

Saturday Academic Program

Opening Plenary

8:30–10:00 AM OSC Ballroom

Cannabis Research at Ole Miss: Analytical and Product Development Activities

Mahmoud A. ElSobly, National Center for Natural Products Research, School of Pharmacy, University of Mississippi

1A: 2017 to the Present: What's New with the "Legal" Status of Cannabis? A Review of Changes at the State and Federal Level

10:30–12:00 PM Tundra

ORGANIZERS: *David Bush*, Industrial Hemp Foundation, and *Linda Schutjer*, CSU System

1B: Genomics & Genetics of Cannabis, Part I

10:30–12:00 PM Great Plains

Chair: *SangHyuck Park*, CSU-Pueblo

10:30 Draft Genomes of Two Hemp Accessions, Carmagnola C24 and USO31

SangHyuck Park, CSU-Pueblo, *Jianwei Zhang*, University of Arizona

11:00 Cannabis Microbiome Sequencing: Implications for Cannabis Safety Testing

Kyle Boyar, Medicinal Genomics

11:30 Towards Developing High Throughput Methodology for Cannabis Breeding, Genome Screening and Identification

Reggie Gaudino, Steep Hill Laboratories

1C: Hemp Cultivation, Processes, and Uses

10:30–12:00 PM Aspen Leaf

Chair: *Yaneth Correa-Martinez*, CSU-Pueblo

10:30 Quantifying the Environmental Impacts of Cannabis Cultivation

Drayton Browning, Colorado State University, *Jason Quinn*, Colorado State University

11:00 Exploratory Pilot Assessment of the Sustainability of the Hemp Supply Chain in the State of Colorado

Yaneth Correa-Martinez, CSU-Pueblo, *Glenn Willis*, CSU-Pueblo, *Leonardo Bedoya-Valencia*, CSU-Pueblo

11:30 Hemp Cultivation, Processing, Analysis, Purification, and Uses

Robert Sievers, Sievers Infinity, LLC and University of Colorado Boulder, *Randall Shearer*, Sievers Infinity, LLC and University of Colorado Boulder, *Christie Spencer*, Kel-Sie Biotech, *Garrett Hause*, Elation Cannabis, *Patricia Morgan*, Elation Cannabis, *Stephanie Hess*, Boulder Community Hospital, *Imma Ferrer*, University of Colorado Boulder, *Michael Thurman*, University of Colorado Boulder, *Ed Wassom*, Kel-Sie Biotech and PhenoCo Agricultural Solutions

1D: Cannabis Source Identification

10:30–12:00 PM Wolf Den

Chair: *David Boston*, CSU-Pueblo

10:30 Geographical Origin Traceability of *Cannabis sativa* L. by ATR-FTIR Spectroscopy and Chemometrics

Mariana Fernandes Ramos, UFRGS, *Chad Kinney*, CSU-Pueblo, *Kristina Proctor*, CSU-Pueblo, *Xiao Cui*, CSU-Pueblo, *Flávio A. de Oliveira Camargo*, UFRGS

11:00 Three Separate Groups Combine for Seed-to-Insight Solutions

Terri Miller, SignaKey LLC, *Richard McDermott*, SignaKey LLC

11:30 Chemical Barcoding for Source Identification

David Boston, CSU-Pueblo, *Chad Kinney*, CSU-Pueblo

2A: Working with a Research University: Ensuring Regulatory Compliance through the Research Project Life Cycle

1:30–3:00 PM Tundra

ORGANIZER: *Catherine Bens*, Colorado State University

Panelists: *Linda Schutjer*, CSU System, *David Doty*, CSU

2B: Genomics & Genetics of Cannabis, Part II

1:30–3:00 PM Great Plains

Chair: *SangHyuck Park*, CSU-Pueblo

1:30 Population Genomics of Terpenoid Synthase Genes in Landrace Varieties and Drug Cultivars

Alisha Holloway, Phyllos Bioscience, Inc., *Kayla Hardwick*, Phyllos Bioscience, Inc.

2:00 Genetic Characterization of Cannabis Used for Medical Research

Nolan Kane, University of Colorado Boulder, *Daniela Vergara*, University of Colorado Boulder

2:30 Scanning Informative Regions of the Cannabinoid Synthases to Identify Relevant SNPs

Christopher Pauli, Steep Hill Laboratories, *Reggie Gaudino*, Steep Hill Laboratories, *Keith Allen*, Steep Hill Laboratories, *Daniela Vergara*, Steep Hill Laboratories

2C: Adverse Effects of Cannabis, Part I

1:30–3:00 PM Aspen Leaf

Chair: *Brad Roberts*, Southern Colorado Emergency Medicine Associates

2:00 The Influence of Stereotype Threat on Cannabis Users' Immediate and Delayed Recall Memory: A threat to the Validity of Previous Research on Cognitive Decline?

William Bloxham, *David Peterzell*

2:30 Legalized Cannabis in Colorado Emergency Departments: A Cautionary Review of the Negative Health and Safety Effects

Brad Roberts, Southern Colorado Emergency Medicine Associates

2D: Poster Session

1:30–3:00 PM Ballroom

1. How A Community Centered Non-Profit, Realm of Caring, Uses Quantitative and Qualitative Data to Fulfill the Cannabis Community's Needs

Courtney Collins, Realm of Caring

2. Effect of Magneto-Priming on Germination Percentage

of Industrial Hemp

Kathrin Spendier, University of Colorado Colorado Springs

3. Can Farmers in Utah Grow Hemp Without Modifying Current Soils?

Jeffrey Colbert, Weber State University

4. Fear Memory Extinction is Enhanced by Cannabidiol When Given During Acquisition in Female Mice

Zackary Montoya, CSU-Pueblo, *Amy L Uebernik*, CSU-Pueblo, *Jeffrey P Smith*, CSU-Pueblo

5. Sex Differences in GluN2B-Containing NMDA Receptor Dependent Acquisition of Cognitive Fear Memories and Effects of HU-211

Courtney Turner, CSU-Pueblo, *Amy L Uebernik*, CSU-Pueblo, *Jeffrey P Smith*, CSU-Pueblo

6. HU-211-Sensitive, Cognitive Learning and Memory Processes Modulate GluN2B Surface Expression in the Mouse Brain

Jose Vigil, CSU-Pueblo, *Jeffrey P Smith*, CSU-Pueblo, *Amy L Uebernik*, CSU-Pueblo, *Sam Koch*, CSU-Pueblo

7. The Effects of Medicinal Cannabis on Seizures in Adults with Medically Refractory Epilepsy: A Progress Report

Mathieu Conroy, CSU-Pueblo, *Barbara Brett*, CSU-Pueblo

8. Synthetic Cannabinoids Reduce Sindbis Viral Titers and Promote Metabolic Homeostasis in Infected HuH7 Cells

Juan Rodriguez, CSU-Pueblo

9. Exploring the Information Practices of Cannabis Nurses

Connie Pascal, Rutgers University

10. The Potential of Whole Hemp Seed as a Prebiotic to Support Growth and Metabolism of Anticarcinogenic Probiotic Bacteria

Whitney Lujan, CSU-Pueblo, *Krystal Hrbac*, CSU-Pueblo, *Audria Linkowski*, CSU-Pueblo, *Annette Gabaldon*, CSU-Pueblo

11. The Effects of Co-Activation of Cannabinoid Type 2 and Estrogen Receptors on Osteogenesis in Cultured Primary Human Osteoblasts

Derrick Williams, CSU-Pueblo, *Annette Gabaldon*, CSU-Pueblo

12. A Grounded Theory Dissertation Proposal: Developing a Cannabis Curriculum for Medical School Students and Continuing Medical Education Courses

Courtney Collins, Realm of Caring

13. Therapeutic Cannabinoids in Anxiety and Depression: Results from an Observational Research Study

Megan Brunstetter, Realm of Caring Foundation, *Erin Martin*, Johns Hopkins University, *Nicholas Schlienz*, Johns Hopkins University, *Joel Munson*, Realm of Caring Foundation, *Heather Jackson*, Realm of Caring Foundation, *Marcel Bonn-Miller*, University of Pennsylvania, *Ryan Vandrey*, Johns Hopkins University

14. A Holistic Framework to Assess the Sustainability of the Hemp Industry in Colorado

Glenn Willis, CSU-Pueblo, *Yaneth Correa-Martinez*, CSU-Pueblo

15. Extraction of Biopolymers from Hemp Biomass

Guy Mendel, CSU-Pueblo, *Richard Farrer*, CSU-Pueblo,

Yaneth Correa-Martinez, CSU-Pueblo, *Leonardo Bedoya Valencia*, CSU-Pueblo

16. Negative Edibles Experiences: A Survey of Cannabis Edibles Users

Jane M Fraser, CSU-Pueblo, *Josh Meisel*, Humboldt State University, *Sue Sisley*, Scottsdale Research Institute

17. Repeated Synthetic Cannabinoid (WIN 55,212-2) Administration Reduces Tolerance to Its Dopamine Releasing Effects

Thomas Everett, *EB Olsen*

18. Specific PAR wavelengths and UV light potentially influence cannabinoid production and trichome density in Cannabis sativa L. throughout different stages of growth and development

Trevor Regas, CSU-Pueblo

3A: Risk Management: The Links between Insurance, Safety, Compliance and Good Business

3:30-5:00 PM

Tundra

ORGANIZER: *Mike Rosenthal*, Cannabis Risk Management Association

Panelists: *Jessica Velasquez*, Indiva Investors, *Rudy Ellenbogen*, Cannabis on Purpose

3B: Genomics & Genetics of Cannabis, Part III

3:30-5:00 PM

Great Plains

Chair: *SangHyuck Park*, CSU-Pueblo

3:30 Genomic Characterization of the Entire Terpene Synthase Family in Cannabis

Keith Allen, Steep Hill Laboratories

4:00 Stirring the Pot: Genetic Analysis of Hemp-type, Legal Drug-type, and Federally-Supplied Research Grade Cannabis

Anna Schwabe, University of Northern Colorado, *Connor Hansen*, University of Northern Colorado, *Richard Hyslop*, University of Northern Colorado, *Mitchell McGlaughlin*, University of Northern Colorado

4:30 Aroma Perception Reflects Genetic Variation Within Cannabis Strains

Anna Schwabe, University of Northern Colorado, *Samantha Naibauer*, University of Northern Colorado, *Mitchell McGlaughlin*, University of Northern Colorado, *Avery Gilbert*, Headspace Sensory LLC

3C: Adverse Effects of Cannabis, Part II

3:30-5:00 PM

Aspen Leaf

Chair: *Brad Roberts*, Southern Colorado Emergency Medicine Associates

3:30 Trends in Suicide Rates Relative to Population Data on Marijuana and Other Drug Use, Unemployment, and Binge Drinking Rates

Christine Miller, MillerBio, *Monica Jackson*, American University, *Kevin Sabet*, Yale University

4:00 A Latent Class Analysis of Canadian Adolescent Alcohol and Marijuana Use on School Performance

James McIntosh

3D: Hemp Biopolymers, Fibers, and Uses

3:30–5:00 PM

Wolf Den

Chair: *Nebojsa Jaksic*, CSU-Pueblo**3:30 Biopolymers in Hemp Biomass: Extraction and Application***Richard Farrer*, CSU-Pueblo, *Yaneth Correa-Martinez*, CSU-Pueblo, *Leonardo Bedoya Valencia*, CSU-Pueblo, *Guy Mendel*, CSU-Pueblo**4:00 Development of Bast Fibers in *Cannabis sativa L.* and Their Industrial Uses***Eun Soo Kim*, Konkuk University, and Korea Hemp Institute, *Wonkyun Choi*, Korea Hemp Institute**4:30 Study of Hemp Textile Composites***Nebojsa Jaksic*, CSU-Pueblo**Sunday Academic Program****4A: Cannabis Across the College Curriculum**

8:30–10:00 AM

Tundra

ORGANIZER: *Karen Yescavage*, CSU-PuebloPanelists: *Robert A. Mikos*, Vanderbilt University, *Paul Seaborn*, University of Denver, *Vanessa Fishback*, University of Colorado Denver, *Mark Paulson*, Northern Michigan University, *Annisa Manzanares*, CSU-Pueblo**4B: Advances in Analytic Methods for Cannabis Research, Part I**

8:30–10:00 AM

Great Plains

Chair: *Chad Kinney*, CSU-Pueblo**8:30 Cannabis CBDA/THCA Chemotype Determination Using Atmospheric Solids Analysis Probe Coupled with a Compact Mass Spectrometer (ASAP-CMS)***Jack Henion*, Advion, Inc, *Ben Nie*, Advion, Inc**9:00 Mystery Compounds Observed in Cannabis Processing: Acetone and the Double-Peak***James Parco*, UCANN TECH**9:30 The Use of Colorimetric Arrays to Test for Cannabinoids in Marijuana Flower, Concentrates, and Topicals***Andres Mora*, Doane University, *Michael Kangas*, Doane University, *Amanda Debono*, AgriScience Labs, *Andrea Holmes*, Doane University**4C: New Developments in Medical Cannabis Research, Part I**

9:00–10:00 AM

Aspen Leaf

Chair: *Hinanit Koltai*, ARO, Volcani Center**9:00 Synergistic Cytotoxic Activity of Cannabinoids from *Cannabis sativa* Extracts on T Cells Associated with Cutaneous T Cell Lymphoma Cell Lines (CTCL)***Moran Mazuz*, ARO, Volcani Center, *Amir Tiroler*, ARO, Volcani Center, *Lilach Moyal*, Rabin Medical Center, Beilinson Hospital, *Emmilia Hodak*, Rabin Medical Center, Beilinson Hospital, *Avi Drori*, MedC Biopharma Corporation, *Guy Drori*, MedC Biopharma Corporation, *Owen Van Cauwenberghe*, AgMedica Bioscience Inc., *Dvora Namdar*, ARO, Volcani Center, *Iris Amitay-Laish*, Rabin Medical Center, Beilinson Hospital, *Hinanit Koltai*, ARO, Volcani Center**9:30 Sexual Dimorphism in the Effects of Cannabidiol and Dexamabinol on Fear Learning and Memory in Mice***Amy L Uhernik*, CSU-Pueblo, *Zack Montoya*, CSU-Pueblo, *Jose Vigil*, CSU-Pueblo, *Courtney Turner*, CSU-Pueblo, *Jeffrey P Smith*, CSU-Pueblo**4D: Agronomy, Physiology, and Biology of Cannabis, Part I**

8:30–10:00 AM

Wolf Den

Chair: *Nirit Bernstein*, ARO, Volcani Center**8:30 Canopy Defoliation During Flowering Increases Yield for *Cannabis indica* var. Flo***Matthew Wheatley*, UCANN TECH**9:00 Cannabidiol Inhibits Growth and Lowers Crude Protein Content of the Tobacco Hornworm *Manduca sexta****Matthieu Conroy*, CSU-Pueblo, *SangHyuck Park*, CSU-Pueblo**9:30 Hypochlorous Acid as an Effective Treatment for Powdery Mildew Outbreaks***Matthew Wheatley*, UCANN TECH, *Todd Knupp*, UCANN TECH**5A: Characterizing Microbial Communities: Evaluating Microbial Diversity and its Effect on Plant Health in Cannabis Cultivation**

10:30–12:00 PM

Tundra

ORGANIZER: *Maureen Phenix*, Growcentia, Inc.Panelists: *Peter Baas*, Growcentia, Inc., *Karuna Chourey*, Growcentia, Inc., *James Henriksen*, Growcentia, Inc.**5B: Advances in Analytic Methods for Cannabis Research, Part II**

10:30–12:00 PM

Great Plains

Chair: *Vanessa Fishback*, University of Colorado Denver**10:30 Overcoming the Challenges Associated with Heavy Metal Analysis of Cannabis & Hemp using ICP-MS***Sandy Kanapilly*, PerkinElmer, *Aaron Hineman*, PerkinElmer**11:00 Extraction and Isolation of Cannabinoids Intended for Other Experimental Investigations***Dustin Seifried*, CSU-Pueblo, *Matthew A. Cranswick*, CSU-Pueblo**11:30 Effects of Pressure in Supercritical CO₂ Extraction of Cannabis***James Parco*, UCANNTECH**5C: New Developments in Medical Cannabis Research, Part II**

10:30–12:00 PM

Aspen Leaf

Chair: *Hinanit Koltai*, ARO, Volcani Center**10:30 Cannabis Use for Pain in a Large Population-Based Survey of Adult Athletes***Joanna Zeiger*, Canna Research Group, *Ed Flegler*, To-Life in Peace, LLC; Canna Research Group, *William Silvers*, University of Colorado School of Medicine, Canna Research Group, *Robert Zeiger*, Kaiser Permanente Southern California, Canna Research Group**11:00 Detection of THC on Surfaces in a Room Exposed to Cannabis Vaporizer Use***Cristina Sempio*, University of Colorado Anschutz Medical

Campus, *Emily Lindley*, University of Colorado Anschutz Medical Campus, *Jost Klawitter*, University of Colorado Anschutz Medical Campus, *Russel Bowler*, National Jewish Health, *John Adgate*, University of Colorado Anschutz Medical Campus, *William Allshouse*, University of Colorado Anschutz Medical Campus, *Lauren Awdziejczyk*, University of Colorado Anschutz Medical Campus, *Mike Vandyke*, University of Colorado Anschutz Medical Campus, *Rabwa Netsanet*, University of Colorado Anschutz Medical Campus, *Tessa Crume*, University of Colorado Anschutz Medical Campus, *Gregory Kinney*, University of Colorado Anschutz Medical Campus

11:30 What the Hemp? Evaluating the Health Impacts of Cannabidiol (CBD) and Medical Cannabis Use

Jackson Heather, Realm of Caring, *Marcel Bonn-Miller*, University of Pennsylvania, *Ryan Vandrey*, Johns Hopkins University

5D: Agronomy, Physiology, and Biology of Cannabis, Part II

10:30–12:00 PM Wolf Den

Chair: *Nirit Bernstein*, ARO, Volcani Center

10:30 Cataloging Existing Variation and Rebuilding Better Cannabis Genomes for New Markets

John McKay, New West Genetics

11:00 Pest Management Using Essential Oil Based Products For Cannabis Production

Stephanie Wedryk, Rx Green Technologies, *R. Cole Gage*, Rx Green Technologies

11:30 Standardization of Secondary Metabolites in the Medical Cannabis Product: Challenges and Potential Solutions

Nirit Bernstein, ARO, Volcani Center

Mechoulam Lecture

12:30–1:30 PM OSC Ballroom

Marijuana as Medicine: An Historical Perspective

Allyn Howlett, Wake Forest School of Medicine

6A: Data Analytics in the Cannabis Industry

1:30–3:00 PM Tundra

ORGANIZER: *Brian Keegan*, University of Colorado Boulder

Panelists: *Cyrus Dioun*, University of Colorado Denver, *Emily Fata*, Diagon Consulting, *Brian Lewandowski*, University of Colorado Boulder, *Paul Seaborn*, University of Denver

6B: Advances in Analytic Methods for Cannabis Research, Part III

1:30–3:00 PM Great Plains

Chair: *Vanessa Fishback*, University of Colorado Denver

1:30 Overcoming the Challenges Associated with Pesticide Analysis of Cannabis & Hemp and Understanding the Matrix Effects and the Impact of Various Clean-Up Strategies

Toby Astill, PerkinElmer

2:00 Chemical Profile Changes in Response to Biotic and Abiotic Stresses of *Cannabis sativa* L.

SangHyuck Park, CSU-Pueblo, *Eric Gostin*, CSU-Pueblo

2:30 A robust extraction method for cannabinoid analysis and in-extraction chemical modification of acidic cannabinoids

Dustin G. Seifried, CSU-Pueblo, *Mariana Fernandes Ramos*, CSU-Pueblo, *Chad A. Kinney*, CSU-Pueblo

6C: New Developments in Medical Cannabis Research, Part III

1:30–3:00 PM Aspen Leaf

Chair: *Hinanit Koltai*, ARO, Volcani Center

1:30 Cannabis for Inflammatory Bowel Disease Research in Israel

Timna Naftali, Tel Aviv University, *Libi Bar-Lev Schleider*, Tikun Olam Organization for Medical Cannabis, *Hinanit Koltai*, ARO, Volcani Center, *Shelly Matalon*, Meir Hospital, *Fred Konikoff*, Tel Aviv University

2:00 The Effects of Medicinal Cannabis on Seizures in Adults with Medically Refractory Epilepsy

Matthieu Conroy, CSU-Pueblo, *Barbara Brett*, CSU-Pueblo

2:30 Challenges and Findings of Studying Cannabis in Parkinson Disease

Maureen Leehey, University of Colorado, *Ying Liu*, University of Colorado, *Felecia Hart*, University of Colorado, *Jost Klawitter*, University of Colorado, *Cristina Sempio*, University of Colorado, *Sarah Fischer*, University of Colorado, *Christen Epstein*, University of Colorado, *Mary Cook*, University of Colorado, *Stefan Sillau*, University of Colorado, *Zachrey Baud*, University of Colorado, *Heike Newman*, University of Colorado, *Olga Klepitskaya*, University of Colorado, *Emil Diguillo*, University of Colorado, *Sarah Baker*, University of Colorado, *Tristan Seawalt*, University of Colorado, *David Vu*, University of Colorado, *Trevor Hawkins*, University of Colorado, *Michelle Fullard*, University of Colorado, *Jacquelyn Bainbridge*, University of Colorado

6D: Public Health

1:30–3:00 PM Wolf Den

Chair: *Yuan Long*, CSU-Pueblo

2:00 Cannabis Sativa Exposure and Sensitization: Relationship to Asthma, Dermatitis and Food Allergy

William Silvers, University of Colorado School of Medicine, *Nathan Rabinovitch* National Jewish Health

2:30 The Impact of Online Social Support on Cannabis Rehabilitation

Yuan Long, CSU-Pueblo, *Kuangyuan Huang*, CSU-Pueblo

7A: Current State of Technology and Applications of Industrial Hemp

3:30–5:00 PM Tundra

ORGANIZER: *Nebojsa Jaksic*, CSU-Pueblo

Panelists: *Kevin Sparks*, CSU-Pueblo, *Duane Stjernholm*, Colorado Hemp Processing Collaborative

7B: K12 Cannabis Research Study: Student Use

3:30–5:00 PM Great Plains

ORGANIZER: *Tim Peters*, CSU-Pueblo

Panelists: *Ashley Brooks-Russell*, Health Kids Colorado Survey, *Jack*

Reed, Colorado Department of Public Safety, *Jessica Newirth*, Colorado Department of Public Health and Environment

7C: Medicinal Cannabis

3:30–5:00 PM

Aspen Leaf

Chair: *Karen Yescavage*, CSU-Pueblo**4:00 ICR's New Cannabis Patient Registry: Driving innovation by Filling Knowledge Gaps about Real World Use of Medical Cannabis***Sue Sisley*, Scottsdale Research Institute, *Barbara Brett*, CSU-Pueblo**4:30 Cannabis Legalization and Opioid-Related Deaths in Colorado, 1999–2018***Karen Yescavage*, CSU-Pueblo, *Xiao Cui*, CSU-Pueblo**Monday Academic Program****8A: K12 Cannabis Research Study: Restorative Justice Implementation**

8:30–10:00 AM

Tundra

ORGANIZER: *Margie Massey*, CSU-PuebloPanelists: *Lynn Knight*, CSU-Pueblo, *Jenny Piazza*, CSU-Pueblo, *Pam Richmond*, CSU-Pueblo, *Ron Wiley*, TriNot Restorative Solutions and other Community Stakeholders**8B: Cannabis and Commerce, Part I**

8:30–10:00 AM

Great Plains

Chair: *Brian Vanden Heuvel*, CSU-Pueblo**8:30 'Stem Synergy' in Action: An Analysis of Vertical Integration's Impacts on Product Quality within the Recreational Cannabis Industry***Geoff Ostrove*, Stem Holdings**9:00 Putting the Consumer First: Formulating with USP and GMP Standards for Cannabis Products***Scott Karolchyk*, MedPharm Holdings**9:30 Data Tools That Will Change How Cannabis is Used***Donna Shields*, Holistic Cannabis Academy, Navigator Genomics**8C: Law, Crime, and Cannabis Policy, Part I**

8:30–10:00 AM

Aspen Leaf

Chair: *David Bush*, Hoban Law Group**8:30 The Politics of Cannabis***Cindy Sovine*, Sovine Consulting**9:00 Marijuana Research at the National Institute on Drug Abuse***Heather Kimmel*, National Institute on Drug Abuse**9:30 Hemp in Interstate and International Commerce***David Bush*, Hoban Law Group**9A: The Cannabis Conversation: Driving Change Through Data and Communication**

10:30–12:00 PM

Tundra

Chair: *Abby Tillinghast*, Colorado Department of TransportationPanelists: *Sam Cole*, Colorado Department of Transportation, *Glenn Davis*, Colorado Department of Transportation, *Becky Bui*, Colorado

Department of Public Safety

9B: Cannabis and Commerce, Part II

10:30–12:00 PM

Great Plains

Chair: *Brian Vanden Heuvel*, CSU-Pueblo**10:30 Cultivars and Consumption: A Preliminary Analysis of Self-Reported Eating and Drinking Behaviors in a Sample of Cannabis Tourists***Richard Donnelly*, University of Northern Colorado, *James Gould*, University of Northern Colorado**11:00 Alternatives to Address Cannabis Intoxication in the Workplace and Clinical Trials***Russ Phifer*, WC Environmental**11:30 Update from the Hemp Feed Coalition on the Approval of Hemp in Animal Feed by the FDA-CVM***Hunter Buffington*, Hemp Feed Coalition**9C: Law, Crime, and Cannabis Policy, Part II**

10:30–12:00 PM

Aspen Leaf

Chair: *David Bush*, Hoban Law Group**10:30 How Cannabis-Derived Medications Go Through the FDA Approval Process***Alice Mead*, Greenwich Biosciences/GW Pharmaceuticals, *Mark Bolton*, Greenwich Biosciences/GW Pharmaceuticals**11:00 New Opportunities for Research in Colorado***Tyrell Towle*, MedPharm Holdings**11:30 Law, Crime, and Recreational Cannabis Policy***Jennifer Schlosser*, CSU-Pueblo**9D: Maximizing Energy Return Utilizing a Collaborative Approach**

10:30–12:00 AM

Wolf Den

ORGANIZER: *Devin Moeller*, Black Hills EnergyPanelists: *Eric Sisco*, Black Hills Energy, *Matthew Firth*, Black Hills Energy**9D: Closing Remarks**

12:00–12:30 PM

OSC Ballroom

Abstracts

Opening Plenary: Cannabis Research at Ole Miss: Analytical and Product Development Activities

Mahmoud A. ElSobly, National Center for Natural Products Research, School of Pharmacy, University of Mississippi

Cannabis is one of the oldest medicinal plants known to man. The interest in cannabis based products and cannabinoids for medical purposes has exploded in the last few years. At The University of Mississippi, under contract with the National Institute on Drug Abuse (NIDA), resides the only cannabis production operation in the United States to provide research materials for investigators around the country. These include marijuana plant material, cigarettes, extracts and purified cannabinoids, made available through the NIDA Drug Supply Program (DSP). Analytical Procedures were validated for quantifying the levels of cannabinoids and terpenes in these products.

Aside from providing standardized materials for research, a major effort is expended on developing cannabis-based products. Derivatives of both THC and CBD have been developed and formulated in different dosage forms, including ophthalmic preparations, oral preparations, transmucosal delivery systems and suppositories. Evidence of bioavailability of these drugs from these formulations will be presented and the promise of effective products for various indications will be elaborated.

1A: 2017 to the Present: What's New with the "Legal" Status of Cannabis? A Review of Changes at the State and Federal Level

David Bush, Industrial Hemp Foundation, *Linda Schutjer*, CSU-System

A panel of experts will discuss current issues surrounding cannabis legalization and public policy.

1B: Draft Genomes of Two Hemp Accessions, Carmagnola C24 and USO31

SangHyuck Park, CSU-Pueblo, *Jianwei Zhang*, University of Arizona

Cannabis sativa L., also called hemp or marijuana, is an annual dioecious plant that produces at least 120 cannabinoids in the glandular trichomes of female flowers. The two main constituents are cannabidiol (CBD) and tetrahydrocannabinol (THC). The plant has been used by mankind for over 4,000 years for its recreational and medicinal uses. Recent clinical tests demonstrated therapeutic potentials of CBD in various human diseases including Dravet syndrome. Despite the potency as a drug, genetic mechanisms underlying agriculturally important traits including cannabinoid/terpenoid biosynthesis pathway have not been fully understood. In this study, two hemp varieties, Carmagnola C24 (female) and USO31 (male) were sequenced with PacBio SMRT technology, de novo assembled two draft genomes with FALCON unzip, then polished them with Pilon. The assembled genomes (primary contigs) for C24 and USO31 are about 885 Mb and 984 Mb in size with 469 Mb and 533 Mb haplotigs, respectively, which indicates very high heterozygosity of the hemp genomes. BUSCO evaluations showed at least 89.2%-91.9% completeness of the two genomes. Further MAKER annotation analyses predicted 18,575 and 19,745 protein-coding genes in each genome by using RNA-Seq data as evidences. All data generated will serve as a valuable genetic resource for investigating the mechanisms of cannabinoid biosynthesis in hemp.

1B: Cannabis Microbiome Sequencing: Implications for Cannabis Safety Testing

Kyle Boyar, Medicinal Genomics

The cannabis plant and cannabis products are highly varied and complex matrices with each different product and route of administration having its own considerations for microbial testing. In the absence of rigorous study this immature industry has decided to adopt methods commonly used in food testing to obtain information about the potential microbial hazards present. However, DNA sequencing of both the cannabis microbiome and the conditions before and after culturing tell a tale of inaccurate methodology. Many of the methods that are currently being employed are leading the cannabis industry astray while blinding them to the real hazards that could be present. This presentation will walk you through the data that shows this and the discoveries we've made along the way that will hopefully open fresh discussions with new perspective on how to tackle microbiological contaminants in cannabis.

1B: Towards Developing High Throughput Methodology for Cannabis Breeding, Genome Screening and Identification

Reggie Gaudino, Steep Hill Laboratories

As interest in cannabis grows, identifying genes and gene networks involved in production of the desired metabolites (cannabinoids and terpenes) as well as networks necessary to optimize cultivation potential, will become increasingly important as demand for specific metabolites or "cultivars" grows. In addition to the work Steep Hill has done identifying and analyzing cannabinoid and terpene genes, we have also started a systematic analysis of upstream genes in the cannabinoid and terpene metabolic networks, and genes related to growth, development and oil production. Our approach is to combine our bioinformatics efforts with the speed and ease of High-Resolution Melt methodology. Recent advances in reference genome availability have allowed us to identify and map novel genes and begin the process of metabolic network annotation and SNP identification. SNPs identified in the genes of interest are screened by HRM using a panel of known cultivars to identify any potential informative regions associated with one or more SNPs. Informative regions are then further assessed for their level of informativeness by comparison to chemical or other phenotypic data where available, and analysis of amino acid changes at the codon containing the SNP. The combined process contributes to a database that allows HRM melt curves to act as a proxy for sequence information, and where applicable, functional outcome. Further, when taken together the gene scanning process can yield multiple informative regions per gene/segment, thereby producing a "barcode" that could be used as a strain discriminator/identifier. Various data and process will be presented that outlines the ongoing efforts..

1C: Quantifying the Environmental Impacts of Cannabis Cultivation

Hailey Summers, Colorado State University, *Drayton Browning*, Colorado State University, *Jason Quinn*, Colorado State University

The Intergovernmental Panel on Climate Change has recently affirmed that the primary driver of climate change is contributions to greenhouse gas emissions through anthropogenic means. Industries historically targeted for the majority of anthropogenic emissions include transportation, electricity generation and food, primarily beef.

However, it is possible that a rapidly emerging industry could have a larger impact than those previously identified. The cannabis industry, prior to medical and recreational legalization, has been recognized for its environmental burdens, but results were largely estimated as industry size was not accurately quantifiable due to illegal, off-the-grid growing practices. With recent legalization of medical and recreational cannabis use in several U.S. states, energy consumption data are now publicly available at an industry scale. This work aims to quantify the environmental impacts of cultivating cannabis bud through lifecycle assessment methodology with initial work focused on the Colorado industry. Comparisons of current practices, including indoor, greenhouse and outdoor cultivation techniques, will be analyzed as well as comparisons amongst other leading anthropogenic climate change sectors. Preliminary work shows that the emissions associated with the cannabis industry are larger than anthropogenic industries currently targeted for significant contributions to climate change. These largest impacts are primarily due to high-intensity grow lights and heating, ventilation, and air conditioning requirements associated with simulating plant growth environments indoors. Through our research, we have seen that some cannabis cultivators are taking action to improve growing techniques, directed at minimizing their carbon footprint. However, with little environmental impact information publicly available as well as little incentive due to high economic margins, the cannabis industry is expected to continue to be a major contributor to global greenhouse gas emissions.

1C: Exploratory Pilot Assessment of the Sustainability of the Hemp Supply Chain in the State of Colorado

Yaneth Correa-Martinez, CSU-Pueblo, Glenn Willis, CSU-Pueblo, Leonardo Bedoya-Valencia, CSU-Pueblo

Sustainability has become an increasingly new and central topic in the management of different supply chain systems. In the State of Colorado, consumers are increasingly aware of the involved agents in the cannabis supply chain and its social, political, economic, and environmental impact. Additionally, there is special interest in the governance aspects of the production and trade of hemp and its impact on the sustainability of the chain. While associating food and agricultural supply chains systems and sustainability performance may not be straightforward, this project identifies and proposes several indicators assessing the four sustainability dimensions recommended in the Sustainability Assessment of Food and Agriculture Systems (SAFA) framework proposed by the Food and Agriculture Organization of the United Nations (FAO). The Sustainability Assessment of Food and Agriculture Systems (SAFA) is a holistic global framework for the assessment of sustainability along food and agriculture value chains. SAFA establishes an international reference for assessing trade-offs and collaborations between all dimensions of sustainability. It has been prepared so that organizations, whether companies or small-scale producers, involved with the production, processing, distribution, and marketing of goods have a clear understanding of the constituent components of sustainability and how strengths, weaknesses, opportunities, threats, and progress could be tackled. While there is now a wide awareness of the sustainability concept, there is also a wide interpretation of the definitions and components of sustainability based on different disciplines and political beliefs and values. The need to measure what matters is undeniable; the academic and practical dilemma is to identify what matters to whom and how to measure it. In this proposal, the

SAFA framework will be analyzed regarding its potential utilization as a guideline to achieve sustainable and fair practices in the production and trade of hemp in the State of Colorado. An exploratory study will yield individual structured observations and measurement, structured interviews and visits, and record analysis will be used to collect data and information from an initial pool with representatives of the four governing dimensions. With this analysis, the SAFA framework aims to fill the gap regarding the use of specific sustainability tools, while fostering partnerships for the long-term sustainability of the industry. This research establishes the foundations for future studies oriented towards the development of a set of sustainable best practices for the cannabis/hemp supply chain that could be adapted and adopted at any level (from small growers to local government and agencies as well as policy and lawmakers and regulatory agencies). Further research will use the results of this study to define and propose a framework to assess the sustainability of the hemp supply chain, most likely through an open dashboard to monitor and update the most critical sustainability indicators initially identify by this study.

1C: Hemp Cultivation, Processing, Analysis, Purification, and Uses

Robert Sievers, Sievers Infinity, LLC and University of Colorado Boulder, Randall Shearer, Sievers Infinity, LLC and University of Colorado Boulder, Christie Spencer, Kel-Sie Biotech, Garrett Hause, Elation Cannabis, Patricia Morgan, Elation Cannabis, Stephanie Hess, Boulder Community Hospital, Imma Ferrer, University of Colorado Boulder, Michael Thurman, University of Colorado Boulder, Ed Wassom, Kel-Sie Biotech and PhenoCo Agricultural Solutions

With the passage of the 2018 federal Farm Bill, the pharmaceutical and regulatory scene for hemp-derived medicines is changing rapidly. Hemp has been taken off the US controlled substance list, but not marijuana (still defined as cannabis having more than 0.3% THC). In the state of Colorado alone, the state tax revenues totaled more than one billion dollars in 2018. The FDA has approved Epidiolex® for treatment to reduce the frequency of epileptic seizures. We have recently harvested 1,000 clones of 20 different cultivars of industrial hemp, grown in unincorporated Lafayette, CO. The clones were supplied by either Front Range Biosciences, Lafayette, CO (courtesy of Jon Vaught) or PhenoCo Agricultural Solutions, Greater Denver Area (courtesy of Ed Wassom). The plant varieties also included several transplanted mother plants and all were drip irrigated (every other day) within black plastic sheeting for moisture retention and weed control, especially bindweed. The hemp, after hang-drying in a ventilated barn, was hand-stripped of buds and leaves prior to extraction and processing. The extraction and processing was completed by Ecclesias Extracts of Colorado Springs, CO with the initial maceration in pentane. The desired CBD isolate was the primary product and was of pharmacological grade pure white melting sharply in the range of 69-70°C. Third-party analysis by Altitude Consulting, Englewood, CO, confirmed the high purity of the isolate that was produced. Residual solvent analysis, also completed by Altitude Consulting, demonstrated compliance with limits as specified in the Colorado Code of Regulations. Analysis of crop hemp yields and processed isolate and byproduct terpene/CBD containing oils are consistent with typical industry experience. In our case, plants averaged ca. 636 grams of dry biomass for extraction, yielding an average of ca. 16 g of pure CBD isolate, in addition to byproducts. The purified CBD was converted

to fine powders for delivery via CAN-BD (CO₂-Assisted Nebulization with a Bubble Dryer) to create several products for cannabinoid delivery (sublingual to inhalable to transdermal methods). Several relevant applications are described in U.S. Patent 9,895,321, such as one-free-pass delivery, avoiding P450 oxidative enzymes in the liver, markedly improving bioavailability. We have found that in order to ensure stability of products with long shelf-lives requires attention to packaging barriers to protect against UV-light, and unacceptable oxidant and moisture that affect inhalation delivery and speed of dissolution in sublingual delivery methods of administration. Most cannabinoids are highly lipophilic, but addition of polymers like PVP can markedly increase solubility in aqueous solutions. Analytical techniques like quantitative NMR with the method of standard addition, and coupled HPLC with “Exact Mass” quadrupole mass spectrometry can bring the best of chromatography together with potent mass spectrometry to solve the multiplicity of common cannabinoid isomer interferences. Sorption of cannabinoids into the surfaces of plastic bottles may cause unacceptable losses and require aluminum, steel or glass containers with effective inert surface treatments or coatings. Clear glass containers need to be covered with aluminum foil to protect products and intermediates from damage by photolysis.

1D: Geographical Origin Traceability of *Cannabis sativa* L. by ATR-FTIR Spectroscopy and Chemometrics

Mariana Fernandes Ramos, UFRGS, *Chad Kinney*, CSU-Pueblo, *Kristina Proctor*, CSU-Pueblo, *Xiao Cui*, CSU-Pueblo, *Flávio A. de Oliveira Camargo*, UFRGS

Marijuana is the most consumed illicit drug worldwide. However, cannabis cultivation was reported in 92% of the world's countries from 2010 to 2015, despite its use and planting being prohibited in most of them. In the United States the legal use of cannabis for medical purposes or for recreation can vary from state to state. Therefore, regulatory agencies and law enforcement around the world seek ways to identify the geographical origin of cannabis, especially material being trafficked. This project explores the use of the composition of cannabis plants as a tool to identify geographic origin. The composition of Cannabis plants changes with heat, hence, techniques that do not heat the samples are preferred for maintaining the original constitution of cannabis plants during analysis. A technique that meets this requirement is infrared spectroscopy, a robust, rapid, non-destructive, non-heating technique that requires minimum or no prior sample treatment, and requires small quantities of samples. The present study aims to determine the geographical origin of cannabis samples and the soil they were cultivated in by Attenuated Total Reflection-Fourier Transform Infrared Spectroscopy (ATR-FTIR) and multivariate data analysis.

1D: Three Separate Groups Combine for Seed-to-Insight Solutions

Terri Miller, SignaKey LLC, *Richard McDermott*, SignaKey LLC

IEC is a Global Standards Organization. The SignaKey e-Seal is IEC's specified tracking/tracing, tamper-evident seal. It features a highly encrypted 2D barcode-like mark or Key. Each Key is unambiguously unique. At every node in the seed-to-sale process, the decode may be set to reveal varying layers of information to authorized parties. Decoding also captures the URL, date, time and geospatial coordinates at each step in the block chain. The Key can be decoded via

smartphone or webcam/PC. The cannabis seeds, plants or products are always secured with an e-Seal. Decoding the Key at any instant, displays all (authorized) previous gathered information. The SignaKey technology allows stakeholders to retain information from the grower, plant and strain, identify molecular tagging information and build on it to include initial lab test results, processing methods and formulas, including inactive ingredients. Once scanned to patients at the point of sale, the patient or customer has record of purchases and can be alerted in real time of information related to recalls. Retailers can also send messages to the patient/customer relevant to preferred products, or in regards to in-store experiences or promotions. Cultivators or manufacturers will have access to all information collected in order to improve processes and build upon brands. SignaKey is an anti-counterfeiting technology currently used in the pharmaceutical and automotive industries and is in use on integrated circuits, luxury items and for other applications. SignaKey is not public domain technology and therefore can't be replicated unlike barcode technologies. It prevents all gray market activity and diversion throughout the authorized distribution channel. With 450 physician partners and 2,500 staff, Michigan Healthcare Professional is the largest physician owned healthcare group in the state. They operate multiple certified diagnostic labs. Staff and specialized equipment within these labs are well suited for the testing and certification of THC potency and full spectrum plant properties in a finished product to ensure that flower and derivative products contain those values advertised. Plex Systems is a SaaS and cloud application ERP that manages the manufacturing process, inventory, shipping, supply chain management, quality, accounting, sales, and HR. Plex is targeted towards manufacturing industries with rigorous traceability, quality, and FDA safety requirements. The system must be accessed using a web browser, making its function available from anywhere with an Internet connection. These three powerful allies can produce a closed-loop solution for the tracking and tracing of cannabis and its products from seed through to end-user, ensuring quality controls and preventing diversion and counterfeits. This powerhouse of data amassed can be used to glean insights and improve processes all while protecting brands and providing real-time information to patients and customers all without expensive decode technology.

1D: Chemical Barcoding for Source Identification

David Boston, CSU-Pueblo, *Chad Kinney*, CSU-Pueblo

The ability to identify the source of cannabis is an essential topic for both public safety, policy enforcement, and product differentiation. Current methods of identifying the source of cannabis are both inefficient and easily removed, as in the case of current methods of attaching RFID tags. These tags are easily moved and lost and do not track plant material beyond the point of distribution to customers. One method to improve identification of source is by applying different benign chemical markers to cannabis at harvest to make a resilient barcode that cannot completely removed without extensive effort. Detection of this chemical barcode is a multilayered approach that can be used to determine source, type of cannabis, or other characteristics of the cannabis that is being tested. This presentation will focus on the development of tests and the information that can be extracted from layering information within a chemical barcode. This approach may prove useful with other agricultural products as well.

2A: Working with a Research University: Ensuring Regulatory

Compliance through the Research Project Life Cycle

Catherine Bens, Colorado State University

Universities face challenges in ensuring that the research use of cannabis-related products meets not only federal and state regulatory requirements, but also supports researcher needs, and the needs of the funding sponsor. University administration support systems and faculty both struggle with navigating the legal landscape in a way that balances researcher, university and funding sponsor needs in an often changing legal and university policy environment. This panel will present some of the approaches that the Colorado State University Office of Sponsored Programs and Research Integrity and Compliance Review Office have used within the research project life cycle: project idea through resulting funding agreements. Through these approaches CSU strives to ensure research support and legal protection for both the University, its researchers and sponsors. Panelists will briefly present their university-specific initiatives and tools supporting cannabis research. Topics include:

- » Regulatory product registration review
- » Clinical Review Board with INAD assistance
- » Quality Assurance support for regulated and non-regulated studies
- » Research Advisory Committee
- » Policies
- » Sample agreements: Research, Material Transfer and Non-Disclosure Agreements
- » Problematic terms and conditions

2B: Population Genomics of Terpenoid Synthase Genes in Landrace Varieties and Drug Cultivars

Alisha Holloway, Phyllos Bioscience, Inc., *Kayla Hardwick*, Phyllos Bioscience, Inc.

Terpenoids are organic compounds produced by plants, that in combination produce a vast array of different smells and flavors. Terpenoids have a wide range of known functions, from chemical defense to interspecific communication; many also have important pharmaceutical properties. Chemical profiling and genetic studies of *Cannabis sativa* drug cultivars indicate that terpenoid synthase genes have a complex pattern of expression. We use a new cannabis reference assembly and whole genome sequence data from 100 drug cultivars and landrace varieties that represent worldwide genetic diversity to understand the underlying biology leading to this chemical diversity. Both gene duplication and selection on cannabinoid and terpene synthase genes are major drivers of diversity. Breeding efforts can leverage this information to develop new cannabis varieties that have more precise combinations and quantities of cannabinoids and terpenes.

2B: Genetic Characterization of Cannabis Used for Medical Research

Nolan Kane, University of Colorado Boulder, *Daniela Vergara*, University of Colorado Boulder

We compare cannabis used for medical research to that available in the state markets, analyzing relationships among many widely-used varieties. This, along with previous work characterizing chemical diversity of research-grade genotypes, helps us to understand and interpret medical findings, and may explain why so many studies' findings differ from widely-accepted views about the effects of marijuana. We argue that the dramatic differences between the federally sourced marijuana and that available in the state markets is a major problem, requiring

substantial re-interpretation of much of the medical literature. Future research should focus on material that is more relevant to the general public.

2B: Scanning Informative Regions of the Cannabinoid Synthases to Identify Relevant SNPs

Christopher Pauli, Steep Hill Laboratories, *Reggie Gaudino*, Steep Hill Laboratories, *Keith Allen*, Steep Hill Laboratories, *Daniela Vergara*, Steep Hill Laboratories

Understanding the underlying code of cannabinoid biosynthesis is essential to progress our classification and production of cannabis. By studying single nucleotide polymorphisms and amino acid substitutions in informative regions of the various members of the cannabinoid synthase gene family, we begin to understand the suites of cannabinoid synthases that encode the diverse cannabinoid profiles and the vast intraspecies variation observed. Through previous work, substrate and co-factor binding regions of these genes have been identified which we have targeted through novel primer sets and high throughput screening. The variations observed in these regions can change enzyme efficiency and products, which ultimately may shift the effects of a given cultivar. With greater precision in cannabis classification through genetic analyses of these regions, the research community can use this system to more accurately describe the cannabis studied, as well better allow us to understand the potential medical value of specific cultivars. By furthering our understanding of cannabinoid biosynthesis, this knowledge can be applied as a marker assisted breeding service through the design of novel primers. By allowing breeders to selectively identify and breed for the cannabinoid profile desired, specifically formulated cannabis strains can be developed to expand the known range of cultivars available. By combining this genetic approach with cultivation science to better understand the gene expression of the genome, we are beginning to understand how to optimize this ancient plant.

2C: The Influence of Stereotype Threat on Cannabis Users' Immediate and Delayed Recall Memory: A Threat to the Validity of Previous Research on Cognitive Decline?

William Bloxham, John F. Kennedy University, *David Peterzell*, John F. Kennedy University

Considerable research exists to suggest that long term cannabis use involves small but significant memory impairment. However, only a few studies have considered the possible confounding and stigmatizing effect of stereotype threat, a phenomenon by which members of a stigmatized group underperform on cognitive tests when their group identity is made salient, on cannabis users' test performance. These few studies show a significant effect of stereotype threat on memory performance. The present experiment investigated whether stereotype threat can impair performance on a story memory task involving tests of immediate and delayed recall (WMS-IV Logical Memory subtests). Participants were 42 frequent cannabis users who endorsed using cannabis twice per week or more. They were randomly assigned to either a "threat" or "no threat" condition which included, prior to testing, a written statement that frequent cannabis use was either likely or unlikely to impair task performance. A 2x2 mixed ANOVA revealed that performance was significantly better on immediate recall than delayed recall tasks. However, the predicted main effect of stereotype threat, and the predicted interaction showing that stereotype threat

impairs delayed recall more strongly than immediate recall, were not found. Statistical trends were in the predicted direction to show stereotype threat. However, if the current result is a Type II error, then 514 additional participants would be needed for the current effect to achieve statistical significance, based on a power analysis. If trends reflect a real experimental effect, consistent with the few other recent studies that have explored stereotype threat in cannabis and other substance users, then expectancy effects may pose a threat to the validity of studies asserting impaired memory functioning due to cannabis use. (Such studies often base their statistical conclusions about significant memory deficits on hundreds or thousands of participants, but the magnitude of the “deficit” is often smaller than the magnitude of stereotype threat effects reported here). Additionally, it is possible that some memory and cognition deficits experienced by cannabis users in the real world may result from stigma-related stereotype threat, rather than neuro-cognitive decline from cannabis use.

2C: Legalized Cannabis in Colorado Emergency Departments: A Cautionary Review of the Negative Health and Safety Effects

Brad Roberts, Southern Colorado Emergency Medicine Associates

Colorado legalized recreational marijuana in 2012 with legal sales beginning January 2014. This has led to novel presentations of pathology to Emergency Departments across the state. Most concerning are psychosis, suicide, and links to other substance abuse. Research shows deleterious effects on the brain including complex decision making processes, which may not be reversible with abstinence. Other effects include increases in fatal motor vehicle collisions, adverse effects on cardiovascular and pulmonary systems, and inadvertent pediatric exposures. Cannabis dispensary workers not trained in medicine are giving medical advice which may be harmful to patients. Cannabis research may offer unique opportunities for novel treatment of seizures, chronic pain, spasticity from multiple sclerosis, nausea and vomiting from chemotherapy, and sleep disorders. This has been difficult to navigate due to poor differentiation of the chemical composition of cannabis products. Future research should maximize therapeutic potential by specifying which compound and at what dose may result in benefit. Significant caution to further legalization is advised given adverse outcomes in Colorado.

2D: How A Community Centered Non-Profit, Realm of Caring, Uses Quantitative and Qualitative Data to Fulfill the Cannabis Community's Needs

Courtney Collins, Realm of Caring

The Realm of Caring is an independent 501(c)3 nonprofit that is reimagining the way we think, talk and respond to cannabis and those who use it. They are collaborating on innovative research, providing revolutionary education, and empowering people to lead better lives. The Realm of Caring was established in 2013 through a passionate grassroots community in Colorado Springs, desperate to advocate, educate, and support others seeking access to cannabinoid therapy across the world. The purpose of this poster is to explain how the Realm of Caring continues to respond to the cannabis community's needs by providing evidence-based education for clients/practitioners, financial assistance to offset the cannabinoid therapy costs for families in need and opportunity for collaborative research initiatives with established universities. Through the Realm of Caring's accumulative number of interactions with clients/practitioners, they are able to identify prob-

lems and advance solutions for their community. The collective quantitative and qualitative data presented in this poster about what the community needs propels the purpose for a non-profit in the cannabis industry to exist and to further the mission of evidence-based education, valid research, and financial support for families in need.

2D: Effect of Magneto-Priming on Germination Percentage of Industrial Hemp

Kathrin Spendier, University of Colorado Colorado Springs

Industrial hemp is one of historical importance in the U.S. as manufacturers seek industrial hemp as a renewable and sustainable resource for a wide variety of consumer and industrial products. Seed is one of the most important factors influencing crop yield. The objective of the performed study is to test whether magneto-priming, a form of seed priming that involves magnetic fields, can increase industrial hemp seed germination percentage above 65% at germination temperatures close to 10°C. Beneficial effects of magnetic fields on seedling growths and germination have been reported for many different plant species. However, the effects of magnetic fields on industrial hemp seed germination is largely unknown. In the study, industrial hemp seed is exposed to static and time-varying magnetic fields immediately prior to starting seed germination tests. After the treatment of seeds with magnetic fields, seed are germinated for up to 10 days at temperature ranging from 10°C to 26°C. First results show that the germination percentage of dry seed does not improve in the case of two-hour magneto-priming with static magnetic fields ranging from 65 ± 3 to 505 ± 8 mT at 13.6 ± 0.7 °C. This temperature is similar to soil temperatures in Colorado at planting time. First results on seeds soaked in water prior to application of the static magnetic fields and magneto-priming using time-varying magnetic fields are also discussed.

2D: Can Farmers in Utah Grow Hemp Without Modifying Current Soils?

Jeffrey Colbert, Weber State University

Hemp is a multi-million dollar industry; however, it is only grown in a few states in the US. Utah has a rich agricultural heritage going back to when the Mormon pioneers settled it. In prehistoric time, there was a brackish lake that covered the valley of Utah's Wasatch Front. Because of this lake, and different drainage events, the soil chemistry and composition changes depending on the depth and salts concentration of the lake. The goal of this study is to test soils from different locations along the Wasatch Front in a controlled environment to determine if those soils will support hemp growth yielding high fiber content and quality. This study will test Mg, Ca, N, P, K concentrations along with pH in soils from where the lake created shorelines and where farming is prevalent. Doing this will show how the ancient lake deposited different sediment types and altered the ion concentrations. These same tests will be conducted on potting soil to be used as a control. When the plants have matured, inflorescences, leaves, and stalk will be tested for THC levels. If THC levels are consistent with hemp, no more than %0.3 by dry weight, the study will continue, and fiber quantity will be measured and compared against the different soil collection locations. Thus, answering the question; can Utah farmers grow hemp without modifying their current soils and add take part in a multi-million dollar industry. Future studies may include testing input material to increase fiber yield and quality.

2D: Fear Memory Extinction is Enhanced by Cannabidiol when Given During Acquisition in Female Mice

Zackary Montoya, CSU-Pueblo, Amy L Uhernik, CSU-Pueblo, Jeffrey P Smith, CSU-Pueblo

Cannabidiol (CBD) is reported to have therapeutic potential for psychiatric conditions that affect learning and memory, including anxiety and post-traumatic stress disorders (PTSD). Pre-clinical contextual fear-learning and memory experiments in rodents have commonly been used to test this hypothesis, with recent work showing a memory-enhancing effect of CBD when administered just prior to extinction training in male mice. This suggests potential efficacy for CBD in a clinical setting where the aim is to extinguish previously acquired fear-memories, however, in our recently published work we showed that when administered during the acquisition phase of trace fear-conditioning, male mice responded to CBD with increasing resistance to extinction. Given the well-documented sexual dimorphisms in the acquisition and expression of fear memory, we repeated these experiments with female mice. Interestingly, we saw increased levels and rates of fear memory extinction following a single dose of CBD when given prior to acquisition and reduced generalized fear. This difference between the effects of CBD on male and female fear memory acquisition and expression indicates a need for more research before prescribing CBD as a treatment for learning and memory disorders such as PTSD for both men and women.

2D: Sex Differences in GluN2B-containing NMDA Receptor Dependent Acquisition of Cognitive Fear Memories and Effects of HU-211

Courtney Turner, CSU-Pueblo, Amy L Uhernik, CSU-Pueblo, Jeffrey P Smith, CSU-Pueblo

Misregulation of biological processes underlying fear learning and memory is the cause of several anxiety disorders such as obsessive compulsive, panic, generalized anxiety, severe phobia, and post-traumatic stress disorder (PTSD). Some disorders of fear learning are more prevalent in women than men, but the exact cause of this sex difference remains unknown. Fear learning and memory requires NMDA-receptor activation, and the GluN2B subunit of the NMDA receptor is emerging as especially important for fear learning and memory. Sexual dimorphism in fear regulation is in part due to N-methyl-d-aspartate (NMDA) receptor subtype composition, however, it is unknown if the GluN2B subunit functions differently in the acquisition of male versus female fear memory. Therefore, in the current study we hypothesized that GluN2B-containing NMDA receptors might be responsible for this sexual dimorphism. To pursue this end, we measured the effects of ifenprodil, a GluN2B antagonist, on the acquisition of cognitive fear memories in male versus female C57BL/6 mice. Current treatments for disorders of learning and memory include selective serotonin reuptake inhibitors (SSRIs), tricyclic antidepressants (TCAs), and monoamine oxidase inhibitors (MAOIs), however, negative side effects are common, and so drugs with other targets should be investigated. The cannabinoid, HU-211, is an NMDA receptor antagonist that may selectively target GluN2B. Therefore, we also hypothesized that HU-211 might inhibit the acquisition of cognitive fear memories in a sexually dimorphic manner similar to ifenprodil. These experiments show the potential usefulness of HU-211 as an alternative to current treatments for disorders of learning and memory and evaluate whether this cannabinoid is a GluN2B selective inhibitor of learning

and memory in vivo.

2D: HU-211-Sensitive, Cognitive Learning and Memory Processes Modulate GluN2B Surface Expression in the Mouse Brain

Jose Vigil, CSU-Pueblo, Jeffrey P Smith, CSU-Pueblo, Amy L Uhernik, CSU-Pueblo, Sam Koch, CSU-Pueblo

Disorders of learning and memory are often life-long, debilitating, and progressive disorders. Effective treatments for these disorders and their symptoms are lacking due to limited knowledge of the cellular and molecular mechanisms of learning and memory in general. It is well established that the ability to learn and remember depends greatly on a neuron's ability to regulate its expression of surface receptors. Insertion and removal of the membrane bound GluN2B NMDA receptor subunit has been strongly implicated in the processes of learning and memory, as well as apoptosis, cell survival, and excitotoxicity, while dysfunction of its expression has been implicated in several learning and memory disorders. This study evaluates the effect of a cognitive learning task on the surface expression of the GluN2B subunit in the mouse brain and seeks to determine whether the cannabinoid, HU-211, a putative GluN2B inhibitor, can affect learning and memory. Using a quantitative immunohistochemical approach, it was determined that trace fear conditioning enhanced the surface expression of the GluN2B subunit in select brain regions, and that HU-211 inhibited the acquisition of a trace fear memory. Overall, this suggests that HU-211 may be an effective tool to evaluate the role of GluN2B and its surface trafficking in cognitive learning and memory processes.

2D: The Effects of Medicinal Cannabis on Seizures in Adults with Medically Refractory Epilepsy: A Progress Report

Matthieu Conroy, CSU-Pueblo, Barbara Brett, CSU-Pueblo

Antiepileptic drugs (AED) fail to control seizures in approximately 30% of individuals with epilepsy. This condition, called medically refractory epilepsy (MRE), significantly affects a person's quality of life. A potential adjunctive treatment that may be beneficial for individuals with epilepsy is cannabis. Research in animals and humans suggests that two cannabinoids—delta-9-tetrahydrocannabinol (THC) and cannabidiol (CBD)—may positively affect seizures. In addition, recent randomized control trials (RCTs) confirmed the efficacy of oral CBD as a treatment for Dravet Syndrome and Lennox Gastaut Syndrome. Indications that cannabinoids such as CBD are a safe, effective treatment for seizures in children is suggestive of their potential benefit for adults. The main purpose of the present observational study is to examine the effects of medicinal cannabis use on seizures in adults with MRE who elect to use cannabis as an adjunctive treatment. In particular, we are interested in learning more about the effects of seizures and cannabis use on autonomic physiology. For this study, participants visit the principal investigator's lab three times over the six-month period of the study. They wear a wireless physiological recording device daily for one month before they initiate medicinal cannabis use and for five months after they initiate use. Physiological measures including electrodermal activity, blood volume pulse, heart rate, motion/acceleration, and temperature are collected and processed to produce monthly seizure reports. Seizures and the physiological effects of cannabis are tracked using an event marker on the wireless physiological recording device. During each of the three lab visits, participants provide urine samples that are processed for cannabinoid levels. They also fill out

questionnaires assessing medicinal cannabis use, quality of life, seizure severity, anxiety/depression, side effects, and adverse events. To date 10 participants have been enrolled and two of these participants have completed the study. Physiological and behavioral data collected and progress on this study will be presented.

2D: Synthetic Cannabinoids Reduce Sindbis Viral Titers and Promote Metabolic Homeostasis in Infected HuH7 Cells

Juan Rodriguez, CSU-Pueblo

Alphaviruses are responsible for frequent endemic outbreaks worldwide impacting more than 100 million people and is constantly spreading into new territories. Viruses are pathogens that invade host cells and can seize control over mitochondrial metabolism in order to increase production of new progeny. The endocannabinoid system targets cellular pathways that promotes metabolic stability and cell survival. The ligands responsible for stimulating the cannabinoid 1 receptor (CB1) could potentially interfere with the efficiency of viral progeny formation. I hypothesized that synthetic cannabinoids will reduce Sindbis virus titers and promote mitochondrial stability in hepatocellular carcinoma cells (HuH7). To test this hypothesis, HuH7 cells were infected with Sindbis virus, a prototypical alphavirus and treated with a CB1 agonist (ACEA) and a CB1 inverse antagonist (AM-251) over 24-hours of infection. Viral titers were quantified by plaque assays and the mitochondrial functions were measured with a real-time cellular metabolic analyzer. Interestingly, it was found that synthetic endocannabinoids did decrease viral titers as well as stabilize mitochondrial function. The hypothesis is partially supported as synthetic endocannabinoids can reduce viral titers. More work is being done to understand the overall mitochondrial function.

2D: Exploring the Information Practices of Cannabis Nurses

Connie Pascal, Rutgers University

Two overlapping issues in American society give rise to this dissertation research study: the need to effectively address the public health crisis around chronic conditions and the controversial reemergence of cannabis-based medicine. The legal issues, social stigma, lack of research, and patch-work governance of cannabis-based medicine have complicated and changed the way in which healthcare providers are learning about how to practice cannabis-based medicine. Given that nurses are both an agent of change and on the front line of healthcare, exploring the emergence of the cannabis nurse makes good sense. As an exploratory study, the research question answered by this study is deceptively simple -- 'what are the information practices of cannabis nurses'? Exploring the Information Practices of Cannabis Nurses is an interdisciplinary study that incorporates theories from information science, communication, and knowledge management by studying the phenomenon of cannabis nursing through the information practices being employed by nurses already practicing some form of cannabis-based medicine. Information practices theorize and emphasize the embodiment and sociological aspects of information seeking in everyday life. Designed using qualitative methods, this study looks at a sample of 32 self-described cannabis nurses currently practicing some form of cannabis-based medicine. Data was collected from semi-structured interviews with these nurses between April–October, 2018. This was followed by two rounds of thematic analysis which produced a very rich description of how this set of early adopters are seeking information they believe in and sources they can trust as the

role of the cannabis nurse emerges. Findings so far point to the urgent need for the development of several types of information systems including: decision support and research tools driven by patient / plant genomics; patient journaling and communication systems; and 'lite' electronic medical records software. Findings are also illuminating the effects of the stigma surrounding cannabis on information seeking and knowledge development for health care providers. Some of strongest findings thus far include the nurses' rejection of physicians and the pharmaceutical industry as cognitive authorities; the emergence of an ontology, epistemology, and community of practice of cannabis nursing; the high degree of information literacy in the sample group; and the extraordinary amount of entrepreneurial zeal displayed by the group. Cannabis-based medicine is being shown to improve the health outcomes of people with a wide range of health conditions and, if implemented on a wide enough scale could improve public health overall. The implications show that purpose-built software systems and decision support tools to aid in the integration and implementation of cannabis-based medicine into American healthcare are needed. This study also clearly suggests that cannabis-based medicine is evolving in a different way from any other medical modalities and illustrates the pressing need for more and better education about cannabis and cannabis-based medicine for all levels of healthcare providers, for patients, and the public at large. The finding from this study should prove useful to software designers, nurse educators, and researchers in information science, communication, and knowledge management interested in information seeking, practice theory, healthcare informatics, and adult learning theory.

2D: The Potential of Whole Hemp Seed as a Prebiotic to Support Growth and Metabolism of Anticarcinogenic Probiotic Bacteria

Whitney Lujan, CSU-Pueblo, Krystal Hrbac, CSU-Pueblo, Audria Linkowski, CSU-Pueblo, Annette Gabaldon, CSU-Pueblo

Cancer is a devastating disease that has a global impact. Previous studies have shown that both hemp and probiotics have anticarcinogenic activity in cancer cells, especially, colon cancer. Probiotics are intestinal bacteria that naturally inhabit the colon and carryout diverse functions through metabolism, such as the production of secondary metabolites, e.g. short chain fatty acids. Hemp seeds are from *Cannabis sativa L*, and are a beneficial source of nutrients. Both hemp seed and probiotics are considered functional foods that have overall benefits to human health. A potential preventative resource and treatment for colon cancer is a synbiotic, consisting of whole hemp seeds as a potential prebiotic and probiotic bacterium. It is hypothesized that whole hemp seed will enhance growth rates and metabolic activity of probiotics that are known to have anticarcinogenic properties against colon cancer. To test the hypothesis, *Lactobacillus plantarum* and *Lactobacillus fermentum* have been cultured in MRS broth, split into control and treatment groups, and grown under anaerobic conditions. The control groups include 1% inulin, a known prebiotic and no hemp seed with glucose, as positive controls and no hemp seed without glucose, as a negative control. The treatment groups are 1% and 5% hemp seed (w/v) supplemented into carbohydrate-free media. The pH and colony-forming units were measured at different time points and concentrations of hemp seed, as an index of fermentation and growth. In addition to measuring CFUs and pH, measurements of lactic acid production and short chain fatty acid production are being obtained

as an index of metabolic activity. Both *Lactobacillus fermentum* and *Lactobacillus plantarum* pH data shows that the 5% hemp seed has a greater drop in pH than the 1% hemp seed, 1% inulin, and the negative control. However, the 5% hemp seed does not have greater drop in pH than the glucose, which is because glucose is the preferred carbon source for most living organisms. In the growth of the probiotic bacteria, all groups exhibited higher growth than the negative control. However, in the *Lactobacillus fermentum* the 5% growth was higher than the glucose, where in the *Lactobacillus plantarum* the growth correlated with the pH. The study is currently in progress, but we expect to find an increase in metabolic activity in the 5% hemp seed (vs. negative control) group, as we did in the growth of the probiotics. If indeed an increase in growth and metabolism occurs, a possible synbiotic could be further investigated and shed light on a potential treatment for colon cancer.

2D: The Effects of Co-Activation of Cannabinoid Type 2 and Estrogen Receptors on Osteogenesis in Cultured Primary Human Osteoblasts

Derrick Williams, CSU-Pueblo, Annette Gabaldon, CSU-Pueblo

Postmenopausal osteoporosis develops when bone removal by osteoclasts exceeds bone formation by osteoblasts due, in part, to the loss of the bone protective effects of high serum estrogen. As with estrogen, activation of the cannabinoid type 2 (CB2) receptor is bone protective, thus co-activation of CB2 and estrogen receptors might enhance osteogenesis in primary human osteoblasts (HOBs). We hypothesize that activation of CB2 receptors in isolation will increase HOB differentiation and osteogenesis in HOBs isolated from a 64-year-old, healthy, female (PromoCell, Germany), and that co-activation of CB2 and E2 receptors will also increase in vitro osteogenesis. To test this hypothesis, HOBs were cultured and treated with single CB2 ligands (CB2 receptor agonist, AM1241; or CB2 receptor antagonist/inverse agonist, AM630) in isolation or in combination with 17beta-estradiol (E2, estrogen receptor agonist) for up to 21 days. HOB maturation was evaluated by alkaline phosphatase (ALP) activity while osteogenesis was evaluated by extracellular matrix deposition (i.e. collagen and bone nodule formation). Bone nodule properties of interest were calcium content (indexed by Alizarin Red S staining) and microanatomy (nodule count, size, and surface area) evaluated using ImageJ. The HOBs differentiated and formed bone nodules as expected, with a time-dependent increase in bone nodule formation ($p < 0.05$) and ALP activity ($p < 0.05$). However, for all of the treatment groups, the ligands did not significantly influence ALP activity or bone nodule formation except for AM630, which produced a significantly lower ALP activity relative to the control ($p < 0.05$). Thus, despite the demonstrated time-dependent influences, the data did not support the hypothesis. This lack of response could be due to many factors including the cell type chosen, and thus does not preclude the hypothesized effect of CB2 and estrogen interactions on osteogenesis.

2D: A Grounded Theory Dissertation Proposal: Developing a Cannabis Curriculum for Medical School Students and Continuing Medical Education Courses

Courtney Collins, Realm of Caring

There are glaring problems facing the public health of cannabis consumers today in the United States. Since the FDA continues to classify cannabis as a schedule 1 drug with no inherent medical use,

systematic research about its potential benefits and risks are muted in academic journals and evidence-based findings. As a result, medical practitioners are not prepared to address the questions of a growing number of cannabis consumers because the content is not taught in medical school, nor sufficiently taught in CME courses. The lack of credible references not only leaves doctors with minimal preparation to accommodate patients but also leaves patients without answers to pressing medical questions and problems. This poster explains a grounded theory dissertation proposal to understand the processes of how an established medical practitioner, specializing in cannabis therapy and the endocannabinoid system (ECS), acquires the knowledge to best advise patients seeking medical marijuana advice in the United States. It will define the research problems, research questions, the data collection method, and analysis. Preliminary results in a pilot study suggest that health care providers who are currently advising patients on medical cannabis dosing and administration have had to develop their own protocols using a process of trial and error due to the lack of research, specifically, double-blind, randomized, placebo-controlled trials. This poster identifies how the cannabis curriculum will be developed: by interviewing twenty or more expert cannabis health care professionals about their individual approach to advising patients. Until a saturation of theoretical concepts is completed, the researcher continues to interview participants.

2D: Therapeutic Cannabinoids in Anxiety and Depression: Results from an Observational Research Study

Megan Brunstetter, Realm of Caring Foundation, Erin Martin, Johns Hopkins University, Nicholas Schlienz, Johns Hopkins University, Joel Munson, Realm of Caring Foundation, Heather Jackson, Realm of Caring Foundation, Marcel Bonn-Miller, University of Pennsylvania, Ryan Vandrey, Johns Hopkins University

Introduction: Cannabis is frequently used recreationally for both its mood-enhancing and relaxing effects, and the endocannabinoid system plays a demonstrable role in mood and anxiety disorders. However, cannabis/cannabinoids are not currently approved for the treatment of depression or anxiety, and results of observational studies on the impact of cannabis use among individuals with anxiety and/or depression are inconsistent. Pre-clinical literature involving acute cannabinoid administration, particularly cannabidiol (CBD), is strongly suggestive of an anxiolytic and antidepressant effect, but research in humans is limited. The purpose of this study was to examine the health impact of cannabis product use among individuals with anxiety and/or depression compared with controls who did not use cannabis.

Methods: Study participants included cannabis users (N=55) and non-cannabis using controls (N=33) who listed anxiety or depression as the primary health condition for which they were, or were considering medicinal use of cannabis. These individuals were a sub-group of participants in a medicinal cannabis observational patient research registry. Individuals were included if they endorsed no neuropsychiatric, neurological, or behavioral disorders other than a primary diagnosis of anxiety and/or depression. Participants reported demographic information, described cannabinoid product and prescription medication usage, and completed self-report questionnaires assessing mood and anxiety (Hospital Anxiety and Depression Scale; HADS), sleep (Pittsburgh Sleep Quality Index; PSQI), and quality of life (World Health Organization Quality of Life; WHOQOL-BREF) via web-based surveys. Follow-up surveys containing the same questionnaires were

completed at three-month intervals. Independent samples t-tests and chi-squared tests were used to assess differences in response between users and non-users at baseline, and paired t-tests were used to examine changes in response among individuals who were cannabis non-users at baseline, but initiated cannabis use during the follow-up period.

Results: No significant demographic differences were found between cannabis users and controls at baseline other than education (79% of non-users vs. 95% of users completed high school). Rates of antidepressant and anxiolytic medication usage were similar. Compared with controls, cannabis product users reported significantly lower anxiety (Mean score (+/- SD) = 11.6 (4.2) vs. 13.9 (4.2)) and depression (Mean score = 7.2 (4.0) vs. 10.1 (4.5)) on the HADS. Cannabis users, compared to non-users, were significantly more likely to score within the 'Normal' range (0-7) on the HADS for depression (55.6% vs. 24.2%), and were significantly less likely to score within the 'Severe' range (15-21) for depression (3.7% vs. 21.2%) and anxiety (23.6% vs. 48.5%) at baseline. Cannabis users also reported significantly better sleep on the PSQI (Mean score = 8.8 (3.2) vs. 11.0 (3.6)), and had significantly higher scores in the 'Physical' (Mean score = 63.0 (19.7) vs. 50.0 (19.7)) and 'Psychological' (Mean score = 51.7 (18.6) vs. 39.2 (16.7)) domains of the WHOQOL-BREF. A significant reduction in anxiety (Mean score = 11.0 (2.9) vs. 13.3 (2.4)), but not depression (Mean score = 9.0 (5.0) vs. 10.4 (4.5)), was observed in a small sample of individuals that initiated cannabis product use after completion of their baseline survey (n = 8). The majority of therapeutic cannabinoid users reported regular use of high-CBD products (76%), and 56% reported only using only high CBD products, compared with 18% who reported use of multiple cannabinoid chemotypes.

Conclusion: Medicinal cannabinoid users reported significantly less anxiety and depression than non-users, and those that initiated cannabinoid therapy reported reduced anxiety compared to baseline. These results suggest promise for the use of medicinal cannabinoids, and high CBD products in particular, in this population, but additional, placebo-controlled research is required to ascertain the reliability and validity of these findings.

2D: A Holistic Framework to Assess the Sustainability of the Hemp Industry in Colorado

Glenn Willis, CSU-Pueblo, Yaneth Correa-Martinez, CSU-Pueblo

With the passing of the 2018 Farm Bill, hemp is receiving a much-sought status as an agricultural commodity. The assessment of the sustainability of its production and distribution is gaining increasing relevance, specially in those states where cannabis has been previously legalized. The Bill allows broad cultivation and the transfer of hemp-derived products across state lines, and it removes restrictions along the hemp supply chain as long as those the products are produced in a manner consistent with the law. With the hemp industry finally moving from pilot stages to large scale production, there is not a holistic approach that can be generally applied to assess sustainability of potential production areas. In this poster, we present the Sustainability Assessment of Food and Agricultural Systems (SAFA) framework from the Food and Agriculture Organization of the United Nations for the assessment of sustainability of the growing hemp industry in the state of Colorado. The framework covers four main sustainability dimensions: environmental integrity, economic resilience and profitability, social wellbeing and good governance. The benefits of the framework are associated with its flexibility to be applied in differ-

ent contexts and locations. Furthermore, the framework's principles rely on accessibility and transparency, standardized metrics, communication, broad participation, institutional capacity along the hemp supply chain. If adapted and adopted, Colorado could grow the hemp industry with a holistic picture of sustainability, even in situations of poor data availability (a common aspect in growing industries).

2D: Extraction of Biopolymers from Hemp Biomass

Guy Mendel, CSU-Pueblo, Richard Farrer, CSU-Pueblo, Yaneth Correa-Martinez, CSU-Pueblo, Leonardo Bedoya-Valencia, CSU-Pueblo

A significant portion of plant material is biopolymers that are responsible for the shape and structure of the plant. Cellulose and lignin (the two most abundant biopolymers on earth), along with hemicellulose and pectin, are the primary biopolymers that make up cell walls in plant materials. While cellulose, hemicellulose, and pectin are polysaccharides (polymers consisting of repeating units of sugar), lignin is a more complex biopolymer that does not have a simple formula and structure. Lignin is composed of units of differing cross-linked phenylpropanoid alcohols. Neither cellulose nor lignin is water-soluble; however, cellulose is considered the more hydrophilic of the two because of the vast numbers of hydroxyl moieties that exist in the structure of the polymers. The purpose of this research is to extract cellulose and lignin from hemp biomass, that is a byproduct produced after the extraction of oils from the plant material. Although biopolymers have been extracted from a range of plant materials (wood, corn, rice, etc.), the use of hemp biomass that has undergone treatment intended to extract the oils from the original plant material is an interesting concept. Theoretically, a large percentage of the remaining hemp biomass should consist of the biopolymers that form the cell walls. Several methods for the extraction of cellulose from plant materials are available in the literature, while lignin tends to be treated as an impurity of during the extraction and purification of cellulose. The ability to extract, separate, and purify both cellulose and lignin from the same hemp biomass, while retaining the primary structure and function of the biopolymers is the goal. The initial work has focused on the use of published extraction methods in order to collect cellulose and lignin. Further processing of the extracted cellulose allows for the collection of crystalline nanocellulose. Chemical and physical analysis of the material collected after each step of the extraction process allows for a deeper understanding of the process. Ultimately, development of an environmentally-friendly, low-cost extraction method that consistently produces materials of the desired purity is the goal.

2D: Negative Edibles Experiences: A Survey of Cannabis Edibles Users

Jane M Fraser, CSU-Pueblo, Josh Meisel, Humboldt State University, Sue Sisley, Scottsdale Research Institute

Edible products emerged in recent years as an appealing alternative for users interested in ingesting cannabis orally rather than smoking. While user demand and product diversity has increased, there has been limited research examining edibles as a distinct mode of cannabis administration as most data is based on smoking and combustible cannabis products. Despite their appeal as an alternative delivery system, cannabis edibles have also been the focus of substantial concern relating to packaging, labeling, potency, and accidental ingestion. Drawing on findings from prior interviews with 46 cannabis users who

self-identified as having had a negative experience with an edible, a survey questionnaire was developed and administered online to a national panel of 500 respondents who also reported negative experiences with cannabis edibles. The purpose of the survey was to identify the leading causes, characteristics, coping strategies, and lessons learned for users who had negative edibles experiences. Preliminary findings from this research will be presented.

2D: Repeated Synthetic Cannabinoid (WIN 55, 212-2) Administration Produces Tolerance to Its Dopamine Release Effects

Thomas Evertt, University of Colorado Denver, EB Olesen, University of Colorado Denver

Continued administration of cannabinoids has been shown to elicit tolerance to multiple behavioral/physiological measures, however, the tolerance producing effects of such exposure on dopamine release remain unclear. Vehicle was administered to rats followed by a synthetic cannabinoid

(WIN55-212-2; WIN) using an intravenous dose escalation regimen (0.2–0.8 mg/kg IV over 9 treatments). Tolerance was then assessed in response to this dosing regimen using a series of behavioral/physiological measures that are routinely observed when rodents are treated with WIN (i.e., the tetrad test: catalepsy, hypothermia, antinociception, and spontaneous activity). Lastly, using fast scan cyclic voltammetry, the frequency and amplitude of dopamine release in the nucleus accumbens of freely behaving rats was measured. WIN-treated rats displayed a rightward shift in the dose-response relationship (0.002–0.8 mg/kg IV) in all behavioral/physiological measures when compared to the control group treated with vehicle. Similarly, the dopamine releasing effects of WIN were significantly reduced in the WIN-treated rats when tested at the 0.2 mg/kg IV dose. These results demonstrate that repeated administration of the synthetic cannabinoid WIN can produce tolerance to its dopamine releasing effects. A diminished ability to increase dopamine release may contribute to the abuse of larger cannabinoid doses, thereby advancing the addiction process.

2D: Specific PAR wavelengths and UV light potentially influence cannabinoid production and trichome density in Cannabis sativa L. throughout different stages of growth and development

Trevor Regas, CSU-Pueblo

Cannabis sativa L. is an annual diecious, flowering herb classified in the family Cannabaceae. Cannabinoids, produced predominantly within trichomes located on the outer epidermal layer of female inflorescences, are becoming an increasingly popular research topic, primarily due to their progressively recognized medicinal properties. Cannabidiol (CBD) is the second most prominent cannabinoid found in *Cannabis* and is attributed to a host of medicinal benefits including pain management [1], anti-seizure properties [2], anti-depressant properties [3], reduction in the risk of diabetes [4], and treating various sleep disorders [5]. Recent studies provide insight into various biotic (i.e., insect pressure) and abiotic factors (i.e., light, drought, and wind) affecting morphological and chemical characteristics in plants [6,7,8,9]. However, there is less evidence depicting how environmental factors influence cannabinoid production. Understanding how *Cannabis* responds to different stimuli allows researchers, horticultur-

alists, and clinicians to assess the probable agricultural and medicinal applications of *Cannabis*. In this study, various photosynthetic active radiation (PAR) wavelengths and ultraviolet (UV) light will be utilized to determine the potential impact on trichome formation and cannabinoid production in *C. sativa* (>10% CBD, <0.3%THC) throughout different growth stages (i.e., vegetative vs. flowering). A total of 11 cannabinoids (cannabigerolic acid; CBGA, cannabidiolic acid; CBDA, delta-9 tetrahydrocannabinolic acid; THCA, cannabichromic acid; CBCA, delta-9 tetrahydrocannabivarinic acid; THCVA, and cannabimol; CBN) and their decarboxylated forms will be analyzed to determine their production in response to different light frequencies: blue (450-485 nm), red (625-740 nm), blue/red combination, and ultraviolet-A/B (10-400 nm). Assessing the potential impacts of individual light wavelengths on trichome density and cannabinoid production enables the progression and practicality for optimization in cultivation techniques. Additional research in this field is imperative in order to construct a deeper understanding relating to cannabinoids and the environmental factors that potentially influence their production..

3A: Risk Management: The Links between Insurance, Safety, Compliance and Good Business

Mike Rosenthal, Cannabis Risk Management Association

There are risks inherent in every cannabis business. They potentially affect employees, products, processes, customers, finances and reputations. Identifying these risks and designing tools to mitigate the likelihood of their occurrence and their costs are critical to long-term business success. The cost of a negative event goes far beyond its direct cost. Some estimates are that total costs of negative events are as much as \$8 for every \$1 in direct cost. Add to that the potential effect on customer trust (reputation) and company valuation and those numbers increase even more. This panel will discuss how unaddressed risks can affect businesses and explore methods for identifying and mitigating those risks.

3B: Genomic Characterization of the Entire Terpene Synthase Family in Cannabis

Keith Allen, Steep Hill Laboratories

Terpenes are responsible for most of the odor and flavor properties of cannabis, and variation in terpene content is a key differentiator between different strains. For this reason alone there has long been interest from breeders in creating strains with particular oil profiles, but there is a growing body of preliminary evidence indicating that terpenes play a role in the various effects of cannabis, either directly or by modulating the effect of the cannabinoids. We have analyzed extensive terpene profile data, and ultimately much of the variation we see will be explained by genetic differences, specifically changes to the terpene synthase genes responsible for making all these compounds. There is already excellent work providing functional characterization for 9 mono and sesqui terpene synthases. But without a reasonably complete reference genome, there has been not way to estimate the total size of the family, or the genomic context of the genes. We have taken advantage of newly available genomic sequence data to map the entire terpene synthase gene family, now at about 60 genes. I will discuss our findings, and how we anticipate using these results to guide breeders looking to create new strains with specific, reliable oil profiles.

3B: Stirring the Pot: Genetic Analysis of Hemp-type, Legal Drug-type, and Federally-Supplied Research Grade Cannabis

Anna Schwabe, University of Northern Colorado, *Connor Hansen*, University of Northern Colorado, *Richard Hyslop*, University of Northern Colorado, *Mitchell McGlaughlin*, University of Northern Colorado

Recently several countries have made dramatic changes to reform previously strict cannabis regulations. As public comfort with cannabis (marijuana and hemp) increases, there is a growing interest in the potential medical benefits of the various chemical constituents produced by cannabis. Currently in the United States, the University of Mississippi, funded through the National Institutes of Health/National Institute on Drug Abuse (NIH/NIDA), is the sole Drug Enforcement Agency (DEA) licensed facility to cultivate cannabis for research purposes. As such, federally funded research where participants consume cannabis for medicinal purposes largely relies on NIDA-supplied research grade marijuana. Recent research found that cannabinoid levels in research grade marijuana from NIDA did not align with commercially available cannabis from Colorado, Washington and California. In light of these findings, we sought to investigate where NIDA's research grade marijuana falls on the genetic spectrum of cannabis groups. NIDA research grade marijuana was found to genetically group with hemp-type samples along with a small subset of commercial drug-type cannabis. Overall, commercially available drug-type cannabis was genetically very distinct from NIDA samples. These results suggest that medical participants consuming NIDA marijuana for research purposes may experience different effects than those consuming legal cannabis from dispensaries.

3B: Aroma Perception Reflects Genetic Variation within Cannabis Strains

Anna Schwabe, University of Northern Colorado, *Samantha Naibauer*, University of Northern Colorado, *Mitchell McGlaughlin*, University of Northern Colorado, *Avery Gilbert*, Headspace Sensory LLC

There are thousands of cannabis varieties (strains) which are generally described based on psychotropic effects and phytochemical profile. Recent research has found that aroma profiles are distinctive among strains, but multiple accessions of the same strains from different sources show genetic inconsistencies. Genetic variation may lead to differences in consumer-relevant phenotypic traits such as terpene content, and therefore differences in aroma. By combining molecular genotyping and olfactory phenotyping techniques, we sought to determine whether genetically inconsistent samples within a commercial strain display inconsistent aroma profiles. We genotyped 42 samples from 5 strains to determine the consensus genotype as well as genetic outliers (if any) based on 10 variable microsatellite regions. Results were used to select 4 strains (15 samples) for olfactory testing: "Blue Dream" (5), "OG Kush" (4), "Mob Boss" (3), and "Durban Poison" (3). A genetic outlier sample was included for each strain except "Durban Poison", which served as a control where all samples had an identical genetic profile. Aroma profiles were produced by 55 untrained sniff panelists (33 men, 22 women) using check-all-that-apply ballots with 40 previously validated odor descriptors. The discriminatory aroma profile for the "Mob Boss" genetic outlier was at odds with the consensus samples as well as the strain's previously observed aroma profile. All "OG Kush" samples displayed the strain-typical aroma profile previously described, but the genetic outlier expressed

a high-scoring yet atypical "cheese" note. The "Blue Dream" genetic outlier was far more pungent, chemical, and skunk-like than the mean of the four consensus samples. Although all three samples "Durban Poison" were genetically identical, the scent profiles do not seem to follow a particular pattern, which could be due to different growing, curing, storing or age differences among dispensaries. It appears that within-strain differences identified by microsatellite genotyping are associated with differences in aroma profile.

3C: Trends in Suicide Rates Relative to Population Data on Marijuana and Other Drug Use, Unemployment, and Binge Drinking Rates

Christine Miller, MillerBio, *Monica Jackson*, American University, *Kevin Sabet*, Yale University

Suicide has increased steadily in the U.S. over the last decade, a trend of obvious concern. To elucidate factors that might underlie this trend, we analyzed variables associated with suicide in case control studies and which have increased in magnitude over recent time. Federal data (2000–2015) were accessed for rates of age-adjusted suicide in the general population, unemployment, monthly binge use of alcohol, marijuana use and use of other drugs, and national suicides in veterans. Multiple linear regression was used to estimate the impact of these variables on suicide rates in the general population and in veterans, using standardized estimates. For the United States as a whole, marijuana use in those aged 12 and over was a significant predictor of suicide rates (estimate 0.95, $p < 0.001$). In 6/10 high-marijuana-use states, suicide depended primarily on marijuana use, whereas unemployment was primary in two states. In only 3/10 of low-use states did suicide depend primarily on marijuana use, whereas unemployment was primary in two states and binge alcohol use was primary in one. Suicide in veterans was predicted by unemployment (estimate 0.89, $p < 0.001$). To summarize, in the U.S. population and in several states examined, suicide rates were predicted primarily by marijuana use, whereas unemployment was more important in a few states and for veterans. The case-control results of related research are reviewed, as well as potential neurochemical mechanisms for marijuana's impact on suicidal behaviors.

3C: A Latent Class Analysis of Canadian Adolescent Alcohol And Marijuana Use On School Performance

James McIntosh, Concordia University

This study examines the relation between alcohol and drug use and school performance using sample survey data from the 2012–2013 Canadian Youth Smoking Survey. Academic performance of Canadian grade 7-12 students as represented by school grades is analyzed using mixed ordered Beta probability models. Frequent use of marijuana and to a lesser extent alcohol leads to significantly lower probabilities of getting top grades and much higher probabilities of being in the bottom of the grade distribution. Latent class analysis which reveals ability to be a latent trait shows that not all students react to early marijuana use in the same way. Early ages of first use of marijuana are also associated with significantly poorer academic performance.

3D: Biopolymers in Hemp Biomass: Extraction and Application

Richard Farrer, CSU-Pueblo, *Yaneth Correa-Martinez*, CSU-Pueblo, *Leonardo Bedoya-Valencia*, CSU-Pueblo, *Guy Mendel*, CSU-Pueblo

The cell walls of plants consist of many biopolymers that provide

the basic structure and rigidity to plants. These biopolymers are primarily cellulose, hemicellulose, pectin, and lignin, with cellulose and lignin being the two most abundant biopolymers on earth. All of the biopolymers found in cell walls are composed of carbohydrate (sugar) monomers, except for lignin, which are considered cross-linked phenolic polymers. While the carbohydrate polymers consist of repeating units of sugars, lignin does not have a simple repeating structure, and therefore does not have a general chemical formula, as a result the chemistry of lignin varies from plant-to-plant. Although, neither cellulose nor lignin are water soluble, the large number of hydroxyl groups on the cellulose makes cellulose more hydrophilic than lignin. Both of the biopolymers are biodegradable. Although, biopolymers have been extracted from other plants (wood, corn, rice, etc.), the use of hemp biomass is an interesting proposition, since the original plant material has undergone an initial extraction to remove the oils. After the initial extraction, the majority of the remaining plant material is biopolymers. The purpose of this project is extraction of cellulose and lignin from the hemp biomass, and conversion of the extracted biopolymers to useful fibers or fibrous materials. Initially, published methods for the extraction of cellulose and lignin have been employed. Chemical and physical analysis of the material collected after each successive step in the extraction process, allows for a deeper understanding of the biopolymers and the extraction process. After extraction, the cellulose and lignin will be employed to create polymer fibers through electrospinning of polymer solutions. The physical and chemical properties of the fibers can be varied by chemical modification of the polymers prior to electrospinning and/or chemical modification of the resulting fibers. Physical and chemical analysis of the manufactured fibers will allow for detailed characterization of the final products.

3D: Development of Bast Fibers in *Cannabis sativa L.* and Their Industrial Uses

Eun Soo Kim, Konkuk University and Korea Hemp Institute,
Wonkyun Choi, Korea Hemp Institute

Hemp fibers are one of the strongest natural fibers and most environment-friendly materials. Owing to their high tensile strength and durability and porosity of the fiber cells, hemp fibers are increasingly used in various hemp products. This study focused on analyzing the morphological characteristics of bast fibers for application to specific high-quality products depending on their secondary wall deposition. At different stages of development, from the 3rd internode of *Cannabis sativa* stem aged 28, 52, and 62 days, respectively, were observed and analyzed using scanning electron microscopy and an image analyzer. In the early stage, the fibers with enlarged lumen and thin secondary cell wall showed higher porosity; thus, they are suitable for absorbent products like oil absorbents, or insulations. In the late stage, however, the fibers thickened three times more than that at the early stage; therefore, they are stronger and candidate materials for automotive or construction products.

3D: Study of Hemp Textile Composites

Nebojsa Jakšić, CSU-Pueblo

Humans used hemp for over 10,000 years for food, clothing, rope, etc. Currently, hemp is used in a variety of products from cosmetics and medicine to paper and building materials. In the U.S., until recently, hemp growing was severely restricted due to the federal and state government regulations not distinguishing industrial hemp from

marijuana (Delta(9)-THC levels higher than 0.3%). The Section 7606 of the Agricultural Act of 2014 makes this distinction and allows growing of hemp for research purposes. For this research, industrial hemp use is sanctioned by the federal government through Section 7606 of the Agricultural Act of 2014, as well as by the State of Colorado through the Colorado Industrial Hemp Act of 2015. In addition, effective January 1st 2019, the 2018 Farm Bill substantially improved the hemp policy across the U.S. While hemp is federally still heavily regulated (license required for hemp growers) several provisions bring hemp closer to the mainstream crops. Section 11101 of the Farm Bill includes hemp farmers' protections under the Federal Crop Insurance Act—an important incentive for farmers who wish to grow hemp. In addition, the Farm Bill removes hemp-derived products from its Schedule 1 status and allows such products to be transferred across the state lines for commercial or other purposes. In addition, as a plant, hemp produces 2-3 times more fiber than cotton or 2-4 times more paper than trees per equal growth area. Based on the above facts, it would be advantageous to replace many bio-materials with hemp in as many applications as possible. While there are some commercial products that use hemp as building material (like fiberboard, fiberglass, hempcrete, etc.), there is little rigorous scientific research on using hemp textiles as reinforcing agents in composites. This research investigates various hemp composites as possible replacements for wood products in construction, specifically house framing elements like trusses, studs, and joists. In the first stage of this research, commercially available hemp textiles are used in creation of epoxy-based and concrete-based composite test specimens. Then, hemp textile samples of varying thread densities (10 and 15 ends per inch) are created and used for making such composites. To determine mechanical characteristics of the test specimens produced from hemp textile-epoxy and hemp textile-concrete composites the tests including compression, tension, flexion, and Poisson's ratio are performed using an Instron 1123 tensile and flexural testing instrument and a Forney concrete testing machine.

4A: Cannabis Across the College Curriculum

Karen Yescavage, CSU-Pueblo

Many conference presenters and attendees are likely to be teacher-scholars. This session will provide an opportunity for faculty to discuss their experiences with teaching about cannabis. Disciplines represented include business, law, chemistry, and the social sciences. Panelists will provide their discipline-specific experiences and what they envision the future holds in terms of educating college students about cannabis. The panel will also explore shared pedagogical concerns (e.g., potential for stigma and assumptions made by colleagues and students) and opportunities (e.g., exposing students to cutting edge research and a burgeoning field of study) to educate college students. The panel will discuss the following questions:

- What has been your experience being associated with cannabis studies?
- Have you been asked about your personal relationship to cannabis as a result of teaching about it? If so, how have you responded?
- Have you experienced any stigma by colleagues, administration, and/or students? For example, has anyone expressed any professional concerns due to your association with cannabis studies?
- Have you experienced validation for offering coursework in this field of study?
- Some argue all education is advocacy-based. Have you grappled

with being neutral (as opposed to being for/against cannabis) while deciding upon your course coverage?

- What do you see as the future of cannabis studies within your discipline?

4B: Cannabis CBDA/THCA Chemotype Determination Using Atmospheric Solids Analysis Probe Coupled with a Compact Mass Spectrometer (ASAP-CMS)

Jack Henton, Advion, Inc, Ben Nie, Advion, Inc

The rapidly growing cannabis industry could benefit from modern analytical methods that are quick, easy-to-use, selective, and reliable. ASAP-CMS is a rapid analysis method for intact plant surface materials that skips steps required for LC-MS analyses. Utilizing the ratio of two characteristic fragment ions of the isobaric compounds, CBDA and THCA (m/z 341.2 and m/z 261.1), the method is able to determine the relative ratio and hence relative composition of CBDA/THCA in the plant without any sample extraction or chromatography. These are the two predominant cannabinoids present in marijuana and hemp plants as well as some raw material products. The relative composition of CBDA/THCA determined by ASAP-CMS can be useful for rapid indication of cannabis chemotype with respect to the CBDA/THCA ratio present. The method requires minimal operator training, and could be performed on-site with a compact mass spectrometer. It can potentially be a crop testing tool for growers as well as a tool for authentication of plant materials.

4B: Mystery Compounds Observed in Cannabis Processing: Acetone and the Double-Peak

James Parco, UCANN TECH

As the legalized cannabis industry continues to develop, practitioners are quickly discovering uncharted territory as methods are refined to optimize production and performance. A key mystery involves the “double peak” with THC that appears when a cannabinoid distillate is over-processed that is oftentimes misidentified as CBC. Another mystery compound, acetone, appears in terpene distillation when there is no presence of the solvent at any stage of the process, either in the production lab or testing facility. This paper explores the methods that can reliably identify and reproduce these anomalies. Moreover, we propose several hypotheses as to why the anomalies are occurring and techniques to minimize or abate the problems altogether.

4B: The Use of Colorimetric Arrays to Test for Cannabinoids in Marijuana Flower, Concentrates, and Topicals

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Law enforcement and correctional officers use colorimetric spot tests to make a quick on site presumptive identification when a potential drug is seized from a suspect. These tests offer speed, simplicity of operation, portability, and affordability. The stability and versatility of these spot tests enables “triaging” of samples for additional confirmatory drug analysis, as well as providing quick answers for crime scene analysts in the field. Colorimetric spot tests for the detection of THC include the Duquenois–Levine test. For this test, a small amount of the suspected material is inserted in the test solution which turns purple indicating the presence of marijuana. The downside of these commercially available colorimetric tests includes the use of caustic chemicals with various handling requirements, and they have received

criticism due to multiple instances when people were arrested based on false positives. Colorimetric sensor arrays have the ability to detect a variety of different analytes, in liquid and gas phases, including ions, acids and bases, metal nanoparticles, explosives, pesticides, warfare agents, drugs, various organic compounds, complex mixtures, such as coffee, beer, and soft drinks, and even biological molecules, such as steroids and proteins. Colorimetric arrays are typically composed of multiple colored dyes arranged in a two-dimensional grid, changing color upon interaction with specific analytes. The pattern of color changes can be used to analyze and identify the substance in question. The red, green, blue (RGB) color pattern recognition is based on the combined response from numerous sensors. Colorimetric arrays provide a multitude of different interactions with specific analytes, such as H-bonding, aromatic stacking, Lewis acids and base interactions, etc. Effective arrays typically have the following criteria: high selectivity; high sensitivity; and the ability to detect many analytes with the fewest numbers of sensors. Preferable sensors will also have qualities of solubility in a universal solvent, stability over time, low cost, low toxicity, and a great magnitude of color change. In this study, over 800 marijuana flower, concentrates, and topical samples and were tested and RGB values of 44 colorimetric sensors before and after analyte exposure were determined using the ImageJ. Chemometric analysis was applied to analyze the RGB data. The loading and clustering plots were used in principal component analysis to test the colorimetric arrays for the detection and discrimination of the cannabinoid containing samples. The loading plots identified the best seven of the 44 sensors tested in the arrays. The arrays demonstrated impressive analytical power to discriminate a variety of marijuana flower, concentrates, and topical products at different concentrations from 0.15mM to 3.4mM, which were validated by HPLC. Furthermore, a customized strip of seven sensors was developed that visibly changed colors when extracted cannabinoids were applied directly on the strip. Given the fact that confirmatory instrumental laboratory methods for abused narcotics such as HPLC, GC, and MS are time intensive, costly, and require technical expertise, colorimetric arrays are small, portable, inexpensive, and easy to use. The technology has potential to be customized depending on the application. For example, sensors can be created in various sizes in various patterns, such as 4x4 or 8x8 arrays, containing different sensors that are able to detect the analytes of interest. Digital image analysis allows for compatibility with smart phones and other handheld devices, and smartphone apps could be developed for access to the general public.

4C: Synergistic cytotoxic Activity of Cannabinoids from *Cannabis sativa* Extracts on T Cells Associated with Cutaneous T Cell Lymphoma Cell Lines (CTCL)

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Introduction: Strains of marijuana, *Cannabis sativa*, produce more than 600 different secondary metabolites, including phytocannabinoids and terpenes. A number of phytocannabinoids were found

capable of eliciting death in cancer cells, including leukemia cell-lines, when used alone or in combination. However, data is scarce on the activity of cannabis extracts, their fractions and synergistic combinations which might be highly active against cancer cells and specifically against leukemia. Mycosis fungoides (MF) is the most common type of Cutaneous T-cell lymphomas (CTCL), characterized dermatologically by the evolution of patches, plaques, and tumors. Sézary syndrome (SS) is a leukemic type of CTCL presenting with erythroderma and the presence of neoplastic Sézary T cells in peripheral blood.

Aim: To identify active compounds from cannabis and establish their optimal mixtures for cytotoxic activity against CTCL cells and to determine their mode of action.

Methods: Ethanol extracts of *C. sativa* were analyzed by HPLC and GC/MS and their cytotoxic activity was determined using Alamar Blue-based assay (Resazurin) and tetrazolium dye-based assay (XTT) on MyLa and HUT-78 cell lines and on peripheral blood lymphocytes (PBL) from healthy and SS patients. Annexin V Assay and FACS were used to determine apoptosis and cell cycle, and RNA sequencing was used to determine gene expression.

Results: Active compounds from cannabis that have cytotoxic activity against MyLa and HUT-78 cell lines were identified, and their synergistic mixtures were specified. These mixtures were shown to be active on PBLs of SS patients, and to induce cell apoptosis. Reduced activity was recorded on PBLs of healthy controls. Inverse agonists to cannabinoid receptors reduced the cytotoxic activity of the compounds. Also, gene expression profile was determined following treatments with individual compounds and their synergistic combination.

Conclusions: Specific combinations of *C. sativa* compounds interact synergistically for cytotoxic activity against CTCL cells and induce distinct gene expression. Our approach of specifying formulations of cannabis active compounds with synergistic activity and determination of their mode of action will be subject for clinical trials and may form a base for a new therapy.

4C: Sexual Dimorphism in the Effects of Cannabidiol and Dexanabinol on Fear Learning and Memory in Mice

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Cannabinoids have well documented effects on learning and memory, however, the majority of studies have involved only male subjects. We have conducted a series of fear learning and memory experiments in male and female mice, and our results show significant sexual dimorphism in the effects of two prominent cannabinoids, cannabidiol (CBD) and dexanabinol (HU211). In this work, we have administered cannabinoids prior to conducting Pavlovian fear conditioning protocols, and have observed effects on behavior during conditioning, on the memories that formed 24 hours after conditioning, and on extinction of the memories up to 3 to 5 days later. We present evidence that HU211, is equally effective in these effects, as is a serotonin reuptake inhibitor (SSRI) that is sometimes prescribed to treat Post-Traumatic Stress Disorder (PTSD). We also present evidence that CBD directly targets the underlying biological process of synaptic plasticity which support learning and memory, and that in doing so, it targets more cognitive forms of learning and memory that involve information processing by the hippocampus.

4D: Canopy Defoliation During Flowering Increases Yield for *Cannabis indica* var. Flo

Matthew Wheatley, UCANN TECH

Producing cannabis flowers with the highest possible efficiency is of primary importance to any cultivation facility. An important measure of efficiency may be determined by calculating the yield of dry flowers in a given amount of space in a given amount of time (yield/ft²/day). To this end, advancements in technology and cultivation techniques have allowed for continued improvements in cannabis flower production efficiency. Equipment like rolling tables or benches have led to improved use of space, and methodologies like the Sea of Green (SOG) technique have led to the development of perpetual harvesting. As a means of increasing yield and/or quality, defoliation techniques have been applied to a variety of crops for many years. These include wine grape (*Vitis vinifera*), tomato (*Solanum lycopersicum L.*), and apples (*Malus pumila*) among many others. Following this trend, in recent years defoliation techniques have been applied to cannabis cultivation with reports of great success, though scientific evidence has been lacking. To test the efficacy of defoliation for increasing yields for cannabis flower production, defoliation techniques were used during flowering for *Cannabis indica* var. Flo under greenhouse growing conditions. Removal of fan leaves at two timepoints during flowering allowed for an increase in planting density, canopy airflow, and canopy light penetration. Together, these differences led to an average increase of 50% in yield/area when defoliation-treatment plants were compared with controls.

4D: Cannabidiol Inhibits Growth and Lowers Crude Protein Content of the Tobacco Hornworm *Manduca sexta*

Matthieu Conroy, CSU-Pueblo, Sang-Hyuck Park, CSU-Pueblo

In recent years, there has been a surge in research on the phytocannabinoid constituents of *Cannabis sativa L.* due to their therapeutic potential in disorders such as epilepsy¹, but it is currently unclear as to what the evolutionary benefit of producing phytocannabinoids may be. Our preliminary results demonstrated two contrasting roles of cannabidiol (CBD) in the caterpillar larvae *Manduca sexta*: a defensive role against the larvae and rescuing effects of CBD for ethanol intoxicated larvae, decreasing mortality by up to 40%². The present study sought to further investigate the overall effects of CBD on *M. sexta* by examining how it may change their metabolic profiles. To do this, 60 2nd instar *M. sexta* larvae were fed three different diets: artificial diet (AD), AD + 0.1% medium chain triglyceride (MCT; vehicle) oil, and AD + 0.1% MCT oil + 1mM CBD. *M. sexta* was monitored over the course of 4 weeks, measuring weight at two-day intervals, then samples were lyophilized for body content analysis (total crude protein, non-polar lipids, and glucose). Our results showed that CBD negatively affected the growth of *M. sexta* with a 56% and 20% decrease in weight and length respectively when compared to the two control groups (ANOVA, n=60, p<.01). Despite having shown decreased body mass and length, CBD did not appear to affect the water content or diet consumption in *M. sexta* (ANOVA, n=60, p>.05). A Bradford protein assay showed that CBD decreased total crude protein in *M. sexta* by 34% when compared to control groups (ANOVA, n=60, p<.000) while glucose and total lipid content were not changed (p>.05). To get insight into how CBD affects metabolic profiles, the lyophilized insect biomass was analyzed using gas chromatography time-of-flight mass spectrometry (GC-TOF-MS). The chemical analysis

found 954 different chemicals, but of those 954 only 41 were reliably identified using standards including two neurotransmitters: γ -aminobutyric acid (GABA) and glycine. The data collected via GC-TOF-MS will be used to conduct a principle component analysis which will further reveal what effect CBD may have had on the metabolic profile of *M. sexta*. The study presented here demonstrated CBD is negatively correlated with the growth and the production of total crude protein of *M. sexta* and that CBD changed the overall metabolic profiles of *M. sexta*. This is the first report discussing how CBD influences the overall insect system from growth to metabolite production, and hints at a possible evolutionary benefit for phytocannabinoids as an insect repellent.

4D: Hypochlorous Acid as an Effective Treatment for Powdery Mildew Outbreaks

Matthew Wheatley, UCANN TECH, Todd Knupp, UCANN TECH

Producing clean, pest-free flowers that present no health risks to consumers are a necessity for commercial cannabis producers. This is especially important because the legal use of cannabis is restricted to the medical marketplace for most of the legal cannabis sales in the United States. Because of the need to produce clean flowers as efficiently as possible, during cultivation plant flower canopies are usually as densely populated as is possible while still providing adequate light and airflow for healthy flower development. Rapidly growing and developing flowers release a great deal of moisture through the process of transpiration, leading to humid conditions in the plant canopy that may lead to outbreaks of the fungal pathogen commonly known as powdery mildew. Here we report the use of Danolyte, a commercial formulation of hypochlorous acid, as an effective treatment for eradication of powdery mildew outbreaks. When compared with another commercially available product for treating powdery mildew called PM Wash in a side-by-side trial, Danolyte was just as effective as this costly alternative at eradicating a powdery mildew outbreak on leaves of the indica-dominant cannabis variety "Indiana Bubblegum". The active ingredient in Danolyte (hypochlorous acid) is a chlorine species that is highly effective in low concentrations, and that quickly evaporates following use. Because of its physical and chemical properties, and its efficacy as a powdery mildew treatment, Danolyte is a less costly, unique, and desirable alternative to other chemicals used for treatment of powdery mildew on cannabis leaves.

5A: Characterizing Microbial Communities: Evaluating Microbial Diversity and its Effect on Plant Health in Cannabis Cultivation

Maureen Phenix, Growcentia, Inc.

There are many ways to approach the characterization of microbial communities. These communities of bacteria, also known as consortia, may be considered from the standpoint of what is occurring on a molecular level, a functional level, or a chemical level. Each of these approaches offers unique and valuable perspectives on the microflora of cultivation environments. This panel will offer cultivators a framework for considering the microbial communities that are essential to the life and health of their plants.

5B: Overcoming the Challenges Associated with Heavy Metal Analysis of Cannabis and Hemp using ICP-MS

Sandy Kanapilly, PerkinElmer, Aaron Hineman, PerkinElmer

A new turnkey analytical ICP-MS method has been developed and qualified to allow cannabis laboratories to complete the entire Colorado Heavy Metal assay in one quick method. Data will be presented to show; long term stability of the method, simplicity of sample preparation, robustness towards any contamination from the dirty matrices, and detection limits well below the state requirements. References show that having a validated method for the cannabis testing industry is key in ensuring the highest quality of cannabis reaches the patient. In addition, the influences of the various cannabis sample types tested along with specifics on how to handle flower, concentrates, and edibles, will be discussed.

5B: Extraction and Isolation of Cannabinoids Intended for Other Experimental Investigations

Dustin Seifried, CSU-Pueblo, Matthew A. Cranswick, CSU-Pueblo

With the Agriculture Improvement act of 2018 (S.3042-H.R. 2 (115th)), hemp is now a legal agricultural commodity to produce and use in a variety of products in the U.S., alongside with the FDA's recent approval of a pharmaceutical with the cannabinoid cannabidiol (CBD) as the active ingredient, it is anticipated that research focused on isolating cannabinoids and other phytochemicals from cannabis for further study of potential beneficial applications will increase. This presentation will include a discussion of the isolation of CBD and other cannabinoids utilizing flash chromatography from a bulk hemp extract produced using a recently developed novel method based pressurized liquid extraction. In addition to CBD, cannabichromene (CBC) and tetrahydrocannabivarin (THCV) are cannabinoids of interest where flash chromatography methods are being developed as well. Cannabinoids were isolated using a combination of normal and reversed phase cartridges/columns. Characterization of the cannabinoid content of fractions produced by flash chromatography was done by HPLC.

5B: Effects of Pressure in Supercritical CO₂ Extraction of Cannabis

James Parco, UCANN TECH

This study investigates the effects of pressure on CO₂ supercritical extraction of cannabis. Specifically, we designed an experiment to test the effects of increased pressure levels above the critical point to evaluate the extraction efficiency at low (1800psi) and high (3600psi) pressures. We employed the use of an independent third-party cannabis analytical laboratory to conduct pre- and post-extraction analysis. Based on the results of the study, we confirmed that increased pressure levels during supercritical CO₂ extraction can be significant with respect to overall cannabinoid yields. CBD tends to come out faster and earlier during extraction runs as compared to THC, which tends to be more monotonic and linear during a supercritical CO₂ extraction run.

5C: Cannabis Use for Pain in a Large Population-Based Survey of Adult Athletes

Joanna Zeiger, Canna Research Group, Ed Fleegler, To-Life in Peace, LLC; Canna Research Group, William Silvers, University of Colorado School of Medicine, Canna Research Group, Robert Zeiger, Kaiser Permanente Southern California, Canna Research Group

Little is known about use of and benefits and harm from cannabis for pain in athletes.

Purpose: To determine tetrahydrocannabinol (THC) and cannabidiol (CBD) use for pain in adult athletes.

Methods: The Athlete PEACE Survey used mainly social media and email blasts to recruit and SurveyGizmo to collect data. 1,161 (91.1%) of the 1,274 athletes taking the survey completed it. Current cannabis use was evaluated by asking “In the past two weeks, have you used marijuana (including THC and/or CBD)?” and cannabis type used was assessed by asking “What do you primarily use THC, CBD, or both?”. Cannabis use, benefits, and adverse effects were reported. Solutions IRB approved this study.

Results: The cohort was majority male (62.3%) and Caucasian (89.8%) across mainly 3 sports: triathlon (34.4%), running (25.8%), and cycling (22.2%). More than 75% were athletes for ≥ 11 years and about 75% exercised ≥ 5 days/week with 46.1% exercising ≥ 11 hours/week. Pain was noted in 49.0%. Cannabis was currently used by 26.0% with 61.1% using it for pain. Almost half used cannabis for ≥ 3 years at a frequency of 3 times per week or less. Cannabis was used more often in athletes with pain (32.3% vs. 19.9%, $p < 0.001$), athletes younger than 40 (32.6% vs. 22.9%, $p < 0.001$), and those who exercised 1-4 days per week (36.2% vs. 22.3%, $p < 0.001$). Common benefits from cannabis were improved sleep (71.4%), less pain (68.8%), and calm (58.5%); no benefits were reported by 2.3%. The most common negative effects were increased appetite (24.3%), anxiety (20.9%), and difficulty concentrating (16.6%); 54.8% reported no adverse effects. From 74-85% of athletes who used cannabis for specific pain reported it as ‘very much’ or ‘moderately’ effective.

Conclusions: About 26% of adult athletes use cannabis. Athletes use cannabis to alleviate pain and to improve sleep. Beneficial effects were reported markedly more frequently than adverse effects.

5C: Detection of THC on Surfaces in a Room Exposed to Cannabis Vaporizer Use

Cristina Sempio, University of Colorado Anschutz Medical Campus, *Emily Lindley*, University of Colorado Anschutz Medical Campus, *Jost Klawitter*, University of Colorado Anschutz Medical Campus, *Russel Bowler*, National Jewish Health, *John Adgate*, University of Colorado Anschutz Medical Campus, *William Allshouse*, University of Colorado Anschutz Medical Campus, *Lauren Awdziejczyk*, University of Colorado Anschutz Medical Campus, *Mike Vandyke*, University of Colorado Anschutz Medical Campus, *Rahwa Netsanet*, University of Colorado Anschutz Medical Campus, *Tessa Crume*, University of Colorado Anschutz Medical Campus, *Gregory Kinney*, University of Colorado Anschutz Medical Campus

Introduction: The number of cannabis users increased roughly 16% in the decade ending in 2016, reaching up to 192 million users worldwide. Smoking and vaping are the most common consumption routes with formation of side-stream smoke/vapor which cannabinoids composition is not well known. Secondhand exposure to cannabinoids has been described in the literature, but there are no studies on third-hand cannabis exposure (e.g., ingestion exposure from touching contaminated surfaces) due to deposition of smoke or vapor.

Objective: We leveraged a protocol from an ongoing clinical trial investigating the efficacy of cannabis for chronic and experimental pain alleviation (COMIRB 14-1909). We tested whether cannabinoids could be detected on surfaces and objects in a room where cannabis is vaped using a Volcano Vaporizer loaded with active or placebo whole plant material from the National Institute on Drug Abuse

Drug Supply Program.

Methods: Surface samples were collected from different objects and surfaces using isopropanol imbued wipes in the study drug administration room. Each surface was swabbed in triplicate with varying swabbing patterns. For larger surfaces, fixed areas of 0.06 m² were swabbed. Swabs were placed in a glass vial using a bent paperclip to reduce handling and gloves were changed after each sampling to avoid possible cross-contamination. Samples were extracted using methanol containing the deuterated internal standard. After drying and reconstitution in mobile phases, the extracts were analyzed using LC-ESI-MS/MS in combination with online extraction. The mass spectrometer was run in the multiple reaction monitoring (MRM) mode. Calibration curves were prepared only for tetrahydrocannabinol (THC) by spiking clean smooth surface (area 0.017 m²) with known amounts of THC. Linear range for THC was 2.0-100 ng. Analyst software version 1.4.2 was employed for data acquisition and MultiQuant version 2.1.1 for data analysis (AB Sciex, Foster City, CA, USA).

Results: The extraction procedure was optimized to improve recovery and purity of the extract. THC was detected on 70% of tested surfaces in the study room at quantifiable levels ranging 4.62 - 82.5 ng. Control samples from areas outside of the study room, that were assumed to be unexposed and were thoroughly cleaned, were all negative.

Conclusion: We demonstrated that surfaces exposed to side-stream cannabis vapor could be positive for THC at quantifiable levels. This study represents a first step in understanding how side-stream cannabis vapor may deposit in the environment, potentially resulting in a tertiary exposure pathway. Our surface sampling method can be expanded to quantify surface contamination of THC in environments such as the homes of frequent users and those consuming cannabis by other consumption mechanisms (e.g., dabbing) to quantify potential tertiary exposure for users and non-users.

5C: What the Hemp? Evaluating the Health Impacts of Cannabidiol (CBD) and Medical Cannabis Use

Jackson Heather, Realm of Caring, *Marcel Bonn-Miller*, University of Pennsylvania, *Ryan Vandrey*, Johns Hopkins University

Realm of Caring Foundation (RoC) is conducting an observational research study. 812 current medicinal cannabis users and 471 controls in the RoC patient registry completed health surveys using validated instruments. Cannabinoid users predominantly used oral cannabidiol (CBD) products and reported significantly better quality of life and sleep, and less pain, anxiety, and depression compared with controls. Cannabis users were less likely to have gone to the ER or been admitted to the hospital in the prior month. Demographics, including the health problems for which they were using cannabinoids, were similar across groups. These data suggest medicinal cannabis use may improve a number of key health domains.

Aims: Due to the rapid expansion of medicinal cannabis availability through legislative action rather than traditional drug development, uncertainties remain regarding the safety and efficacy of cannabinoids as therapeutic agents. A comprehensive understanding of the consumers and products involved in cannabinoid therapies could assist both public health and commercial interests in best serving this rapidly growing industry. This study was conducted in a convenience sample of individuals from across the United States that were registered with the Realm of Caring Foundation, a non-profit organization located in

Colorado, USA. The aim of this preliminary analysis was to characterize basic demographic and health profiles of patients currently using cannabinoid products for therapeutic purposes versus those who were considering medicinal cannabis use, but had not yet started cannabinoid therapy.

Methods: Participants (812 cannabinoid users and 471 controls) who were either adult patients or caregivers of patients with a health condition requiring medical treatment completed web-based questionnaires. Questionnaires included basic demographics, quality of life (WHO-QOL), pain (NPRS), sleep (PSQI for adult patients; CSHQ for children), mood (HADS), and details about use of cannabis and other medication/drug use. The study was reviewed and approved by the Johns Hopkins Medicine IRB. Independent samples t-tests and chi-square analyses were used to assess differences between cannabis users and controls on study outcomes.

Results: The demographics of the cannabinoid users versus non-users were comparable; groups did not differ on gender or race, but, on average, cannabinoid users were older than non-users, $t(1281)=-2.34$, $p=0.02$ and had completed a higher level of education $t(10, N=1,218)=18.25$, $p=0.05$. Most cannabinoid users turned to cannabis only after alternative treatments had failed, but most were using in the absence of a formal recommendation from their treating physician. Cannabinoid users had significantly lower ratings for both anxiety [$t(1,158)=4.33$, $p<.001$] and depression [$t(1,217)=5.74$, $p<.001$]. On the WHOQOL-BREF, cannabinoid users reported a better quality of life [$t(1,061)=-4.18$, $p<.001$] and greater perceived health satisfaction [$t(1,052)=-4.22$, $p<.001$] compared to controls. In addition, cannabinoid therapy users exhibited significantly higher WHOQOL-BREF domain scores for physical health [$t(1,052)=-0.85$, $p<.001$], psychological health [$t(1,052)=-4.94$, $p<.001$], and social relationships [$t(1,032)=-3.10$, $p<.01$] compared with controls, but no group differences were observed for the environment domain score [$t(1,067)=-1.35$, $p=.18$]. Cannabinoid therapy users, compared with controls, reported less pain on the NPRS [$t(1,030)=2.25$, $p=.03$], better sleep on both the CSHQ [$t(162)=2.46$, $p=.02$] and the PSQI [$t(904)=2.89$, $p<.01$], use of fewer prescription medications [$t(1,022)=3.12$, $p<.01$], and fewer ER visits [$t(480)=2.92$, $p<.01$] and hospital admissions [$t(303)=2.23$, $p=.03$] in the past 30 days.

Conclusions: In a convenience sample of individuals with significant health problems, medicinal cannabis users reported significantly better health than controls on a number of health domains. This suggests that there may be some added benefit of cannabinoid use on current health care utilization and outcomes for certain health conditions. Additional research is needed to prospectively evaluate the impact of cannabinoid use on health-related outcomes and to identify specific health conditions and cannabinoid product characteristics are associated with greater therapeutic benefit.

5D: Cataloging Existing Variation and Rebuilding Better Cannabis Genomes for New Markets

John McKay, New West Genetics

With the end of prohibition, cannabis cultivation is coming out of the closet. 2018 saw changes in federal law in several countries, allowing for large scale production and marketing of cannabis. In the US, the 2018 Farm Bill/Hemp Farming Act removed legal barriers to the hemp supply chain for grain, fiber and flower. The new bottleneck is genetics, due to a dearth of varieties optimized for large scale

sustainable production and new markets. I will discuss the breeding program of New West Genetics, a company based out of Colorado that has been producing new, certified hemp cultivars, optimized for large scale, mechanized production.

5D: Pest Management Using Essential Oil Based Products For Cannabis Production

Stephanie Wedryk, Rx Green Technologies, *R. Cole Gage*, Rx Green Technologies

Pest management of *Cannabis* spp. in legalized markets differs from other crops that are federally legal to produce. Insecticides and fungicides used in commercial production of federally legal crops are registered through the U.S. Environmental Protection Agency and subject to further requirements by individual states. Many of the active ingredients in commonly used insecticides and fungicides are not available to cannabis growers for several reasons: 1) Federal registrations for use of certain pesticides in cannabis are not possible; 2) Appropriate safety and toxicological testing has not been performed on cannabis; 3) There is a broad industry desire to use fewer toxic chemicals for pest control. Products listed as Minimum Risk Pesticides by U.S. EPA are available for use by cannabis growers that are approved by state agencies. The active ingredients on the Minimum Risk Pesticide List are often less efficacious than traditional pesticides. To assist Cannabis growers in achieving optimal pest control with minimum risk ingredients, Rx Green Technologies has developed two unique pest management products based on essential oils derived from plants. Rx Green Technologies is a leader in bringing growing solutions to cannabis growers that have been thoroughly researched and tested for performance. The first product contains clove, thyme, and citronella oils. The second product contains cinnamon, thyme, and linseed oils. Laboratory testing of the formulations demonstrated stability of the concentrates. The pest management products were tested in a laboratory setting for control of spider mites and powdery mildew. One application of the first product provided 89% control of spider mites after 5 days. One application of the first or second products provided 90.8% and 95.8% control of powdery mildew, respectively, after 12 days. The severity of infection was reduced by greater than 80% compared to treatments without product applied. Pest management is an ongoing challenge for cannabis growers, especially with limited options. Products with minimum user risk, optimal efficacy and stability will assist growers in maintaining a quality operation and product.

5D: Standardization of Secondary Metabolites in the Medical Cannabis Product: Challenges and Potential Solutions

Nirit Bernstein, ARO Volcani Center

Cannabis (*Cannabis sativa L.*) has been cultivated by mankind since antiquity for medical use. The diverse medical potential is predicated on the complex chemical profile, comprising hundreds of secondary metabolites including cannabinoids, terpenes and flavonoids. A major challenge for utilization of cannabis for medicine stems from the lack of standardization of the secondary metabolites profile in the plant material and hence in the products supplied to patients. Environmental conditions during cultivation affect secondary metabolite production and accumulation in medicinal plants. The present study tested the hypothesis that physical and chemical elicitors imposed during cultivation induce changes in the chemical profile in medical cannabis that can be used for standardization of the active secondary metabo-

lites in the plant. Medical cannabis plants of various chemotypes, e.g., high CBD-types, high TC types and mixed CBD-THC types, were subjected to diverse environmental conditions and chemical and physical elicitors, for development of stimulated changes in the chemical profile. Chemical elicitors such as light intensity and quality, temperature and humidity; and chemical elicitors such as nutrients, methyl salicylate, methyl jasmonate and chitosan, were found to affect cannabinoids and terpenes production. For example, NPK supplementation significantly increased CBG levels and lowered CBN levels, while humic acids significantly reduced the natural spatial variability of all of the cannabinoids studied. However, the increased uniformity came at the expense of the higher levels of cannabinoids naturally found in the upper regions of the plants. Chemical elicitors such as methyl salicylate, chitosan and NaCl affected the cannabinoid concentration as well in a specific manner. In the talk we will discuss regulatory effects of various elicitors and cultivation conditions on the chemical profile in an organ and spatially dependent manner. We will demonstrate that chemical or physical elicitors have specific effects on secondary metabolism, and the effects are organ and location specific and can therefore be utilized for development of standardization schemes.

Mechoulam Lecture: Marijuana as Medicine: An Historical Perspective

Allyn Howlett, Wake Forest School of Medicine

Medicinal uses for compounds found in marijuana are many, as supported by in vitro and animal studies. However, few clinical trials have been conducted to provide the evidence necessary to take a product through approval for safety and efficacy by the Food and Drug Administration to be used to treat disease. This talk will take the audience through the historical pathway from the early pharmaceutical development of THC analogs by big pharma (Pfizer, Abbott, Lilly) to attenuate nausea and vomiting, cachexia and pain, to the current medicines that include THC and CBD to treat pain, spasticity and seizures. The question we need to consider is: With the goal to develop pharmacotherapies to target unmet needs in the treatment of disease, how are we moving beyond herbals to the realm of safe and effective medications?

6A: Data Analytics in the Cannabis Industry

Brian Keegan, University of Colorado Boulder

Cannabis legalization is unfolding against the backdrop of larger economic, political, and social disruptions related to powerful new data collection and analysis capabilities. These data-intensive capabilities are increasingly central to new cannabis markets in the form of seed-to-sale tracking systems for regulatory compliance, point-of-sale systems for managing inventories and customer relationships, health-tracking devices and databases for medical research, bioinformatic and genomic technologies for customizing strains for subjective and medicinal effects, industry-level analysis to inform investment and policy decision-making, and agri-tech capabilities for increasing the grow efficiencies. This “datafication” of the cannabis industry represents a profound cultural shift from avoiding data collection out of justified fears of generating criminal evidence, to embracing the value of data-driven cultures to survive in a rapidly-evolving landscape of regulations and markets.

This panel will explore the current state of the data analytics in the cannabis industry and the risks and prospects for “cannabis informat-

ics” going forward. The panel will review the kinds of data currently being used in the cannabis sector and identify areas where the industry is breaking new ground as well as the gaps between best practices in other industries for implementing data-driven cultures. Some of the major challenges the industry faces include (1) the lack of standardized ontologies and operating procedures to make reliable comparisons across type, time, and location; (2) building data infrastructures and cultures to align data collection efforts across strategy, marketing, operations, research, and compliance; and (3) the challenges, opportunities, and responsibilities of sharing and ingesting data from government reports, review sites, social media, for-profit analytic services, and other public information sources.

The panelists will also invite questions from the audience about (1) the role academic and government institutions should play in training workforces with data literacies to work in the cannabis sector, (2) the current state of data collection and analysis practices in their organizations, and (3) the types and configurations of data that would make research, compliance, marketing, etc. easier as the industry matures.

6B: Overcoming the Challenges Associated with Pesticide Analysis of Cannabis & Hemp and Understanding the Matrix Effects and the Impact of Various Clean-Up Strategies

Toby Astill, PerkinElmer

A new analytical LC-MS/MS method has been developed and qualified to allow cannabis laboratories to complete the entire Pesticide assay (including molecules such as Chlordane and pentachloronitrobenzene) in one quick method, using one instrument. Data will be presented to show the long-term stability of the method, simplicity of sample preparation and techniques to overcome matrix effects, robustness towards any contamination from the dirty matrices, and detection limits well below the state requirements (LOQ<=10 ppb). References will show that having a validated method and SOP for the cannabis testing industry is key in ensuring the highest quality of cannabis reaches the patient. In addition, the influences of the various cannabis sample types tested will be discussed, and details specified on how to handle flower, concentrates, and edibles.

6B: Chemical Profile Changes in Response to Biotic and Abiotic Stresses of *Cannabis sativa L.*

Sang-Hyuck Park, CSU-Pueblo, Eric Gostin, CSU-Pueblo

Cannabis sativa L. produces at least 120 cannabinoids that have been used for medicinal and recreational purposes. To investigate the spatial and temporal cannabinoid production, three hemp tissues (flowers, leaves, and stems) were processed using high pressure liquid chromatography to quantify cannabinoids including cannabigerolic acid (CBGA), cannabigerol (CBG), cannabidiolic acid (CBDA), cannabidiol (CBD), Δ^9 -tetrahydrocannabinolic acid (THCA), Δ^9 -tetrahydrocannabinol (THC), and cannabinol (CBN). The chemical analysis indicates that cannabinoids produced by flowers are at least 2.5-fold greater than those found in leaf tissues. Inflorescent cannabinoid concentrations increased throughout the flowering stage, while the production of cannabinoids in leaves decreased. Throughout the analyses, the stem cannabinoids were under the detectable limit. CBN appeared to be scarce and rarely detected from all the tissues examined in this study. In addition, the effects of environmental stresses on the cannabinoid profiles were also examined. The mechanical wounding results show slight increase of CBG, CBD, and THC ($p>0.05$) while

the herbivore treatment increases the three cannabinoids significantly ($p < 0.05$). The excess heat treatment of 45-50°C significantly reduced the CBG level ($p < 0.05$), as well as the CBD and THC ($p > 0.05$). Notably, the drought stress shows a 40% greater accumulation of CBG, whereas, CBD and THC amounts significantly decreased. The results indicate that drought was the most severe environmental restraint for cannabinoid production (70-80% reduction in CBD and THC). The spike in CBG, which is a commonly shared precursor, may be due to the blockage of CBG conversion to CBD and THC. The catalytic function of CBDA/THCA synthase might be inhibited during the water deficit. Our study confirmed that cannabinoids are enriched in flower tissues during the flowering stage, and environmental factors specifically drought are key regulators of cannabinoid production.

6B: Pressurized Liquid Extraction: A Robust Extraction Method for Cannabinoid Analysis and in-Extraction Chemical Modification of Acidic Cannabinoids

Dustin G. Seifried, CSU-Pueblo, Mariana Fernandes Ramos, CSU-Pueblo, Chad A. Kinney, CSU-Pueblo

A robust extraction method for quantification of cannabinoids in cannabis, which is based on pressurized liquid extraction, was developed and compared to an accepted method published by the United Nations Office on Drug and Crime (UNODC). The UNODC and PLE methods were compared for reproducibility and extraction efficiency for Cannabichromene (CBC), Cannabichromenic acid (CBC-A), Tetrahydrocannabivarin (THCV), Cannabidiol (CBD), Cannabigerol (CBG), Cannabidiolic Acid (CBD-A), Cannabigerolic Acid (CBG-A), Cannabinol (CBN), Tetrahydrocannabivarinic Acid (THCV-A), Tetrahydrocannabinol (THC), Cannabidivarin (CBDV), Tetrahydrocannabinolic Acid (THC-A) and Cannabidivarinic Acid (CBDV-A). Advantages of the PLE method compared to the UNODC method include extraction automation and use of nonhalogenated organic solvents. Our previous research demonstrated the potential utility of PLE to carry out chemical modification of acidic cannabinoids by decarboxylation without significant loss of the neutral cannabinoid counterparts. Pressurized Liquid Extraction allows for extraction temperatures from room temperature up to 200°C. Elevated extraction temperatures when coupled with water as the extraction solvent can be used to promote efficient decarboxylation of acid cannabinoids to their neutral counterparts, which can then be extracted with an organic solvent. Extraction conditions, namely extraction temperature, required to efficiently recover native cannabinoids and to decarboxylate acid cannabinoids was investigated as part of this study.

6C: Cannabis for Inflammatory Bowel Disease Research in Israel

Timna Naftali, Tel Aviv University, Libi Bar-Lev Schleider, Tikun Olam Organization for Medical Cannabis, Hinanit Koltai, ARO, Volcani Center, Shelly Matalon, Meir Hospital, Fred Konikoff, Tel Aviv University

In Israel, Inflammatory bowel disease (IBD) patients failing conventional treatment are eligible for a license for medical cannabis subject to physician application and ministry of health approval. Reports from IBD patients of significant improvement in their symptoms while using cannabis prompted our research, which is summarized in this abstract. Since previous studies reported only the prevalence of cannabis use with no data about the effect, mode, duration and dose of

cannabis consumption we first collected data from 30 Crohn's disease patients who were using licensed medical cannabis for an average period of 2.14 (0.3-9) years and a THC dose between 0.5–1.5 mg/day. The results showed a significant reduction in the Harvey Bradshaw disease activity index, from 14 ± 6.7 to 7 ± 4.7 ($P < 0.001$). The number of patients requiring steroid treatment was reduced from 26 to 4. In a double blind placebo controlled pilot study of cannabis use in Crohn's disease, twenty patients with active Crohn's disease received either cigarettes containing 23% of THC (corresponding to 115mg THC twice daily) or placebo. Crohn's disease activity index (CDAI) was reduced from 330 ± 105 to 152 ± 109 in the study group but did not change in the placebo group (p between groups < 0.005). Since THC has undesired central effect, we conducted another study of the use of CBD in active Crohn's disease, that study yielded negative results with no difference in the CDAI between the study and placebo groups. In ulcerative colitis (UC) we conducted a study in which 30 patients with active UC received cigarettes containing 23% of THC, (115mg of THC) BID, or placebo. Lichtiger disease activity score improved in the study group from 10.9 (IQR 9-14) to 5 (IQR 1-7), ($p < 0.000$), and in the placebo group from 11 (IQR 9-13) to 8 (IQR 7-10) ($p = 0.15$). (p between groups 0.001). In search of an oral mode of ingestion we conducted a randomized controlled study in which Crohn's disease patients were given either cannabis oil at a dose of 222mg CBD/66mg THC, (supplied by Tikun Olam) or placebo. Altogether, 50 patients were evaluated both clinically and endoscopically before and after cannabis use. CDAI before the treatment was 288.4 ± 78.0 and 298.5 ± 112.2 in the cannabis and placebo groups, respectively ($p = \text{NS}$). After eight weeks of treatment the CDAI was 143.1 ± 96.0 and 209.5 ± 113.0 in the cannabis and placebo groups, respectively ($p < 0.05$). Simple Endoscopic score (SES-CD) was 9.5 ± 6.5 and 11.9 ± 6 before treatment and 7.17 ± 6 and 9.8 ± 5.4 after treatment in the cannabis and placebo groups, respectively ($p = 0.17$). We concluded that 8 weeks cannabis induced clinical improvement, but no endoscopic change. In collaboration with the Volcani agricultural institute we tested fractions of plant extracted cannabis to identify those with the strongest anti-inflammatory effect. The extract rich in THCA was applied to cell lines and colon tissues taken from IBD patients, and was shown to suppress IL-8 levels, as well as cyclooxygenase-2 (COX2) and metalloproteinase-9 (MMP9) gene expression in both cell culture and colon tissue. In conclusion, we have shown that treatment with cannabis can induce symptomatic improvement in IBD, however cannabis research is only at its beginning.

6C: The Effects of Medicinal Cannabis on Seizures in Adults with Medically Refractory Epilepsy

Matthieu Conroy, CSU-Pueblo, Barbara Brett, CSU-Pueblo

Antiepileptic drugs (AED) fail to control seizures in approximately 30% of individuals with epilepsy. This condition, called medically refractory epilepsy (MRE), significantly affects a person's quality of life. A potential adjunctive treatment that may be beneficial for individuals with epilepsy is cannabis. Research in animals and humans suggests that two cannabinoids—delta-9-tetrahydrocannabinol (THC) and cannabidiol (CBD)—may positively affect seizures. In addition, recent randomized control trials (RCTs) confirmed the efficacy of oral CBD as a treatment for Dravet Syndrome and Lennox Gastaut Syndrome. Indications that cannabinoids such as CBD are a safe, effective treatment for seizures in children is suggestive of their potential benefit for adults. The main purpose of the present observational study is to ex-

amine the effects of medicinal cannabis use on seizures in adults with MRE who elect to use cannabis as an adjunctive treatment. In particular, we are interested in learning more about the effects of seizures and cannabis use on autonomic physiology. For this study, participants visit the principal investigator's lab three times over the six-month period of the study. They wear a wireless physiological recording device daily for one month before they initiate medicinal cannabis use and for five months after they initiate use. Physiological measures including electrodermal activity, blood volume pulse, heart rate, motion/acceleration, and temperature are collected and processed to produce monthly seizure reports. Seizures and the physiological effects of cannabis are tracked using an event marker on the wireless physiological recording device. During each of the three lab visits, participants provide urine samples that are processed for cannabinoid levels. They also fill out questionnaires assessing medicinal cannabis use, quality of life, seizure severity, anxiety/depression, side effects, and adverse events. To date 10 participants have been enrolled and two of these participants have completed the study. Physiological and behavioral data collected and progress on this study will be presented.

6C: Challenges and Findings of Studying Cannabis in Parkinson Disease

Maureen Leehey, University of Colorado, *Ying Liu*, University of Colorado, *Felecia Hart*, University of Colorado, *Jost Klawitter*, University of Colorado, *Cristina Sempio*, University of Colorado, *Sarah Fischer*, University of Colorado, *Christen Epstein*, University of Colorado, *Mary Cook*, University of Colorado, *Stefan Sillau*, University of Colorado, *Zachrey Baud*, University of Colorado, *Heike Newman*, University of Colorado, *Olga Klepitskaya*, University of Colorado, *Emil Diguillo*, University of Colorado, *Sarah Baker*, University of Colorado, *Tristan Seawalt*, University of Colorado, *David Vu*, University of Colorado, *Trevor Hawkins*, University of Colorado, *Michelle Fullard*, University of Colorado, *Jacquelyn Bainbridge*, University of Colorado

Background: The use of cannabidiol (CBD) is increasing in neurological disorders, including Parkinson disease (PD), as it becomes more available in the US, but there is little data regarding its efficacy, tolerability, and the appropriate dosage. We have completed an open label study and started a randomized, controlled study in PD. Evidence suggests that CBD may be better tolerated in PD than delta-9-tetrahydrocannabinol (THC).

Methods: Open label participants took an oral pharmaceutical formulation of purified CBD (Epidiolex®, GW Pharmaceuticals), up to 25 mg/kg/day. The primary outcome was tolerability and safety; secondary outcomes were efficacy in reducing tremor and common PD symptoms on optimal management for their PD. Based on those results, a randomized, controlled study has been initiated using a 30:1 CBD:THC extract from the National Institute of Drug Abuse, formulated into a sesame seed oil solution, with participants taking about 1.25 mL (125 mg CBD and 4.2 mg THC) twice daily. Outcomes are similar.

Results: The open label study included 13 participants (10 male), mean age (SD) 68.15 (6.05), baseline total and motor Movement Disorder Society Unified PD Rating Scale (MDS UPDRS) scores of 39.23 (13.32) and 22.92 (9.30), respectively. The maximum CBD dose was 19.23 (5.44) mg/kg/day, i.e., 1623.01mg/day (range 552.5 mg/day to 3458.75 mg/day; participants took study drug for 26.8 (8.0) days. All

reported at least one adverse event, including diarrhea (n=11 [85%]), somnolence (n=9 [69%]), fatigue (n=8 [62%]), weight gain (4 [31%]), dizziness (n=3 [23%]), abdominal pain (n=3[23%]) and headache, weight loss, nausea, anorexia, and increased appetite (each n=2 [15%]). Five participants (38%) had elevated liver enzymes, 2/5 had a cholestatic pattern, 4/5 were asymptomatic, and all were transient. A total of 132 adverse events were observed, 111 (84%) mild, 19 (14%) moderate, and two (2%) severe; diarrhea was more frequent at higher doses (p value = 0.0307). There were no serious adverse events. Three (23%) stopped study drug due to intolerance. 10 participants (eight male) that completed the study, taking a maximum of 20.25 (3.43) mg/kg/day, i.e., 1731.38 mg/day (range 1014.00 mg/day to 3458.75 mg/day) for an average of 28.5 (3.4) days, had improvement in total and motor MDS-UPDRS scores of 7.70 (9.39, mean decrease 17.8%, p=0.0115) and 6.10 (6.64, mean decrease 24.7%, p=0.0041), respectively. Night-time sleep and emotional behavioral dyscontrol also improved significantly. CBD plasma levels were 181 ng/mL, 376 ± 78 ng/mL (mean ± SEM) and 340 ± 4 ng/mL for the 12.5, 20 and 25 mg/kg/day groups, respectively. 14 days after discontinuation of treatment the values were 13, 24 ± 5, and 39 ± 14 ng/mL. After 15 months of regulatory steps to procure a study drug, a randomized, controlled study was initiated, with the aim to have 60 completed participants. To date, 13 (10 male) started study drug and 10 (eight male) completed the study. The 13 enrolled participants had a mean age (SD) of 68.15 (6.05), total and motor MDS-UPDRS scores of 39.23 (13.23) and 22.92 (9.30), disease duration of 6.08 (3.4) years, Hoehn & Yahr scores of 1.73 (0.56), and were taking 3.98 (331.00) levodopa equivalents. No SAEs and no significant liver enzyme changes have occurred. The efficacy and tolerability results collected to date will be presented in a blinded format.

Conclusion: CBD, in the form of Epidiolex®, may be efficacious in PD, but the dose used in pediatric epilepsy patients was associated with liver enzyme changes that may be cholestatic and resolved in in this older PD population. Further study is being conducted in a randomized, controlled study.

6D: Cannabis Sativa Exposure and Sensitization: Relationship to Asthma, Dermatitis and Food Allergy

William Silvers, University of Colorado School of Medicine, *Nathan Rabinovitch*, National Jewish Health

First and second-hand cannabis exposure has increased substantially and is expected to continue to increase as personal cannabis use becomes legalized in more states and countries. Health effects of exposure may be related to allergic sensitization as a number of reports have found associations between cannabis exposure and asthma, allergic rhinitis, contact dermatitis and urticaria, as well as reported anaphylaxis. In this context, it is to be expected that with greater frequency and magnitude of exposure, the prevalence of cannabis sensitization will increase over time in predisposed atopic children and adults. European studies have reported on a cannabis fruit-vegetable syndrome, occurring when the cannabis allergen Can s 3, a lipid transfer protein (LTP), cross-reacts with various plant homologues. Food reactions often manifest as a severe form of oral allergy syndrome (OAS) because LTPs are resistant to gastric proteolysis once swallowed unlike classical OAS from the birch allergen Bet v 1. Regular cannabis use has been associated with bronchitis symptoms such as chronic cough, wheeze, and increased sputum production, but, to date, marijuana smoking has not been associated with an increase in emphysema or lung can-

cer. These negative studies however are limited by the fact that most marijuana smokers are younger than tobacco smokers and many also smoke tobacco. As such, these studies cannot definitively rule out associations with long-term use of marijuana especially in those who have no concomitant history of smoking tobacco. The prevalence and spectrum of adverse reactions, allergic and non-allergic, will be addressed with individual case presentations and results from population surveys. Patients, parents and their physicians should be aware of the potential link between cannabis exposure, the initiation of new food allergies and worsening of pulmonary and dermatologic disease so that recommendations for decreasing first and second-hand cannabis exposure can be implemented in affected adults and children.

6D: The Impact of Online Social Support on Cannabis Rehabilitation

Yuan Long, CSU-Pueblo, Kuangyuan Huang, CSU-Pueblo

The purpose of this study is to investigate the factors impacting cannabis rehabilitation in an online social network (community). More specifically, would people's response affect quitter's emotion and determination to rehab? If so, what type of social support such as informational, emotional, and networking plays a more important role? The data were collected from an online discussion forum where people share their experiences, seek help, and at the same time support each other when quitting cannabis. A total of one thousand messages have been dissected and analyzed using comprehensive qualitative and quantitative research methods such as content analysis. In-depth findings discover the secrets behind cannabis rehabilitation in particular and drug quitting in general. This research sheds light on both academic and practice. Limited literature studied cannabis rehabilitation in an online social network environment. The research result contributes to theory development in the fields of cannabis research, social support, and public health. Additionally, this research explores the challenges and opportunities gathering and analyzing data in cannabis research from public information sources such as social media. This research also contributes to the cannabis rehabilitation practice by suggesting a more efficient approach to assist quitters using contemporary information technologies.

7A: Current State of Technology and Applications of Industrial Hemp

Nebojsa Jaksic, CSU-Pueblo

It is assumed that all current governmental restrictions that deal with growing industrial hemp will be lifted in the near future. This will create an opportunity to grow hemp for many applications where hemp is not presently used. This session will address the current state of industrial hemp growing, harvesting, and processing technologies as well as some novel hemp applications. Some technological problems and possible solutions dealing with relatively high manual labor efforts involved in harvesting and processing hemp stock will be described. The use of hemp as an ingredient in food products, dietary supplements, clothing, paper, structural materials, composites etc. will be addressed. Some of the current endeavors and future plans for the hemp industry will be presented.

7B: K12 Cannabis Research Study: Student Use

Tim Peters, CSU-Pueblo

This panel is led by a diverse group of experts in the field. Dr. Ash-

ley Brooks-Russell, Project Director of the Healthy Kids Colorado Survey will share her knowledge of the current data on student use and youth risk behavior; Jack Reed, Statistical Analyst for the Colorado Department of Public Safety will address issues of public safety in schools revolving around marijuana; Jessica Neuwirth, Colorado Department of Public Health and Environment's Retail Marijuana Education and Youth Prevention Coordinator will present efforts in education and prevention; and representatives from the Pueblo school district and law enforcement will share their perspective based on first hand interactions they are having daily with school age youth in Pueblo.

7C: ICR's New Cannabis Patient Registry: Driving Innovation by Filling Knowledge Gaps About Real World Use of Medical Cannabis

Sue Sisley, Scottsdale Research Institute, Barbara Brett, CSU-Pueblo

CSU-Pueblo announces the start of an innovative cannabis science project—representing one of the world's first research databases on the use of cannabis for medical purposes. The registry was launched in response to a call by the medical community for insight on current users that may guide new marijuana laws and regulations. This registry has been developed to address the lack of research data on the safety and efficacy of cannabis. We need this database to help develop and answer future questions on the medical use of cannabis, such as who uses it, for what reasons, through which methods, and at what dose. The CSU-Pueblo Cannabis Registry will be used to compile and store clinical data collected directly from patients who use medical marijuana. The data will be gathered from retail sites and clinics across the US initially, and then expand to accommodate international patients. We need to improve our understanding of the real-world use of medical cannabis and to make these data available to other researchers and collaborators. This is the first registry of cannabis users that has been designed to stimulate research and to broaden our knowledge of this field. The registry will eventually help us better understand the possible risks and benefits related to the use of these diverse products.

7C: Cannabis Legalization and Opioid-Related Deaths in Colorado, 1999-2018

Karen Yescavage, CSU-Pueblo, Xiao Cui, CSU-Pueblo

The National Institute on Drug Abuse recently funded two studies to examine the relationship between cannabis legalization and adverse outcomes associated with prescription opioids. Bachhuber, Saloner, Cunningham, and Barry (2014) found that states with medical cannabis laws had a 25% lower mean annual opioid overdose mortality rate relative to states without medical cannabis laws. They examined this association—which generally strengthened over time—from 1999 to 2010. The second study, by Powell, Pacula, and Jacobson (2015), found legally protected access to medical marijuana dispensaries was associated with lower levels of opioid prescribing, lower self-report of nonmedical prescription opioid use, lower treatment admissions for prescription opioid use disorders, and a reduction in prescription opioid overdose deaths. Notably, the reduction in deaths was present only in states with dispensaries (not just medical marijuana laws) and was greater in states with active dispensaries. The purpose of our research was to test if legal access to cannabis impacts mortality rates due to opioid overdose. Rather than compare Colorado with other states, we assessed opioid mortality rates across counties within the state. Initial-

ly, we assessed trends in Colorado counties with populations greater than 100,000, over the past five years (2014-2018). We ran ANOVA and time series analyses to compare opioid-overdose mortality rates among counties with and without recreational cannabis legalization. The change in level and slope of opioid-related deaths were compared. Expanding upon this initial research, additional analyses were performed on opioid mortality rates going back to 1999 in order to compare the potential impact of both recreational and medical cannabis legalization.

8A: K12 Cannabis Research Study: Restorative Justice Implementation

Tim Peters, CSU-Pueblo

The Restorative Justice grant investigators will discuss the activities creating momentum in the community in which students who illegally use or possess cannabis will participate in restorative process vs. the typical punitive system. Members of the panel will include stakeholders within the restorative process throughout Pueblo County who will share their role in the project. In addition, research panelists will share the ethnographic processes by which the creation of momentum was studied.

8B: 'Stem Synergy' in Action: An Analysis of Vertical Integration's Impacts on Product Quality within the Recreational Cannabis Industry

Geoff Ostrove, Stem Holdings

Synergy occurs when a company recirculates, recycles, repackages, and redeploys an intellectual property that it already owns. This strategy involves “transforming intellectual properties into ‘brand names’ with product lines that can be consumed across media venues.” While synergy is often a goal of most vertically integrated corporations, the Walt Disney Company has developed the strategy so well that the phrase ‘Disney synergy’ has come to represent “the ultimate in cross-promotional activities.” It thus serves as “the quintessential example of synergy in the media/entertainment industry” (Wasko, 2001: 71). Within the United States’ recreational cannabis industry, there has been a dramatic increase in the use of synergy, with many companies becoming increasingly integrated both vertically and horizontally. Stem Holdings, a publicly shared cannabis company, has embraced these strategies so strongly that the phrase “Stem Synergy” has come to serve as the quintessential example of synergy within the recreational cannabis industry. Utilizing research methods such as document analysis and in-depth interviews, this paper analyzes the impacts that this increase in synergistic practices has on the quality of the products within the United States’ recreational cannabis industry. It will also provide empirical financial data highlighting sales trends that have been affected by vertical and horizontal integration efforts. This paper will begin with a brief history of traditional cannabis branding strategies, as well as an overview of current cannabis marketing tactics. It will then provide a description of some of the cannabis industry’s largest corporations and provide examples of how Stem Holdings and other publicly shared cannabis companies are utilizing synergy in their product development strategies. Finally, this paper will provide some conclusions about how the use of synergy has impacted product quality and overall sales within the recreational cannabis industry. Overall, this important research study aims to answer the question: How does an increase in synergistic business practices impact product quality

and overall sales within the United States’ recreational cannabis industry?

8B: Putting the Consumer First: Formulating with USP and GMP Standards for Cannabis Products

Scott Karolchyk, MedPharm Holdings

All products are formulated to specific dosage forms for drugs to be effectively delivered to consumers. A formulation development team offers design and optimization of formulations based on research needs for oral tablets, capsules, powders, solutions, suspensions, topical creams and ointments, gels and solutions. Different dosage forms require different pharmaceutical technologies and usually present different technical challenges for formulation development. Formulation development to determine the optimal dosage form, composition and manufacturing route is a fundamental part of product development. Getting a formulation development right helps to optimize drug delivery performance and product stability and allows research studies to take place quickly. A good formulation must be manufacturable, chemically and physically stable throughout the manufacturing process and product shelf life and bioavailable. In addition, many quality standards and GMP requirements must be met to ensure the efficacy and safety of the finished product. This helps accelerate project timelines and includes pre-formulation, excipient-API compatibility assessment and optimization, physicochemical testing, formulation screening, lab scale formulation and accelerated stability studies to achieve the desired characteristics. Good Manufacturing Practice (GMP) is a set of regulations, codes, and guidelines for the manufacture of drug substances and drug products, medical devices, in vivo and in vitro diagnostic products, and foods. The term GMP is recognized worldwide for the control and management of manufacturing and quality control testing of pharmaceutical products. GMPs is that part of quality assurance which ensures that products are consistently produced and controlled to the quality standards appropriate to their intended use. GMP is concerned with both production and quality control. Both industry and regulatory practices will need to be informed by the best techniques of risk assessment and management. The last few years has seen the FDA steer industry further in the direction of a Quality-by-Design (QbD) approach, and away from the Quality-by-Testing (QbT) approach traditionally taken by the pharmaceuticals sector. This move has largely been lauded by business as a sensible move likely to ensure consistent quality of the end product. Quality objective can be achieved only through careful planning and implementation of QA system and practical implementation of GMP. The effective implementation of GMP requires extensive care and knowledge about the different components of GMP that should be incorporated from the inception of the manufacturing building and product development till the production. Integrated with analysis and stability storage, your team can screen a wide range of formulations in a timely and cost-effective manner in order to identify the most promising formulation to progress through to further development.

8B: Data Tools That Will Change How Cannabis is Used

Donna Shields, Holistic Cannabis Academy/Navigator Genomics

The cannabis and hemp industries are plagued with the “trial and error” consumer problem : what cultivar, what product, what dose, what delivery system is best for me? Plus these same consumers are often taking multiple pharmaceuticals not knowing what interaction

(good or bad) may be occurring with their cannabis use. A consumer friendly pharmacogenomics test now provides a solution to this problem. Consumers can have their genetic profile matched the most efficacious prescription medicines (as well as those they should avoid) and the most appropriate cannabinoids for their personal genetic make-up. A quantifiable evaluation of drugs and cannabis, such as this, is much needed and long overdue. Other technology consumer-app driven tools are emerging that provide real-time data. Physicians can immediately know of their patient's use and outcome of cannabinoid products in a HIPAA-compliant way. These tools provide detailed insights on product usage, dosing, relief state and much more, right into the hands of the practitioner, dispensary or product producer.

8C: How Cannabis-Derived Medications Go Through the FDA Approval Process

Alice Mead, Greenwich Biosciences/GW Pharmaceuticals, Mark Bolton, Greenwich Biosciences/GW Pharmaceuticals

Securing approval from the Food and Drug Administration (FDA) is difficult for any investigational medication, but the challenges are even greater for products derived from botanical materials. In addition, there are additional hurdles and requirements for products containing substances that may affect the central nervous system (CNS). Strict control of the conditions of cultivation and harvest of the botanical starting material is the essential first step. Multiple quality control steps, specifications (agreed to by FDA), and batch-to-batch consistency are required at each point along the way as the botanical raw material moves through various stages into a finished drug product. Since cannabis is classified in Schedule I of the Controlled Substances Act, special federal and state license and security requirements apply. Because cannabinoids have CNS activity, a full battery of abuse potential studies must be conducted. Upon FDA approval, a new cannabinoid product must be rescheduled under both state and federal law before it can be dispensed by pharmacies.

8C: New Opportunities for Research in Colorado

Tyrell Towle, MedPharm Holdings

In 2017, Colorado passed a new law, HB17-1367, creating a new category of regulated marijuana licenses in the state: The Marijuana Research and Development Cultivation License (MJ R&D license). This license allows for cannabis companies to create research projects for growing, formulating, and even conducting clinical trials with cannabis. Holders of this license can partner with researchers and provide dosage forms for their studies. The MJ R&D license is unique in the country and puts Colorado in the position to be a global leader in cannabis research. This presentation will get into the details of the new license, discuss the opportunities it creates for researchers, and encourage cannabis researchers to seek partnerships with MJ R&D license holders in the industry.

8C: Hemp in Interstate and International Commerce

David Bush, Hoban Law Group

The landmark Agricultural Improvement Act, signed into law on December 20, 2018, created, for the first time, a framework for federal regulation of commercial hemp production in the United States. States, US territories and Indian nations will be invited to participate in administering the new federal regulatory system through approved plans. But the contemplated intergovernmental cooperation in regu-

lating hemp has raised a number of questions concerning the nature and extent to which hemp and hemp products may be transported and sold in interstate commerce. Moreover, the new law did not alter the continuing obligations of the United States under various international drug control treaties to which it is a signatory. Ambiguities and potential conflicts between and among the laws at all levels of government will require resolution in order to remove continuing clouds of uncertainty over free commerce in hemp and hemp products.

9A: The Cannabis Conversation: Driving Change Through Data and Communication

Abby Tillinghast, Colorado Department of Transportation

CDOT will host a panel of traffic safety and data collection experts. Panelists will present and discuss recent data on impaired driving and cannabis—and on collection methods, applications and constraints. Information presented will include longitudinal data on marijuana-involved traffic crashes, arrests, injuries and fatalities, and self-reported data on cannabis use, opinions and behaviors. Information will be presented from CDOT's annual driver survey and research from the public outreach and engagement campaign called The Cannabis Conversation. The panel will then invite attendees to explore the scientific, behavioral, legal, economic and social elements tied to the issue of cannabis-impaired driving in a round table discussion focused on identifying solutions. The panel will discuss the following questions:

1. What are the challenges in using and collecting data on driving under the influence of cannabis? How can more or improved data help?
2. What are the perceptions and realities of the limitations of reliable data collection?
3. Given the data we have, why do varying opinions persist regarding the dangers of driving under the influence cannabis? How can we change social norms to see drugged driving as dangerous as drunk driving?

9B: Cultivars and Consumption: A Preliminary Analysis of Self-Reported Eating and Drinking Behaviors in a Sample of Cannabis Tourists

Richard Donnelly, University of Northern Colorado, James Gould, University of Northern Colorado

The purpose of this study was to explore cannabis consumption and the food and beverage preferences of the consumer while under the psychoactive effects of cannabis. A purposive sample of patrons of a cannabis tourism company in Colorado yielded 201 responses. The measurement instrument was composed of seventeen categorical and Likert-type items assessing preferences for cannabis, frequency of food type consumption and beverage choice. Independent Samples T-testing indicated that the frequency of vegetable consumption was higher among users of indica than sativa. Pearson Product correlation testing within the cultivars revealed that the preferred strength of psychoactive effect was most associated with snack food consumption ($r = .32$, $p < .01$) among sativa users. Preferred psychoactive strength among indica consumers was most associated with eating meats ($r = .39$, $p < .01$), dairy ($r = .31$, $p < .01$) and sugary foods ($r = .29$, $p < .05$). Over one-third of all sativa and indica users reported that cannabis had no effect on their preferences for meal size or beverage. The most pre-

ferred beverage for consumers of both cultivars was water.

9B: Alternatives to Address Cannabis Intoxication in the Workplace and Clinical Trials

Russ Phifer, WC Environmental

As more states allow either medical or recreational use of cannabis (marijuana), the issue of workplace safety due to possibly impaired workers presents a dilemma for employers. While drug testing can determine if a worker has consumed cannabis, there is no way to determine from drug testing the date and time when the worker took the drug. Since the metabolites of cannabis products can remain in the body for up to three or even four weeks, a worker who shows no evidence of impairment and can safely and productively handle job responsibilities may be at risk of losing his job. This paper will explore the issue of worker safety and cannabis use, and propose a sensible approach to evaluating a worker's ability to perform in a safe and productive manner.

9B: Update from the Hemp Feed Coalition on the Approval of Hemp in Animal Feed by the FDA-CVM

Hunter Buffington, Hemp Feed Coalition

With the passage of the Farm Bill and speculation that hemp in the pet industry will be 225 million by 2022, hemp in animal feed is a hot topic. GRAS designation for humans has occurred for hemp seed, but that does not legalize hemp for pets or production animals. The Hemp Feed Coalition is working on gaining this approval and sharing their knowledge about this approval process to expedite the legalization of hemp in animal feed. The Hemp Feed Coalition is a diverse set of stakeholders whose mission is to increase agricultural markets and the hemp industry's market specifically by shepherding hemp grain products through the Food Additive Petition process with the FDA Center for Veterinary Medicine.

2018 Update:

- » Formed the Hemp Feed Coalition (HFC)
- » Partnership between the Colorado Hemp Industries Association and Friends of Hemp (Kentucky)
- » HFC has met with the FDA-CVM and are currently working on completing a Feed Additive Petition (FAP) for hemp seed oil for dogs and cats in the beginning of 2019
- » Clinical trials will begin after we meet with the FDA one more time to get final approval of the study
- » Focus on cold pressed hemp seed oil for the first ingredient
- » Members include: National Animal Supplements Council, High Plains Nutrition, New West Genetics, True Leaf Pet, Dr Rob Silver (DVM) and Elizabeth and Tim Ryan (Colorado State University), and many others.

2019 Initiative:

- » Established New HFC sub-committees for 2019 for more detailed focus:
 - » Dog and cat committee which will focus on the current FAP for hemp seed oil, and begin to establish study protocols for dogs and/or cats for hemp seed flour
 - » Exploratory committee on hemp for horses
 - » Exploratory committee for cattle and ruminants
 - » University outreach to engage other experts and researchers working in hemp and animal feed
 - » Ingredient committee will focus on hemp seed flour and explore

others

- » Estimated a \$7 million budget to get the approval finalized for hemp as animal feed
- » Based on seven species and five ingredients x \$250,000 (the average cost of an RFP)
- » The coalition is looking for additional resources both financial and intellectual
- » Join the coalition to receive updates and sub committees
- » Implementing a "Winner's Circle" campaign sponsored by New West Genetics for \$10,000 matches with a goal to raise \$100,000 in by the end of March
- » The Hemp Feed Coalition's goal is to begin another FAP for a new ingredient and add an additional species to the hemp seed oil FAP in 2019

Call to action: One of the most important opportunities the Hemp Feed Coalition has is to partner with researchers and universities who are conducting studies with companion and production animals with industrial hemp. The sub-committee will be working to connect these researchers to the HFC, identify grants and fundraising opportunities to pay for research that will assist with approval, and identify labs that can conduct appropriate plant and tissue analysis that meets the FDA protocols for current and future Feed Additive Petitions.

9C: The Politics of Cannabis

Cindy Sovine, Sovine Consulting

This presentation will focus on the current political structures around marijuana and hemp and why exactly that is still the case. We will delve into Tracer reports that show most anti-cannabis spending is coming from alcohol and pharmaceutical companies for whom cannabis is significantly disrupting their status quo. I will discuss the interaction between marijuana and hemp at the state and federal level, as well as give an overview of the 2019 legislative session and how cannabis policy has transpired under a new administration. In an era where the opioid epidemic has reached crisis levels, I will discuss the bill to add opioid prevention as well as autism to the list of conditions in which one can receive a medical marijuana recommendation. I will outline the current political structure's impact on patients, especially the thousands of medical refugees who have flocked from all over the country to Southern Colorado to treat their children's debilitating conditions. We will review the subjective nature of child welfare, the health care system and other areas in which patients rights are being superseded by political systems. I will also provide a brief overview of what to expect in the near future.

9C: Marijuana Research at the National Institute on Drug Abuse

Heather Kimmel, National Institute on Drug Abuse

While marijuana is illegal under federal law, an increasing number of states in the United States have moved to decriminalize or legalize it in some form. Public opinion about marijuana use has become more permissive, while proliferating marijuana dispensaries for medical or recreational use are providing novel methods and formulations for consuming marijuana. We have been learning about some short-term effects of these policy changes; however, many questions remain unanswered about their longer-term public health impacts as well as other social and economic effects. These questions are the focus of intense public and scientific debate as state citizens consider and vote on

medical and recreational marijuana laws and as clinicians and policy makers seek treatment and legislative guidance from scientific research findings. One of the research priorities of National Institute on Drug Abuse (NIDA) is to support the science addressing public health challenges like those posed by changes in state and local marijuana laws. NIDA-supported research aims to help inform decision-making related to these policies, both in reducing the burden of drug related negative outcomes and in continuing to explore the therapeutic potential of marijuana-derived compounds for pain and addiction. This presentation will provide an update on the findings from marijuana policy research currently underway at NIDA described at previous ICR meetings, as well as information on available marijuana research opportunities in the context of overall NIDA priorities.

9C: The Colorado Green Rush: Understanding Police Attitudes Toward Recreational Cannabis in Southern Colorado

Jennifer Schlosser, CSU-Pueblo

There is much controversy that continues to surround legalized cannabis in Colorado; from before Amendment 64 was passed, to the first few months in the new era of legalization, to the current position, five years later. This research examines the relationship between crime and legal cannabis in the mid-sized, rural, Southern Colorado town of Pueblo, and Pueblo County through two points of analysis: 1) crime trends before and after recreational legalization and 2) police officers' attitudes toward legalization. The data include statistical information on various crimes reported from 2010-2017 as well as the results of 20 individual interviews with city police officers. The research concludes with policy recommendations for Colorado and other states considering recreational legalization.

9D: Maximizing Energy Return Utilizing a Collaborative Approach

Devin Moeller, Black Hills Energy, Eric Sisco, Black Hills Energy, Matthew Firth, Black Hills Energy

Given the limited literature available assessing the carbon footprint for indoor cannabis production, specifically the allocation and efficiency of energy-use with the production life-cycle. We are interested in presenting summary usage statistics within our utility, to begin the discussion on establishing best practices to minimize electricity usage per unit of output.