifestyle cannabis company based in Oregon. We are dedicated to inspiring the eternal search of the adventurous spirit—embracing community, wellness, and lifestyle. We go above and beyond industry standards, to ensure you're receiving consistently excellent cannabis flower, extracts, and edibles.

**Chem Service, Inc.****Booth #514**

Over 55 years of manufacturing and supplying analytical reference standards. Organic and inorganic standards including pesticides, metabolites, PAH's, PBDE's, PCB's, phthalates, bisphenols, vitamins, and many more. A leader in custom standards made to meet your strict requirements, Chem Service is accredited ISO Guide 34, ISO 17025, and certified ISO 9001.

**Chiral Technologies****Booth #453**

Chiral Technologies, Inc. is the global market leader in enantioselective chromatography, offering the most extensive portfolio of DAICEL chiral stationary phases available. Scientists in the pharmaceutical, agricultural, and food industries, universities, and government agencies rely on our expertise to separate chiral molecules into single enantiomers in research and development departments, QC laboratories, and manufacturing.



CHROMacademy Booth #313 and #337

CHROMacademy offers instruction for the analytical chemistry community via Live @Your Place, video training, and www.CHROMacademy.com. CHROMacademy.com is an intuitive e-learning and troubleshooting platform for HPLC, GC, sample preparation, mass spec, biochromatography, basic laboratory skills, and infrared spectra. CHROMacademy offers its members LITE (free), Premier, and Corporate membership options.

**Compassionate Certification Centers Booth #255**

Join us from April 12–14, 2018, at the David L. Lawrence Convention Center in Pittsburgh, PA for our next annual World Medical Cannabis Conference & Expo! Close to 3,000 people attended last year's Expo, which featured 150+ vendors, several keynote speakers, workshops, and an array of panel discussions with industry leaders.
www.cccregister.com

**CompuGroup Medical Booth #426**

CGM LABDAQ®, the #1 installed Laboratory Information System (LIS) in the U.S., is uniquely designed to help manage the workflow of your laboratory including: cannabis testing workflow automation, interfaces for LC–MS and METRC systems, results reporting, maintaining testing records, quality control software, chain of custody, specimen tracking and storage, and secure login with username and password.

**eCS Therapy Center Booth #145**

The ECS Therapy Center is a nationally recognized nonprofit focused on community education and research. The eCS Therapy Center offers accredited and community education certification programs, in addition to partnering on research projects focused on medical cannabis patients. Research 2017: "The Medical Cannabis Recommendation: An Integral Exploration of Doctor-Patient Experiences."

Eden Labs Booth #504

Eden Labs has pioneered extraction and distillation technology for the cannabis industry since 1994. Led by CEO AC Braddock since 2009, Eden produces the highest yielding, most-reliable CO₂ systems for commercial and industrial use up to 6000L SCFE plants. Eden's brand is highlighted by its innovation and a reputation for an elevated customer experience.

**Edibles List Magazine Booth #560**

EdiblesList.com and *Edibles List Magazine* is the premier resource on cannabis infused edibles education, and more, including: vapes, topicals, concentrates, tinctures, flowers, tech, distribution, and events. You can read our magazine in print, online, or via app. We also have an edibles distribution company and produce the Infused Expo and The 4th Annual Best of Edibles Awards.



Elixinol**Booth #434**

A global leader in hemp-derived CBD, Elixinol uses supercritical CO₂ whole plant extraction and 100% organic certified European hemp. All Elixinol products are regularly tested for the highest purity and potency. Inspired by hemp advocate and Elixinol CEO, Paul Benhaim, the entire Elixinol team is dedicated to ongoing hemp education.

**Ellutia****Booth #347**

Ellutias offer a range of gas chromatography instruments for cannabis analysis. Ellutia GCs are the ideal solution for laboratories looking to start cannabis GC analysis, thanks to their simple operation, compact size, lower cost, and outstanding performance.

**Emerald Scientific****Booth #455 & #457**

Emerald Scientific is the premier distributor of scientific instruments, equipment, and supplies for cannabis analysis. We serve testing labs; extraction facilities; genetics and seed companies; and conventional research laboratories that investigate related compounds. We advocate for collaboration, transparency, and evolution of the cannabis industry toward reliable and sophisticated science.

**Encore Scientific****Booth #428**

Encore Scientific is an FDA registered, cGMP compliant custom supplier of top quality, fine ingredients. Our catalog also includes an extended line of equipment and accessories to outfit a laboratory of any size. Contact the Encore team today to see how we can provide excellent support for your business!

**Flowering Hope Foundation****Booth #155**

The Flowering H.O.P.E. Foundation is a Colorado 501c3 nonprofit organization focusing on education and resources for families seeking alternative health options. We create opportunities for a better quality of life. Our support group helps connect families around the world with research, laboratory reports, dosing tools, but most importantly, each other.

**Fluid Management Systems****Booth #552**

The FMS, Inc. PLE[®] system is a high-speed pressurized liquid extraction system designed to perform sample extraction of multiple samples for the analysis of pesticides and potency in cannabis simultaneously. The PLE system delivers high recoveries and excellent precision for all analytes in minutes instead of hours.



Freedom Leaf**Booth #153**

Freedom Leaf, Inc., a fully reporting and audited publicly traded company under the symbol (OTCQB:FRLF) is a movement marketing company comprised of a portfolio of news, published and digital media, "online" marijuana-related websites, offering advertising, public relations, business consulting, branding services, business development, and incubation.

**Fritsch****Booth #335 & #337**

Since 1920, FRITSCH has engineered & manufactured a wide range of precision milling and grinding systems to meet GLP and cGMP requirements. For sample preparation and production applications, the controllable and reproducible milling outputs set a new standard for the cannabis industry. Visit us during the conference to discuss your specific applications.

**Full Spectrum Analytics, Inc.****Booth #414**

We are an end-to-end solutions provider, specializing in chromatography instrumentation service. Our prompt on-site response time makes us one of the leading support providers in today's analytical instrument marketplace. FSA brings you the best solutions for your laboratory service needs, at a moment's notice.

**GenTech Scientific****Booth #442**

For over 20 years, GenTech has provided its services to thousands of satisfied customers. We offer you the instruments required to test cannabis at a fraction of the cost of new instruments. Let GenTech help alleviate the cost of starting up your cannabis laboratory, with our instrument expertise and extended warranties!

**Hamilton Robotics****Booth #149**

Hamilton Robotics is a leading global manufacturer of automated liquid handling workstations, standard application-based solutions, small devices, and consumables. Our platforms provide fully automated solutions for extraction, separation, and many other sample preparation techniques for workflows such as cannabinoid analysis, pesticide screening, genetic testing, and microbial contamination.

**Hemco Corporation****Booth #343**

HEMCO Corporation manufactures cannabis extraction hoods to meet your size and design requirements including large floor mount hood enclosures and benchtop fume hoods. All hoods and enclosures feature Class I Div I explosion-proof lighting. Factory fire suppression is recommended along with optional explosion-proof exhaust systems and laboratory furniture.



Higher Promos**Booth #242**

Higher Promos helps grow the marijuana industry with useful promotional products (decorated apparel, imprinted gifts, customized awards). Our associates listen and collaborate with you to find the perfect solution for your needs. We recommend the best choices for your audience based on recipient demographics, program goals, timing, and budget.

**Highlife Magazine****Booth #111**

HIGHLIFE Media is a print and digital media company on the frontline of recreating the perceptions of medical cannabis, recreational marijuana, and industrial hemp globally. We provide a collective of HIGH-class contributors of original content and an on-the-ground print/digital campaign presence to build brand awareness and education in the emerging cannabis space. We are challenging the "Stoner Stigma."

**IMPACT Network**

IMPACT Network is a 501c3 nonprofit Improving Marijuana Policy and Accelerating Cannabinoid Therapeutics for Women Worldwide. We envision a world where cannabis is a safe, effective, accessible, and affordable option for all women. Through clinical research and community outreach, we find new solutions to underserved women's health issues.

**JEOL USA****Booth #214**

JEOL is a leading manufacturer of high-resolution mass spectrometers, nuclear magnetic resonance spectrometers, and electron microscopes. The JEOL AccuTOF-DART mass spectrometer permits near-instantaneous analysis of plant material, extracts, and even edibles with little or no sample preparation. The AccuTOF-DART can even be applied to species identification directly from plant material.

**Julabo USA, Inc.****Booth #448**

JULABO USA manufactures high quality, German-made liquid temperature control instruments from -95 °C to +350 °C. With a wide range of capacities, our products accommodate cannabis extraction/component isolation spanning: ethanol distillation, winterization, butane extraction, SCF CO₂ extraction to vacuum distillation processes. Contact JULABO for an expert consultation.

**Knalysis Technologies****Booth #412**

Knalysis Technologies has developed a suite of fully customizable, cloud-based software to seamlessly link physician, producer, provider, and patient. We are quantifying the efficacy of cannabis products in the treatment of specific symptoms. The Knalysis solution set includes our Knalysis Wellness Tracker, Analytics Web Portal, and the Cannabis Patient Manager.



Lab Manager**Media Partner**

With the understanding that most lab managers move into that role with little business or management background, *Lab Manager's* editorial is focused on filling that knowledge gap. With topics ranging from managing budgets to hiring staff to making informed laboratory purchases, our goal is to help our readers be successful both as scientists and business operators.

**LCGC****Booth #313 & #315**

LCGC's mission is to enhance the productivity, efficiency, and the overall value of separation science globally. Through unbiased peer-reviewed content, trusted troubleshooting advice, and best practice applications solutions, we serve as a mentor to laboratory-based analytical chemists so they can enhance their proficiency in modern chromatographic technique and instrumentation.

**LenitivLabs****Booth #307 & #309**

LenitivLabs line of proprietary products utilize the latest cannabis manufacturing technologies and research to deliver high-quality, consistent products that contain no harmful additives. Founded by media personality and wellness advocate Montel Williams, the line currently includes CO₂ extracted oils in a spectrum of THC:CBD ratios and nutritious one-shot drinks. www.lenitivlabs.com

**LGC Standards****Booth #438**

LGC manufactures cannabis testing standards for pesticides, growth regulators, terpenes, trace elements, and residual solvents. Available as single component solutions and mixtures, these products are manufactured in accordance with ISO Guide 34 requirements. Rely on LGC to help you deliver safe, high-quality medical and recreational cannabis products to your customers.

**Mac-Mod Analytical****Booth #411**

MAC-MOD Analytical uses advanced state-of-the-art analytical software to match our product portfolio with your separation needs. We leverage our 30-plus years of technical expertise and manufacturing network to help you solve your toughest application problems. We value our customers, and we strive to deliver the most innovative HPLC and UHPLC columns and accessories available.

**Marijuana Venture****Booth #256**

Marijuana Venture, the nation's #1 cannabis business magazine, is distributed at major retailers throughout the U.S. and Canada, including Barnes & Noble, Books-A-Million, Hudson airport stores, and more. In 2015, it received an award as one of America's fastest-growing magazines. *Marijuana Venture* also has a quarterly spinoff, *SunGrower & Greenhouse*.



Medical Genomics**Booth #360**

Medicinal Genomics is a leader in cannabis safety testing, cannabis genetics, and point-of-grow testing solutions. Medicinal Genomics' tests ensure patients have access to safe, quality cannabis, while also helping growers and producers identify desirable plant traits, detect harmful microbes, and increase yields.

**Microfluidics International Corporation****Booth #212**

Microfluidics manufactures fluid material processors for unparalleled cell disruption, microencapsulation, microemulsions, dispersions, and deagglomeration. Microfluidizers convert fluid pressure more efficiently into shear forces, setting industry standards in high-pressure homogenization.

HORIBA provides particle characterization products for drug release applications. These include Laser Light (LA-960), Surface Area (SA-9600) and Zeta Potential (SZ-100).

**Milestone, Inc.****Booth #404**

Milestone microwave sample preparation systems offer cannabis testing laboratories unique, high quality digestion solutions for the analysis of metals in cannabis flower and finished products. Additional offerings provide solvent free extractions that produce a full terpene profile with high yields requiring no extra processing.

**MilliporeSigma****Booth #221 & #223**

MilliporeSigma provides innovative solutions, support, and expertise required for laboratory success. In addition to the analytical tools required for small molecule identification, separation, and quantification, we continue to set the standard for analytical research by providing a full range of products for water purification, protein detection, and membrane filtration.

**Nacalai****Booth #238**

Nacalai provides HPLC columns for difficult-to-separate compounds. Our Cosmocore PBr HPLC column can separate 11 cannabinoids under 14 min. The Cosmocore Cholesterol HPLC column can baseline separate Δ -8 THC and Δ -9 THC and metabolites. Additionally, we provide FREE column screening in our San Diego lab and FREE liquid chromatography consultation.

**NCIA****Booth #311**

The National Cannabis Industry Association was founded on the principle of power in numbers. As the industry's national trade association, NCIA works every day to ensure our growing business sector is represented in a professional and coordinated way on the national stage, and is treated fairly under federal law.



OLCC**Booth #406**

Visit the shared OLCC and ODA booth for information about the recreational marijuana program and rules from both agencies. Staff will also be available to answer your burning questions.

**Omni International****Booth #240**

Omni International's homogenizers have been a laboratory staple for over 60 years. Omni sets the industry standard with a commitment to outstanding design, performance, and a uniquely diversified solution-based product line. We offer a complete portfolio of homogenizers and reagents for sample preparation in pharmaceutical, life science, biotechnology, agricultural, microbiology, and chemical research laboratories.

**Oregon Cannabis Retailers (ORCA)****Booth #358**

The Oregon Retailers of Cannabis Association (ORCA) is a member supported nonprofit trade association. Our mission is to create a thriving and respected legal cannabis industry through lobbying, advocacy, and community organizing.

**PathogenDx****Booth #510**

PathogenDx has developed a game changing, disruptive microbial testing solution. Current microbial testing takes days, is costly, and not scalable. Our PDx-C test takes less than 6 hours from leaf to data, at a fraction of the cost, and can run multiple samples while analyzing multiple pathogens simultaneously.

We are the better, faster, cheaper solution to Purity Assurance.

**PerkinElmer****Booth #239**

PerkinElmer is a global leader committed to innovating for a better world. Our 9,000 employees are passionate about helping customers solve issues impacting the diagnostics, discovery, and analytical solutions markets. Our detection, imaging, informatics, and service capabilities, combined with deep market knowledge and expertise, help customers gain earlier, accurate insights.

**Persee Analytics, LLC****Booth #244**

Persee is a world-leading manufacturer of analytical instrumentation. We provide affordable and reliable solutions for cannabis analysis. Our production line includes microwave digestion, UV-vis spectrometers, AAS, heavy metal analyzer, HPLC, GC-MS, and XRF. The professional team will give the analytical method of potency, terpene, pesticide, residual solvent, and heavy metals.



Pistil Point**Booth #307 & #309**

Pistil Point is one of the largest craft-cannabis producers in the world with indoor and outdoor facilities throughout Oregon and California. Pistil Point Labs creates cannabis extractions through various pharmaceutical level processes in line with the cannabis genetics cultivated through our large network of farms.

**PITTCON****Booth #338**

The leading conference and exposition for laboratory instrumentation, services, and methodologies for the sciences is February 26–March 1, 2018 in Orlando, FL. The dynamic expo is complemented by a diverse Technical Program, Short Courses, networking opportunities, and more. Attend this event to expand your network of scientific resources.

**Pixis Labs****Booth #246**

Pixis labs is proud to be the first ORELAP certified cannabis testing lab in Oregon. As the premier full-service testing laboratory in Portland, Oregon, we provide reliable, accurate, and on time analysis for our clients testing environmental, municipal drinking water, storm water, waste water, hazardous waste, food testing, nutritional analysis, pesticides, microbiology, and package labeling.

**ProKure****Booth #554**

ProKure is the EPA-registered, OMRI-listed solution to mold, mildew, and odor for cultivators. ProKure utilizes a patented, water-activated pouch technology to conveniently and safely create chlorine dioxide (ClO₂) on site in any quantity.

**Promium****Booth #446**

Element LIMS from Promium provides a robust, configurable, and affordable information management solution for laboratories that test recreational marijuana. Functionality provides accurate and timely analytical results while improving operational performance and reporting. With broad scientific functionality and seed-to-sale software integration, Element LIMS supports testing for potency, pesticides, terpenes, water activity, mold, and residual solvents.

**RESTEK Corporation Booth #237 & #336**

Chromatography is what we do and who we are. We are an independent, international team of employee-owners serving analysts with unrivaled Plus 1 service, applications, and expertise. From LC and GC columns to sample preparation, standards to accessories, Restek is your first and best choice.



Revolutionary Tactics**Booth #157**

We are an exclusive staffing company that specializes in recruiting and educating highly competent and compassionate physicians for medical cannabis practices. Our staffing focuses on building meaningful relationships that work toward a common goal yielding exclusive results. Our educational approach engages and challenges physicians to expand their scientific and clinical knowledge.

**Ricca Chemical Company****Booth #436**

With over 45 years of chemical manufacturing experience, trust Ricca Chemical Company for your cannabis processing and testing chemical needs. With a broad range of extraction chemicals, terpenes, and testing standards, our dedicated team of technical and service experts will ensure that you receive the products you need.

**Rylie's Smile Foundation****Booth #260**

www.RyliesSmileFoundation.org, is a 501c3 created by young Rylie because of concern felt over the children "left behind." Rylie was diagnosed with aggressive bone tumors and a seizure disorder that resulted from her treatment. Rylie is the inspiration for Rylie's Law and fought for MMJ to be allowed on school property. Rylie is a voice for pediatrics in the MMJ community.

**Scientific Instrument Services****Booth #218**

Scientific Instrument Services is a leading provider of supplies and services for scientific instrumentation.

SIS manufactures thermal desorption systems (TD5 & ADS2000) that specializes in providing cannabis profile identification, including CBD, THC, terpenes, and pesticide residue when coupled to a GC or GC-MS. ISO9001:2008 & 13485:2003

**SCIEX****Booth #252**

SCIEX instruments have been designed with the production laboratory in mind. Developed for cannabis, we aid in the analysis for potency, pesticides, terpenes, and mycotoxins in one injection. Our instruments ensure all of your method requests may be accomplished on one single instrument.

**SciPhy Systems****Booth #318**

SciPhy Systems is here to bring your business into the future of phytochemical processing. From craft cannabis to industrial hemp, SciPhy develops uncompromising post-harvest solutions that exceed the demands of the cannabis industry. Let us build you the processing system you have been envisioning, and leave the past behind.



Shimadzu Scientific Instruments Booth #327

Shimadzu Scientific Instruments is the American subsidiary of Shimadzu Corporation, founded in 1875. We are the experts in medical cannabis testing and offer solutions for potency profiles, pesticide screening, fungicide analyses, residual solvents, terpene profiles, mycotoxins/aflatoxins, and heavy metals. Visit us about your cannabis testing and research needs or visit www.GrowYourLab.com.

**Simply Kind Solutions Booth #253**

Simply Kind Solutions is an emerging leader in the Human Capital services industry, which harnesses the power of technology to deliver complete and total staffing solutions to organizations of all sizes, exclusively catering to companies within the cannabis industry.

**Spectro Analytical Instruments Booth #407**

A member of the AMETEK Materials Analysis Division, SPECTRO Analytical Instruments is a worldwide leading supplier of ICP, ICP-MS and X-ray fluorescence spectrometry technology, used for the elemental analysis of materials in agriculture, agronomy, environmental, industry, research, and academia. For more information go to our website at www.spectro.com

**Spectroscopy Booth #313 & #315**

Spectroscopy's mission is to enhance the productivity, efficiency, and overall value of spectroscopy as a practical analytical technology across a variety of fields. Scientists, technicians, and laboratory managers gain proficiency and competitive advantage for the real-world issues they face through unbiased, peer-reviewed technical articles, trusted troubleshooting advice, and best-practice application solutions.

**Spex Booth #222**

Visit SPEX SamplePrep/CertiPrep at booth 222 to learn how our products can help in your testing of cannabis bud and edibles for potency, pesticides, residual solvents, and contamination. See our Freezer/Mill, a cryogenic grinder, our Geno/Grinder, a high throughput homogenizer, and our range of certified reference materials. Visit www.spex.com for information.

**SWECO Booth #455**

SWECO, represented by Industrial Sales Company, is the world leader in vibratory screening offering a full line of separation and screen innovations for all markets. Sweco vibratory screens are used for all types of solid and liquid separation applications including plant material and food processing.



Technology Networks**Booth #558**

Analytical cannabis from Technology Networks focuses on the needs of the cannabis testing industry, providing a single resource for original articles, the latest news, views, and technical resources from this rapidly developing field.

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Terpenes & Testing Magazine**Booth #408**

Terpenes and Testing combines primary source reporting with curated content that provides insight into cannabis cultivation, testing laboratories, and the scope of extraction. Stop by our booth and read editorial spreads from experts and journalists in the industry; each providing an objective curation of knowledge on these relevant and consistently evolving topics.

**The Analytical Scientist****Booth #354 & #356**

The Analytical Scientist (www.theanalyticalscientist.com) is a publication that celebrates—and scrutinizes—the people, technology, and innovations shaping analytical science. Twice a year, we publish *The Cannabis Scientist*, which explores good science in the growing field of medical cannabis. To find out more, come to our booth or visit www.theanalyticalscientist.com/thecannabisscientist.

the
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The Oregon Media Group**Media Partner**

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**The Scientist****Media Partner**

The Scientist is an award-winning print and digital publication devoted to covering a wide range of topics central to the study of the life sciences. Aimed at an audience of researchers, the articles explore the latest scientific discoveries, news, trends in research, innovative techniques, new technology, business, and careers.

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Verder Scientific**Booth #345**

Verder Scientific Inc., comprised of the Retsch, Carbolite Gero, and ELTRA brands, sets the standard in high-tech scientific equipment serving research institutions, analytical laboratories, and manufacturing companies for decades. The company manufactures and supplies instruments for sample preparation, elemental analysis as well as heat treatment of solid materials.



VETS (Veterans Ending The Stigma) **Booth #410**

An Ohio Based 501C3 Nonprofit Organization

By means of constructive dialogue, anecdotal reason, and novel erudition, Veterans Ending The Stigma aspires to end all stigma associated with veterans, namely perceptions about mental illness, homelessness, and the use of medical cannabis to treat conditions such as post-traumatic stress, traumatic brain injury, and chronic pain.

Through education, camaraderie, and community outreach, we can end the stigma placed upon our veterans.



VRS Recruiting **Booth #143**

VRS Recruitment is a staffing agency focused on providing highly qualified analytical chemists to testing laboratories across the United States. Our specialty is filling positions focused on mass spectrometry and chromatography. All of our recruiters are graduate level scientists. Please visit our booth (#143) and website for more information (www.massspecjobs.com)!



Weedmaps **Booth #506 & #508**

Weedmaps is the world's largest technology platform focused on servicing the cannabis industry nationally and internationally by providing services for brands, retailers, doctors, laboratories, and deliveries. With a fully built API, we aim to provide transparency of data to our consumers through all of our integrated laboratory partners.



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