PROGRAM BOOK

2021 VIRTUAL CANNABIS RESEARCH CONFERENCE

AUGUST 3-5, 2021

Exploring New Cannabis Research Frontiers

WEBINAR SERIES
Institute of Cannabis Research
COLORADO STATE UNIVERSITY PUEBLO

Monthly Webinar Series

Supporting Cannabis Research:

- Basic and applied sciences
- Medical and clinical
- Public health and social impacts
- Economic impacts

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The Institute of Cannabis Research: Supporting cannabis research to impact the State of Colorado and beyond

2021 VIRTUAL CANNABIS RESEARCH CONFERENCE

Annual International Conference

Journal of Cannabis Research

The official publication of the Institute of Cannabis Research

BMC Part of Springer Nature

Learn more at: https://www.csupueblo.edu/institute-of-cannabis-research/

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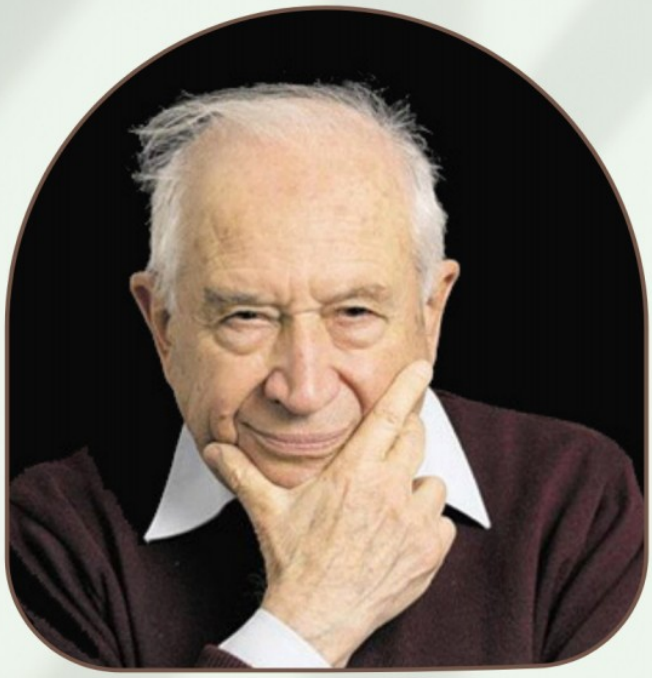
2021 VIRTUAL CANNABIS RESEARCH CONFERENCE

WEDNESDAY, AUGUST 4
10:20 AM, MT

LIVE w/Q & A

FIRESIDE CHAT



Dr. Raphael Mechoulam

"The Father of Cannabis Research"

Best known for his discovery of tetrahydrocannabinol (THC),
one of the 113 known cannabinoids found in the cannabis plant.
Mechoulam jumpstarted the medical revolution
which has transformed the debate around cannabis and the lives of so many people.

MODERATOR: DR. CHAD KINNEY

CONFERENCE PLATFORM INSTRUCTIONS & ACCESS LINKS

Welcome to the 2021 Virtual Cannabis Research Conference!
The conference begins Tuesday, August 3rd at 9:00 am MT
and ends on Thursday, August 5th.

The virtual conference is best experienced by using the Google Chrome web browser.

ATTEND THE CONFERENCE - morressier.com/signup/CRC2021

Create an account with an email address and password
Follow the directions on the site to complete your account.
Once logged in, you can navigate to your conference on the left-hand side under 'My Conferences.'

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I cannot find my event link, can you help me?
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Is it a requirement to have a Morressier account?
Yes, you must have an account to attend a conference.

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CrC2021

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ABOUT CONFERENCE

The 2021 Virtual Cannabis Research Conference will be held as an interactive, virtual experience on August 3-5, 2021.

This multi-disciplinary, three-day virtual conference attracts attendees from across the country and overseas. The comprehensive conference explores new cannabis knowledge and innovations that improve lives and contribute to science, medicine, and society. The 2021 Virtual Cannabis Research Conference allows you to connect with the brightest innovators who come from the following industries:

- ✓ Medical,
- ✓ University Researchers,
- ✓ Private Industry,
- ✓ Public Policy Officials,
- ✓ Laboratory Instrumentation,
- ✓ Equipment,
- ✓ Data Analysis Software, and Others.

2021 VIRTUAL CANNABIS RESEARCH CONFERENCE

This virtual research conference is like no other and will feature:

- ✓ 100+ Live & On-Demand Presentations
- ✓ Virtual Poster Hall
- ✓ Interactive, Virtual Exhibit Hall
- ✓ Virtual Networking Lounge

There is no better time or place to connect with global cannabis experts while actively planning new research ventures.

THE HOSTS

Institute of Cannabis Research
COLORADO STATE UNIVERSITY-PUEBLO

The Institute of Cannabis Research (ICR) at Colorado State University Pueblo

The Institute of Cannabis Research (ICR) was established in 2016 at Colorado State University Pueblo becoming the first multi-disciplinary cannabis research center at a regional, comprehensive institution of higher education. The ICR supports and facilitates unbiased and innovative cannabis research in wide-ranging areas in the sciences, medical (including basic and clinical research), economic impacts, the social sciences, and other areas. In addition to its research efforts, the ICR also supports the dissemination of cannabis research results through a variety of mechanisms including this annual conference, the publication of the Journal of Cannabis Research, and a monthly webinar series.

Oregon State University
Global Hemp Innovation Center

OSU Global Hemp Innovation Center

OSU's Global Hemp Innovation Center is home to the world's leading experts in hemp research. The largest of its kind in the nation, it promises to advance the research of hemp and its market potential across multiple diverse industries and research fields to serve the growing international demand for innovative approaches to food, health, and fiber.

VIRTUAL EXHIBIT HALL

OPENS DAILY: 8 AM - 4:30 PM, MT

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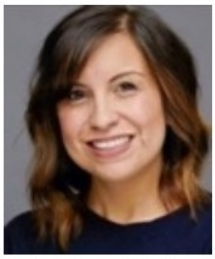

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Institute of Cannabis Research
Director, Office of
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Leader of Animal Health &
Nutrition Research Consortium
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and Advisor to the Research
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Oregon State University

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& Nutraceuticals
Oregon State University

Brian Vanden Heuvel, Ph.D.
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Biology, and Bioinformatics
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Joanna Zeiger, PhD
CEO
Canna Research Foundation

VISIT THE
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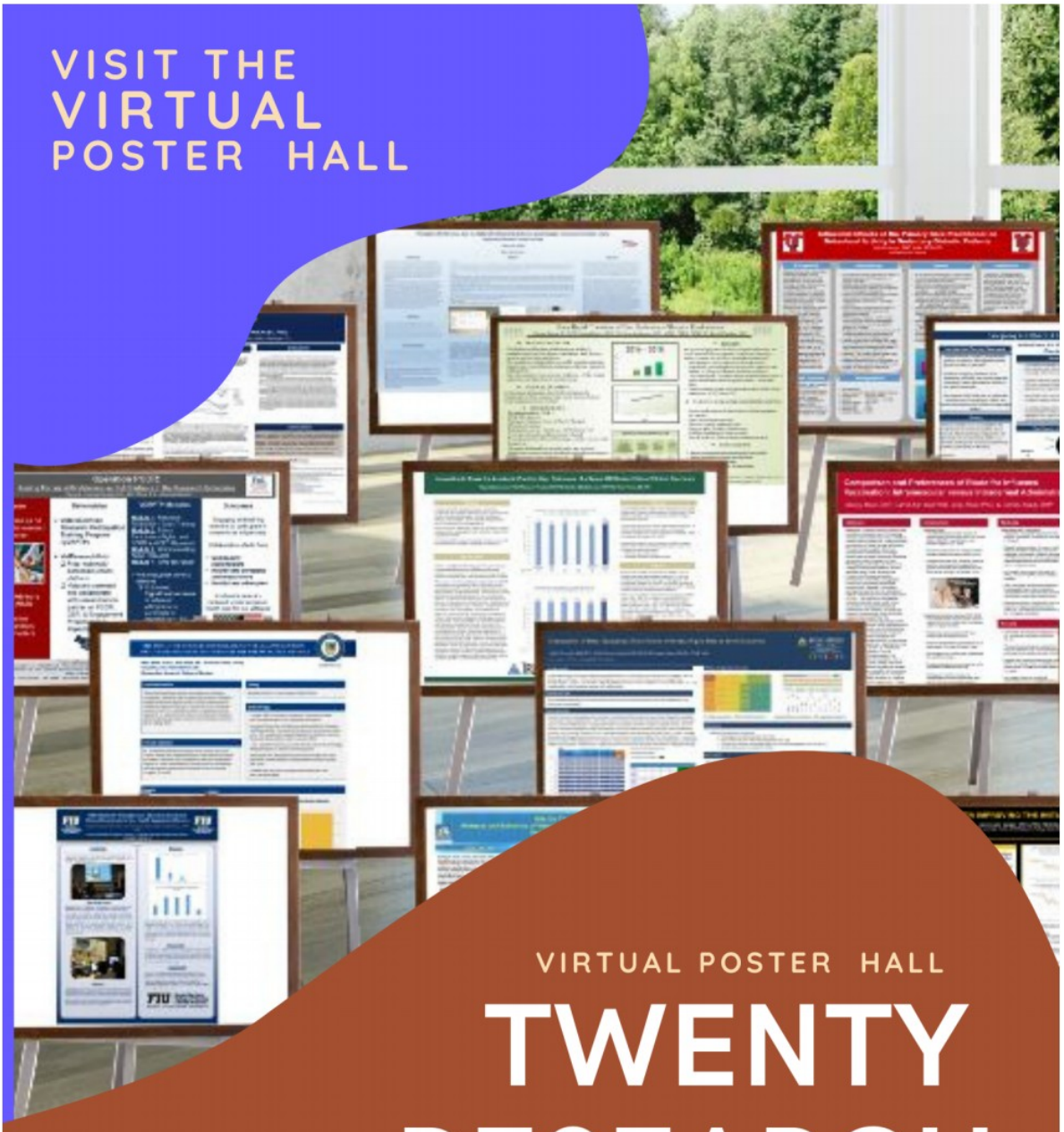
POSTER HALL



VIRTUAL POSTER HALL

TWENTY RESEARCH POSTERS

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KEYNOTE SPEAKER – OPENING PLENARY ADDRESS

DR. MARILYN HUESTIS

SHORT- AND LONG-TERM CONSEQUENCES OF CANNABIS USE

TUESDAY, AUGUST 3, 2021 | 9:00 AM – 10:20 AM MT

Some form of medical cannabis is legalized in almost all US states, and legalized adult use of cannabis for recreational purposes is approved in at least 16 states and the District of Columbia. These changes in public opinion and policy have both short and long-term positive and negative consequences. Detailed discussions of these topics will occur over the next three days of the ICR 2021 Cannabis Conference "Exploring Cannabis Research Frontiers." The potential of cannabinoid pharmacotherapies for numerous indications is great due to the unique and diverse mechanisms of action of Δ9-tetrahydrocannabinol (THC), cannabidiol (CBD), cannabigerol (CBG) and the more than 100 other cannabinoids in the cannabis plant. Few pharmacological data are available for most of these cannabinoids and for the hundreds of other chemicals in the complex cannabis species. We will briefly explore some potential pharmacotherapies and what needs to occur next to advance the field of medical cannabis. The highly conserved endogenous cannabinoid neurotransmitter system plays a critical role in important survival functions, such as hunger, reproduction, body temperature, movement, memory and executive function, as well as attempting to maintain homeostasis. Perturbation of this neurotransmitter system with excess amounts of exogenous cannabinoids affect operation of complex equipment and most importantly, maturation of the developing brain. In fetal, infant, child and adolescent brains, the endogenous cannabinoid neurotransmitter system is negatively affected by cannabis exposure in utero, during breastfeeding, from secondhand cannabis smoke, accidental exposure to attractive food products and cannabis self-administration. Introduction of these positive and negative short and long-term consequences of cannabis intake will hopefully challenge your thinking for the many excellent oral and poster presentations to come.

Dr. Marilyn A. Huestis will serve as the **Opening Plenary** speaker for the Cannabis Research Conference 2021. Dr. Huestis brings an extraordinary breadth and depth in clinical and forensic toxicology, anti-doping, diagnostic screening and confirmation drug testing, and cannabinoid agonists and antagonists.

Through her research, she focused on improving people's lives by reducing deaths from drugged driving, finding novel medications to treat drug dependence and using drug testing as a tool for drug dependence treatment. Her research encompassed the mechanisms of action of cannabinoid agonists and antagonists, effects of in utero drug exposure, and the neurobiology and pharmacokinetics of novel psychoactive substances.

She has published 474 peer-reviewed manuscripts and book chapters, and more than 800 abstracts were presented at national and international meetings. ational Commission on Forensic Sciences before its termination. She is past president of the Society of Forensic Toxicologists, past Chair of the Toxicology Section of the American Academy rensic Sciences, and past president of The International Association of Forensic Toxicologists.

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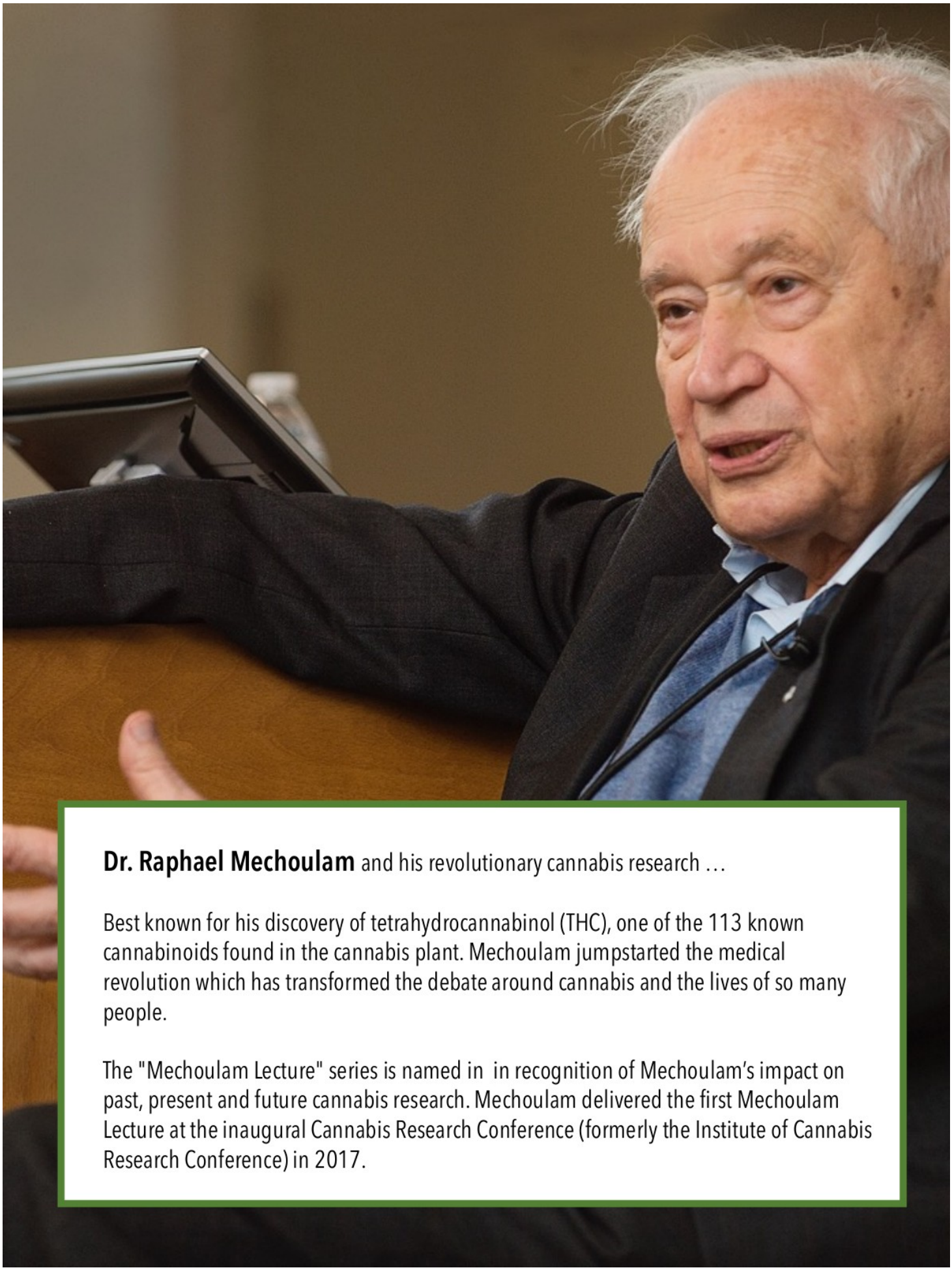

Dr. Raphael Mechoulam and his revolutionary cannabis research …

Best known for his discovery of tetrahydrocannabinol (THC), one of the 113 known cannabinoids found in the cannabis plant. Mechoulam jumpstarted the medical revolution which has transformed the debate around cannabis and the lives of so many people.

The "Mechoulam Lecture" series is named in in recognition of Mechoulam's impact on past, present and future cannabis research. Mechoulam delivered the first Mechoulam Lecture at the inaugural Cannabis Research Conference (formerly the Institute of Cannabis Research Conference) in 2017.

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THE MECHOULAM LECTURE

DR. DANIELE PIOMELLI

THE ROLE OF ENDOCANNABINOID AND PARACANNABINOID SIGNALS IN PAIN REGULATION

WEDNESDAY, AUGUST 4, 2021 | 12 :00 PM – 1:30 PM MT

The endocannabinoid system is an important regulator of pain processing. Anandamide-mediated signaling at peripheral CB1 receptors may act as a 'gate' that limits entrance to incoming pain-related information. Analogous functions have been ascribed to paracannabinoid messengers – endogenous bioactive lipids that share key biogenetic and degradative steps with the endocannabinoids but do not interact with cannabinoid receptors.

Dr. Piomelli's keynote will highlight the complementary roles of endocannabinoid and paracannabinoid signals in pain regulation.

Dr. Daniele Piomelli will deliver the **Mechoulam Lecture** at the 2021 Cannabis Research Conference. Dr. Raphael Mechoulam, for whom the lecture series is named, recommended Dr. Piomelli for this honor. Dr. Piomelli is a Distinguished Professor of Anatomy and Neurobiology and Louise Turner Arnold Chair in Neurosciences at the University of California, Irvine.

He is co-director of UCI's Center for the Study of Cannabis and Editor-in-Chief of Cannabis and Cannabinoid Research, a journal dedicated to studying cannabis, its derivatives, and their endogenous counterparts in the human body.

Daniele Piomelli studied pharmacology and neuroscience with James H. Schwartz and Eric Kandel at Columbia University (1983-1988), and with Paul Greengard at the Rockefeller University (1988-1990). In 2000, two of his mentors (Kandel and Greengard) were awarded the Nobel Prize for their contributions to physiology and medicine. Daniele is an author of more than 400 peer-reviewed articles in journals such as Nature, Science, Nature Medicine, PNAS, and Nature Neuroscience, three full-length books, and 34 patents.

He founded the department of drug discovery and development (D3) at the Italian Institute of Technology in Genoa (Italy), which he directed from 2007 to 2016, and three biopharmaceutical start-ups based on discoveries made in his lab.

Colorado's Hemp Program

CDA's Hemp Program provides the regulatory Platform to cultivate Hemp in Colorado

Components of the program:

- Registration of land areas (Hemp Online Portal)
- Sampling and Inspection
- Compliance

Coming Soon:

- Colorado State Hemp Plan, effective January 2022
- Hemp Center of Excellence

Program Staff

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- Margaret Foderaro, Hemp Inspection and Outreach Coordinator, Margaret.Foderaro@state.co.us

COLORADO
Department of Agriculture
Industrial Hemp Program

For information visit: www.colorado.gov/hemp
For questions email: industrialhemp@state.co.us

ORAL & POSTER SESSION TITLES

TRACK: Biology, Chemistry, Physiology, and Agronomy of Cannabis

Cannabis Genomics and Genetics

Chair: Sang-Hyuck Park, PhD, Colorado State University Pueblo

Through advancements in the field of molecular biology and next-generation sequencing technology, multiple hemp genome sequencing data that near the reference level has been publicly available. The genome sequencing data enables us to explore genome structural variations among different hemp varieties and species, providing a powerful analytic tool to address questions raised in the biology, chemistry, and evolution of Cannabis. The objective of this session is to provide recent updates on cannabis genome sequencing and genetic regulations in agronomically important traits, particularly cannabinoid and terpene biosynthesis, as well as industrial applications.

Chemistry and Biochemistry of Cannabinoid Synthesis and Biosynthesis

Chair: Fred Shahbazi Raz, PhD, University of Windsor

Cannabis has been integral to Eurasian civilization for millennia, but a century of prohibition has limited investigation. With spreading legalization, science is pivoting to study the pharmacopeia of the cannabinoids, and a thorough understanding of their biosynthesis and chemistry is required to engineer strains with specific cannabinoid profiles, and to better prepare synthetic and semi-synthetic cannabinoids using either chemoenzymatic and extraction approaches coupled with synthetic chemistry. This session focuses on recent research enhancing our understanding of the biosynthesis, biochemistry, and chemistry of cannabinoids. Presentations discussing the pathways and the enzymes' mechanisms of action are encouraged, as are investigations into the mechanism and characterization of non-enzymatic decarboxylation of the cannabinoic acids. Similarly, novel synthesis and biosynt.

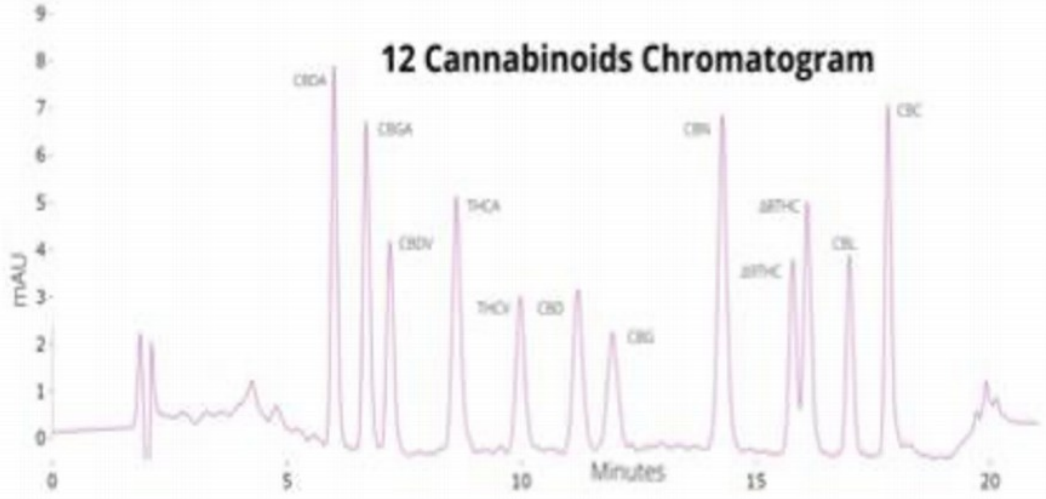
Sensory Functional Changes With Acute Marijuana Use: Visual, Olfactory and Auditory

Chair: Denise Valenti, PhD, IMMAD LLC

This session will focus One each on the science and recent research advancements specific to each of three senses; Visual, Olfactory and Auditory as it relates to marijuana use. Presentations should explore existing science relative to the cannabinoid system while including the latest research results. Presentations are encouraged that address the nature of neuroprocessing including research at the receptor level, axonal/dendritic, primary nuclei, brainstem and upstream brain regions.

CANNABINOID ANALYSIS BY PORTABLE HPLC

Due to its small size, light weight, hand-portability, and lower solvent usage, the Axcend Focus LC® is uniquely suited for both field and laboratory analysis of cannabinoid compounds. Shown below is the detection and separation of 12 Cannabinoids in a Restek standard.



UV detection of 12 cannabinoids in a Restek standard at 235 nm using the portable Axcend Focus LC. Elution Order shown above and below. Flow rate: 0.97 µL/min; Gradient %B: 0 min–3%, 1 min–25%, 10 min–25%, 17 min–60%, 18 min–95%, 20 min–95%; Equilibration Time: 4 min; Mobile Phase A (50% H_2O 50% ACN 0.3 M NH4Ac buffer pH 4.6); Mobile Phase B (50% MeOH 50% ACN); Column: 10 cm x 150 µm i.d.; Phenomenex Kinetex 1.7 µm C8. *(See table below for more details.)*

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* – Cannabinoid samples provided by Restek Corporation.

** – Axcend Focus LC UV detection is also available from Axcend® at 255 and 275 nm in fixed wavelengths or in variable wavelengths between 200–400 nm.

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TRACK: Cannabis Industry

Global Trends in Cannabis Science and Hemp Industry

Chair: Eunsoo Kim, PhD, Colorado State University | Co-Chair: Jace Callaway, PhD, Finola

This session will focus on global trends in Cannabis science and hemp industry. The more the global hemp market explosively expands, the greater the demand for knowledge and innovative ideas about hemp products. Since the legalization of hemp cultivation, many countries have been looking for various types of technology to process hemp for its potential uses. Through academic activities and international networking, researchers, farmers, and producers particularly need to learn about regional information from around the world. We will encourage many global hemp experts to present and share their achievements at this conference.

How the Cannabis Industry Gets Involved With Cannabis Research – Filling the Research Gaps

Chair: Matthew Elmes, PhD, CannaCraft

Our knowledge of cannabis and cannabinoids is not nearly as advanced as it should be, partially due to federal prohibition and associated high regulatory burdens that need to be overcome in order to perform high quality research. Recent legalization efforts at the state-level has given rise to a an exciting and fast-paced cannabis industry in some areas of the United States. The cannabis industry has now matured to the point where it is a major driving force behind research efforts to innovate and advance our understanding of cannabis and cannabinoids. This session will focus on industry led research being used to develop innovative products for the market and also how they are tackling some of the big scientific questions about cannabinoids that academia is lagging behind on.

TRACK: Economic and Social Impact

Achieving Social and Economic Equity in the United States Cannabis Landscape

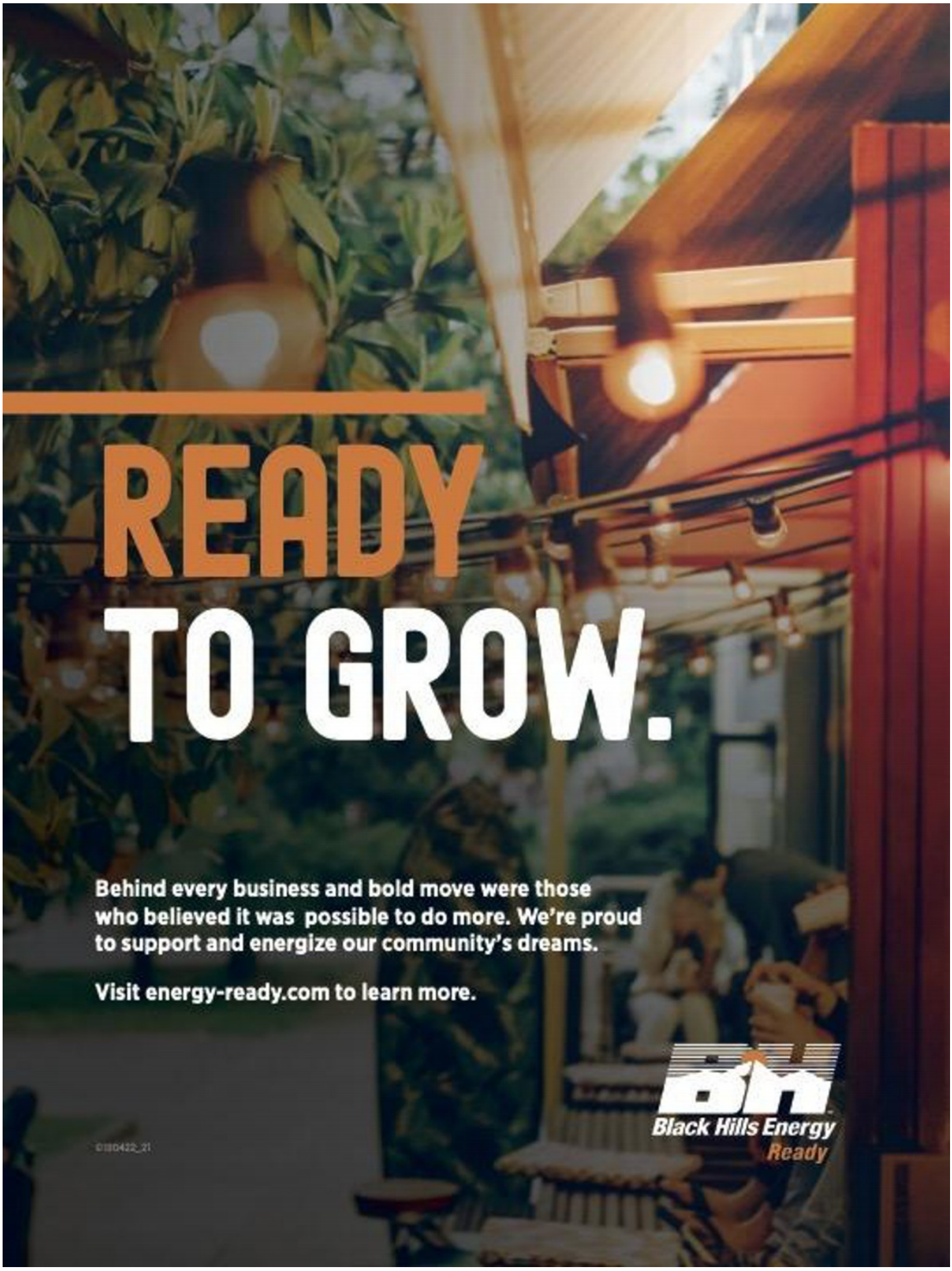
Chair: Duncan I. Mackie, PhD, MedParm Holdings

In 2020, Americans spent nearly $18B on cannabis and cannabis products, a 65 % increase from 2019. US cannabis retail spending may reach as high as $37B by 2024 as more states vote for adult use legalization measures. Concurrently with this skyrocketing industry growth, black individuals across the country are arrested for cannabis-related offenses at a rate 1.5 to 10 times higher the arrest rate of white individuals. A 2019 report surveyed cannabis employees across the nation as 38.6 % women, with women holding 17.6 % of director or executive leadership position. These disparities in access to lawful participation in the legal cannabis industry contribute to a landscape of social and economic inequity. This session will foster data-driven conversations regarding the current state of the industry, challenges to overcome, and evidence-based opportunities for improvement at the individual, organizational, and systemic levels.

The Sustainability of Cannabis and Hemp: Economics and Life Cycle Assessment

Chair: Jason Quinn, Colorado State University-Fort Collins

The sustainability analysis of cannabis and hemp production represents a critical aspect of defining future research and development areas. Sustainability is divided into two interconnected areas: Techno-Economic Assessment (TEA) and Life Cycle Assessment (LCA). These assessment techniques can be used to understand critical operational decisions by growers and policy makers in terms of economics and environmental impact. This session will pull together experts in the area of sustainability to present results from the modeling of large-scale cultivation systems. The session will identify critical areas for research focused on improving the economic viability and environmental impact of cannabis and hemp production.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TRACK: Hemp Cultivation, Processes, and Uses

Industrial Hemp and Its Byproducts as Livestock Feed

Chair: Massimo Bionaz, PhD, Oregon State University | Co-Chair: Serkan Ates, PhD, Oregon State University

The recent legalization of industrial hemp (Cannabis sativa) has led to a sudden increase in its cultivation. Extraction of essential oils from hemp seed and cannabidiol (CBD) from plant biomass (leaves and flowers) yields large amounts of post-extraction byproducts that have currently little to no use. The chemical composition of hemp byproducts (e.g. hemp meal, spent hemp biomass) suggests that they can potentially be included in livestock diets, although currently, it is illegal to feed hemp or its byproducts to livestock due to lack of information on the cannabinoid residuals. Therefore, data on cannabinoid residuals in the products (e.g., meat, milk, and egg) of animals fed industrial hemp and its byproducts are needed to inform the legalization of the use of hemp and its byproducts as feed for livestock. Besides assessing cannabinoid residuals, it is also important to evaluate the effect of industrial hemp and its byproducts on the health and performance of animals. This session would cover research on all the aspects of the use of hemp and it byproducts with livestock, with a major emphasis on the use of post-CBD extraction biomass as feed supplement for livestock.

Key Pest and Disease Threats in Industrial Hemp

Chair: Punya Nachappa, PhD, Colorado State University | Co-Chair: Adrianna Szcepaniec, PhD, Texas A & Am University

Pest and disease identification and management is an increasing challenge for hemp growers across the country. In this symposium, we will present recent research related to the biology and management of economically threatening pests and diseases of hemp. The symposium will feature researchers from all career paths including, students, post-docs and faculty.

TRACK: Medical & Clinical Research

Cannabis Research, Academic Medical Centers, and University Research

Chair: Ruth Charbonneau, JD, RN, Thomas Jefferson University

As more states pass medicinal and adult-use cannabis legislation, the prevalence of cannabis use is surpassing the research needed to support its efficacy. Like Thomas Jefferson University, academic medical centers and research universities are conducting research and developing departments focused on advancing cannabis research supported by foundation, industry, and governmental agency funding. This session will focus on research conducted at academic medical centers and research universities to highlight clinical areas of interest.

Cannabis, the Brain, and Neurological Diseases

Chair: Duncan I. Mackie, PhD, MedPharm Holdings | Co-Chair: Jordan Tishler, MD, Inhale MD

Increasing evidence suggests that cannabis exposure results in altered brain circuitry which can lead to cognitive impairment, an increase in neuropsychiatric disorders, and other adverse outcomes. Other evidence suggests that cannabis research will lead to the development of a new class of therapeutics for treating devastating neurological disorders including PTSD, epilepsy, and Alzheimer's Disease. In this session, we will explore how cannabis exposure alters neural circuitry at the cellular and molecular level as well as the benefits and harms of cannabis and cannabinoids for therapeutic development in neurological disease at the pre-clinical and clinical levels.

COLLEGE OF HEALTH PROFESSIONS

Institute *of* Emerging Health Professions

Thomas Jefferson University is one of the first major health science universities to provide comprehensive cannabis education and research through the Institute of Emerging Health Professions and The Lambert Center for the Study of Medicinal Cannabis & Hemp. Jefferson offers a Master of Science program and three graduate certificates that are fully online and taught by faculty recognized as national experts and leaders in the cannabis field. Unlike other programs, Jefferson M.S. degree provides a distinct combination of evidence-based science and business concepts to prepare students to enter the cannabis industry and/or better care for patients.

- The M.S. in Medical Cannabis Science and Business is designed to provide students with the knowledge in cannabis medicine, science, business and policies required to enter the cannabis industry and develop innovative cannabis business models. The program encompasses 3 graduate cannabis certificates culminating with a research design course and a capstone project.
  - **The Cannabis Science Graduate Certificate** provides an in depth view of the botany and chemistry of the cannabis plant, cannabinoids pharmacology and resultant effects, and how to identify and quantify the different chemical components and potential toxicants in cannabis.
  - **The Cannabis Medicine Graduate Certificate** is designed to provide an understanding of the underlying science and clinical application of endocannabinoids, phytocannabinoids and synthetic cannabinoids.
  - **The Cannabis Business Graduate Certificate** equips students with the knowledge, skills and entrepreneurial mindset needed to turn a unique winning idea that fills an unmet need in the cannabis industry into reality.

Jefferson
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We offer other cannabis education including the Pennsylvania Department of Health approved continuing education recommender course. For additional information visit **Jefferson.edu/IEHP** or contact The Institute of Emerging Health Professions at **IEHP-Info@Jefferson.edu**.

TRACK: Public Health and Education

Cannabis Knowledge, Attitudes, Patterns of Use: Observational Outcome Studies

Chair: Joanna Zeiger, PhD, Canna Research Foundation | Co-Chair: William Silvers, MD, University of Colorado School of Medicine

This session would focus on epidemiologic studies of cannabis use in various populations, including patients and providers. Studies should include information about cannabis patterns of use and/or knowledge and attitudes about cannabis. Outcomes studies are also encouraged which might examine cannabis and effects on opioid use, whether cannabis impacts well-being (including, sleep improvement, decreased anxiety, and pain relief). In addition, we would include studies exploring benefits and harms and degree of usage. We hope that talks in this session will guide public health and education efforts.

Marijuana and CBD Consumption During Pregnancy

Chair: Karli Swenson, BA, BS, University of Colorado Anschutz Medical Campus

This session would focus on epidemiologic studies of cannabis use in various populations, including patients and providers. Studies should include information about cannabis patterns of use and/or knowledge and attitudes about cannabis. Outcomes studies are also encouraged which might examine cannabis and effects on opioid use, whether cannabis impacts well-being (including, sleep improvement, decreased anxiety, and pain relief). In addition, we would include studies exploring benefits and harms and degree of usage. We hope that talks in this session will guide public health and education efforts.

TRACK: Quality Assurance and Quality Control of Cannabis Products

Advancements in Quality Control for Cannabis

Chair: Sheldon Henderson, Axcend

Testing of cannabis products is critical for quality control and adhering to regulatory guidelines. Turnaround time for testing results is measured in days and may delay critical information required to maximize harvesting or processing decisions. In this session we will focus on advancements in quality control measures and testing. These advancements could include field based as well as laboratory methodologies for potency, pesticides , heavy metals, residual solvents, or mold/mycotoxins.

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PANEL SESSION TITLES

TRACK: Economic and Social Impact

Reimagining the Black Community Through Cannabis and Hemp

Chair: Matthan Ibidapo, Cannabis South LLC//International

The session will cover environmental, systemic issues in black and brown communities. These are some of the most important and challenging areas for the cannabis and hemp industries . since they have and still are profoundly incarcerated and are the majority of the world's population in America prisons. Further, this session will explore activities and opportunities to incorporate social equity into burgeoning cannabis industries.

The Sustainability of Cannabis and Hemp: Economics and Life Cycle Assessment

Chair: Jason Quinn, PhD, Colorado State University-Fort Collins

The Sustainability Analysis of Cannabis and Hemp Production Represents a Critical Aspect of Defining Future Research and Development Areas. Sustainability Is Divided Into Two Interconnected Areas: Techno-economic Assessment (tea) and Life Cycle Assessment (LCA). These Assessment Techniques Can Be Used to Understand Critical Operational Decisions by Growers and Policy Makers in Terms of Economics and Environmental Impact. This Session Will Pull Together Experts in the Area of Sustainability to Present Results from the Modeling of Large Scale Cultivation Systems. the Session Will Identify Critical Areas for Research Focused on Improving the Economic Viability and Environmental Impact of Cannabis and Hemp Production.

TRACK: Medical & Clinical Research

Expanding Landscape of Cannabis Research at the CU Anschutz Medical Campus

Chair: Emily Lindley, PhD, University of Colorado Anschutz Medical Campus | Co-Chair: Lori Walker, PhD, University of Colorado Anschutz Medical Campus

The goal of this panel is to provide attendees with the opportunity to learn more about the high-quality scientific cannabis research being conducted on the CU Anschutz Medical Campus. Research on our campus ranges from basic science to observational human studies and randomized clinical trials of cannabis products. Panelists will cover a range of topics, including the latest evidence on cannabis impaired driving, the influence of the gut microbiome on the metabolism of cannabinoids, and new clinical trials of cannabinoids for chronic pain, opioid reduction, and autism. Panelists will also discuss the benefits and limitations of using observational and clinical trial approaches in cannabis research, and the challenges associated with conducting cannabis research.

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TRACK: Public Health and Education

Community College Paving the Way for Cannabis Research in Chicago

Chair: Amanda Gettes, Olive-Harvey College

Olive-Harvey College, a community college on the southeast side of Chicago, is building a greenhouse, extraction and infusion lab and partnership with a 4-year institution to provide CBD oil for research purposes. OHC is the only community college in Chicago offering cannabis credit education with a mission of educating the future workforce, activists, thought leaders and entrepreneurs in the Illinois cannabis industry and empower individuals who have been disproportionately affected by the war on drugs through restorative justice.

Seed to Success: Community Colleges Role in Cannabis Workforce Development and Industry Partnerships

Chair: Amanda Gettes, Olive-Harvey College | Co-Chair: Ruthanne Orihuela, Community College of Denver

Olive-Harvey College and The Community College Of Denver Faculty And Staff, Along With Industry Partners, Will Discuss The Unique Role Community Colleges Play In Responding to the Cannabis Industry's Need For An Appropriately Skilled Workforce. Postsecondary Programs Offering Certificates And Degrees Can Help Professionalize The Cannabis Industry And Provide Additional Legitimacy And Quality Measures For Industry Employment.

The Impact of Lack of Standards of Cannabis Labelling and Dosing on Research and Consumption

Chair: Joanna Zeiger, PhD, Canna Research Foundation

This Panel Discussion Will Cover Several Areas Regarding the Lack of Standardized Labelling and Dosing and Its Impact on the Industry. in Terms of the Effect on Scientific Research, Particularly Questionnaire Based Studies, Participants Are Unable to Give Accurate Information About How Much Cannabis They Are Using and What Ratios of Cbd and Thc They Are Using; This Makes it Difficult for Researchers to Determine Accurate Information on What Doses Work Best for Various Conditions. for Consumers, the Lack of Standardization Is Also Problematic Because Often They Do Not Know How Much They Are Taking, How Much to Take (since Each Company Has Its Own Dosing Schedule), and How Determine What Ratio of Cbd:thc Is Most Beneficial. in Addition, the Labels on Many Products Are Difficult to Read and Droppers for Tinctures Are Often Not Marked Meaning it Is Guess Work to Determine How Much of a Dropper to Consume. Standardized Labelling and Dosing Will Make Things Easier for Researchers and Safer for Consumers.

CDOT, CDPHE and Oregon Partners Discuss What We Know and Don't Know About Cannabis and Public Health

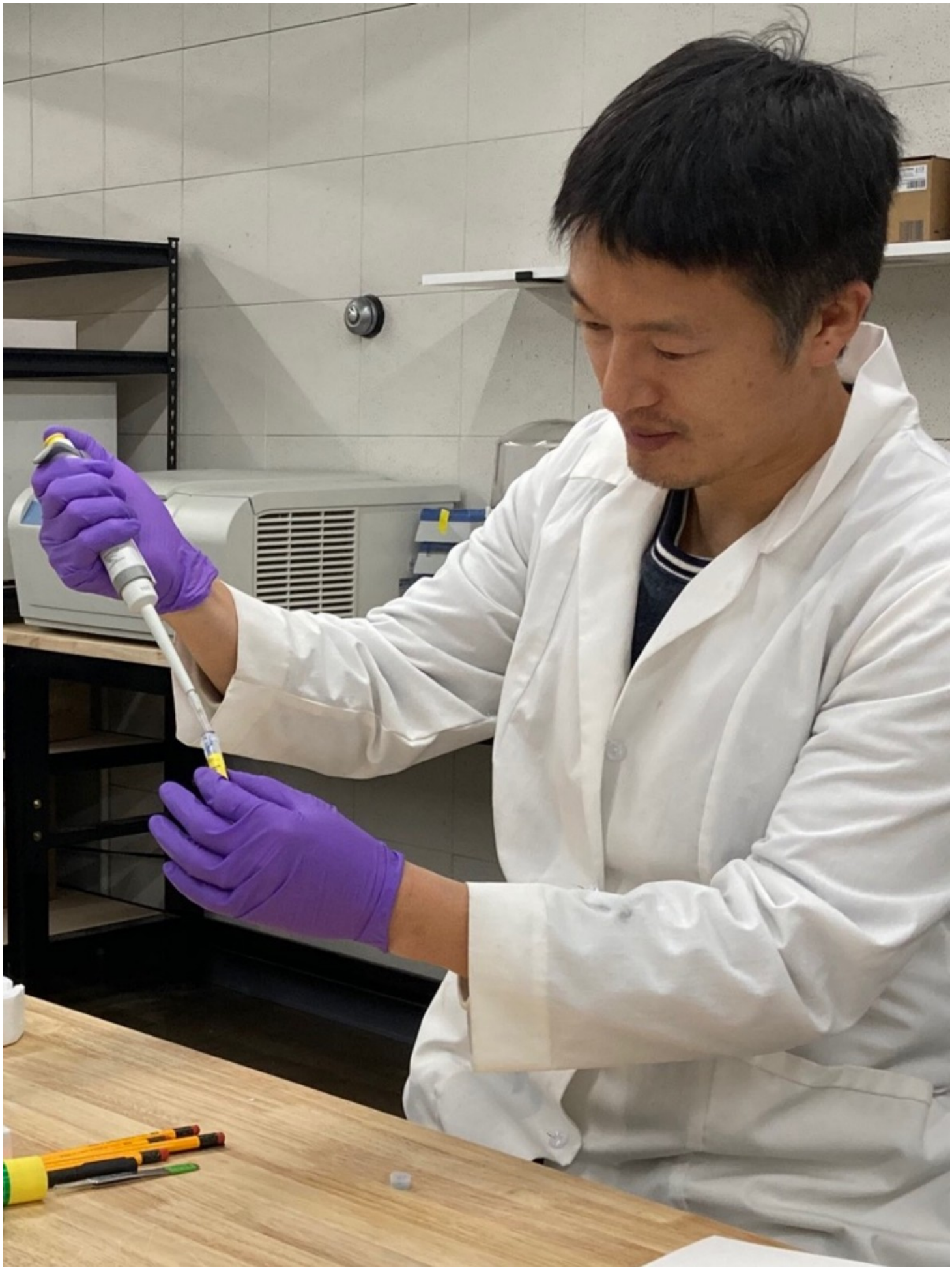
Chair: Sam Cole, CIG/CDOT | Co-chair: Sam Aspnes, CIG/CDOT

Adult-use cannabis has been legal in Colorado and Oregon for more than half a decade. During that time, public agencies and advocacy groups have conducted a great deal of research and engagement regarding how to minimize the negative impacts on public health. While cannabis has contributed to economic opportunities for many communities, we also know that impaired driving has proven dangerous and persistent. Join public health experts and traffic safety communicators in a lively panel examining the research, data, and personal stories that illustrate the impact of the issue.

Additives in Cannabis Products

Chair: Stephen Goldman, Phytatech DBA Kaycha Labs

The Vape Associated Lung Injury (vali) Crises of Recent Times Has Taught Us a Lot About the Risks Involved in Cannabis Products Currently for Sale in the United States. the Topic Will Discuss Current Trends, Evaluate Recent Work Done in the State of Colorado by the Additives Subcommittee of the State's Science & Policy Workgroup (cdphe and Med Collaboration) and What Steps Industry Is Taking to Mitigate These Risks.



Law and Regulation and Its Role in Cannabis Research

Chair: Ruth Charbonneau, JD, RN, Thomas Jefferson University

As More States Pass Medicinal and Adult-use Legislation, the Prevalence of Cannabis Use Is Surpassing the Research Needed to Support Its Efficacy. However, Cannabis Remains a Controlled Schedule I Drug Under the Controlled Substance Act. Therefore, Per Federal Law and Regulations, Cannabis Has No Accepted Medical Use and a High Potential for Abuse. Nonetheless, State Laws Outline the Scope of Medical Cannabis and Adult-use, Relying on Existing Standards, Which May Not Be Specific to Cannabis or Not Supported by Research. This Session Will Focus on Research That Drives Public Policy or Knowledge, Including, but Not Limited To, Measurements of Cannabis Use While Driving, Negative Implications of Cannabis Use, Agricultural and Laboratory Standards, and Taxation Policy.

The Varieties of Cannabis Regulatory Experiences: The Intersection of Standards, Regulations, and Research

Chair: Jahan Marcu, PhD, Marcu and Arora

Researchers, licensed cannabis operators, financial institutions, and their cohorts seemed to be challenged by a labyrinth of federal roadblocks and ever-changing State regulations impacting cannabis clinical research and medical usage. Guidance documents and standards developed by globally recognized non-profit organizations have a precedence for providing clarity surrounding accepted best practices. Historically, standards groups are aided by experts from industry, academia and healthcare, providing the technical expertise and real-world experience that leads to the creation and adoption of guidance documents to allow governments to properly regulate the industry to protect public health and to allow researchers to conduct reproducible studies. Combining scientific research, policy, and industry guidance, the result is a robust and evolving set of standards that provide ever pressing solutions to a nascent industry. The combined presence of the panel, representing three standards groups. with active Cannabis standards development committees, will discuss their roles and hopes for cannabis and hemp industries. The panel will provide a distillation from peer-reviewed journal articles, consensus standards, and guidance documents. Attendees will be able to participate in a discussion that will better their understanding of the solutions that exist, and how they can support the application of expertise and data in guiding research and creating policy. We welcome attendees to bring their most pressing questions and issues for panelists to discuss.

What Will it Take to Gain Federal Legal Approval to Feed Hemp and Its By-products to Animals?

Chair: Hunter Buffington, Hemp Feed Coalition | Co-Chair: Ruth Charbonneau, JD, RN, Thomas Jefferson University

The Session Will Begin With an Update on the Hemp Feed Coalition's Work to Gain Federal Legal Approval for Hemp and Its By-products to Be Used as Animal Feed Ingredients. This Will Include the Steps Necessary to Gain Fda-cvm Approval for Each By-product Including: Ingredient Homogeneity, Contamination Concerns, Varietal and Geographic Variations That Affect Nutritional Composition and Identified End-use. This Session Will Also Discusses Current Research Addressing the Safety Concerns and Need for Data Collection and Clinical Feed Trials That Are Necessary to Show Safety and Efficacy of These Ingredients for Each Species; Including: Intended Use, Inclusion Rates and Animal Categories. the Presentation Will Conclude With a Panel Discussion to Answer Specific Research and Regulatory Questions Presented to the Panelists.

University Lawyers Weigh in on Campus Cannabis Research

Chair: Linda Schutjer, Colorado State University-Fort Collins

This panel will consist of a group of university lawyers who work on issues surrounding cannabis research on their campus. There are practical and legal issues associated with such research and the laws are changing frequently. Cannabis research on campus starts with production and ends with potential products and includes everything in-between. Each step can present unique challenges for legal compliance. Researchers will be provided insights into how to do cannabis research right to avoid the potential violation of law. Panelist will represent counsel from various state's with potentially different approaches to cannabis and will present on the issues they have seen -- which may be state specific.


VOLUNTEER

TUESDAY, AUGUST 3, 2021| SCHEDULE-AT-A-GLANCE

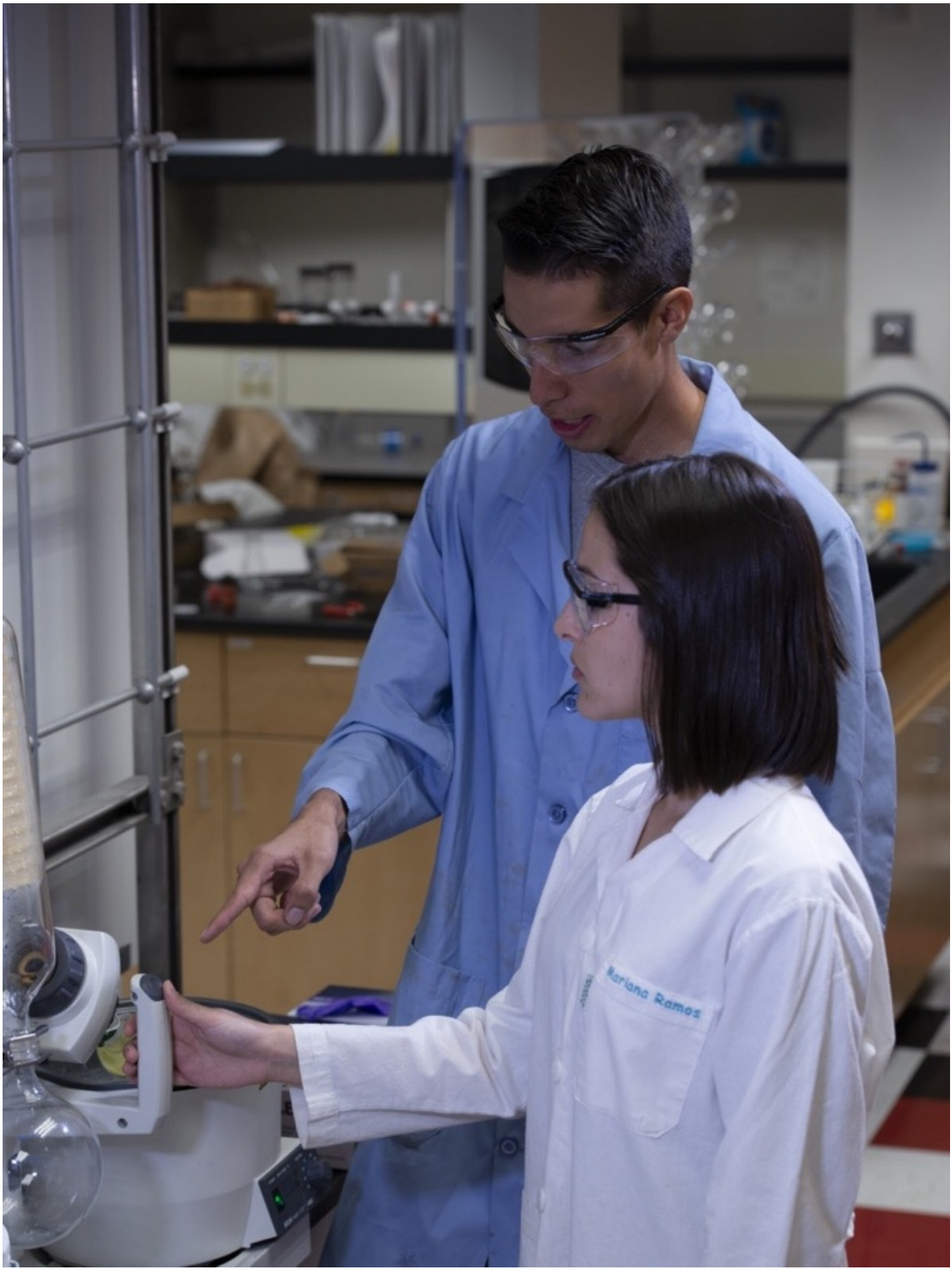
TIME (MT)	CONCURRENT SESSION 1	CONCURRENT SESSION 2	CONCURRENT SESSION 3	CONCURRENT SESSION 4
9:05 - 10:20 AM	KEYNOTE ADDRESS presented by DR. MARILYN HUESTIS			
10:20 - 10:40 AM		FRITSCH	VISIT THE VIRTUAL EXHIBIT HALL	CannaKeys Unlocking the Science
10:40 - 10:45 AM	SESSION CHAIR WELCOME ADDRESS			
	PANEL DISCUSSION	CANNABIS, THE BRAIN, AND NEUROLOGICAL DISEASES	CANNABIS RESEARCH, ACADEMIC MEDICAL CENTERS, AND UNIVERSITY RESEARCH	PANEL DISCUSSION
10:45 -11:10 AM	EXPANDING LANDSCAPE OF CANNABIS RESEARCH AT THE CU ANSCHUTZ MEDICAL CAMPUS: UPDATES AND DISCUSSION OF BARRIERS TO CONDUCTING CANNABIS RESEARCH - moderated by EMILY LINDELY, PHD	EFFECTS OF CANNABIS AND CBD ON BRAIN AND PLASMA NEUROTRANSMITTERS IN MICE - presented by NICHOLE REISDORPH, PHD	CANNABIS RESEARCH AT THE NATIONAL INSTITUTE ON DRUG ABUSE - presented by HEATHER KIMMEL, PHD	CDOT, CDPHE AND COMMUNITY PARTNERS DISCUSS WHAT WE KNOW AND DON'T KNOW ABOUT CANNABIS AND PUBLIC HEALTH IN COLORADO - moderated by SAM COLE
11:10 - 11:35 AM		MINOR CANNABINOIDS AND NEUROINFLAMMATION: A NEW APPROACH TO TREATMENTS FOR NEURODEGENERATIVE DISEASES - presented by DUNCAN I. MACKIE, PHD	DEVELOPMENT OF A CANNABIS HARM REDUCTION COURSE FOR LAND GRANT UNIVERSITY STUDENTS - presented by ABIGAIL WIEGAND, MS	
11:35 AM-12:00 PM		ORAL CBD EXTRACT DIFFERENTIALLY MODULATES THE STRESS-EVOKED BRAIN SEROTONIN AND PERIPHERAL INFLAMMATORY RESPONSES IN MALE VERSUS FEMALE RATS - presented by MONIKA FLESHNER, PHD		
12:00 PM - 1:30 PM	BREAK SPONSORED BY	FRITSCH	VISIT THE VIRTUAL EXHIBIT HALL	CannaKeys Unlocking the Science
1:30 PM - 1:35 PM	SESSION CHAIR WELCOME ADDRESS			
	PANEL DISCUSSION	CANNABIS, THE BRAIN, AND NEUROLOGICAL DISEASES	CANNABIS RESEARCH, ACADEMIC MEDICAL CENTERS, AND UNIVERSITY RESEARCH	MARIJUANA AND CBD CONSUMPTION DURING PREGNANCY
1:35 PM -2:00 PM	SEED TO SUCCESS: COMMUNITY COLLEGES ROLE IN CANNABIS WORKFORCE DEVELOPMENT AND INDUSTRY PARTNERSHIPS - moderated by AMANDA GETTES, MPA	THE EFFECTS OF MEDICINAL CANNABIS USE ON SEIZURES IN ADULTS WITH MEDICALLY REFRACTORY EPILEPSY - presented by BARBARA A BRETT (BRETT-GREEN), PHD	CLINICIAN ATTITUDES, TRAINING, AND BELIEFS ABOUT CANNABIS: AN INTERPROFESSIONAL ASSESSMENT - presented by KELSEY SMITH, BA	MARIJUANA FOR MORNING SICKNESS: A PSYCHOSOCIAL, CLINICAL AND LEGAL ANALYSIS AND DISCUSSION - presented by KARLI SWENSON, BS, BA
2:00 PM - 2:25 PM		PESTICIDE CONTAMINATION TOXICITY IN CANNABIS: IMPLICATIONS TO MEDICAL USE IN NEUROLOGICAL DISEASES - presented by DORINA PINKHASOVA	WHAT CANNABIS RELATED DATA IS REPORTED IN THE FDA FAERS DATABASE - presented by TERESA A. SIMON, MPH	BELIEFS AND ATTITUDES REGARDING PRENATAL MARIJUANA USE: PERSPECTIVES OF PREGNANT WOMEN WHO REPORT USE - presented by JUDY CHANG, MD
2:25 PM - 2:50 PM			MEDICAL CANNABIS USE REDUCES OPIOID PRESCRIPTIONS IN PATIENTS WITH CHRONIC BACK PAIN presented by BRYAN RENSLO	CBD USE IS ASSOCIATED WITH ILLICIT DRUG USE AND PRENATAL CANNABIS USE presented by NATACHA M. DE GENNA, PHD
2:50 PM - 3:10 PM	BREAK SPONSORED BY	FRITSCH	VISIT THE VIRTUAL EXHIBIT HALL	CannaKeys Unlocking the Science
3:10 PM - 3:15 PM	SESSION CHAIR WELCOME ADDRESS			
	PANEL DISCUSSION	PANEL DISCUSSION	CANNABIS RESEARCH, ACADEMIC MEDICAL CENTERS, AND UNIVERSITY RESEARCH	MARIJUANA AND CBD CONSUMPTION DURING PREGNANCY
3:15 PM - 3:40 PM	COMMUNITY COLLEGE PAVING THE WAY FOR CANNABIS RESEARCH IN CHICAGO - MODERATED BY AMANDA GETTES, MPA	SUCCESSFULLY NAVIGATING NIH PEER REVIEW: NCCIH OPPORTUNITIES FOR SCIENTISTS RESEARCHING CANNABIS presented by Patrick Still, PHD	THE EFFECTS OF CANNABIS CONSUMPTION ON HEART RATE AND RHYTHM IN POST-MI PATIENTS - presented by LORI WALKER, PHD	INVESTIGATING THE EFFECTS OF CBD DURING PREGNANCY ON MOUSE OFFSPRING BEHAVIOR AND THE BRAIN EPIGENOME - presented by NICOLE M. WANNER, DVM
3:40 PM - 4:05 PM			CANNABIS USE IN PEOPLE WITH PARKINSON'S DISEASE: REPORTED PATTERNS OF USE, SYMPTOMATIC BENEFITS, AND ADVERSE EFFECTS VIA FOX INSIGHT - presented by MAUREEN LEEHEY,	INFANT OUTCOMES RELATED TO CANNABIS EXPOSURE DURING LACTATION - presented by ALICE ORDEAN, MD
4:05 PM - 4:30 PM			FEATURED SPEAKER BROUGHT TO YOU BY BIOMERIEUX IMPACT OF ASSOCIATION OF OFFICIAL ANALYTICAL COLLABORATION (AOAC) INTERNATIONAL FOR CANNABIS LABS & LAB VALIDATION SUMMARY presented by JOHN MILLS, PHD	OBSTETRIC PROVIDERS' RESPONSES TO PREGNANT PATIENT DISCLOSURES OF MARIJUANA USE - presented by JUDY CHANG, MD
4:30 PM - 5:30 PM	JOIN US IN THE VIRTUAL NETWORKING LOUNGE			

WEDNESDAY, AUGUST 4, 2021 - SCHEDULE –AT-A-GLANCE

TIME (MT)	CONCURRENT SESSION 1	CONCURRENT SESSION 2	CONCURRENT SESSION 3	CONCURRENT SESSION 4	CONCURRENT SESSION 5
	SESSION CHAIR WELCOME ADDRESS				
9:00 AM - 9:05 AM	CANNABIS KNOWLEDGE, ATTITUDES, PATTERNS OF USE: OBSERVATIONAL OUTCOME STUDIES	PANEL DISCUSSION | WHAT WILL IT TAKE TO GAIN FEDERAL LEGAL APPROVAL TO FEED HEMP AND ITS BY-PRODUCTS TO ANIMALS? - moderated by HUNTER BUFFINGTON, MNM	CANNABIS RESEARCH, ACADEMIC MEDICAL CENTERS, AND UNIVERSITY RESEARCH	GLOBAL TRENDS IN CANNABIS SCIENCE AND HEMP INDUSTRY	CHEMISTRY AND BIOCHEMISTRY OF CANNABINOID SYNTHESIS AND BIOSYNTHESIS
9:05 AM - 9:30 AM	REAL WORLD DISPENSARY DATA FOR IBD PATIENTS USING MEDICAL CANNABIS - presented by JAMI KINNUCAN, MD		THE SATIVA-INDICA DEBATE: POTENTIAL DIFFERENCES IN THE SUBJECTIVE RESPONSE OF CANNABIS BY STRAIN CLASSIFICATION - presented by SARAH OKEY, PHD	TRENDS IN THE KOREAN HEMP INDUSTRY AND DEVELOPMENT OF CBD EXTRACTION METHODS - presented by JOON-HEE HAN, PHD	CREATION OF A SPRAY-DRIED CANNABINOID OIL-IN-WATER (COW) NANOEMULSION POWDER. - presented by ABHINANDAN BANERJEE, PHD
9:30 AM - 9:55 AM	CHANGES IN CANNABIS USE METHODS AMONG COLORADO POPULATIONS AND RELATED HEALTH EFFECTS - presented by RICHARD HOLDMAN, MD		SECONDARY METABOLITES PROFILED IN CANNABIS INFLORESCENCES, LEAVES, STEM BARKS, AND ROOTS FOR THE DEVELOPMENT OF NOVEL NATURAL HEALTH PRODUCTS - presented by DAN JIN, PHD	PHARMACOLOGICAL ACTION AND CHANGES OF GENE EXPRESSION BY CANNABIDIOL TREATMENT IN HUMAN DERMAL PAPILLA CELLS AND A549 LUNG CANCER CELLS - presented by KEUN-CHEOL KIM, SD	EVALUATION OF THERMO-CHEMICAL CONVERSION TEMPERATURES OF HEMP (CANNABIS SATIVA L.) BIOMASS CANNABINOID ACIDS BY PRESSURIZED LIQUID EXTRACTION - presented by KENNETH J OLEJAR, PHD
9:55 AM -10:20 AM	CANNABIS ATTITUDES, PATTERNS OF USE, AND SUBJECTIVE EFFECTS AMONG FOLLOWERS OF THE ALLERGY ASTHMA NETWORK (AAN) - presented by JOANNA S. ZEIGER, PHD		CANNABIS-DERIVED COMPOUNDS CANNABICHROMENE AND D9-TETRAHYDROCANNABINOL INTERACT AND EXHIBIT CYTOTOXIC ACTIVITY AGAINST UROTHELIAL CELL CARCINOMA CELLS - presented by OMER ANIS, MD	AUTO-FLOWERING HEMP VARIETIES AND THEIR IMPACT ON THE MODERN HEMP INDUSTRY - presented by JACE CALLAWAY, PHD	
10:20 AM - 10:40 AM	BREAK SPONSORED BY	FRITSCH	VISIT THE VIRTUAL EXHIBIT HALL		CannaKeys
10:20 AM	Join DR. RAPHAEL MECHOULAM and DR. CHAD KINNEY - FOR A LIVE "FIRESIDE CHAT with LIVE Q & A				
	SESSION CHAIR WELCOME ADDRESS				
10:40 AM - 10:45 AM	CANNABIS KNOWLEDGE, ATTITUDES, PATTERNS OF USE: OBSERVATIONAL OUTCOME STUDIES	INDUSTRIAL HEMP AND ITS BYPRODUCTS AS LIVESTOCK FEED	CANNABIS RESEARCH, ACADEMIC MEDICAL CENTERS, AND UNIVERSITY RESEARCH	GLOBAL TRENDS IN CANNABIS SCIENCE AND HEMP INDUSTRY	CHEMISTRY AND BIOCHEMISTRY OF CANNABINOID SYNTHESIS AND BIOSYNTHESIS
10:45 AM -11:10 AM	PILOT KNOWLEDGE AND ATTITUDES SURVEY ON CANNABIS IN CLINICALLY RECRUITED PARTICIPANTS - presented by TERESA SIMON, MPH	HEMP SEED CAKE AND ITS POTENTIAL AS FEED INGREDIENT - presented by RAJ KASULA, DVM	THE POTENTIAL IMPACT OF CANNABIDIOL IN THE TREATMENT OF EQUINE LAMINITIS - presented by BABAK BABAN, PHD	PRESENT STATE OF INDUSTRIAL HEMP IN EAST ASIA - presented by EUN-SOO KIM, PHD	INHIBITION OF UDP-GLUCURONOSYLTRANSFERASE ENZYMES BY MAJOR CANNABINOIDS AND ITS METABOLITES - presented by SHAMEMA NASRIN, M.PHARM
11:10 AM - 11:35 AM	CANNABIS USE FREQUENCY AND PERCEIVED EFFICACY TO MANAGE PSYCHOLOGICAL PAIN - presented by KAREN YESCAVAGE, PHD	INVESTIGATING CANNABINOID DEPOSITION IN SHEEP FED INDUSTRIAL HEMP BIOMASS - presented by BRONWYN BLAKE, PHD	MEASUREMENT OF THC IN EXHALED BREATH AFTER MARIJUANA SMOKING: EXPLORING THE POTENTIAL OF A TRANSPORTABLE LC-CMS SYSTEM - presented by JACK HENION, PHD	REGULATIONS AND POLICIES FOR POVERTY REDUCTION THROUGH CANNABIS INDUSTRIALIZATION: A CASE STUDY OF A MOUNTAINOUS COMMUNITY IN WESTERN NEPAL - presented by THOMAS MICHAEL KLOEPFER, PHD	IN SILICO ELUCIDATION OF THE ENZYMATIC SYNTHESIS OF THCA, CBDA AND CBGA FROM CBGA - presented by JOHN FREDERICK TRANT, PHD
11:35 AM -12:00 PM	CANNABIS USE AND POST-OPERATIVE COMPLICATIONS IN PATIENTS UNDERGOING PANCREATIC RESECTION - presented by HELEN MADSEN, MD	HEPATIC CANNABINOIDS RESIDUALS AND BILIRUBINEMIA ARE HIGHLY AFFECTED BY FEEDING SPENT HEMP BIOMASS AND WITHDRAWAL PERIOD IN LAMBS - presented by MASSIMO BIONAZ, PHD		HOW CANNABIS SUPPLY CHAIN MANAGERS NAVIGATE THE EMERGING LEGAL CANNABIS INDUSTRY - presented by MELLIE PULLMAN, PHD	CHARACTERIZATION OF THE CANNABIS PLANT MICROBIOME FOR THE DEVELOPMENT OF IMPROVED CULTIVATION STRATEGIES - presented by CAROLINA LOBATO, PHD
12:00 PM - 1:30 PM	MECHOULAM LECTURE PRESENTED BY DR. DANIELE PIOMELI				
	SESSION CHAIR WELCOME ADDRESS				
1:30 PM - 1:35 PM	CANNABIS KNOWLEDGE, ATTITUDES, PATTERNS OF USE: OBSERVATIONAL OUTCOME STUDIES	INDUSTRIAL HEMP AND ITS BYPRODUCTS AS LIVESTOCK FEED	PANEL DISCUSSION	ACHIEVING SOCIAL AND ECONOMIC EQUITY IN THE UNITED STATES CANNABIS LANDSCAPE	CHEMISTRY AND BIOCHEMISTRY OF CANNABINOID SYNTHESIS AND BIOSYNTHESIS
1:35 PM -2:00 PM	ASK YOUR HEALTHCARE PROVIDER ABOUT CANNABIS (APAC) - presented by TRACY KLEIN, PHD	FEEDING SPENT HEMP BIOMASS TO FINISHING LAMBS: EFFECTS ON BLOOD PARAMETERS RELATED TO HEALTH AND METABOLISM - presented by MASSIMO BIONAZ, PHD		WILL LEGALIZATION OF CANNABIS HELP CORRECT JUDICIAL, ECONOMIC, AND SOCIAL INJUSTICES OF THE PAST DECADES? - presented by ERNST CEBERT, PHD	A MECHANISTIC MODEL EXPLAINING LIGAND AFFINITY FOR, AND PARTIAL AGONISM OF, CANNABINOID RECEPTOR 1 AND 2 - presented by DANIEL MEISTER, BS
2:00 PM - 2:25 PM	HOW HAS COVID-19 IMPACTED THE DEMAND FOR MEDICAL CANNABIS? - presented by MAHA HAQ, MS	EVALUATION OF HEMPSEED CAKE ON CATTLE PERFORMANCE, CARCASS CHARACTERISTICS AND FEEDING BEHAVIOR IN FINISHING DIETS - presented by THOMAS WINDERS, MS	LAW AND REGULATION AND ITS ROLE IN CANNABIS RESEARCH - moderated by RUTH CHARBONNEAU, RN, JD	UP IN SMOKE: THE EFFECT OF MARIJUANA LEGALIZATION ON PERSONAL BANKRUPTCY - presented by IRENA HUTTON, PHD	MAJOR AND MINOR CANNABINOIDS AND PHARMACOLOGICALLY RELEVANT CENTRAL NERVOUS SYSTEM RECEPTORS: IN-SILICO ANALYSIS - presented by FRED SHAHBAZI RAZ, PHD
2:25 PM - 2:50 PM		PLASMA CANNABINOID CONCENTRATIONS DETERMINED FROM HEIFERS FED HEMPSEED CAKE IN FINISHING DIETS BY RAPID SCREENING WITH MASS SPECTROMETRY - presented by ERIC MICHAEL SERUM, PHD			MEDICAL CANNABIS: A NATURAL PRODUCT WITH COMPLEX CHEMICAL AND BIOCHEMICAL PROFILES - presented by LAKSHMI KOTRA, PHD
2:50 PM - 3:10 PM	BREAK SPONSORED BY	FRITSCH	VISIT THE VIRTUAL EXHIBIT HALL		CannaKeys

WEDNESDAY, AUGUST 4, 2021 - SCHEDULE –AT-A-GLANCE

	WELCOME ADDRESS				
3:10 PM - 3:15 PM	**CANNABIS KNOWLEDGE, ATTITUDES, PATTERNS OF USE: OBSERVATIONAL OUTCOME STUDIES**	**INDUSTRIAL HEMP AND ITS BYPRODUCTS AS LIVESTOCK FEED**	**PANEL DISCUSSION**	**PANEL DISCUSSION**	
3:15 PM - 3:40 PM	DOES CANNABIS USE REDUCE OPIOID USE? CANNABIS THE EXIT DRUG - presented by UMA DHANABALAN, MD	THE USE OF HEMP SEED AS A FEED INGREDIENT FOR LAYING HENS: AN EVALUATION OF FATTY ACID TRANSFER - presented by BRIAN PARR - PHD	UNIVERSITY LAWYERS WEIGH IN ON CAMPUS CANNABIS RESEARCH - moderated by LINDA SCHUTJER, JD	REIMAGINING THE BLACK COMMUNITY THROUGH CANNABIS AND HEMP - moderated by MATTHAN IBIDAPO, BA	
3:40 PM - 4:05 PM	REGULATING HEAVY METALS IN CANNABIS AND HEMP: WHAT CAN WE LEARN FROM THE PHARMACEUTICAL INDUSTRY? - presented by ROBERT THOMAS, C.CHEM				
4:05:00 PM - 4:20 PM					
4:05 PM - 5:05 PM	**JOIN US IN THE VIRTUAL NETWORKING LOUNGE**				


Mariana Ramos

THURSDAY, AUGUST 5, 2021 - SCHEDULE-AT-A-GLANCE

TIME (MOUNTAIN TIME)	CONCURRENT SESSION 1	CONCURRENT SESSION 2	CONCURRENT SESSION 3	CONCURRENT SESSION 4	CONCURRENT SESSION 5
	SESSION CHAIR WELCOME ADDRESS				
9:00 AM - 9:05 AM	THE SUSTAINABILITY OF CANNABIS AND HEMP: ECONOMICS AND LIFE CYCLE ASSESSMENT	ADVANCEMENTS IN QUALITY CONTROL FOR CANNABIS	PANEL DISCUSSION	KEY PEST AND DISEASE THREATS IN INDUSTRIAL HEMP	HOW THE CANNABIS INDUSTRY GETS INVOLVED WITH CANNABIS RESEARCH
9:05 AM - 9:30 AM	THE GREENHOUSE GAS EMISSIONS OF GROWING CANNABIS INDOORS - presented by HAILEY SUMMERS, M.ENG	REGULATION OF CANNABIS CONTAMINANTS IN THE U.S.: INCONSISTENCIES IN LIMITS, LACK OF RELEVANCY TO AGRICULTURE, AND NEED FOR CENTRALIZED OVERSIGHT - presented by MAXWELL LEUNG, PHD	THE IMPACT OF LACK OF STANDARDS OF CANNABIS LABELLING AND DOSING ON RESEARCH AND CONSUMPTION - moderated by JOANNA ZEIGER, PHD	THE IMPORTANT PLANT PATHOGENS AFFECTING CANNABIS SATIVA – EPIDEMIOLOGY AND MANAGEMENT - presented by ZAMIR PUNJA, PHD	HOW THE CANNABIS INDUSTRY GETS INVOLVED IN CANNABIS RESEARCH - presented by MATTHEW ELMES, PHD
9:30 AM - 9:55 AM	LIFE CYCLE ASSESSMENT OF GREENHOUSE HEMP PRODUCTION AND PRODUCT FORMATION IN SOUTHERN COLORADO - presented by JONAH M. GREENE, MS	A NEW RAPID, SIMPLE, AND EFFICIENT EXTRACTION METHOD FOR CANNABINOIDS IN CANNABIS PLANT MATERIAL - presented by ALICIA STELL, PHD		SMALL PEST, BIG PROBLEM: INNOVATIVE STRATEGIES TO MANAGE HEMP RUSSET MITE IN HEMP. - presented by CHRISTOPHER B HAYES, BFA	CHARACTERIZATION OF CANNABIS EMULSION INFUSED BEVERAGES FOR DROPLET SIZE AND ZETA POTENTIAL – AS INDICATORS OF BIO-AVAILABILITY AND SHELF LIFE - presented by VIDUMIN
9:55 AM -10:20 AM	WHOLE FARM AND ENTERPRISE ANALYSIS TOOL FOR EVALUATING HEMP PRODUCTION - presented by CLARK SEAVERT, MS	CANNABIS WATER ACTIVITY TESTING VALIDATION USING A RESISTIVE ELECTROLYTE SENSOR - presented by BRADY CARTER, PHD		IDENTIFYING KEY RESEARCH GAPS TOWARDS DEVELOPMENT OF EFFECTIVE ARTHROPOD PEST MANAGEMENT SYSTEMS IN CANNABIS CROPS - presented by WHITNEY CRANSHAW, PHD	CANNABINOIDS AND WATER: MERGE THE INSOLUBLES - presented by HAROLD HAN, PHD
10:20 AM - 10:40 AM	**BREAK SPONSORED BY**	FRITSCH	**VISIT THE VIRTUAL EXHIBIT HALL**		CannaKeys
	SESSION CHAIR WELCOME ADDRESS				
10:40 AM - 10:45 AM	THE SUSTAINABILITY OF CANNABIS AND HEMP: ECONOMICS AND LIFE CYCLE ASSESSMENT	ADVANCEMENTS IN QUALITY CONTROL FOR CANNABIS	PANEL DISCUSSION	KEY PEST AND DISEASE THREATS IN INDUSTRIAL HEMP	
10:45 AM -11:10 AM	INSIGHTS FROM A LED RETROFITS AND THE INTERACTIVE EFFECTS ON HVAC OPERATION, ENVIRONMENTAL CONDITIONS, AND YIELD - presented by DAN BANKS, BS	REMOTE POTENCY ANALYSIS FOR QUALITY CONTROL OF HEMP DERIVED CANNABINOIDS IN VARIOUS MATRIXES - presented by SHELDON HENDERSON, MBA	THE VARIETIES OF CANNABIS REGULATORY EXPERIENCES: THE INTERSECTION OF STANDARDS, REGULATIONS, AND RESEARCH - moderated by JAHAN MARCU, PHD	THE VECTOR ECOLOGY OF CIRCULIFER TENELLUS AND ITS ASSOCIATION WITH BEET CURLY TOP VIRUS IN HEMP - presented by JUDITH CHIGINSKY, BS	
11:10 AM - 11:35 AM	MEDICAL VS. RECREATIONAL MARIJUANA SALES IN COLORADO DURING COVID-19 PANDEMIC - presented by MONICA HERNANDEZ COMPARAN	LC-MS/MS METHOD WITH ESI AND APCI ION SOURCE FOR ANALYSIS OF PESTICIDES AND MYCOTOXINS IN MEDIUM-CHAIN TRIGLYCERIDE OIL CANNABIS TINCTURES - presented by AVINASH DALMIA, PHD		INFLUENCE OF HEMP CULTIVARS ON CANNABIS APHID REPRODUCTION AND DEVELOPMENT - presented by ERIKA PEIRCE, BA.SC	
11:35 AM -12:00 PM		IMPROVING DATA QUALITY AND SAMPLE TURN AROUND TIME WITH AN FULLY AUTOMATED PESTICIDE WORKFLOW SOLUTION - presented by TOBY ASTILL, PHD		THE CANNABIS APHID (PHORODON CANNABIS PASSERINI): A NEWLY DESCRIBED VECTOR OF POTATO VIRUS - presented by WILLIAM JACOB PITT, BS	
12:00 PM - 1:30 PM	**BREAK SPONSORED BY**	FRITSCH	**VISIT THE VIRTUAL EXHIBIT HALL**		CannaKeys
	SESSION CHAIR WELCOME ADDRESS				
1:30 PM - 1:35 PM	PANEL DISCUSSION	SENSORY FUNCTIONAL CHANGES WITH ACUTE MARIJUANA USE: VISUAL, OLFACTORY AND AUDITORY	PANEL DISCUSSION	KEY PEST AND DISEASE THREATS IN INDUSTRIAL HEMP	
1:35 PM -2:00 PM	THE SUSTAINABILITY OF CANNABIS AND HEMP: ECONOMICS AND LIFE CYCLE ASSESSMENT - moderated by JASON QUINN, PHD	PRELIMINARY STUDY OLFACTION AND ACUTE CANNABIS USE - presented by DENISE A. VALENTI, PHD	ADDITIVES IN CANNABIS PRODUCTS - moderated by STEPHEN GOLDMAN, MS	GALLING AND REPRODUCTION OF THE SOUTHERN ROOT-KNOT NEMATODE, MELOIDOGYNE INCOGNITA, ON HEMP (CANNABIS SATIVA) CULTIVARS - presented by ERNEST C. BERNARD, PHD	
2:00 PM - 2:25 PM		RETINAL DYSFUNCTION WITH ACUTE CANNABIS USE - presented by DENISE A. VALENTI, PHD		CHALLENGES OF MANAGING FIRE ANTS IN SOUTHERN HEMP - presented by KATELYN KESHEIMER, PHD	
2:25 PM - 2:50 PM				CONTROLLING ARTHROPODS PRESENT IN HEMP IN EASTERN OREGON presented by SILVIA RONDON	
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HERBARIUM OF ICR, CSU-PUEBLO
Scientific Name : Cannabis sativa L.
Variety Name : Yuma Crossbow
Location : CSU-Pueblo
Desc : High CBD contents
Collector : EunSoo Kim
Collection Date : Oct 12, 2020 No :

TUESDAY, AUGUST 3, 2021

9:00 AM – 10:20 AM

Opening Plenary Keynote - Short & Long-Term Consequences of Medical & Legal Cannabis
Chair: Chad Kinney | Presenter: Dr. Marilyn Huestis
Sponsored by PIC -SOLUTION

Some form of medical cannabis is legalized in almost all US states, and legalized adult use of cannabis for recreational purposes is approved in at least 16 states and the District of Columbia. These changes in public opinion and policy have both short and long-term positive and negative consequences. Detailed discussions of these topics will occur over the next three days of the ICR 2021 Cannabis Conference "Exploring Cannabis Research Frontiers." The potential of cannabinoid pharmacotherapies for numerous indications is great due to the unique and diverse mechanisms of action of Δ9-tetrahydrocannabinol (THC), cannabidiol (CBD), cannabigerol (CBG) and the more than 100 other cannabinoids in the cannabis plant. Few pharmacological data are available for most of these cannabinoids and for the hundreds of other chemicals in the complex cannabis species. We will briefly explore some potential pharmacotherapies and what needs to occur next to advance the field of medical cannabis. The highly conserved endogenous cannabinoid neurotransmitter system plays a critical role in important survival functions, such as hunger, reproduction, body temperature, movement, memory and executive function, as well as attempting to maintain homeostasis. Perturbation of this neurotransmitter system with excess amounts of exogenous cannabinoids affect operation of complex equipment and most importantly, maturation of the developing brain. In fetal, infant, child and adolescent brains, the endogenous cannabinoid neurotransmitter system is negatively affected by cannabis exposure in utero, during breastfeeding, from secondhand cannabis smoke, accidental exposure to attractive food products and cannabis self-administration. Introduction of these positive and negative short and long-term consequences of cannabis intake will hopefully challenge your thinking for the many excellent oral and poster presentations to come.

10:40 AM - 12:00 PM

Expanding Landscape of Cannabis Research at the CU Anschutz Medical Campus: Updates and Discussion of Barriers to Conducting Cannabis Research

Panel Discussion | Chairs: Emily Lindley, Lori Walker

The goal of this panel is to provide attendees with the opportunity to learn more about the high-quality scientific cannabis research being conducted on the CU Anschutz Medical Campus. Research on our campus ranges from basic science to observational human studies and randomized clinical trials of cannabis products. Panelists will cover a range of topics, including the latest evidence on cannabis impaired driving, the influence of the gut microbiome on the metabolism of cannabinoids, and new clinical trials of cannabinoids for chronic pain, opioid reduction, and autism. Panelists will also discuss the benefits and limitations of using observational and clinical trial approaches in cannabis research, and the challenges associated with conducting cannabis research.

CDOT, CDPHE and Oregon Partners Discuss What We Know and Don't Know About Cannabis and Public Health
Panel Discussion | Chairs: Sam Cole, Sam Aspnes

Adult-use cannabis has been legal in Colorado and Oregon for more than half a decade. During that time, public agencies and advocacy groups have conducted a great deal of research and engagement regarding how to minimize the negative impacts on public health. While cannabis has contributed to economic opportunities for many communities, we also know that impaired driving has proven dangerous and persistent. Join public health experts and traffic safety communicators in a lively panel examining the research, data, and personal stories that illustrate the impact of the issue.

TUESDAY, AUGUST 3, 2021

10:45 AM – 11:10 AM

Cannabis Research at the National Institute on Drug Abuse
Oral Presentation | Author: Heather Kimmel | Chair: Ruth Charbonneau

While cannabis 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 cannabis use has become more permissive, while proliferating cannabis dispensaries for medical or recreational use are providing novel methods and formulations for consuming cannabis. 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 cannabis 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 cannabis 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 cannabis-derived compounds for pain and addiction. This presentation will provide an update on the findings from cannabis policy research currently underway at NIDA described at previous ICR meetings, as well as information on available cannabis research opportunities in the context of overall NIDA priorities.

Effects of Cannabis and CBD on Brain and Plasma Neurotransmitters in Mice
Oral Presentation | Authors: Nichole Reisdorph, Katrina Doenges, Cassandra Levens, Jon Manke, Michael Armstrong, Kevin Quinn, Rick Reisdorph, Kristine Kuhn | Chair: Amy Uhernik

While cannabis 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 cannabis use has become more permissive, while proliferating cannabis dispensaries for medical or recreational use are providing novel methods and formulations for consuming cannabis. 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 cannabis 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 cannabis 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 cannabis-derived compounds for pain and addiction. This presentation will provide an update on the findings from cannabis policy research currently underway at NIDA described at previous ICR meetings, as well as information on available cannabis research opportunities in the context of overall NIDA priorities.

Development of a Cannabis Harm Reduction Course for Land Grant University Students
Oral Presentation | Authors: Abigail Wiegand, Jennifer Perry, Robson Machado | Chair: Ruth Charbonneau

Recreational marijuana has been increasingly legalized across the United States. Maine legalized recreational cannabis for users 21 years of age or older in 2016 and legal sales began in 2020. Despite this legislation, cannabis is banned on the University of Maine campus due to it remaining a federally illicit drug. Currently, students who are found in violation of the UMaine alcohol and drug policies are required to take a harm-reduction course that primarily focuses on alcohol. These contradictions confuse consumers and university employees alike. Cannabis is a vastly different drug from alcohol, and it best serves our community to provide specific relevant information as it becomes available with increasing research. A 1-hour cannabis harm-reduction course was designed using evidence-based harm-reduction techniques and current cannabis research. It was delivered to six undergraduate UMaine student participants, who then completed an online self-assessment. Upon completion of this study, the course will be officially implemented for use by the UMaine Student Wellness Resource Center as part of the sanctioned requirements for those who violate the cannabis policy. The results demonstrate the efficacy and relevance of the course's implementation at UMaine, according to the participants' reported attitudes and cannabis use habits. All participants reported feeling very confident in making an informed decision about using cannabis increased after receiving the course, and three reported an increase in confidence–a key goal of harm reduction. Half of the participants reported increases in cannabis use during college and/or the COVID-19 pandemic, indicating a potential increase in policy violations or other adverse outcomes. One-third of the participants reported consuming cannabis daily, while others were occasional users or abstinent, but no one had a medical marijuana prescription. Each participant perceived cannabis as having both benefits and adverse effects. Protecting cannabis consumers is marked by regulation and research gaps due to the shifting legal status of marijuana. Proactive, systematic policies and programs are recommended for effective harm reduction and to realistically confront the reality of marijuana consumption in the US. Courses like the product of this research are vital for circulating reliable information about marijuana to consumers.

Minor Cannabinoids and Neuroinflammation: a New Approach to Treatments for Neurodegenerative Diseases
Oral Presentation | Author: Duncan I. Mackie, Tyrell Towle | Chair: Duncan I. Mackie

The first recorded use of cannabis dates to 2700 B.C. Since then, researchers have identified >120 unique cannabinoids. Cannabinoids function through their interaction with G protein coupled receptors (GPCRs). MedPharm Research has a longstanding interest in the activity of the cannabinoids that are produced within C. sativa for the treatment of neurological diseases such as Alzheimer's disease. The purpose of this research project was to further develop methods of isolation to purify these unique cannabinoids and characterize the effects of cannabinoids and cannabinoid mixtures isolated from different strains of C. sativa on microglia activation states.
Microglia are macrophages located in the central nervous system (CNS) and are the main immune defense in the CNS. During neurodegenerative disorders microglia adopt the M1 activation state and secrete inflammatory factors like tumor necrosis factor-**α** (TNF-**α**), interleukin-1**β** (IL-1**β**), and IL-6. This abundance of inflammatory signaling contributes to the neuronal damage observed in Alzheimer's disease. To resolve the pro-inflammatory condition, microglia switch to the M2 activation state and inhibit the inflammatory response through the production of anti-inflammatory and neurotrophic factors, including IL-10, brain-derived neurotrophic factor (BDNF) and glial cell-derived neurotrophic factor (GDNF). Interestingly, the cannabinoid receptor 2 (CB2R) is a GPCR expressed in microglia that modulates microglial activation states. Our study focused on the isolation of minor cannabinoids and their ability to affect the different activation states of microglia. We performed pharmacological and mechanistic characterization of minor phytocannabinoid species in human microglia utilizing several biochemical techniques such as MTT, ELISAs, and NanoBiT protein: protein interaction assay. Next, we are investigating the effects on cultured microglia exposed to lipopolysaccharide (LPS) plus interferon **γ** (IFN**γ**) to induce microglial M1 to M2-activation transition. Treatment with cannabis derived phytocannabinoids were tested for the ability to attenuate the activation of microglia by shifting M1 to M2 activation states through the CB2 receptor and reducing microglial inflammatory signaling. These findings are of great significance for treatment modalities of neurodegenerative diseases with an inflammation component. Ultimately, providing the mechanistic basis for the development of cannabis derived therapeutics for the treatment of neurological diseases with an inflammatory component.

TUESDAY, AUGUST 3, 2021

11:35 AM – 12:00 PM

CBD Extract Differentially Modulates the Stress-evoked Brain Serotonin and Peripheral Inflammatory Responses in Male Versus Female Rats

Oral Presentation | Author: Shelby Hopkins, Monika Fleshner,, Tel Kelley, Rachel Roller, Robert S. Thompson, Dorothy Colagiovanni, Jonathan Noe | Chair: Amy Uhernik, Jordan Tishler

Olive-Harvey College and the Community College of Denver faculty and staff, along with industry partners, will discuss the unique role community colleges play in responding to the cannabis industry's need for an appropriately skilled workforce. Postsecondary programs offering certificates and degrees can help professionalize the cannabis industry and provide additional legitimacy and quality measures for industry employment.

Orthopaedic Patient Perspectives on Medical Cannabis: a Survey of Over 2500 Patients

Oral Presentation | Author: Clay Townsend, Stephen Stache, Saloni Sharma, David S. Stolzenberg, Malathy Srinivasan, MD, Ari Greis, Asif M. Ilyas | Chair: Ruth Charbonneau

Background - Nationwide perspectives of cannabis have changed dramatically over recent decades, however the perception and acceptance of medical cannabis (MC) by the general public remains poorly understood. The purpose of this study is to assess current orthopaedic patient perspectives of MC, and to investigate factors that may represent barriers to patient utilization of MC.

Methods
From October 2020 to January 2021, all patients presenting for an office visit with one of thirteen musculoskeletal physicians at a metropolitan academic institution across New Jersey and Pennsylvania were asked to participate in this study. Patients completed a survey that was created by the investigators regarding patient opinions of MC.

Results & Discussion
A total of 2,547 orthopaedic patients completed the survey. One in ten patients currently used MC for a medical condition. Of the patients not currently using MC, most (81.6%) would consider using MC for a chronic pain condition. Cost was the most commonly selected barrier to using MC at 50.3%, and 71.4% believed the cost to be either expensive or not affordable. One-quarter (26.2%) of patients selected social stigma as a barrier for use. Most (90.6%) were aware of the legality of MC in their state, and most (89.3%) believed MC should be legal throughout the U.S. Most agreed that MC is safe for use with orthopaedic conditions (75.2%) and are safer than opioids (77.1%). Older patients were significantly less likely to believe MC is safe, or that MC is safer than opioids.

Conclusion
The majority of orthopaedic patients would consider using MC for chronic pain, or for other orthopaedic conditions. Most were aware of the legal status of MC in their state, and 9 in 10 believed MC should be legal throughout the U.S. General public knowledge, cost, and social stigma remain barriers for orthopaedic patient utilization of MC.

1:30 PM – 2:50 PM

Seed to Success: Community Colleges Role in Cannabis Workforce Development and Industry Partnerships

Panel Discussion | Chairs: Amanda Gettes, MPA, Ruthanne Orihuela, MA

Olive-Harvey College and the Community College of Denver faculty and staff, along with industry partners, will discuss the unique role community colleges play in responding to the cannabis industry's need for an appropriately skilled workforce. Postsecondary programs offering certificates and degrees can help professionalize the cannabis industry and provide additional legitimacy and quality measures for industry employment.

Clinician Attitudes, Training, and Beliefs About Cannabis: an Interprofessional Assessment
Oral Presentation | Author: Kelsey Smith, Erin L. Kelly, Rebecca Ashare, Gregory Garber, Emily Hajjar, Brooke Worster
Chair:Ruth Charbonneau

Interest in and use of cannabis among adult patients continues to grow in popularity across the United States. The majority of states have a patchwork of laws enabling the use of cannabis as an adjuvant therapeutic option, but neither public nor commercial insurers cover the costs of anything associated with medical cannabis. The Federal restrictions on cannabis in addition to its FDA Schedule 1 designation make clinical research discouragingly burdensome, which in turn puts medical professionals at odds with their inclination to provide evidence-based care. Many patients could potentially derive meaningful benefits from cannabis; however, clinicians rarely engage in conversations around its use with patients, leaving them exposed to more risks and the intolerable side effects of cannabis. The underdeveloped nature of clinical training on cannabis leaves medical providers unprepared to answer patient questions or prescribe medical cannabis. This study used a brief online survey to assess attitudes, training, and experiences regarding medical cannabis and certifying patients to use medical cannabis among 344 clinicians in the state of Pennsylvania. As is consistent with prior literature, this study found a significant need for additional clinical training for all clinicians regarding medical cannabis. Just over half of participants reported completing any type of formal training for medical cannabis use, with less than 8% reporting this training present in their residency, fellowship, or graduate/professional schooling. Using independent t-tests, certifying physicians were significantly more comfortable than non-certifying clinicians (pharmacists, nurse practitioners, and physician assistants) with patient use of medical cannabis, saw fewer risks, more benefits, and felt better prepared to discuss its use with vulnerable populations (range of Cohen's d= .62-1.29). All clinicians noted significant limitations to their understanding of how medical cannabis can affect patients and many indicated a desire for more research and training to fill in gaps in their knowledge. This study adds to current knowledge by demonstrating that while new physicians do not feel prepared to educate their patients on cannabis, neither do pharmacists, nurses practitioners, or physician assistants. Improving the quality of medical cannabis research and training will further improve clinician comfort discussing and preparing patients to use it.

The Effects of Medicinal Cannabis Use on Seizures in Adults With Medically Refractory Epilepsy
Oral Presentation | Author: Barbara A Brett-Green | Chairs: Amy Uhernik, Jordan Tishler

For approximately 20 - 30% of people with epilepsy, seizures are not well-controlled by anti-epileptic drugs. This condition, called medically refractory epilepsy (MRE) is associated with increased morbidity and mortality, and has a substantial impact on a person's quality of life. This gap in treatment has led people with MRE to seek alternative treatments, such as cannabinoid-based medications, specifically, cannabidiol (CBD), which has been shown in several randomized control trials to decrease seizure frequency. Although video EEG is the standard approach used to detect seizures, it cannot be used in ambulatory or real-life settings. Alternatively, seizure diaries are used to document seizure frequency, however they are notoriously unreliable. Continuous monitoring of non-EEG physiological signals, using a device such as the E4 made by Empatica, has the potential to improve our understanding of epilepsy and seizures. Accordingly, this preliminary observational study, funded by the ICR, examined the effects of medicinal cannabis use on seizure frequency in ten adults with MRE who had elected to use cannabis as an adjunctive treatment. Participants wore a wireless physiological recording device that measured electrodermal activity, blood pulse volume, motion/acceleration, and temperature daily for six months – one month prior to adding CBD to their treatment regime and for five months after. This physiological data was subsequently processed by Empatica to produce seizure reports. A two-tailed correlated samples t-test on seizure rates before and after CBD initiation showed a statistically significant increase in the seizure rate $t(9) = -2.65$, $p = 0.026$. This result contrasts with previously reported behavioral data from this study which showed statistically significant improvements in quality of life and anxiety as well as a statistically significant decrease in adverse events. One possible explanation for the seizure rate results and their lack of correspondence with the behavioral results may have to do with the cyclical nature of seizures, suggesting that the time-frame for recording seizures before and after CBD may need to be equivalent and may possibly need to cover identical months in order to more accurately reflect the effects of CBD on seizures. Alternative approaches to analyzing seizure data will be discussed.

TUESDAY, AUGUST 3, 2021

1:35 PM – 2:00 PM

Marijuana for Morning Sickness: a Psychosocial, Clinical and Legal Analysis and Discussion
Oral Presentation | Author: Karli Swensoin | Chair: Karli Swenson

Each year, millions of women in America suffer from morning sickness, or pregnancy-induced nausea and vomiting. Morning sickness can be debilitating, so women seek a treatment that they feel is safe. Many women fear the risk of potential birth defects caused by pharmaceuticals and instead self-medicate with marijuana, which they consider to be a safer, more natural remedy. Cannabis consumption among pregnant women has increased along with legality and availability of marijuana and its components, tetrahydrocannabinol (THC) and cannabidiol (CBD). However, research regarding consumption of cannabis and its components during pregnancy is limited. When women are searching for an alleviant for their nausea symptoms, they are obtaining information from physicians, pharmacists, peers and marijuana dispensary professionals (budtenders). However, no group has adequate and complete information for them regarding the safety and efficacy of marijuana for morning sickness. Physicians hands are tied as the literature is lacking physiologically relevant information, and legal restrictions bars most researchers from conducting medically relevant studies. Budtenders commonly encourage women to consume their products for morning sickness, though they receive little to no training on the pharmacokinetics of marijuana, physiology, drug interactions nor dosing. Despite the legality of consumption increasing across the United States, individual states have specific laws regarding required drug screening during labor and delivery, which often legally mandate a referral to Child Protective Services (CPS) upon a positive screen. With the fear of CPS involvement, many women fear disclosing their consumption to their medical provider, leading to an indefinite cycle of misinformation. With the end goal to improve communication within and between professions, and to increase patient, provider, and budtender education, we discuss the current gaps in knowledge and explain the resources that women commonly access when searching for information regarding the safety of marijuana consumption.

Beliefs and Attitudes Regarding Prenatal Marijuana Use: Perspectives of Pregnant Women Who Report Use
Oral Presentation | Authors: Judy Chang, Jill A Tarr, Cynthia Holland, Natacha M. De Genna, Gale Richardson, Keri Rodriguez, Jeanelle Sheeder, Kevin Kraemer, Doris Rubio, Marian Jarlenski, Robert Arnold | Chair: Karli Swenson

Background: With the increasingly permissive legal and social environments regarding marijuana, it is important to understand prenatal marijuana use from the perspective of women who use marijuana. Our objective was to qualitatively describe the marijuana use experiences, beliefs, and attitudes of women who used marijuana during pregnancy.

Methods: We conducted semi-structured interviews with pregnant women who had either reported current marijuana use or had urine testing positive for marijuana. Interviews were transcribed verbatim and analyzed for patterns and themes.

Results: Twenty-five pregnant women who used marijuana during their pregnancies participated in our study interviews. Main themes that emerged from the interviews were that women: 1) reported higher amounts of marijuana use prior to pregnancy and attempted to reduce their use once they realized they were pregnant; 2) used marijuana to help with nausea and appetite changes during pregnancy or to improve mood; 3) described marijuana as "natural" and "safe" compared to other substances such as alcohol, tobacco, other recreational drugs, and prescribed medications; 4) had conflicting opinions regarding whether marijuana was addictive; and 5) were uncertain but had some concerns regarding potential risks of prenatal marijuana use.

Conclusion: Pregnant women who used marijuana in pregnancy held contradictory beliefs about continued use; they reported trying to reduce usage and were worried about potential risks, but also felt that marijuana is more natural and safer than other substances, including prescribed medicines. These findings have implications for how practitioners address prenatal marijuana use and highlight the need for further research on developmental outcomes.

Pesticide Contamination Toxicity in Cannabis: Implications to Medical Use in Neurological Diseases
Oral Presentation | Authors: Dorina Pinkhasova, Laura E. Jameson, Kendra D. Conrow, Haleigh Boulanger, Michael P. Simeone, Allan Davis, Thomas C. Wiegers, Carolyn Mattingly, Maxwell Leung | Chairs: Amy Uhernik, Jordan Tishler

Cannabis can now be recommended by physicians for therapeutic use in various medical conditions in 34 states and Washington, D.C. With wider acceptance for medical use, more attention is given to toxicology and the human health risk of cannabis contaminants. Yet, there is currently no U.S. Environmental Protection Agency (EPA) guideline on pesticide applications in cannabis due to its status as a Schedule I substance. Additionally, cannabis is not being regulated by the U.S. Food and Drug Administration as a pharmaceutical. In this study, we examined medical cannabis as a potential route of pesticide exposure to patients with neurological diseases. We compared the qualifying conditions for medical use and pesticide testing requirements of cannabis in 33 states and Washington, D.C. Movement disorders were the most common neurological category of qualifying conditions, including epilepsy, certain symptoms of multiple sclerosis, Parkinson's Disease, and any cause of symptoms leading to seizures or spasticity. According to the public health reports in 20 states, more than 100,000 patients fell into this category, with over 20,000 patients reporting seizures or epilepsy as their qualifying condition. When it came to pesticide regulation, six states imposed the strictest U.S. EPA tolerances (i.e. maximum residue levels) for food commodities on up to 400 pesticidal active ingredients in cannabis, while pesticide testing was optional in three states. Dimethomorph showed the largest variation in action levels, ranging from 0.1 to 60 ppm in 5 states. We evaluated the potential connections between insecticides, cannabinoids, and seizure using the Comparative Toxicogenomics Database, a biomedical text-mining tool that captures the mechanistic connections between environmental exposure and adverse health outcomes. Twenty-two insecticides, two cannabinoids, and 63 genes were associated with 674 computationally generated chemical-gene-phenotype-disease (CGPD) tetramer constructs. Notable functional clusters included oxidation-reduction process (183 CGPD-tetramers), synaptic signaling pathways (151), and neuropeptide hormone activity (46). Cholinergic, dopaminergic, and retrograde endocannabinoid signaling pathways were linked to 10 genetic variants of epilepsy patients. Further research is needed to assess human health risk of cannabinoids and pesticides in support of a national standard for cannabis pesticide regulation.

TUESDAY, AUGUST 3, 2021

2:00 PM – 2:25 PM

What Cannabis Related Data Is Reported in the FDA Faers Database
Oral Presentation | Author: Teresa A. Simon | Chair: Ruth Charbonneau

Background: Recent reports on the consumption of delta-8 Tetrahydrocannabinol (THC) have led to a qualmish riddle. While delta-8 THC is an isomer of delta-9 THC that some believe is legal to synthesize under the hemp farm bill, the U.S. Food and Drug Administration (FDA) and Drug Enforcement Agency (DEA) websites lists delta-8 THC as illegal. Despite this conundrum and a lack of safety data, delta-8 THC products exploded into the market, with no age restrictions on purchasing this intoxicating compound derived from hemp outside of licensed operators. We explored the FDA Adverse Event Reporting System (FAERS), a US database originally designed to support the FDA's post marketing safety surveillance program for approved drugs and biologics. It has evolved to much broader public health utilization, as Health Care Professionals (HCP) and consumers can report adverse events/side effects from any medication or product.
Methods: On March 11, 2021, a FAERS database search was conducted with Product names (aka search terms): delta 8; delta 9 and cannabis sativa (CS). We used proportional reporting ratio (PRR)to compare the proportion of spontaneous reports for a given drug that are linked to a specific adverse outcome, compared to the same values for the same event pairs for other cannabis derived products.
Results/Conclusion: FAERS Data as of December 31, 2020 shows 33 cases listing delta 9; 580 CS and 135 case reports listing delta-8 THC as "suspect product active ingredient" (SUSPECT). We identified an almost doubling of thoracic and respiratory adverse events for delta-8 THC compared to the same events in CS.

Ages ranged from 1 month to > 85 years. Most of the cases were 18 to 64 years and more often males. The most common reactions by SUSPECT:

- Delta 9: toxicity to various agents (45%) followed by medication error (33%) and drug abuse (18%)
- Cannabis sativa: toxicity to various agents (14%); accidental overdose (14%); feeling abnormal (13%)
- Delta 8 THC: dyspnea (22%) followed by respiratory disorder (13%) and cough (11%).

Limitations: These results suggest a potentially different safety profile for delta-8 THC, which has to be validated with further research.

2:25 PM – 2:50 PM

CBD Use is Associated With Illicit Drug Use and Prenatal Cannabis Use
Oral Presentation | Authors: Natacha M. De Genna, Stefanie Kennon-McGill, Gale Richardson, Judy Chang | Chair: Karli Swenson

Although the FDA and American College of Obstetricians and Gynecologists strongly advise against the use of cannabidiol (CBD) during pregnancy, CBD is widely available and marketed to pregnant women. The effects of CBD on human embryonic and fetal development are unknown, but preclinical studies indicate that there may be teratogenic effects. More data are needed on the prevalence and correlates of CBD use in perinatal populations. This study includes survey data from a mixed methods study of cannabis and tobacco use in younger pregnant women (N=103: 64% Black, 25% White, 10% Biracial; 1% Asian) ages 14-21 (M age = 19.7, SD = 1.7 years). Eighteen percent of the sample reported lifetime CBD use (9% smoked, 4% edibles, 4% vaped, 2% topical). However, only 2% used CBD during pregnancy. Age and race were related to lifetime CBD use. Lifetime users were older (M = 20.5 years, SD = 1.3) than non-users (M = 19.7 years, SD = 1.8, $t = 2.21$, $p < .03$). Fewer Black participants (11% vs 39% of non-Black participants) had ever used CBD ($\chi^2 = 10.6$, $p < .001$). Lifetime CBD use was associated with pre-pregnancy cigarette ($p < .02$), JUUL ($p < .007$), alcohol ($p < .004$), and cannabis use ($p < .02$), including blunts, bowls, bongs, joints, vaping, and edibles. Participants with lifetime CBD use were more likely to have also used illicit drugs ($\chi^2 = 13.95$, $p < .001$), such as non-medical use of prescription drugs, hallucinogens, cocaine, and codeine syrup, compared to participants who had not previously used CBD. Lifetime CBD use was also associated with prenatal cannabis use (30% vs 14%, $\chi^2 = 5.88$, $p < .02$). Women with lifetime CBD use were more likely to smoke bowls (50% vs 16%, $\chi^2 = 5.53$, $p < .019$) and joints (57% vs 16%, $\chi^2 = 7.24$, $p < .007$) while pregnant. Lifetime CBD use was not associated with depressive symptoms, stress, social support, pregnancy intendedness, or severity of nausea and vomiting during pregnancy. These preliminary results suggest that lifetime CBD use may be a risk marker for prenatal cannabis and other illicit substance use in this population.

TUESDAY, AUGUST 3, 2021

2:25 PM – 2:50 PM

Medical Cannabis Use Reduces Opioid Prescriptions in Patients With Chronic Back Pain

Oral Presentation | Author: Bryan Renslo, Ari Greis, M. Ilyas, Clay Townsend | Chair: Ruth Charbonneau

Background: Opioids are routinely prescribed for the treatment of chronic pain despite the opioid epidemic. Medical cannabis (MC) has shown efficacy in treating chronic pain, but there is limited evidence to show that MC can effect opioid use. This study investigates whether the use of MC in patients with chronic musculoskeletal noncancer back pain can reduce opioid usage.

Methods: Data regarding filled opioid prescriptions was gathered from a Prescription Drug Monitoring Program (PDMP) system for patients with a diagnosis of chronic musculoskeletal noncancer back pain who were certified for MC access between February 2018 through July 2019. Average morphine milligram equivalents (MME) per day of opioid prescriptions filled within the six months prior to access to MC was compared to that the six months after obtaining access to MC. Results and Discussion: There was a significant decrease in overall average MME/day after MC prescription from 15.1 to 11.0 (n=186, $p<0.01$). The percentage of patients who dropped to 0 MME/day was 38.7%. Sub-analysis of patients who started at less than 15 MME/day and greater than 15 MME/day show significant decreases from 3.5 to 2.1 (n=134, $p<0.01$) and 44.9 and 33.9 (n=52, $p<0.01$), respectively. Percentage of patients who dropped to 0 compared to baseline at 3-, 6-, and 9-month time points post MC certification. Patients who used only a single administration route showed a significant decrease (n=[illegible], $p=0.054$), while patients who used two or more routes showed significant decrease (n=[illegible], $p<0.01$).

Conclusion: Access to MC reduced opioid use for patients with chronic back pain. Patients with lower baseline opioid use have a better chance of stopping opioid use altogether. Pain and daily functional scores improved compared to baseline. The use of multiple routes of administration of MC simultaneously is more strongly associated with reduced opioid utilization.

3:10 PM – 4:30 PM

Community College Paving the Way for Cannabis Research in Chicago

Panel Discussion | Chair: Amanda Gettes, MPA

Olive-Harvey College, a community college on the southeast side of Chicago, is building a greenhouse, extraction and infusion lab and partnership with a 4 year institution to provide CBD oil for research purposes. OHC is the only community college in Chicago offering cannabis credit education with a mission of educating the future workforce, activists, thought leaders and entrepreneurs in the Illinois cannabis industry and empower individuals who have been disproportionately affected by the war on drugs through restorative justice.

3:15 PM – 3:40 PM

Genetic Basis for Production of Thcv, a Rare and Potentially Medically Valuable Cannabinoid

Oral Presentation | Authors: Alisha Holloway, Erica Bakker | Chair: Sanghyuck Park

Tetrahydrocannabivarin (THCV), a rare cannabinoid, has medical potential as a neuroprotectant, anti-inflammatory, and as a therapeutic to improve glycemic control in type 2 diabetic patients. THCV is a homologue of THC that differs only in the length of the alkyl side chain (3C vs 5C, respectively). Determination of alkyl side chain length depends on differences in early precursor molecules, yet the same downstream cannabinoid synthases are utilized for synthesis of final products. While cannabis plants can produce up to 30% of their dry weight in cannabinoids, very few produce more than 1-2% THCV. Additionally, THCV producing plants have not been improved for commercial cultivation. The goal of our work was to identify genes involved in the pathway for production of propyl (3C) cannabinoids, and to develop genetic markers for breeding improved high THCV cultivars.

We assessed cannabinoid content via HPLC in several hundred greenhouse-grown cannabis plants from 67 seed lots. We genotyped all plants with a proprietary 55k SNP Illumina BeadArray and performed nested association mapping to identify genetic markers of propyl cannabinoid production.

We identified two genetic markers flanking the KR/FabG1 gene in the cannabis genome which are significantly associated with THCV content and were validated in additional THCV-producing germplasm. Compared to the reference genome, genotypes with alternate alleles at KR-associated markers predict production of THCV. However, genotype at KR-associated markers does not completely explain variation in THCV production; some plants with heterozygous genotypes at THCV markers produced higher quantities of THCV and higher ratios of THCV:THC than plants with homozygous alternate genotypes. This occurred within seed lots, suggesting that additional modifier genes impact THCV content.

The KR gene is a strong candidate for influencing THCV production. In Arabidopsis, this enzyme is integral for fatty acid biosynthesis cycles that iteratively elongate alkyl-chains. In Cannabis, plastid fatty acid biosynthesis forms precursor molecules with the final alkyl chain length. Thus, we expect that cannabis plants with reduced expression of KR are less able to make longer alkyl chain cannabinoids, resulting in relatively more precursor molecules with the shorter propyl side chain found in THCV compared to the pentyl chain of THC.

TUESDAY, AUGUST 3, 2021

2:25 PM – 2:50 PM

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Oral Presentation | Author: Bryan Renslo, Ari Greis, M. Ilyas, Clay Townsend | Chair: Ruth Charbonneau

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Conclusion: Access to MC reduced opioid use for patients with chronic back pain. Patients with lower baseline opioid use have a better chance of stopping opioid use altogether. Pain and daily functional scores improved compared to baseline. The use of multiple routes of administration of MC simultaneously is more strongly associated with reduced opioid utilization.

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Successfully Navigating NIH Peer Review: NCCIH Opportunities for Scientists Researching Cannabis
Panel Discussion | Chair: Patrick Still, PhD | Co-Chair: Inna Belfer

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Investigating the Effects of Cbd During Pregnancy on Mouse Offspring Behavior and the Brain Epigenome

Oral Presentation | Authors: Nicole M Wanner, Mathia Colwell, Amanda Rezabek, Christopher Faulk | Chair: Karli Swenson,

The use of the non-psychoactive cannabinoid cannabidiol (CBD) has exploded in recent years, but its effects during fetal development and early life are understudied. Previous work by others indicates that CBD possesses anxiolytic, antiemetic, anti-inflammatory, neuroprotective, and other beneficial effects during direct exposure in adults. However, studies of prenatal exposure to Δ^9-tetrahydrocannabinol (THC) have identified detrimental effects on behavior and neurotransmitter regulation, raising concerns about similar outcomes for CBD. Epigenetic perturbation is a crucial mechanism mediating developmental exposure outcomes; disruption of DNA methylation resetting during embryogenesis can impart phenotypic changes that persist long after exposure has ceased. Brain epigenome disruptions have also been found in prenatal THC exposure and human neuropsychiatric diseases such as schizophrenia and autism. To better understand the consequences of developmental CBD exposure, female mice were exposed to 20 mg/kg CBD during pregnancy and lactation. Spatial memory, anxiety/compulsivity, and sociability assays were performed on adolescent and adult offspring, and DNA methylation in the cerebral cortex and hippocampus was measured by reduced-representation bisulfite sequencing and pyrosequencing. Twelve-week-old adult offspring displayed sex-specific differences in memory and anxiety behavior, while postnatal day 36-42 adolescent offspring did not exhibit significant changes in anxiety, indicating a potential delayed onset of phenotypic outcomes. Additionally, thousands of differentially methylated loci (DMLs) were identified in the brain regions of adult offspring with functional enrichment for neurogenesis, synaptic function, and neuropsychiatric disease ter These findings represent the first investigation of perinatal CBD's effects on the epigenome and indicate that exposure is associated with mixed age- and sex-dependent behavior outcomes in offspring.

The Effects of Cannabis Consumption on Heart Rate and Rhythm in Post-mi Patients

Oral Presentation | Authors: Lori Walker, Leah Gillet, Cecelia Johnson-Sasso, Brian Miller, Courtney Shakowski, Christine Tompkins
Chair: Ruth Charbonneau

With changing legislation, cannabis use is increasing, especially amongst older individuals. Since the incidence of cardiovascular disease increases dramatically with increasing age, it is increasingly likely that people with cardiovascular disease will be regular cannabis users. While it is well accepted that cannabis use can increase heart rate, the effects on cardiac rate and rhythm in people with cardiovascular disease is poorly understood. Therefore, this study aimed to determine the effects of cannabis consumption on cardiac rate and rhythm in healthy subjects and subjects with ischemic heart disease (IHD). Subjects were fitted with a Zio® monitor and asked to record cannabis use. Using ambulatory cardiac monitoring for up to 14 days, we compared cardiac rate and rhythm profiles for one-hour prior to cannabis use to a four-hour period following use. Thirty-seven control subjects (57% males) and 24 IHD subjects (58% males) completed the study. Additionally, we analyzed 35 reports from non-cannabis using patients with IHD who wore Zio® monitors for standard clinical indications. In controls, HR increased 20 min (4.99 ± 6.7 bpm, $p=0.08$) after use, then declined 4 hours following use (-7.4 ± 7.7, $p<0.001$). Conversely, subjects with IHD showed minimal HR increase (1.6 ± 3.9 bpm) and blunted HR decline (-3.4 ± 5.6 bpm, $p<0.001$). Supraventricular tachycardia (SVT) (29.7% vs. 58.3%; $p=0.04$) and non-sustained ventricular tachycardia (NSVT) (5.6% vs. 47.8%, $p=0.01$) were the most frequently occurring arrhythmias in controls and IHD subjects, respectively. Incidence of SVT decreased as cannabis use increased in both groups. Conversely, NSVT tended to increase with increased use in controls, and was significantly more prevalent in IHD. However, arrhythmia burden did not differ between cannabis users and non-users with IHD. These data suggest that cannabis use is associated only with minimal changes in HR and that these HR trends are blunted in subjects with IHD. No statistically relevant difference was observed in the frequency of arrhythmias between cannabis users and non-users with IHD. These findings highlight our limited knowledge regarding the potential arrhythmic and/or antiarrhythmic effects of cannabis. Further study is necessary to determine the safety of cannabis use in this population.

Cannabis Use in People With Parkinson's Disease: Reported Patterns of Use, Symptomatic Benefits, and Adverse Effects Via Fox Insight

Oral Presentation | Authors: Maureen Leehey, Samantha Holden, Christopher Domen, Stefan Sillau, Ying Liu | Chair: Ruth Charbonneau

Background - People with Parkinson disease (PD) are using cannabis for therapeutic purposes, but there is limited evidence on efficacy and adverse effects, especially regarding dosing and the varying quantities of tetrahydrocannabinol (THC) and cannabidiol (CBD) in products. Thus, many are taking cannabis without medical guidance. Valuable information can be gained by asking about subjective experiences with cannabis in PD. The purpose of this study is to investigate cannabis use patterns among individuals with PD and the frequency and magnitude of reported symptomatic effects.

Methods - An anonymous, 15-question, web-based survey was hosted by the Michael J. Fox Foundation Fox Insight platform. The introduction defined cannabis product types and asked respondents to reference their product labels. Questions focused on use patterns and subjective effects on thirty-six predefined Parkinson disease-related symptoms (rated from -2-markedly worse to +2-markedly better).

Results and Discussion - 1,881 people with PD with cannabis use experience responded (58.5% men; mean age 66.5 years; 50.5% <3 years of PD). 73.0% of respondents reported medicinal, 19.7% both medicinal and recreational, and 7.3% recreational only as the purpose of their cannabis use, however, 31.8% of respondents did not inform their provider of their cannabis use. 1630 (86.7%) of respondents knew the type of cannabis product they took: among them 69.8% took higher CBD and 30.2% higher THC products. Most common use was via oral administration, once daily, and for less than six months duration. Frequent improvements were reported for pain, anxiety, agitation, and sleep (>50% of respondents, mean magnitude 1.28-1.51). Dry mouth, dizziness, and cognitive changes were common adverse effects (20.9-30.8%, mean -1.13 to -1.21). More frequent symptomatic changes of greater magnitude, both beneficial and adverse, were reported with THC versus CBD.

Conclusions - People with PD are using more CBD products, via oral administration, with mild subjective benefits primarily for sleep, pain, and mood sympto Adverse effects were relatively less frequent than benefits and were also of mild magnitude overall. Higher THC products may be higher risk/higher reward for symptomatic effects in PD. This information may allow clinicians to better counsel patients and provide a foundation for future studies.

Trial Registration - Not applicable.

Infant Outcomes Related to Cannabis Exposure During Lactation

Oral Presentation | Author: Alice Ordean | Chair: Karli Swenson

Cannabis is the most commonly used illicit drug during pregnancy and lactation with prevalence rates ranging between 2 and 5%. With legalization of cannabis expanding across North America, women may be falsely reassured about the safety of cannabis use during their reproductive years. These trends lead to growing concerns about the possible effects of maternal cannabis use while breastfeeding. A systemic review of the literature was conducted using electronic databases including Medline, Embase and PsychInfo from their start to July 2018. Keywords included lactation or breastfeeding AND cannabis or marijuana. Articles were limited to original research articles, human studies and English language. Review articles, commentaries, opinions and studies focused on antenatal cannabis exposure and polysubstance use were excluded. Main outcomes consisted of reported infant developmental outcomes. One hundred and seventy-one articles were identified with only two articles meeting inclusion criteria. Based on our systematic review, there is insufficient evidence regarding the risks to infants of exposure to cannabis in breast milk. It is likely that exposure to cannabis during lactation represents a continued risk from in utero exposure since longitudinal studies following prenatally exposed individuals from infancy to early adulthood have documented an association between in utero cannabis exposure and negative long-term neurodevelopmental and behavioral outcomes. Limitations to these findings include controlling for concurrent exposures and other confounders such as a lack of standardized assessments of the amount and timing of cannabis exposure. Evidence-based recommendations for risk reduction include counselling breastfeeding women to abstain or reduce cannabis use in order to decrease the potential short and long-term risks associated with breast milk cannabis exposure.

Impact of Association of Official Analytical Collaboration (AOAC) International for Cannabis Labs & Lab Validation Summary
Oral Presentation | Authors: John Mills, PhD | Chair: Ruth Charbonneau

AOAC approvals benefit the cannabis industry by providing you third party independent validation to authenticate package insert claims and the test kit performance providing confidence and brand protection; methods may have enhanced performance to provide you confidence and brand protection while impacting product safety, integrity and public health. AOAC is a leader in analytical excellence contributing to the advancement of product safety, product integrity, and public health. AOAC has a long history of leveraging the power of many making to strengthen impact to fit for purpose methods through the development of standards methods. Through Cannabis Analytical Science Program (CASP), AOAC influences cannabis science and cannabis safety impacting cannabis science and validation to bring reliable analytical test methods and method validations to ensure safety, science, and protect the industry, consumers, and products. The validation process ensures five main elements are confirmed: matrix study, inclusivity, exclusivity, stability, and robustness in both internal studies and independent studies. Validation methods are publicly accessible. An AOAC method brings you and the industry third party independent validation to authenticate package insert claims, test kit performance to confirm scientific robustness and rigor to provide you confidence, consumer health and safety, and brand protection; methods may have enhanced performance. AOAC methods demonstrate robust and reliable science and expand the cannabis industry.

Obstetric Providers' Responses to Pregnant Patient Disclosures of Marijuana Use
Oral Presentation | Authors: Judy Chang, Cynthia Holland, Jill A Tarr, Doris Rubio, Kevin Kraemer, Keri Rodriguez, Robert Arnold
Chair: Karli Swenson

Background/Objective - The American College of Obstetrics and Gynecology and the American Academy of Pediatrics recommend that all obstetrics care providers advice pregnant people to avoid use of marijuana during pregnancy. Few empiric studies examine how obstetric care providers respond to patient's disclosures of prenatal marijuana use. Our analysis sought to describe obstetrical care providers' counseling approaches in response to patients' disclosures of marijuana use during direct observation of first prenatal visits.

Methods - We audio-recorded patient-provider conversations during first obstetric visits. Audio recordings and verbatim transcripts were reviewed for patient disclosure of past or current marijuana use. Providers' responses to these disclosures were qualitatively analyzed.

Results - Among 468 audio-recorded patient-provider obstetric conversations, 87 patients (19%) disclosed marijuana use during their first obstetric visit. In 24% of these visits, obstetric providers did not respond to marijuana use disclosures and offered no counseling. In 19% of the visits, providers simply asked when the patient had last used marijuana, without offering any additional information or guidance. When providers did respond to positive disclosures only 15% discussed specific risks involved with perinatal marijuana use while 14% used more generic statements discouraging marijuana use in pregnancy that did not address why it was important not to use marijuana during pregnancy. Providers most frequently (25%) used punitive counseling techniques such as mentioning the need to send urine for drug screens and warnings that child and protective services will be involved if the patient or baby tests positive for marijuana at the time of delivery. In less than 1% providers offered referrals to support services or resources such as social work or behavioral health.

Implications: Providers need additional training on information about perinatal marijuana use and communication skills to use when counseling pregnant patients on marijuana.

WEDNESDAY, AUGUST 4, 2021

9:00 AM – 10:20 AM

What Will It Take to Gain Federal Legal Approval to Feed Hemp and Its By-products to Animals?

Panel Discussion | Chair: Hunter Buffington, MNM , BA, Ruth Charbonneau, JD

The Session will begin with an update on the Hemp Feed Coalition's work to gain Federal legal approval for hemp and its by-products to be used as animal feed ingredients. This will include the steps necessary to gain FDA-CVM approval for each by-product including: ingredient homogeneity, contamination concerns, varietal and geographic variations that affect nutritional composition and identified end-use. This session will also discuss current research addressing the safety concerns and need for data collection and clinical feed trials that are necessary to show safety and efficacy of these ingredients for each species; including: intended use, inclusion rates and animal categories. The Presentation will conclude with a panel discussion to answer specific research and regulatory questions presented to the panelists.

9:05 AM – 9:30 AM

Creation of a Spray-dried Cannabinoid Oil-in-water (cow) Nanoemulsion Powder.

Oral Presentation | Authors: Abhinandan Banerjee, Justin Binder, Paul Tucci, Rayan Salama, John Frederick Trant | Chair: Fred Shahbazi Raz

Highly lipophilic phytocannabinoids, such as THC and CBD, are being studied extensively for their anti-inflammatory, analgesic, anti-emetic, and psychoactive properties. Their lipophilicity, however, leads to poor aqueous solubility and reduced bioaccessibility. To overcome these challenges, we have recently formulated fridge-stable COW nanoemulsions by high pressure homogenization, and examined the effect of various physico-chemical stressors on the chemical and colloidal longevity of such syste However, reduced cannabis potency upon prolonged storage of such nanoemulsions under ambient conditions in highly diluted systems make it desirable for us to create alternative formulations which would combine prolonged cannabis potency retention with easy packaging and storage. Spray-dried cannabinoid powders promise to be one such type of formulation. We have, therefore, created a novel spray-dried 'cannabis powder' with high cannabinoid loadings, simultaneously applying a design of experiment approach to optimize the spray-drying parameters and to explore the process parameter space. The resultant powder, obtained using optimized spray-drying process parameters, was full characterized. Colloidal properties of the reconstituted COW nanoemulsions obtained by redispersing the powders in water were measured. Spray-dried COW nanoemulsions are expected to help us in milking this exciting field for beefing up the Canadian strategic advantage in cannabis science.

Real World Dispensary Data for Ibd Patients Using Medical Cannabis

Oral Presentation | Authors: Jami Kinnucan, Arun Swaminath, Maheep Sangha, Joanna S. Zeiger | Chairs: Joanna Zeiger, William Silvers

Cannabis use is common in patients with inflammatory bowel disease (IBD) to mitigate pain and other sympto Patterns of use have not been studied in IBD patients. Patients with a diagnosis of IBD who were certified in New York State for medicinal cannabis dispensed from Columbia Care (NY, NY) from January 2016- March 2020 were studied. The database included age, gender, date of first dispensary visit, number of dispensary visits, duration of visits, whether prescription pain medication was dispensed and reduced between visits, cannabis type(s) used, daily prescribed dosage Δ-9-tetrahydrocannabidiol (THC) and/or cannabidiol (CBD) and route(s) of administration. Products were classified as low THC:CBD , equal THC:CBD, high THC:CBD. ANOVA and t-tests with Bonferroni correction were used to test for mean differences; Bonferroni adjusted chi-squares were used to examine gender differences. Of the 592 patients with a diagnosis of IBD as a qualifying condition for medicinal cannabis 47.3% were female and had an average age of 43.3 years (18-87y), average number of visits of 15 (SD:15.0), mean duration of follow-up of 421 days (SD: 325.1). Female patients were older in age ($p<0.05$), more likely to have co-diagnosis of cancer and chronic pain ($p<0.001$), more likely to have pain medication use at first visit ($p<0.05$), had fewer follow-up visits, and used less cannabinoids than males (both $p<0.05$) with a larger increase in cannabinoids prescribed from first to last visit ($p<0.001$). In all patients, there was an increase in total cannabinoid exposure from first visit to last (mg/day): THC 9.2 to 19.5 mg/day and CBD 7.4 to 9.3 mg/day (both, $p<0.001$). There was a significant reduction in pain medication use. Cannabinoid dosing and routes of administration varied from first to last visit, with vaping and tincture the most common routes used. We observed gender differences related to cannabis use in IBD patients. Daily cannabinoid doses were lower than prior published randomized trials in IBD patients, although there was an increase in daily cannabinoid dose over the study period. Prospective studies are needed to further assess impact on dosage of THC/CBD, impact on symptoms, adverse effects, psychological impact, and quality of life changes.

WEDNESDAY, AUGUST 4, 2021

9:05 AM – 09:30 AM

The Sativa-indica Debate: Potential Differences in the Subjective Response of Cannabis by Strain Classification

Oral Presentation | Authors: Sarah Okey, William Corbin | Chair: Ruth Charbonneau

Background - The quickly emerging U.S. cannabis industry regularly dichotomizes cannabis strains into two distinct classifications: sativas and indicas. However, despite anecdotal reports that sativas are uplifting and indicas are relaxing, there is very little scientific evidence examining these clai Given the discrepancies between dispensary opinion and academic knowledge on the sativa-indica dichotomy, this pilot study examined the subjective response to smoked cannabis flower based on strain classification.

Method - As part of a larger and ongoing two-week long ecological momentary study, weekly adult cannabis users (n=10) reported on in-the-moment subjective effects within 30-minutes of smoking cannabis flower. Subjective effects included low-arousal negative affect (e.g., drowsy, sluggish), high-arousal negative affect (e.g., panicked, anxious), low-arousal positive affect (e.g., calm, relaxed), high-arousal positive affect (e.g., outgoing, excited), physical pain, and level of high/intoxication. Participants additionally reported on the specific cannabis strain smoked, number of hits took, and THC concentration. Cannabis strains were dichotomized into indicas or sativas based on Leafly, a popular online cannabis search engine. Strains that were considered a combination of sativa and indica (a.k.a. hybrid) were excluded from analyses.

Results - A total of 69 smoking sessions across participants were included in analyses. Mixed effects regression models found that, after controlling for sex, age, THC concentration, and number of hits, strains classified as indica were associated with greater low-arousal negative affect (Est.=001, p=.01, CI=.0003, .002) and greater high-arousal negative affect (Est=.001, p<.001, CI=.0003, .001) relative to sativas. Strains classified as sativas were associated with greater high-arousal positive affect (Est=-.001, p=.02, CI=-.002, -.0002) relative to indicas. No differences emerged on low-arousal positive affect, pain, or reported level of high/intoxication.

Conclusions - To our knowledge, this was the first study to examine whether in-the-moment subjective response differed between cannabis considered either as sativa or indica. Preliminary results suggest that indicas may produce greater overall negative effects and sativas may produce greater high-arousal positive effects. Other effects, such as being relaxed or high, did not differ between strain type. It is unknown whether these findings were expectancy based. Given the popularity of the sativa-indica verbiage in legal cannabis dispensaries, more research on this topic is warranted.

Trends in the Korean Hemp Industry and Development of Cbd Extraction Methods

Oral Presentation | Authors: Joon-Hee Han, Min Hong, Sun-Yeop Lee, Tae-Hyung Kwon, Soo-Ung Lee | Chairs: Eun-Soo Kim, Jace Callaway

Chuncheon Bioindustry Foundation (CBF), a non-profit organization established by Chuncheon city in Korea, aims to promote the bioindustry by supporting biotech companies. Recently, Korean industry's interest in hemp has been incrementally increasing as the major components of CBD (Cannabidiol) are applicable to various industrialization. However, numerous restrictions were applied on R&D and industrialization of CBD because flowers, leaves and cannabinoids are classified as narcotic drugs. CBF is expecting the restrictions on hemp and cannabinoids to be alleviated in Korea as per global trend. Our final goal is to develop Korean original hemp varieties that contain high CBD content with minimum THC, and apply them to various industrial fields (foods, cosmetics, and pharmaceuticals, etc.) to preoccupy not only Korea but also overseas markets. Since 2020, CBF obtained the approval for R&D on hemp and CBD from the MFDS (Ministry of Food and Drug Safety) of Korea, and has been developing varieties, CBD extraction and productization in collaboration with universities and companies in Gangwon Province. Currently, CBF is focused on intensive research to establish efficient extraction methods and conditions to apply CBD industrially. As the first, an ultrasonic extraction method was attempted for each of various solvents (water, ethanol, methanol and acetonitrile) and concentrations (20%, 50%, 70%, 90% and 100%), which are mainly used to quickly analyze the cannabinoid content of hemp material using HPLC. The results showed the highest CBD potential content(73.78 mg/g dry weight) in 50% ethanol. As the second, a supercritical fluid extraction method was used to increase the CBD yield and purity on various extraction conditions. As a results, the highest potential content of CBD(522.6 mg/g) and THC(19.1mg/g) were detected in optimal condition of CO2 flow (60g/min), 200 bar and extraction time of 120 min. In addition, the lowest potential content of THC (9.4 mg/g) and CBD (497.1 mg/g) were detected in condition of CO2 flow (50g/min), 250 bar and extraction time of 120 min. Based on these results, ultrasonic extraction will be used for rapid analysis of cannabinoid content of raw materials, and mass production of CBD will be established by optimizing the supercritical extraction method.

WEDNESDAY, AUGUST 4, 2021

9:30 AM – 09:55 AM

Pharmacological Action and Changes of Gene Expression by Cannabidiol Treatment in Human Dermal Papilla Cells and A549 Lung Cancer Cells

Oral Presentation | Authors: Keun-Cheol Kim, Yoon-Jong Park, Jin-Sung Park | Chairs: Eun-Soo Kim, Jace Callaway

We have studied pharmacological action and changes of gene expression by cannabidiol (CBD) treatment in human alopecia model cells and A549 lung cancer cells. Dermal papilla cells maintain stemness niche of the hair follicle and regulate cyclic hair growth via wnt/ β-catenin signaling pathway. Testosterone, a causative hormone of androgenic alopecia, down-regulated the expression of various genes such as FGFr1, Wnt5α, and β-catenin of dermal pallia cells. PMA treatment also showed the down-regulation of β-catenin, suggesting that the early entry into catagen by down-regulation of β-catenin may accelerate alopecia. However, CBD treatment restored β-catenin expression by testosterone and PMA, suggesting a possibility for alopecia treatment. We have obtained interesting data on regulatory roles of CBD for cell death and survival in A549 lung cancer cells. Proliferation of A549 cells were inhibited by CBD treatment dose dependent manner. However, approximately 10% of cell population were considered as dead cells in CBD-treated A549 cell population, and cell cycle of remainders was maintained. Interestingly, multi-vesicular bodies were detected in cytoplasmic region by CBD treatment using microscopic analysis, presumed that cellular differentiation was shown in CBD-treated A549 cells. On the other hand, cell migration activity was decreased in CBD-treated A549 cells. Molecular analysis suggests that CBD could regulate expression of marker proteins for cell death and EMT. These results suggest that CBD could be utilized as unique or combinatory medicine for treatment of alopecia and lung cancer.

Evaluation of Thermo-chemical Conversion Temperatures of Hemp (cannabis Sativa L.) Biomass Cannabinoid Acids by Pressurized Liquid Extraction

Oral Presentation | Authors: Kenneth J Olejar, Chad Kinney | Chair: Fred Shahbazi Raz

Cannabinoids are increasingly becoming compounds of medical interest. However, cannabis plants only produce carboxylated cannabinoids. In order to access the purported medical benefits of these compounds, the carboxylic acid moiety must be removed. This process is typically performed by heating the plant material or extract, however cannabinoids being thermolabile can readily degrade, evaporate, or convert to undesired metabolites. Consequently, processes have been examined to minimize the unwanted attributes associated with thermal decarboxylation. The use of pressurized liquid extraction (PLE) has been applied to the extraction of a variety of source materials. This study examined the use of PLE for the thermo-chemical conversion of acidic cannabinoids to their neutral counterparts using water as the solvent followed by an extraction with ethanol. Temperature being a key factor for the conversion of acidic cannabinoids to neutral cannabinoids was examined in detail for six cannabinoids and their corresponding acidic forms and CBN a primary degradation product. The use of PLE also provides the ease of performing the decarboxylation during the extraction process. Cannabinoids in the extracts produced using PLE were quantified by HPLC. The experiments established the optimum temperatures for the thermo-chemical conversion of acidic cannabinoids to their neutral counterparts. CBC, CBG, CBN, THC, and THCV all had statistically significant maxima at 100 °C. The corresponding acids of CBCA and CBGA had a statistical minima at 120 °C, THCA at 140 °C, and THCVA at 80 °C. CBDV and CBDVA had maxima and minima at 120 and 140 °C, respectively. CBD's maxima was 160 °C, however the minima for CBDA was 120 °C. The cannabinoids of THCV and THC demonstrated a decrease at the highest temperature suggesting that degradation was occurring, however this degradation was not significantly increasing CBN. Much like thermo-conversion of the cannabinoid acids, there is a range of optimum temperatures for the thermo-chemical conversion process. Establishing whether maxima or minima are going to be used influences the final selection of a temperature for a given cannabinoid. Additionally, minimization of unwanted cannabinoids in the final extract may influence the thermo-chemical conversion temperature selected.

WEDNESDAY, AUGUST 4, 2021

9:30 AM – 09:55 AM

Secondary Metabolites Profiled in Cannabis Inflorescences, Leaves, Stem Barks, and Roots for the Development of Novel Natural Health Products

Oral Presentation | Author: Dan Jin | Chair: Ruth Charbonneau

Background - The legal cannabis market is growing quickly in North America. Currently, most cannabis growing facilities only harvest the flower tops, which contain the highest amounts of the psychoactive tetrahydrocannabinol (THC) and non-psychoactive cannabidiol (CBD). Most other plant parts are discarded. This is a potentially unnecessary waste. Cannabis leaves, stem barks, and roots have the potential to be developed into novel natural health products and medications. According to traditional medicine, each part of the cannabis plant has various medicinal properties and were indicated for a wide range of conditions relating to pain and inflammation. These therapeutic effects may be attributable to compounds beyond THC and CBD.

Methods - The aim of this study is to leverage a comprehensive investigation of chemical profiles in each plant part. The metabolites of the study included 14 cannabinoids, 45 terpenoids, 7 flavonoids, 3 sterols and 3 triterpenoids. This multipart study included the development of quantitative methods using liquid chromatography with mass spectroscope (LC-MS) for cannabinoids, liquid chromatography with ultraviolet detector and mass spectroscope (LC-UV-MS) for flavonoids, and gas chromatography with mass spectroscope (GC-MS) for terpenoids and sterols.

Results and Discussion - Cannabis inflorescence was characterized primarily by cannabinoids (15.77-20.37%), terpenoids (1.28-2.14%), and flavonoids (0.07-0.14%); the leaf by cannabinoids (1.10-2.10%), terpenoids (0.13-0.28%), and flavonoids (0.34-0.44%); stem barks by sterols (0.07-0.08%) and triterpenoids (0.05-0.15%); roots by sterols (0.06-0.09%) and triterpenoids (0.13-0.24%).

Conclusions - This comprehensive profile of bioactive compounds can form a baseline of reference values useful for research and clinical studies to understand the "entourage effect" of cannabis, as well as for applying the scientific method for investigating the traditional therapeutic use for each plant part.

Changes in Cannabis Use Methods Among Colorado Populations and Related Health Effects

Oral Presentation | Author: Richard Holdman, MD , MPH | Chair: Ruth Charbonneau

Cannabis can be used through a variety of methods; including smoking, eating, drinking, vaporizing, and dabbing. Additionally, different forms of cannabis can be consumed through more than one method. For example, cannabis concentrate can be vaporized or dabbed. Cannabis products can also vary widely on the amount of tetrahydrocannabinol (THC), the most psychoactive substance found in cannabis. This amount (% THC concentration) has been trending upwards on a yearly basis. Concern has been raised about products with high THC concentration due to their potential for adverse health effects in consumers of these products. Since retail cannabis legalization the State of Colorado has invested in monitoring cannabis use patterns through the Behavioral Risk Factor Surveillance Survey and Healthy Kids Colorado Survey; yielding information about different methods of use. Prevalence rates for methods of cannabis use among Colorado populations was calculated using Behavioral Risk Factor Surveillance Survey and Healthy Kids Colorado Survey results between 2015 and 2019. Information on cannabis health effects and increasing THC concentration in products was gathered through an ongoing systematic review of scientific literature performed by the Colorado Department of Public Health and Environment's Marijuana Health Monitoring Program. Findings from Healthy Kids Colorado Survey showed significant increases of dabbing (6.9% 2017 to 10.2% 2019) and vaporizing (4.0% in 2017 to 6.8% in 2019) cannabis amongst youth in Colorado. At the same time smoking cannabis decreased amongst the same population (17.6% 2017 to 15.3% 2019). Adult use (Colorado adults ages 18 years and older) remained stable regarding method of consumption since 2015, with smoking remaining the most prevalent method of cannabis consumption (14.4% in 2019). Review of scientific literature has shown moderate evidence that adolescents and young adults who use cannabis with higher THC concentration (>10% THC) are more likely than non-users to continue cannabis use and develop future mental health symptoms and disorders. Dabbing amongst Colorado youth significantly increased between 2017 and 2019. The use of cannabis products with high THC concentration among adolescents and young adults has been shown to be associated with continued cannabis use and future mental health symptoms and disorders.
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Auto-flowering Hemp Varieties and Their Impact on the Modern Hemp Industry

Oral Presentation | Author: Jace Callaway | Chairs: Eun-Soo Kim, Jace Callaway

Until the 1990s, hemp was typically tall and primarily cultivated for its bast fibre. Hempseed was collected as a secondary product and the production of low THC flowers was not of much interest to anyone. While hempseed has a long history of use in China, India and other Asian cultures, its production was small scale and labor intensive. Apparently no work had been done to develop hemp as an industrial oilseed crop. As a result, hempseed had not been a topic of nutritional research nor had it been exposed to modern food manufacturing technologies until the mid to late 1990s. Before then, hempseed was considered to be a low quality grain that was to animals. In an unlikely series of events, 'FINOLA' became the first example of auto-flowering Cannabis that could be harvested with a standard combine as an oilseed crop. It was identified in Finland during an agricultural survey that began in 1995, and was initially given the breeder code FIN-314. It was obvious that this variety produced flowers, pollen and viable seed at high latitudes (> 60 N) during the long days of the short Finnish summer, while other varieties of Cannabis could not. In this context, auto-flowering defines the "day neutral" variety, where the onset of flowering is independent of day length. The introduction of auto-flowering hemp has allowed for the mechanised production of hempseed on an industrial scale, for both human foods and animal feed. This unique trait was an important innovation for modern hemp agriculture, because such varieties have a determinant developmental morphology. The short stature and large flower are particularly important for the mechanised harvest of hempseed as an economical grain. This genetic resource has changed the face of hemp from tall, branching plants with sparse flowering, to short, columnar plants with massive flowering structures. Subsequently, the reasons for growing hemp have shifted, within a relatively short amount of time, from industrial fibre production to industrial scale grain and flower production.

Cannabis Attitudes, Patterns of Use, and Subjective Effects Among Followers of the Allergy Asthma Network (aan)

Oral Presentation | Authors: Joanna S. Zeiger, William S Silvers, Tonya A. Winders, Mary K Hart, Robert S. Zeiger
Chairs: Joanna Zeiger, William Silvers

In the US, cannabis use is increasing in the general population and various disease populations due to legalization and perceived benefit to combat primary symptoms of pain, insomnia, and anxiety. However, cannabis use is poorly studied in allergic/asthmatic patients, a group with whom route of administration could have broad adverse effects, since smoking and vaping cannabis in this population could lead to increased symptoms of cough and wheeze, as well as increased use of asthma medications and exacerbations. We determined cannabis patterns of use in asthma and allergy patients recruited via AAN due to the lack of information regarding cannabis in this population. Adult AAN followers completed an anonymous online survey on patterns of cannabis use. The Asthma Control Test determined asthma control. Cluster and factor analyses were performed. Eighty-eight (18.0%) of the 489 respondents currently use cannabis with the majority <50 years-old (60.2%), female (72.4%) and White (71.6%). Of non-cannabis users (N=401), 2.5% reported cannabis allergy. Cluster analysis revealed a liberal attitude towards cannabis was observed in 84/88 (95.5%) of current users compared to 109/184 (59.2%) former users and 62/217 (28.6%) never users (P<0.001). In current cannabis users, 40.9% of physicians inquired about cannabis use; only 37.5% of cannabis using respondents wanted to discuss cannabis. Purposes for cannabis use were medical (26.1%), recreational (34.1%), or both (39.8%). Primary cannabinoid used was tetrahydrocannabinol (33.0%), cannabidiol (19.3%), or both (47.7%). Smoked and vaped cannabis were reported by 53.4% and 35.2% cannabis users, respectively. Fifty-one (58.0%) cannabis users reported current asthma with 39.2% uncontrolled and of these, 50% smoked cannabis. Factor analysis revealed significantly more beneficial than adverse subjective cannabis effects. Beneficial effects included improved sleep (75.0%), less pain (68.2%), calm (68.2%) and decreased anxiety (67.0%); however, 19.3% reported coughing, 5.7% wheeze, and 6.8% shortness of breath from cannabis. Coughing was associated with smoking cannabis, as 31.9% of smokers and 4.9% non-smokers reported cough with cannabis use (P<0.001). A minority of AAN respondents currently use cannabis, but it's concerning that half of current cannabis users with uncontrolled asthma reported smoking cannabis and a minority of physicians inquire about its use.

WEDNESDAY, AUGUST 4, 2021

9:55 AM – 10:20 AM

Cannabis-derived Compounds Cannabichromene and D9-tetrahydrocannabinol Interact and Exhibit Cytotoxic Activity Against Urothelial Cell Carcinoma Cells

Oral Presentation | Authors: Omer Anis, Ajjampura C. Vinayaka, Nurit Shalev, Dvora Namdar, Stalin Nadarajan, Seegehalli M. Anil, Ofer Cohen, Eduard Belausov, Jacob Ramon, Einav Mayzlish Gati, Hinanit Koltai | Chair: Ruth Charbonneau

Cannabis sativa contains more than 500 constituents, yet the anticancer properties of the vast majority of cannabis compounds and their combinations remains unknown. We aimed to identify cannabis compounds and their combinations presenting cytotoxicity against bladder urothelial carcinoma (UC), the most common urinary system cancer. An XTT assay was used to determine cytotoxic activity of C. sativa extracts on UC cell lines T24 and HBT-9. Extract chemical content was identified by high-performance liquid chromatography (HPLC). Fluorescence-activated cell sorting (FACS) was used to determine apoptosis and cell cycle, and stained F-actin was examined by confocal microscopy . Scratch and transwell assays were used to determine cell migration and invasion, respectively. Gene expression was determined by quantitative Polymerase chain reaction (PCR). The most active decarboxylated extract fraction (F7) of high-cannabidiol (CBD) C. sativa was found to contain cannabichromene (CBC) and D9-tetrahydrocannabinol (THC). Synergistic interaction was demonstrated between CBC and THC whereas cannabinoid receptor (CB) type 1 and type 2 inverse agonists reduced the cytotoxic activity. Treatments with CBC and THC or CBD led to cell cycle arrest and cell apoptosis. CBC and THC or CBD treatments inhibited cell migration and affected F-actin integrity. Identification of active plant ingredients (API) from cannabis that induce apoptosis and affect cell migration in urothelial carcinoma cell lines forms a basis for pre-clinical and clinical trials to examine the effect of cannabis-based treatments on bladder cancer.

Hemp Seed Cake and Its Potential as Feed Ingredient

Oral Presentation | Authors: Raj Kasula, Fausto Solis, Byron Shaffer, Frank Connett, Chris Barrett, Rodney Cocker, Eric Willinghan
Chairs: Massimo Bionaz, Serkan Ates

Hemp seed and hemp seed products such as Hemp Seed Cake (HSC) have shown to increase unsaturated fatty acid (FA) profile in eggs, including linoleic and α-linolenic fatty acids. However, the use of hemp products in animal feed is still a concern due to the potential residues of the of Δ-9 tetrahydrocannabinol (THC), a psychoactive substance present in the hemp plant; thus, research to explore the subject is justified. A multi-parameter research was carried out to characterize the chemical composition and the safety of feeding HSC to commercial laying hens; its effects on layer performance, egg quality, systemic parameters, organs and tissues; and the residues of cannabinoids in organs and tissues. Eight hundred (800) Bovan caged hens in lay at 30 weeks of age were distributed into 4 treatments of 200 hens per treatment based on the inclusion levels (0%, 10%, 20% and 30%) of HSC. Each treatment comprised of 8 cages of 25 hens each that served as replicates. The study was carried out for 16 weeks following a 3-week acclimation. The results showed consistency in nutritional, mycotoxin and heavy metal values of HSC while the cannabinoids were below levels detectable by laboratory analyses, demonstrating levels well under the legal limits of 0.3%. Performance parameters such as feed intake, body weights, hen-day production, feed conversion and livability were not consistently affected. In terms of egg quality, egg weight and egg mass were not impacted, while eggshell strength, the linoleic and linolenic fatty acids were improved. HSC also improved egg lutein, yolk pigmentation and Haugh units. The cannabinoids residues in eggs was below the detectable level. Systemic parameters such as blood pH, blood profile, total protein and the mineral profiles were not consistently affected, and no effect was observed on tissues and organ health parameters. The cannabinoid residues in eggs, blood, breast meat, body fat, liver, kidneys, and spleen were below detectable levels. The results of the study showed that feeding HSC in laying hens did not affect the health and performance nor caused residues in their products even up to 30% inclusion.

Pilot Knowledge and Attitudes Survey on Cannabis in Clinically Recruited Participants

Oral Presentation | Authors: Teresa A. Simon, Anthony Silvestrone, Phil Molloy, Greg Cuozzo, Jahan Marcu | Chair: Karli Swenson

Background - Research shows that patients who use medical cannabis seem to obtain their knowledge experientially, most often through trial and error via personal use or the internet, as opposed to obtaining this information from a health care professional (HCP) as you would other medicines.1 Many patients express frustration with the inability to discuss their questions regarding cannabis with their medical doctors, as current studies highlight a gap in knowledge in many specialty HCP and pharmacists.2,3. It is possible that this trend could potentially shift significantly as accredited medical education becomes increasingly available for HCPs.

Methods - We developed a pilot survey study modified from existing surveys to understand the knowledge, attitudes and beliefs around cannabis use among the public and patients.2,3 Participants were recruited from internal medicine and rheumatology clinics (i.e., patients), and random solicitation (i.e., non-patients). At the time of abstract submission, a total of 59 respondents; 57 questionnaires were completed and 2 random solicitation surveys were partially completed: The sample distribution:18 from an internal medicine practice, 6 from a rheumatology clinic and 35 from random solicitation.

Results/Conclusion - Preliminary data shows 91% of respondents support the legalization of cannabis for medical purposes and 84% consider cannabis to be beneficial for certain medical conditions. 72% thought cannabis to be less harmful to your health than tobacco and 46% consider cannabis to be addictive. Notably, nearly half (46%) stated that CBD can offer pain relief, while 72% of respondents could not correctly identify which cannabinoid has been attributed with reducing seizures in patients who suffer from epilepsy. Randomly solicited participants seemed to be more informed compared to patients recruited from the clinical practices, in terms of understanding the potential therapeutic uses of cannabis and its compounds.

1 Kruger DJ, Moffet IM, Seluk LC, Zammit LA. J Cannabis Res; 2020 Sep 18;2(1):29.
2 Fitzcharles MA, Ste-Marie PA, Clauw DJ, Jamal S, et.al. BMC Musculoskeletal Disorders 2014,15:258.
3. Hwang J, Arneson T, St Peter W. P&T; Nov 2016;41;11.

WEDNESDAY, AUGUST 4, 2021

10:45 AM – 11:10 AM

Present State of Industrial Hemp in East Asia

Oral Presentation | Author: Eun-Soo Kim | Chairs: Eun-Soo Kim, Jace Callaway

East Asian countries such as South Korea, Japan, and China have long cultivated and used hemp products. However, after World War II, the cultivation of hemp in South Korea and Japan decreased rapidly due to the advent of the artificial fibers and strict regulations by their governments. Thus, only a few sectors of hemp industry have been maintained in this region of the world over the past half century. Although South Korea and Japan partially legalized industrial hemp, hemp cultivation there remains largely inactive. In contrast, the hemp market in China has expanded significantly, and China has become the largest hemp producer in the world.

Motivational issues within a country can influence the market patterns of other countries' specific products. I will introduce the case between Canada and South Korea as an example. Until 2016, Canadian hemp producers mainly exported hempseeds for food; however, after 2017 they turned their attention to the CBD industry. What explains this abrupt shift in focus? It was directly caused by the South Korean hempseed boom in 2014. To understand how this happened, we need to recognize the special circumstances and cultural background of South Korea. In addition, I will present basic information about the hemp industry in China and Japan. China has mainly focused on producing hemp for fibers and seeds to use for cloth, paper, oil, and food. Recently, China has expanded its hemp research and its production of fine hemp textiles and for the CBD industry. However, Japan has imported large amounts of hemp seeds and fibers from Canada and China. Japan has been gearing up to produce premium hemp fibers using imported fibers. They have a strategy for the hemp market that involves diversifying and manufacturing high-quality products based on Cannabis research and development.

The Potential Impact of Cannabidiol in the Treatment of Equine Laminitis

Oral Presentation | Authors: Babak Baban, Hesam Khodadadi, Jack C. Yu | Chair: Ruth Charbonneau

Laminitis is inflammation of the laminae of the foot, the soft tissue structures that attach the coffin or pedal bone of the foot to the hoof wall. The inflammation and damage to the laminae causes extreme pain and leads to instability of the coffin bone in the hoof. In more severe cases it can lead to complete separation of and rotation of the pedal bone within the hoof wall. Laminitis is a crippling condition which can be fatal in severe cases. In fact, more than 7% of equine deaths are linked to laminitis. Current treatments are only symptomatic rather than causative therapeutic method. Therefore, there is an exigent need to discover new alternative therapeutic modalities for laminitis with more effectivity as well as less adversarial sympto Cannabidiol (CBD) has been shown to have a significant potential as an Immuno-modulatory agent.

In this study we collected blood samples from 10 horses (5 normal and 5 with laminitis). The leukocytes including myeloid and lymphoid cells were sorted out using flow cytometry. The sorted cells were plated using 96 well plates in triple wells. One set of cells was treated with CBD (10 mg/ml) for 48 hours and then the cell morphology as well as inflammatory and phenotypic markers of cells were measured and analyzed using floJo software.

Our results showed a shift in function and expression of markers expressed by leukocytes treated with CBD compared to non treated samples.

In conclusion, our data suggest that CBD can be a considered as a therapeutic target in the treatment of equine laminitis.

WEDNESDAY, AUGUST 4, 2021

10:45 AM – 11:10 AM

Inhibition of UDP-glucuronosyltransferase Enzymes by Major Cannabinoids and Its Metabolites

Oral Presentation | Authors: Shamema Nasrin, Christy Watson, Gabriela Fort, Keti Bardhi, Gang Chen, Philip Lazarus | Chair: Fred Shahbazi Raz

The UDP-glucuronosyltransferase (UGT) family of enzymes plays a central role in the metabolism and detoxification of a wide range of endogenous and exogenous compounds. UGTs have a high degree of structural similarity and display overlapping substrate specificity, often making estimations of potential drug-drug interactions difficult to fully elucidate. One such interaction yet to be examined may be occurring between UGTs and cannabinoids, as the legalization of recreational and medicinal cannabis and subsequent co-usage of cannabis and therapeutic drugs increases in the U.S. and internationally. In the present study, the inhibition potential of the major cannabinoids Δ9-tetrahydrocannabinol (THC), cannabidiol (CBD), and cannabinol (CBN), as well as their major metabolites, was determined in microsomes isolated from HEK293 cells overexpressing individual recombinant UGTs (rUGT), as well as from microsomes from human liver and kidney specimens. The highest inhibition was seen by CBD against the glucuronidation activity of rUGTs 1A9, 2B4,1A6 and 2B7, with the binding-corrected IC50 (IC50,u) values of 0.38 ± 0.06 μM, 0.69 ± 0.14 μM, 1.3 ± 0.31 μM and 2.6 ± 0.47 μM, respectively. Strong inhibition of UGT1A9 was also demonstrated by THC and CBN, with IC50,u values of 0.53 ± 0.15 μM and 0.30 ± 0.037 μM, respectively. Strong inhibition of UGT2B7 was observed for THC and CBN, with IC50 values of 1.7 ± 0.42 μM and 2.5 ± 0.62 μM, respectively. Weak inhibition was observed for a couple of UGTs with several cannabinoid metabolites. These data suggest that cannabinoids are able to inhibit UGT activity. In addition to playing an important role in drug-drug interactions, these potential cannabis-UGT interactions may particularly have profound implications for patients with impaired hepatic or kidney function.

11:10 AM – 11:35 AM

Cannabis Use Frequency and Perceived Efficacy to Manage Psychological Pain

Oral Presentation | Authors: Karen Yescavage, Frances Martin, Lara Gribble | Chairs: Joanna Zeiger, William Silvers

Background - Experiencing negative emotions is a form of psychological pain. Substances are often used to try to manage such pain. One purpose of this exploratory study was to assess how frequently people use cannabis when experiencing different types of negative emotions. Given there is very little research published contrasting use of cannabis with THC and without THC (i.e., CBD), a second purpose of the study was to compare the two.

Methods - One hundred and eighty cannabis users completed an online survey to assess frequency of cannabis use in an attempt to manage eight forms of negative emotions. Following frequency of use questions, participants were asked to estimate the impact of THC to address these various forms of psychological pain, namely, how frequently cannabis containing THC: (1) made it better, (2) made no difference, and (3) made it worse. A repeated measures ANOVA was conducted to assess significant differences of cannabis use frequency across the eight negative emotions. Of the 180 participants, 78 reported using both forms of cannabis, i.e., cannabis predominantly containing THC and cannabis predominantly containing CBD (used separately). This allowed for comparisons between the two. Due to the smaller N, data were averaged across the eight negative emotions.

Results and Discussion - Anxiety, Irritability, and Sadness/Depression all prompted "regular" THC cannabis use. Anger and Panic "sometimes" prompted THC cannabis use. Guilt/Shame, Rage, and Self-Hatred "rarely" prompted THC cannabis use. Furthermore, when comparing THC with CBD in terms of both frequency of usage and perceived efficacy, THC was more frequently used than CBD and was reported to be more efficacious in managing negative emotions.

Conclusions - Participants in this study reported significantly different rates of cannabis usage as a function of negative emotion type, with fairly regular usage on average. THC was reported to be used significantly more frequently than CBD, and that THC helped to make negative emotions "better." While CBD was reported to more frequently make "no difference" compared to THC, THC was reported to more frequently make negative emotions "worse." The findings of this self-report observational study suggest further exploration of THC to manage negative emotions is warranted.

Investigating Cannabinoid Deposition in Sheep Fed Industrial Hemp Biomass

Oral Presentation | Authors: Bronwyn Blake, Gaye Krebs, Ken Dods, Chris May, Dana White, Danny De Rosa
Chairs: Massimo Bionaz, Serkan Ates

Industrial hemp has been identified as a potential alternative summer forage for ruminants in Australia. Little to no data exists on hemp forage as a feed for ruminants, therefore current regulations in Australia in restrict grazing livestock on hemp crops. The concern is that if hemp or hemp products containing tetrahydrocannabinol (THC), the psychoactive component of cannabis, or related compounds are fed to animals, it may accumulate in their tissues and detectable levels could transfer to meat, milk or other animal-based consumables. This study investigated cannabinoid accumulation in tissues from sheep fed industrial hemp biomass. Hemp biomass was collected after seed harvest and processed into one of two experimental diets, including hemp at 28 or 56% of the total ration. Ten Merino castrated male sheep of approximately 12 months of age were fed one of the two diets for 56 days, in a randomised complete block design. Cannabinoids were measured in the diets, urine, faeces, liver, kidney fat, subcutaneous fat, and loin. Only Δ9-THC and THCA were detected in the treatment groups but at extremely low levels (<300 µg/kg DM). In many cases, the result was below the limit of reporting, which simply means it was not detected due to analytical limitations. Statistical analysis could only take place where all replicates returned a result above the limit of reporting. Only THCA was detected in the liver, whilst only Δ9-THC was detected in the kidney fat and loin. Both types of THC were detected in the subcutaneous fat. Currently, regulations state zero tolerance for THC in animal tissues and this is what researchers and producers should work towards. The sheep in the current trial were given every opportunity to express cannabinoid residues i.e. they grew fat and were exposed to hemp for a long time (56d). Whilst there indeed were residues, they were extremely low. This suggests there is plenty of scope to develop management practices for feeding hemp biomass to ruminants allowing their products to enter the market with zero THC.

Measurement of Thc in Exhaled Breath After Marijuana Smoking: Exploring the Potential of a Transportable Lc-cms System

Oral Presentation | Authors: Jack Henion, Changtong Hao, Simon Prosser, Hannah Jeon, Peter Stambeck, Karolinska Beck
Chair: Ruth Charbonneau

Tetrahydrocannabinol (THC) can be measured in exhaled breath several hours after smoking of cannabis. THC is present in the aerosol particles that are formed in the small airways during normal breathing. The detection time of THC in breath is believed to relate to the time of impairment. This possibility makes it potentially attractive for investigation of suspects of drugged driving, preferably already at the roadside since the breath sample is non-invasive and easy to collect. In this study we describe a method using a simple non-invasive breath sample collection technique and a transportable LC-CMS system. Exhaled breath aerosol was sampled with the commercial BreathExplor™ device from recreational cannabis users and controls. The breath collection device consists of three equivalent collectors mounted in parallel. For forensic toxicology purposes sample B and sample C produced by the BreathExplor™ collection device is available for additional testing if desired. The collection procedure used 12 breaths and took 2-3 min. The collected breath samples were then extracted from the collectors using a small volume (50 uL) of methanol solution with internal standard, THC-d3. Positive ion SIM LC-CMS analyses under atmospheric pressure chemical ionization (APCI) conditions were used for analysis of the breath samples. The monitored ions were m/z 315.3 for the [M+H]+ of THC and m/z 318.3 for THC-d3. Calibrators were prepared in sequential concentrations from 10 pg and 10 ng THC/sample using blank collectors. Analyses showed a linear relationship between the amount THC and the THC/THC-d3 peak area ratio, with a coefficient of determination equal to R 2 > 0.99. The LLOQ was set to 10 pg/sample. Authentic samples following cannabis smoking were obtained from 5 individuals. Control samples were obtained from 5 drug-free healthy individuals. Breath samples collected between 20 min to 6 hours following cannabis smoking were all positive for THC with concentrations ranging from 1.1 to 26.8 ng/sample. Results suggest there is potential for roadside screening of drivers who have THC in their breath from recent smoking of marijuana using a simple and readily available breath specimen with a transportable LC/CMS instrument.

WEDNESDAY, AUGUST 4, 2021

11:10 AM – 11:35 AM

Regulations and Policies for Poverty Reduction Through Cannabis Industrialization: a Case Study of a Mountainous Community in Western Nepal

Oral Presentation | Authors: Thomas Michael Kloepfer, Kaneko Shinji | Chair: Thomas Michael Kloepfer

The cultivation of Hemp, cannabis sativa, has a long history of utilization in various regions around the world. The uses of hemp are imbedded in many of the agricultural practices, religious practices, and rural economic practices of the past and present.In western Nepal, hemp is specifically used as a stable food crop and cash crop, however the Nepali Narcotic Drug Control Act of 1976 ultimately prohibits Nepali farmers from sowing, trading, or selling their hemp crop in order to sustain their livelihood. Today farmers are continuing these practices illegally, especially in remote isolated regions where hemp has grown for centuries. The purpose of this study was to understand the current social acceptability of hemp cultivation in rural Nepal, as well as consider the future potential for legitimate cultivation.

In this study we tested two interconnected behaviours associated with hemp farming in the hill regions of Western Nepal. The item count technique methodology was used to estimate the number of farmers(N=288) that actively sow or plant hemp, and which of them may also be selling hemp husks, a byproduct used in illicit drug production, for income generation. We compared our item count treatment with a direct questionnaire for farmers within the same region Our results indicate that planting hemp is not a sensitive behaviour, where more than 95% of farmers plant hemp. The item count technique, however, did indicate that selling hemp husks is a sensitive behaviour, where 30% of farmers indicated selling husks when asked using the item count technique compared to the 5% of farmers who admitted to selling hemp "husks" when asked directly. This result shows that some but not all of the farmers are directly involved in the selling of hemp husks.

Our contribution to the ongoing global debate regarding hemp cultivation for fuel, fiber, food, and medicine is founded in issues pertaining to Human Rights, Development, and Alternative Development. New policies at the local, regional, and global level could reconsider the impact of licit hemp cultivation in regions where it is already socially accepted and practiced.

Hepatic Cannabinoids Residuals and Bilirubinemia Are Highly Affected by Feeding Spent Hemp Biomass and Withdrawal Period in Lambs

Oral Presentation | Authors: Massimo Bionaz, Serkan Ates, Ruth Muchiri, Richard B. van Breemen | Chairs: Massimo Bionaz, Serkan Ates,

Spent hemp biomass (SHB), the byproduct of the extraction of cannabidiol (CBD) from hemp, is not legal to be fed to livestock due to the presence of cannabinoids. Legalization by FDA-CVM requires data on cannabinoid residuals in the products of animals fed with SHB. For the purpose, 35 lambs were randomly assigned to five feeding treatments containing either no SHB (CON) or SHB at 10% (LH1) or 20% (HH1) for 4 weeks with 4 weeks withdrawal from SHB, or SHB at 10 (LH2) or 20% (HH2) for 8 weeks. The SHB contained 2.24% CBD-total (1.88% CBDA) and 0.07% tetrahydrocannabinol (THC)-total (0.03% Δ9-THC). Body weight and daily feed intake were recorded. Blood was collected through the study to measure parameters related to liver health and function. Cannabinoids in liver samples were measured using LC- The intake of total cannabinoids was (mean±SD mg/kg BW) 109.4±20.2 for LH and 197.6±37.1 for HH. We detected 0.01 μg/g CBDA in the livers of CON lambs which was not different from the two withdrawal groups (0.08 and 0.02 μg/g in HH1 and LH1, respectively; $P>0.94$). CBDA in liver of lambs that received SHB for 8 weeks (LH2, HH2) was larger ($P<.0001$) than those only receiving SHB for 4 weeks (LH1, HH1) and CON lambs. The amount of CBDA found in liver was greater ($P<.0001$) in HH2 (14.1 μg/g) compared to LH2 lambs (2.5 μg/g). No detectable Δ9-THC was measured in liver of CON and LH1 lambs, while 2 out of 7 lambs in HH1 (mean=6.1 ng/g) and all the lambs in LH2 (44.4 ng/g) and HH2 (85.2 ng/g) had Δ9-THC in liver. Similar pattern was observed for the other cannabinoids. Among blood parameters measured, only bilirubin was linearly increased by the amount of SHB fed ($P<0.01$), indicating an inhibition of liver clearance ability without compromising liver health. Results indicated that hepatic residual of cannabinoids is dependent upon the levels of SHB in diet. SHB withdrawal for a period of 4 weeks was sufficient to substantially decrease or eliminate cannabinoids in the liver. The increase in bilirubin might be due to inhibition of bilirubin metabolism by cannabinoids.

Cannabis Use and Post-operative Complications in Patients Undergoing Pancreatic Resection

Oral Presentation | Authors: Helen Madsen, Heather Carmichael, Marco Del Chiaro, Ana Gleisner, Richard Schulick, Camille Stewart | Chairs: Joanna Zeiger, William Silvers

Introduction - Pain relief and nausea are reported therapeutic benefits of cannabis, which may be of use to surgical patients. There is little evidence assessing the effects of cannabis on surgical outcomes, however, which must be examined prior to exploring its potential benefits. We hypothesized that post-operative complications after major pancreatic resection were similar between self-reported cannabis users and non-users.

Methods - This is a single-center, retrospective review from 2017-2019 of all patients who underwent elective pancreaticoduodenectomy or distal pancreatectomy. The primary outcome was any in-hospital complication, graded by severity (1=minor, 5=severe). Stepwise logistic regression modeling was used to adjust for potential confounding risk factors.

Results and Discussion - There were 366 patients who underwent pancreaticoduodenectomy (n=263, 71.9%) or distal pancreatectomy (n=103, 28.1%). Most patients were male (52.2%) with a median age of 65 [IQR 58-72]. Indications for surgery included pancreatic/periampullary cancer (n=222, 60.7%), cystic neoplasm/cyst (n=66, 18.0%), neuroendocrine tumor (n=40, 10.9%), pancreatitis (n=17, 4.6%), and other (n=21, 5.7%). Overall, 22.1% (n=81) of patients reported cannabis use, either current (n=66, 18.0%) or prior (n=15, 4.1%). Most reported use with a medical card (n=62/81, 77%). Cannabis users were younger (60 vs. 66 years, p=0.001), and were more likely to have smoked tobacco (p=0.04), but otherwise were similar to non-users. In cases where type of cannabis use was reported (n=61), the most common methods of ingestion were smoking (n=20, 33%) or edibles (n=18, 30%). There were 219 (59.8%) patients who developed an in-hospital complication (grade 1-2, n=159 (72.6%); grade 3-5, n=60 (27.3%). On univariable analysis, current/former tobacco smoking was associated with complications (50.9% vs. 39.9%, p=0.048), but cannabis use was not (20.6% vs. 24.3%, p=0.48). In multivariable analysis, a trend towards increased complications was observed with tobacco smoking (OR 1.47, 95% CI 0.95 – 2.29, p=0.09), but there continued to be no association between cannabis and complications (OR 0.77, 95% CI 0.46 – 1.31, p=0.34).

Conclusion - A significant proportion of patients undergoing pancreatic resection report cannabis use. Results suggest that cannabis use does not increase the risk of post-operative complications. Prospective evaluation of cannabis use is warranted to determine safety and possible post-operative therapeutic efficacy.

Characterization of the Cannabis Plant Microbiome for the Development of Improved Cultivation Strategies

Oral Presentation | Authors: Carolina Lobato, PhD, Katherine Cuadros Patino, Cernava Tomislav, Gabriele Berg | Chair: Sanghyuck Park

Plant growth-promoting bacteria are well known for improving plant health and increasing field yields in agricultural applications. However, their efficiency depends on their interaction with the host plant species and the genotype. We explored the effects of different growth-promoting strains with a broad host range on industrial hemp (Fedora 17) under laboratory conditions and in the field. We selected the Gram-negative strains S. rhizophila P69 and S. plymuthica HRO-C48 because of their well-documented biocontrol and plant growth-promoting characteristics. Even though there is no evidence of their presence in the Cannabis microbiome so far, both of these strains have shown to be efficient colonizers of the endosphere in other plants. To analyze how suitable these treatments are and how they affect Cannabis plants, we made observations on the germination rate, growth capacity, and plant health. We further visualized the microbial colonization of different plant tissues by implementing fluorescent in situ hybridization-confocal laser scanning microscopy (FISH-CLSM) techniques. Complementary gas chromatography-mass spectrometry (GC-MS) analyses were used to identify potential differences in the volatile organic compounds (VOCs) composition of plants subjected to the different treatments. We also compared the microbiome composition of Fedora 17 seeds between different treatments and plant generations. S. plymuthica HRO-C48 treated plants showed an improved survival rate in the field. In contrast, S. rhizophila P69 treated plants had slightly higher biomass. The GC-MS analysis indicated a possible influence of the treatments in the VOCs composition of flowers. This is also the first known analysis of the seed endosphere community in Cannabis plants and represents the first step for the discovery of the emerging benefits of the host-specificity of seed endophytes for Cannabis fitness. This study highlights the need for tailored strategies to respond to the requirements of modern Cannabis cultivation adequately.

WEDNESDAY, AUGUST 4, 2021

11:35 AM – 12:00 PM

How Cannabis Supply Chain Managers Navigate the Emerging Legal Cannabis industry

Oral Presentation | Author: Madeleine (Mellie) Pullman, Dan Krause | Chair: Eunsoo Kim, Jace Callaway

The cannabis industry is a new quasi-legal industry. Growing, selling, and using cannabis are still illegal in most countries. However, 24 countries and multiple U.S. states have recently approved cannabis for either medical and/or recreational use. This research focuses on value-added producers (VAPs), companies that process cannabis to manufacture ingestible, inhalable, or topical products. Due to public health concerns, the VAP tier of the cannabis supply chain faces stringent regulatory focus and turbulence. Using multiple case studies of VAPs in an emerging cannabis industry, this research investigates how these companies' primary supply chain decision-makers make and implement strategic decisions in an environment characterized by fast-changing regulations.

1:30 PM – 2:50 PM

Law and Regulation and its Role in Cannabis Research

Panel Discussion | Chair: Ruth Charbonneau

As more states pass medicinal and adult-use legislation, the prevalence of cannabis use is surpassing the research needed to support its efficacy. However, cannabis remains a controlled Schedule I drug under the Controlled Substance Act. Therefore, per federal law and regulations, cannabis has no accepted medical use and a high potential for abuse. Nonetheless, state laws outline the scope of medical cannabis and adult-use, relying on existing standards, which may not be specific to cannabis or not supported by research. This session will focus on research that drives public policy or knowledge, including, but not limited to, measurements of cannabis use while driving, negative implications of cannabis use, agricultural and laboratory standards, and taxation policy.

1:35 PM – 2:00 PM

A Mechanistic Model Explaining Ligand Affinity For, and Partial Agonism Of, Cannabinoid Receptor 1 and 2

Oral Presentation | Authors: Daniel Meister, Fred Shahbazi Raz, John Frederick Trant | Chair: Fred Shahbazi Raz

Background - Cannabis sativa produces over 120 structurally similar phytocannabinoids. Although THC and CBD are very well studied, many of the others have not been biologically characterized. The primary targets of the cannabinoids are thought to be cannabinoid receptors 1 (CB1) and 2 (CB2), class A G-protein coupled receptors (GCPR). Understanding CB1 agonism by THC and its analogues has broad pharmacological implications as it is used extensively both therapeutically and recreationally. In this study, we investigated the effect that the alkyl side chain on THC analogues has on their ability to bind and activate the CB1 and CB2 receptors in silico. We also propose a model to predict the affinity of new ligands for the orthosteric site and propose a mechanism to describe the mechanism of partial agonism.

Materials and Methods - Docking of ligands was performed using both rigid receptor and induced fit methods using the Schrodinger computational suite, followed by both classical molecular dynamics simulations and MM-GB(PB)SA calculations as well as Gaussian Accelerated Molecular Dynamics (GaMD) which were performed using Amber to determine long time scale structural changes in the CB1 receptor.

Results - IFD results were found to have good correlations with experimental values ($R2=0.81$ and 0.75, for CB1 and CB2, respectively) however, we found that this can be improved upon by factoring in ligand lipophilicity ($R2=0.92$ for CB1 and 0.81 for CB2). This may be due to lipophilic ligands being able to diffuse into the membrane resulting in higher local concentrations near the receptors. Complexes were then subjected to long-timescale MDs and GaMDs to investigate receptor activation. Results showed that for alkyl chains shorter than 5 carbons, two distinct ligand conformations, similar in energy, are possible–having a considerable impact on receptor activation. Longer chains only had one conformation and were able to better activate the CB1 and CB2 receptors. This information will help in the design of novel inhibitors and activators of these and other GPCR receptors and this expansion is a current focus of our lab.

Ask Your Healthcare Provider About Cannabis (apac)

Oral Presentation | Authors: Tracy Klein, Ross J. Bindler, Karina Destine, Daniel Montes | Chairs: Joanna Zeiger, William Silvers

Obtaining medical cannabis begins with a order from a licensed healthcare provider for treatment of an approved condition. Conditions and authorizers vary by state. Patients frequently purchase cannabis from retailers with inconsistent counseling. Those using cannabis for cancer prefer to get information from their care team, but few do so. Clinicians are reluctant to authorize cannabis based on their own lack of knowledge and discomfort but are open to learning. The need for high quality education regarding cannabis for medical use has been recommended for all health professionals. Programs training health professionals have not yet routinely integrated curriculum regarding cannabis. Health professionals often seek other health professionals as their primary source of information. We report the first phases of a three-part national study focusing on improving communication between health care professionals and patients seeking medical information regarding cannabis.

A 2-hour cannabis CE module with a pharmacist/nurse practitioner(NP) team was deployed on a national web platform from April 2020-March 2021. Of 841 NPs completing the module and its pre and post survey, 184 (22%) also completed a follow-up assessment of changes to practice within 3 months. Knowledge scores were compared with repeated measures ANOVA. Descriptive statistics and qualitative analysis evaluated clinical application.

24.4% were in states with medical and adult use cannabis, 43.5% with medical cannabis only, and 31.5% in restricted states. A significant total increase of 39.3% was noted in knowledge (95% CI: 30.6 to 47.9%, $p<0.001$). The greatest increases were for pharmacokinetics (33.6% to 80.6%, $p<0.001$) and drug-drug interactions (46% to 95.2%, $p<0.001$). Most (82.6%) knew less than half of the information before the module. Since completion, 92.4% are now likely to ask about cannabis use and 81.5% are likely to counsel regarding cannabis use. NPs similarly advised CBD and cannabis for anxiety (9,9); pain (18, 13); neuropathy (1,1); arthritis (6, 4); and PTSD (3, 3). Unique conditions for CBD included smoking cessation and complex regional pain syndrome. Unique conditions for cannabis include decreased appetite and Crohn's disease.

Education on cannabis efficacy and evidence can further improve individualized discussions with patients and provider confidence.

Feeding Spent Hemp Biomass to Finishing Lambs: Effects on Blood Parameters Related to Health and Metabolism

Oral Presentation | Authors: Massimo Bionaz, Serkan Ates, Erminio Trevisi, Nathan Parker, Hunter Ford
Chairs: Massimo Bionaz, Serkan Ates

Spent hemp biomass (SHB), the byproduct of the extraction of cannabidiol from hemp, currently has little to no use. SHB could potentially be included as a low-cost, alternative feedstuff in livestock diets. To assess the feasibility of using SHB as feed and its effect on health, 35 lambs were randomly assigned to five feeding treatments: no SHB (CON), SHB at 10% (LH1) or 20% (HH1) for 4 weeks (Period 1) with 4 weeks withdrawal from SHB (Period 2), or SHB at 10 (LH2) or 20% (HH2) for 8 weeks. Performance of the animals was assessed, and blood was collected for isolation of plasma and white blood cell differential and phagocytosis. Statistical significance was declared with $P<0.05$.

Feed intake decreased in animals fed 20% SHB (HH2) in Period 1 but not in Period 2, when HH1 and LH2 had higher feed intake compared to CON. None of the parameters related to performance was affected. Compared to the other groups, feeding 20% SHB affected metabolism with a decrease in cholesterol, non-esterified fatty acids (NEFA) and β-hydroxybutyrate (BHB). Compared to CON, LH2 lambs had higher cholesterol, glucose, and NEFA in Period 2. Urea was increased by LH2 and HH2 compared to CON in Period 2. Paraoxonase was linearly decreased by SHB while alkaline phosphatase, a marker of bone formation, was linearly increased by SHB. Oxidative stress parameters indicated an improved anti-oxidative ability of lambs fed SHB compared to CON. Immune function was not affected by SHB. Results suggest a strong effect of SHB on metabolism. For some parameters this was likely due to change in feed intake, such as cholesterol, but for others was not, such as the level of NEFA which was likely driven by a direct effect on adipose tissue and BHB, which might indicate an effect of SHB on rumen fermentation. It is unclear the effect on urea and paraoxonase by SHB. The effect of urea was possibly driven by feed intake in LH2 but not in HH2. The effect of SHB on alkaline phosphatase may indicate an increase in bone formation by SHB.

WEDNESDAY, AUGUST 4, 2021

1:35 PM - 2:00 PM

Will Legalization of Cannabis Help Correct Judicial, Economic, and Social Injustices of the Past Decades?

Oral Presentation | Authors: Ernst Cebert, Jeffrey Steiner, Mr. Mark A. Cebert - Lewis & Clark Law School, Mr. Michael A. Cebert
Chair: Stefanie Maletich

The root cause of our current problems with Cannabis sativa L. (Cannabis) is based on racism. After releasing the propaganda film called Reefer Madness in 1936, Cannabis became an additional instrument used by the authorities to marginalized Mexicans and African-Americans. More than eight decades later, some modern-day politicians continue to reiterate the racist theme of connecting Cannabis to undesirable behaviors and criminal acts by minorities. Statements by well-established leaders including Kansas State Representative Steven Alford in 2018 that, "What you really need to do is go back in the '30s when they outlawed all types of drugs in Kansas [and] across the United States. What was the reason why they did that? He continued, "One of the reasons why, I hate to say it, was that the African Americans, they were basically users and they basically responded the worst off to those drugs just because of their character makeup, their genetics and that". Former Attorney General Jeff Sessions' philosophy is that, "Good people don't smoke marijuana". So, where are we in 2021, in trying to correct these well-embedded Cannabis-related disparities? Alabama A&M University and other Historically Black Colleges & Universities are partnering with other public and private institutions such as Oregon State University and Phylos Bioscience to reach out to minority groups, offering resources including education, materials, and other support in this transition towards decriminalization. Undoing 85+ years of directed-discriminatory practices will be a challenge. This presentation will highlight example partnerships to promote equity and what's being proposed by authorities at the State and Federal levels.

2:00 PM - 2:25 PM

Evaluation of Hempseed Cake on Cattle Performance, Carcass Characteristics and Feeding Behavior in Finishing Diets

Oral Presentation | Authors: Thomas Winders, Eric Michael Serum, David J. Smith, Bryan W. Neville, Golam Kafi Afrose Mia, Samat Amat, Carl Dahlen, Kendall C. Swanson | Chairs: Massimo Bionaz, Serkan Ates

As hempseed oil production continues to increase, there is increasing interest in feeding byproducts of industrial hemp production to livestock. An experiment using crossbred heifers (n = 31; initial BW= 494 kg, SE = 10) was conducted to determine the effects of feeding hempseed cake, a hempseed oil production byproduct, in a corn-based finishing diet (10% forage) formulated to meet or exceed ruminally degradable and metabolizable protein requirements on growth, performance, carcass characteristics, and feeding behavior. Heifers were assigned randomly to one of two treatments: 1.) diet containing 20% dried distillers grains plus solubles (CON, n=16), or 2.) diet containing 20% hempseed cake (HEMP, n=15) on a dry-matter basis. Cattle were housed in two pens, had ad-libitum access to feed and water, and individual intakes and feeding behavior were captured using the Insentec BV feeding system across the feeding period (111 d). Dry matter intake was not different between treatments ($P = 0.94$), while CON cattle had improved final body weight, average daily gain, and feed efficiency (G:F; $P \leq 0.05$) compared to HEMP cattle. Hot carcass weight was greater for CON compared to HEMP ($P = 0.03$), while all other carcass characteristics were not different ($P \geq 0.20$). Control and HEMP cattle were not different ($P \geq 0.32$) for number of meals, time spent eating, number of visits to the bunk per day, meal size, or eating rate. Overall, these data suggest hempseed cake could be a viable alternative feed source for ruminants depending on availability and cost. Further understanding of hempseed cakes' nutrient utilization is critical to determining this products viability as a feedstuff for cattle.

WEDNESDAY, AUGUST 4, 2021

2:00 PM – 2:25 PM

How Has Covid-19 Impacted the Demand for Medical Cannabis?

Oral Presentation | Authors: Maha Haq, Amanda Joseph, Anthony Dutcher | Chairs: Joanna Zeiger, William Silvers

The demand for medical cannabis sharply increased in 2020. Our case study determined whether there was any correlation between the COVID-19 pandemic and demand for cannabis through medical recommendations. Preliminary data was assessed utilizing patient information provided by Veriheal, a virtual medical cannabis recommendation platform with a database containing survey assessments of ≥ 125,000 patients. We merged Veriheal's patient sign-up count and appointment dates with the official CDC COVID-19 case data tracker.

Following this, comparisons were drawn between the amount of cannabis interest (sign-ups) and adoption (appointments) by virtue of Veriheal's data in 2020 alongside with key spikes in COVID-19 cases provided by the CDC's data tracker. Sign-ups and appointments were analyzed based on state, city, age group, gender, and condition/reason for cannabis use. Although cannabis has traditionally been recommended for pain relief, the data suggests that the increased interest in cannabis during 2020 was instead correlated with mental stress. Further analysis suggests that interest in cannabis sharply increased throughout the months associated with mass societal distress in the U.S. (eg., BLM protests & pre-elections) compared to months with no drastic societal shock events.

In the data, participants selected "Happy/Bliss" as reasons over "Relief/Pain-Free" for medical cannabis use, contrary to the original hypothesis which theorized participants would utilize medical cannabis for pain relief and support. "Happy/Bliss" grew in prevalence by 46% in 2020 compared to previous years. Although data from 2019 demonstrated that cannabis was commonly sought out and utilized for physical pain relief, findings suggest that medical cannabis purchases and consumption have increased following the collective societal shock events in 2020.

Based on the patient assessments, the data suggests that people suffered from a depressive episode or had anxiety during the pandemic. We further extrapolate that America went through times of unrest beyond the pandemic, which influenced the amount of sign-ups and appointments through Veriheal. Exogenous shocks in addition to the pandemic like protests, riots, and elections caused major worries and uncertainty for the nation, therefore, medical cannabis is being sought out as a tool for mental health and a means to achieve happiness.

Major and Minor Cannabinoids and Pharmacologically Relevant Central Nervous System Receptors: In-silico Analysis

Oral Presentation | Authors: Fred Shahbazi Raz, Daniel Meister, John Frederick Trant | Chair: Fred Shahbazi Raz

When evaluating the major cannabinoids are considered, yet there are over a hundred minor cannabinoids present. The role of these is poorly understood at best, and in some cases, completely unknown. They are generally disregarded due to their low quantity; but this is only in comparison to the major compounds, the average consumer is still potentially taking in mg quantities of these compounds. It is clear that the effects of cannabis extend beyond that induced by the major cannabinoids alone. Several minor cannabinoids are, for instance, reported to be far more potent than CBD and THC against the cannabinoid receptors. We report for the first time our preliminary in silico investigation into the activity of the minor cannabinoids on not only cannabinoid receptors receptors but ~30 other major nervous system receptors. A thorough computational screen of the minor cannabinoids through molecular docking was conducted to determine their binding affinity to determine which cannabinoids can affect which receptors. This was followed by MD/MM-GBSA calculations for more accurate determination of binding affinity. Cannabinoids which were found to be potential binders were then investigated for their effects on the receptors to determine if they have an agonistic or antagonistic effect by (GaMD) and monitoring structural changes in the receptors and comparing to the behaviour with known or endogenous molecules. Several of the minor cannabinoids, specially THCP, was found to be significantly better binders to CB1 and CB2. It extends to long hydrophobic pocket of the cannabinoid Receptors and activate G-protein. For Opioid Receptors, the Cannabisol showed better binding score than Morphine. It acts as a full agonist for all opioid receptors and can be a novel finding which leads to the conformational changes activation of intracellular heterotrimeric Gi/o family proteins. For the third series of proteins Fatty acid binding Proteins (FABP), transporting AEA to the breakdown by FAAH, AEA had a better binding affinity than all minor cannabinoids and compounds that bind to FABPs block may effect on allosteric site of FABPs. This work is expected to move into in vitro validation, and could prove a rich source for bioprospecting potential medicinal compounds.

WEDNESDAY, AUGUST 4, 2021

2:00 PM – 2:25 PM

Up in Smoke: the Effect of Marijuana Legalization on Personal Bankruptcy

Oral Presentation | Authors: Irena Hutton, Casey Dougal | Chair: Stefanie Maletich

Marijuana offers a low-cost alternative to traditional medical treatment for a variety of health conditions. We use the legalization of medical marijuana in the U.S. to study the effect of a quasi-exogenous reduction in the cost of medical care on personal bankruptcy rates. The staggered passage of legalization laws across states allows us to use difference-in-difference research design. Using a sample of 27.6 million personal bankruptcies filed in all 50 states over 1994 - 2018 and aggregated to the county-year level, we find that annual bankruptcy filings decline by 6.2 percent (t-stat.=3.70) following state-level medical marijuana legalization. This is equivalent to roughly 22 personal bankruptcies per county per year relative to a baseline of 361 bankruptcies per county-year. This result is robust to variation in the sample time period used for estimation, to clustering standard errors on different dimensions, controlling for recreational marijuana legalization and decriminalization, controlling for the 2008 Financial Crisis or the roll out of the Affordable Care Act, excluding regions with particularly high bankruptcy rates, and to using alternative estimators. For example, we measure similar reductions in bankruptcy rates following medical marijuana legalization using a nearest neighbor matching estimator which matches legalizing and non-legalizing counties in the year prior to legalization on personal bankruptcy, income, and unemployment rates and population. Our results also indicate that larger declines occur in populations facing higher out-of-pocket medical costs, such as those with high insurance rates or those residing in concentrated hospital markets, where medical costs are higher and quality is lower. Consistent with this medical cost channel, we find no effect of legalization on business bankruptcies, and limited support for alternative explanations for the reduction in personal bankruptcies, such as an increase in economic activity, a decrease in marijuana-related arrests, or substitution away from other hard drugs following legalization. In summary, marijuana legalization has had a significant effect on consumer finances by offering a low price substitute to medical care and reducing financial distress due to high healthcare costs.

2:25 PM – 2:50 PM

Medical Cannabis: a Natural Product With Complex Chemical and Biochemical Profiles

Oral Presentation | Author: Lakshmi Kotra | Chair: Fred Shahbazi Raz

Cannabis has entered into healthcare and patient care in an usual way in the recent years, and it has been a challenge to connect all aspects involved with this natural product to a typical pharmaceutical agent for medicinal chemists and pharmaceutical community. Our research group has been investigating medical cannabis to understand its chemistry as a potential medical substance, its biological responses in vitro in various cell lines, and making sense of their clinical use for various disease conditions.

First aspect we explored was the decarboxylation of cannabis in order to generate chemically consistent cannabis extracts, in order to understand receptor responses. Cannabis extracts with measurable and consistent amounts of carboxylic cannabinoids and their decarboxylated analogs are sought after for medical use. Analytical methods and cell-based in vitro systems were employed to profile the natural product, as well as to derive cAMP functional responses of cells to various cannabinoids and cannabis extracts.

We developed a scalable process from lab to production scale using microwave technology to obtain consistent, fully-decarboxylated cannabis extract, especially Δ9-tetrahydrocannabinol (THC) and cannabidiol (CBD) content, in order to address this challenge. In fact, a high-THC cannabis extract produces a differential functional response than the same concentration of THC, varying as much as 8 to 10-fold. In male and female human neuronal cell cultures (LAN-5 and SH-SY5Y, respectively), phytocannabinoids generated different functional responses; this is further complicated in the presence of sex hormones, testosterone and estradiol.

Chemical compositions of cannabis extracts, including the carboxylated forms such THCA, CBDA and their decarboxylated forms THC and CBD would give rise to significant variability in the cell responses. Cannabinoids also exhibit different functional responses in male and female neuronal cells. Heterogeneity in chemical composition, lack of universal standards and the inherent differences in male and female cells warrant systematic investigations at the cellular and higher levels with a defined chemistry of medical cannabis.

WEDNESDAY, AUGUST 4, 2021

2:25 PM – 2:50 PM

Plasma Cannabinoid Concentrations Determined from Heifers Fed Hempseed Cake in Finishing Diets by Rapid Screening With Mass Spectrometry

Oral Presentation | Authors: Eric Michael Serum, Shubhashis Chakrabarty, Thomas Winders, Bryan W. Neville, Kendall C. Swanson, David J. Smith | Chairs: Massimo Bionaz, Serkan Ates

Hempseed cake, a byproduct of hempseed oil production, could contribute protein and fiber to the dietary requirements of ruminants. However, there are no data documenting the appearance or clearance of phytocannabinoids in animals fed hemp processing products. To investigate the impact of feeding hempseed cake on production endpoints and cannabinoid residues in cattle, 32 cross-bred heifers were fed rations containing 20% dry matter–either hempseed cake (treatment) or distiller's grains (control)–for approximately 112 days. Plasma and urine were collected throughout the feeding period and tissues were collected after withdrawal periods of 0, 1, 4, and 8 days. Plasma samples (d 2, 7, 14, 42 and 98) from a cohort of six control and six treated animals were evaluated for phytocannabinoid content by rapid screen electrospray ionization mass spectrometry. Cannabinoids measured included: tetrahydrocannabinolic acid (THCA), cannabidiolic acid (CBDA) cannabichromenic acid (CBCA), cannabigerolic acid (CBGA), cannabidivarinic acid (CBDVA), cannabinolic acid (CBNA), tetrahydrocannabinol (THC), cannabidiol (CBD), cannabidivarin (CBDV) and cannabinol (CBN). CBD and THC as well as CBDA and THCA were quantified together due to their identical molecular ion peaks and fragmentation patterns. Following facile workup, extracts (5 µL) were injected onto a Sciex 5600+ time-of-flight mass spectrometer for rapid analysis. The methodology was extended to analysis of the hempseed cake fed during the cattle study to estimate dietary exposures. Concentrations of phytocannabinoids in the hempseed cake ranged from 0.01–9.15 mg/kg in ascending order: CBN, CBNA, CBDV, CBGA, CBDVA, CBCA, CBD/THC, and CBDA/THCA. Plasma concentrations ranged from 0.1–10 ng/mL listed in no particular order: CBNA, CBDA/THCA, CBGA, CBCA, CBDVA. CBD/THC, CBN, and CBV were not detected (LODs 0.4–2.9 ng/mL for CBN, CBDV, CBD/THC). The character and relative distribution of phytocannabinoids in plasma were consistent with the cannabinoids measured in hempseed cake. The rapid screening approach was able to completely delineate which cattle had been exposed to the hempseed cake diet without false positives. Cattle fed hempseed cake met comparable production endpoints as controls but did contain carboxylic acid type phytocannabinoids in plasma without apparent bioaccumulation.

3:10 PM – 4:30 PM

University Lawyers Weigh in on Campus Cannabis Research

Panel Discussion | Chair: Linda Schutjer

This panel will consist of a group of university lawyers who work on issues surrounding cannabis research on their campus. There are practical and legal issues associated with such research and the laws are changing frequently. Cannabis research on campus starts with production and ends with potential products and includes everything in-between. Each step can present unique challenges for legal compliance. Researchers will be provided insights into how to do cannabis research right to avoid the potential violation of law. Panelist will represent counsel from various state's with potentially different approaches to cannabis and will present on the issues they have seen -- which may be state specific.

Reimagining The Black Community through Cannabis And Hemp

Panel Discussion | Chair: Matthan Ibidapo

The session will cover environmental, systemic issues in black and brown communities. These are some of the most important and challenging areas for the cannabis and hemp industries . since they have and still are profoundly incarcerated and are the majority of the world's population in America prisons. Further, this session will explore activities and opportunities to incorporate social equity into burgeoning cannabis industries.

In Silico Elucidation of the Enzymatic Synthesis of Thca,cbda and Cbga from Cbga

Oral Presentation | Authors: John Frederick Trant, Fred Shahbazi Raz, Daniel Meister, Anupom Roy | Chair: Fred Shahbazi Raz

The biosynthesis of cannabinoids remains incompletely understood at the molecular level. Newly identified oxidoreductases, tetrahydrocannabinolic acid synthase (THCAS), CBDAS, and CBCAS catalyze the oxidative cyclization of cannabigerolic acid (CBGA) into THCA, CBDA and CBCA. All three enzymes are highly similar, and all three enzymes produce all three products in different ratios. The "leakiness" of these enzymes is peculiar. They all have FAD in the active site, unusually covalently bound at both ends by the enzyme, locking it in place. Mutational analysis of the active-site suggests a key role for some residues, and product ratios are highly pH dependent. CBDAS shares 84% sequence similarity to THCAS and the reaction mechanism of CBDAS is most probably similar to that of THCAS, CBCAS remains uncharacterized. The reaction mechanism for the conversion of CBGA into different products remains unclear based on crystal structure and mutational analysis. In this work, we investigated the enzymatic mechanism of last step of cannabinoid biosynthesis by computational modeling and structural analysis. Homology modeling followed by induced fit docking investigates the binding of CBGA to the active site as a function of local pH. The protonation state of the implicated residues (TYR484, TYR417, HIS292) was investigated in each of the 8 possible combinations for each receptor. To investigate the conformational stability of the substrate in the active site and to relax the simulation system for QM/MM calculations, MD simulations were performed. (QM/MM) study by Guassian provide important insight into mechanistic details that was not be possible via experimental analysis alone, and our preliminary results help explain what is happening in these pockets. The catalysis of THCA synthesis involves a hydride transfer from C3 of CBGA to N5 of FAD and the deprotonation of O6 of CBGA by TYR484 and water in conversion of CBGA to THCA. However, H292 and Tyr419 play important roles in changing CBGA to CBDA and CBCA. This modelling is expected to allow for enzymatic engineering allowing potential access to some of the other cannabinoids which are produced as side products from this enzymatic reaction, and that could show very significant biological activity.

The Use of Hemp Seed as a Feed Ingredient for Laying Hens: an Evaluation of Fatty Acid Transfer

Oral Presentation | Authors: Brian Parr, Mallorie Snider, HuiChang Chae, Tony Brannon | Chairs: Massimo Bionaz, PhD, Serkan Ates

The reinvention and growth of the hemp industry has presented multiple opportunities to examine the benefits of various parts of the hemp plant. This study sought to observe the benefits associated with using hemp seed as a feed ingredient for laying hens.

Fifty Red Star layer hens were used in this experiment. Half of the hens were randomly assigned to a control diet and were fed commercially available organic layer pellets that could be obtained locally (Organic Egg Layer Pellets). The other half were assigned an experimental diet which consisted of 50% organic layer pellets and 50% hemp hearts. Every 7 days, hen weights were collected and recorded. Every 24 hours, feed weigh backs were collected, and fresh feed was given. The collected eggs were transferred to the lab for fatty acid composition analysis via gas chromatography. As a result, there was no significant difference in egg production between the control and experimental laying hens, $t(45) = 495$, $p = 6229$. Also, there was no significant difference in the amount of feed that hens consumed to lay eggs. In the fatty acid composition of egg yolk, saturated fatty acids such as, palmitic acid (PMA) and palmitoleic acid (POA), as well as monounsaturated omega-9 fatty acids, such as oleic acid (OLA), were significantly higher in control eggs (soy-fed) than in experimental eggs (hemp-fed). Stearic acid (saturated fatty acids) is significantly higher in experimental eggs (hemp-fed) than in control eggs (soy-fed). Polyunsaturated omega-6 fatty acids such as linoleic acid (LLA) and polyunsaturated omega-3 fatty acids, such as alpha-linolenic acid (ALA) and docosahexaenoic acid (HDA), are significantly higher in experimental eggs (hemp-fed) than in control eggs (soy-fed). Results suggest that the inclusion of hemp seed in the layers diet had no adverse effects concerning number of eggs produced and resulted in similar amounts of feed consumption. It was also determined that the polyunsaturated fatty acids were increased in the experimental egg yolks due to the inclusion of hemp seed in the layers diet.

WEDNESDAY, AUGUST 4, 2021

3:15 PM – 3:40 PM

Does Cannabis Use Reduce Opioid Use? Cannabis the Exit Drug®

Oral Presentation | Author: Uma Dhanabalan | Chair: Kenneth Finn

CANNABIS is in Schedule I drug since 1970, due to the Controlled Substance Act (CSA). It means Cannabis has a high potential for abuse, no currently accepted medical use and lack of accepted safety. Opioid overdose deaths in the United States have risen 35% since 2015 reaching 70,630 in 2019 and topped 90,000 in 2020. Determine the therapeutic impact of medical cannabis with chronic pain, opioids, other medications, and the quality of life (QOL) over time.

A retrospective, longitudinal, case-control design was used to study 30 adults with chronic pain who were certified as Medical Marijuana (Cannabis) patients in Massachusetts and followed over one year. The outcome variables were related to changes in participants Prescription Monitoring Program(PMP) positive for opioids and all narcotics, change in pain level and Quality of life QOL.

Statistical Significance was set at a p-value of 0.05.The sample included a total of 30 patients of which 18(60%) males and 28(93%) Participants reported a statistically significant reduction in pain from initial (M= 6.5, SD = 2.0) to first visit (M= 4.3, SD = 2.2) ($p<.001$) and to second visit (M = 3.9, SD = 2.2) ($p<.001$). There was a statistically significant decrease in current number of medication prescriptions from initial (M = 6.3, SD 6.8) to first visit (M = 5.1, SD 6.5) ($p<.001$) and to second visit (M = 4.7, SD = 7.0) ($p< .001$). There was a statistically significant decrease in total number of medications PMP positive from initial (M = 1.4, SD = 1.7) to first visit (M = .87, SD = 1.5) ($p = .001$) and to second visit(M = .67, SD = 1.1) ($p = .01$)

The study results demonstrated statistically significant reductions in prescription and non-prescription medications–including opioids, narcotics, and other pharmaceuticals, as well as a decrease in pain; a decrease in the total number of medications; and an improvement in QOL.

Cannabis can be a safe alternative to other treatment modalities for managing chronic pain and improving QOL while reducing overall harm. Further research is needed to show cannabis' efficacy and safety profile in different populations.

3:40 PM – 4:05 PM

Regulating Heavy Metals in Cannabis and Hemp: What can we learn from the Pharmaceutical Industry?

Oral Presentation | Author: Robert Thomas, C. Chem | Chair: Joanna Zeiger, William Silvers, MD

The lack of federal oversight with regard to medicinal cannabis and hemp products in the US has meant that it has been left to the individual states to regulate its use. Medical marijuana is legal in 36 states, while 16 states allow its use for adult recreational consumption. The sale of these products is strictly regulated by their THC and CBD content, depending on their use. However, it's also critical to monitor levels of contaminants such heavy metals, as the cannabis plant is known to be a hyper-accumulator of heavy metals in the soil. Unfortunately, there are many inconsistencies with heavy metal limits in different states where medical cannabis is legal. Some states define four heavy metals while others specify up to eight. Some are based on limits directly in the cannabis, while others are based on consumption per day. Others take into consideration the body weight of the consumer, while some states do not even have heavy metal limits. So clearly there is a need for consistency across state lines, in order that consumers know they are using products which are safe to use. This oral presentation will take a closer look at how the pharmaceutical industry changed its 100-year-old sulfide precipitation test for a small group of heavy metals, to finally arrive at a list of 24 elemental impurities using plasma spectrochemical techniques. The cannabis industry can learn a great deal from this process to not only understand the many potential sources of heavy metal contamination, but also how the final cannabis products can be contaminated by the manufacturing equipment, the extraction process and the delivery systems used.

THURSDAY, AUGUST 5, 2021

9:00 AM – 10:20 AM

The Impact of Lack of Standards of Cannabis Labelling and Dosing on Research and Consumption.

Panel Discussion | Chair: Joanna Zeiger

This panel discussion will cover several areas regarding the lack of standardized labelling and dosing and its impact on the industry. In terms of the effect on scientific research, particularly questionnaire based studies, participants are unable to give accurate information about how much cannabis they are using and what ratios of CBD and THC they are using; this makes it difficult for researchers to determine accurate information on what doses work best for various conditions. For consumers, the lack of standardization is also problematic because often they do not know how much they are taking, how much to take (since each company has its own dosing schedule), and how determine what ratio of CBD:THC is most beneficial. In addition, the labels on many products are difficult to read and droppers for tinctures are often not marked meaning it is guess work to determine how much of a dropper to consume. Standardized labelling and dosing will make things easier for researchers and safer for consumers.

9:05 AM – 9:30 AM

How the Cannabis Industry Gets Involved in Cannabis Research: from Product Quality Improvements to Clinical Risk Assessment

Oral Presentation | Authors: Matthew Elmes, Jeff Lombardo, Keith Aqua | Chair: Matthew Elmes

While non-hemp cannabis remains federally illegal, over recent years a thriving cannabis industry has emerged in many areas of the United States. Despite ever-changing regulatory burdens, the cannabis industry has now matured to the point where it is attracting scientists and other leading experts to conduct research to create better products and advance our knowledge of cannabis and cannabinoids.

Research within CannaCraft takes place across many broad areas of focus. Much effort is devoted to improving the quality and stability of manufactured cannabis products. One particular challenge has been that emulsification of THC promotes oxidative damage to the molecule, leading to shorter-than-desired shelf life for infused beverages. We will provide an overview of the in-house strategies developed to overcome this phenomenon to create shelf-stable beverage formulations.

Assisting clinical research efforts around cannabis and cannabinoids has recently become an additional industry priority. We recently participated in a collaborative, IRB-approved observational research study looking at potential liver toxicity resulting from daily CBD consumption in order to provide important clinical data requested by the FDA to aid in determining appropriate regulatory paths for cannabinoids. Healthy adults that attested to taking CBD daily were recruited and their ad libitum CBD intake was monitored via phone app, as well as perceived effects and adverse events. Following two months of daily CBD consumption, a blood draw was taken and common markers of hepatotoxicity (ALT, AST, ALP, Bilirubin) were assessed. This observational study concluded with a total of 839 daily CBD users completing the study. The participants exhibited no evidence of liver toxicity after consuming CBD for a minimum of 60 consecutive days. Of all participants tested, only three exhibited clinically-relevant elevations of ALT, and all three were found to concurrently take prescription medications known to elevate liver enzymes so the data from these few participants are under further investigation. A listening session has been scheduled with the FDA to apprise them of these germane clinical findings.

Over the past decade cannabis has gone from 'black market' to a respected modern industry that is actively providing valuable data and techniques to support both industrial and academic pursuits.

THURSDAY, AUGUST 5, 2021

9:05 AM – 9:30 AM

Regulation of Cannabis Contaminants in the U.s.: Inconsistencies in Limits, Lack of Relevancy to Agriculture, and Need for Centralized Oversight

Oral Presentation | Authors: Maxwell Leung, Laura E. Jameson, Dorina Pinkhasova, Haleigh Boulanger, Kendra D. Conrow, Michael P. Simeone, Thomas Cahill, Neya Jourabchian, Iniobong Afia, Steve Johnson, Cindy Orser | Chair: Sheldon Henderson

The inconsistency in the regulation of cannabis agriculture presents a potential challenge to human health and the environment. Here, we curated the regulated contaminants in medical and recreational cannabis in 33 states and Washington, D.C. and compiled complete lists from regulatory documents for pesticides, inorganics, solvents, and microbes/mycotoxins. Twenty-eight of the 34 jurisdictions set contaminant limits or action levels, 21 of which created their own contaminant lists. The remaining 7 jurisdictions compiled lists from other sources. These sources included (i) the Herbal Medicine Compendium; (ii) the U.S. EPA 40 CFR Part 180 Tolerances and Exemptions for Pesticide Chemical Residues in Food; and (iii) the pesticides examined by the USDA in its 2010-2011 Pilot Study: Pesticide Residue Testing of Organic Produce. All but one state attempted to categorize contaminants. Yet, many of these contaminants, particularly pesticide-related chemicals, were improperly categorized. Using the U.S. Environmental Protection Agency CompTox Chemicals Dashboard, we generated a comprehensive list of 682 unique contaminants regulated in the U.S. These included 565 pesticides, 71 solvents, 26 inorganics, and 17 microbes and mycotoxins. We found large variations in action levels that could not be explained by patterns of use, human health risk, or environmental concerns. For instance, three states applied the same action level to all of their regulated contaminants. The top three categories of pesticides are herbicides (153), insecticides (128), and fungicides (112). Since medical and recreational cannabis consumption is increasing in the U.S. and the number of states with some degree of legal use continues to increase, the lack of federal oversight has led to a scattershot approach to the regulation of contaminants and contaminant levels in this industry. This may either confuse growers or encourage overuse of chemicals, resulting in potential health risks to the consumers as well as adverse effects on the environment.

The Greenhouse Gas Emissions of Growing Cannabis Indoors

Oral Presentation | Authors: Hailey Summers, Jason Quinn, Evan Sproul | Chair: Jason Quinn

Cannabis cultivation has grown substantially since legalization. However, little was known about the magnitude of greenhouse gas emissions (GHGs) from growing cannabis indoors. Our recent publication quantified the GHGs from standard indoor cultivation practice around the United States using life cycle assessment methodology. We found that GHGs range from about 2200 to 5200 kg CO2e per kg-dried flower, and are mostly due to indoor environmental controls, lights, and carbon dioxide for increased plant growth. We also observed regional trends showing areas such as the Colorado Rockies and Midwest United States resulting in more than twice as much GHGs than regions like the East and West Coasts. Our continued work is now focused on communicating these results to the consumer. To do this, we have evaluated GHGs on a consumer-friendly portion which in this case we are calling a serving size. One serving size was determined to be the amount of dried cannabis flower necessary to deliver the consumer 10 mg of tetrahydrocannabinol (THC). Comparisons are made between one serving size of cannabis to other food-based consumables including meat, dairy, and legume products as well as recreational consumables including beer, wine, and spirits. Increased consumer awareness may help drive the industry toward more sustainable practices, but informing the consumer has inherent challenges. These challenges and limitations will also be presented. Last, future work investigating GHG reduction potentials are evaluated. The GHGs from greenhouse and outdoor growth environments, adopting alternative clean-energy technology solutions, and policy-based adoption scenarios will be presented and discussed.

The Important Plant Pathogens Affecting Cannabis Sativa – Epidemiology and Management

Oral Presentation | Author: Zamir Punja, PhD | Chair: Punya Nachappa, Adrianna (Ad) Szczepaniec

The increased cultivation of Cannabis sativa L. (cannabis and hemp) in North America is resulting in larger acreages of these crops, which is accompanied by a corresponding increase in previously unreported diseases. In our research conducted on greenhouse grown cannabis, we have reported a number of important pathogens that can reduce the growth and quality of affected plants. Understanding the epidemiology of these pathogens and developing management approaches are key to ensuring commercial success of the crop. In the early phases of plant growth, infection of rooted cuttings by Fusarium and Pythium spp. can cause significant losses. Both pathogens are easily spread during hydroponic cultivation but the implementation of biological control agents can provide some protection. Powdery mildew infections caused by Golovinomyces spp. can also cause damage if not managed. The appearance of a number of viral pathogens, including Cucumber mosaic virus and Alfalfa mosaic virus, as well as Hop Latent viroid, are also causing reduced plant growth. Strategies for management of these pathogens have not yet been developed. At the final stage of inflorescence development, Botrytis bud rot and infection of floral tissues by other fungi such as Penicllium spp. and Sclerotinia can also cause reductions in harvestable product. These pathogens are difficult to manage in the absence of registered chemicals but biological control products and cultural practices may offer some promise.

THURSDAY, AUGUST 5, 2021

9:05 AM – 9:30 AM

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9:30 AM – 9:55 AM

A New Rapid, Simple, and Efficient Extraction Method for Pesticides in Cannabis Infused Products

Oral Presentation | Authors: Alicia Stell, Candice Cashman | Chair: Sheldon Henderson

With the continued growth of the cannabis industry and the further progression of the legislation around it, the quality control of the products is becoming increasing important. With a growing number of consumers, it is important to guarantee the safety of the products they are consuming. Arguably, pesticide analysis is one of them most difficult challenges of a cannabis lab. Accurate, simple and rapid methods for the determination of pesticides in cannabis infused products is needed. The QuEChERS method has been shown to be practical for pesticide analysis on a number of different sample types. While the QuEChERS method is relatively quick compared to other methods, it is also a manual and tedious process. Herein, a rapid, simple and efficient automated method for the extraction of cannabis infused products that improves the pesticide extraction process is being reviewed. The EDGE, an automated extraction system, is a new technology that combines the processes of pressurized fluid extraction and dispersive solid phase extraction in one. The EDGE will automatically add the solvent, agitate and then extract the sample with elevated temperature and pressure. The extract is automatically cooled and filtered and ready for analysis upon collection. The EDGE was utilized to extract pesticides from a variety of different cannabis infused products, including a range of edibles and the flower itself. The samples were spiked with a standard containing the Oregon state pesticides regulated for cannabis products. Extracts were analyzed on a SCIEX Triple Quad 7500 LC-MS/ The average recoveries obtained for most pesticides in all samples were found to be within 60-101% with most standard deviations below 10%. The EDGE's extractions produced excellent recoveries and reproducibly compared to the standard QuEChERS method for the pesticides extracted in less than 10 minutes in one simple automated process. Thus, the EDGE method offers a rapid, simple, and efficient solution for cannabis testing.

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9:30 AM – 9:55 AM

Characterization of Cannabis Emulsion Infused Beverages for Droplet Size and Zeta Potential – as Indicators of Bio-availability and Shelf Life

Oral Presentation | Author: Vidumin Dahanayake | Chair: Matthew Elmes

Kinetic solubility and therefore bio-availability of cannabis oils can be improved by incorporating them into droplets as oil in water "nano-emulsions". For increased bio-availability, It is desirable to have a monodispersed particle size distribution with a size <200 nm. These droplets are being used in beverages where where particle size affects bio-availability, pharmacokinetics and mouthfeel. Alongside particle size, the interfacial surface charge known as Zeta potential, influences long term shelf stability of these emulsion beverages.

Life Cycle Assessment of Greenhouse Hemp Production and Product Formation in Southern Colorado

Oral Presentation | Authors: Jonah M. Greene, Hailey Summers, Jason Quinn | Chair: Jason Quinn

In 2018, hemp was redefined as an ordinary agricultural commodity on the federal level, creating a plethora of opportunities in all sects of the industry including feminized seed production, CBD biomass production for CBD oil and distillate, smokable CBD flower production, and even raw hemp biomass production for fibrous products. With such a broad range of products and production systems, the true environmental sustainability of each product system is difficult to quantify and understand without detailed modeling that captures all aspects of the system from water use to material and energy inputs. Furthermore, regional weather differences and local energy grids can dramatically alter total carbon emissions associated with energy consumption for greenhouse climate control. The focus of this work was to research the current hemp industry and develop detailed process models to better understand the inputs and outputs of the most common hemp-based products. The scope of the work was limited to greenhouse hemp production in Durango, CO with a focus on feminized hemp seed production, feminized clones, CBD-rich hemp biomass production for oil extraction, and smokable CBD flower. Detailed process modeling with regional and temporal resolution was used in conjunction with Life Cycle Analysis methodology to quantify critical sustainability metrics for the various CBD products. Results from the modeling work indicate that year-round operation of a 23,040 sqft greenhouse facility in Durango, CO emits 1057.4 tonnes CO2-eq/yr for hemp seedling production (0.13 kg CO2-eq/seedling), 909.5 tonnes CO2-eq/yr for CBD-rich biomass production (87.13 kg CO2-eq/kg CBD biomass (dry)), 868.6 tonnes CO2-eq/yr for feminized seed production (0.05 kg CO2-eq/seed), and 886.2 tonnes CO2-eq/yr for smokable flower production (824.6 kg CO2-eq/kg dried flower).

Small Pest, Big Problem: Innovative Strategies to Manage Hemp Russet Mite in Hemp.

Oral Presentation | Authors: Christopher B Hayes, Punya Nachappa, Olivia Carter, Whitney Cranshaw | Chairs: Punya Nachappa, Adrianna Szczepaniec

Cannabis sativa, or hemp, is quickly becoming a crop of global agricultural importance, yet pests associated with the crop and pest management needs are essentially undescribed. Among the most serious hemp pests is a microscopic mite, Aculops cannabicola, the Hemp Russet Mite (HRM). Due in part to its minute size, HRM can go unrecognized by growers and the extent of its economic impact is likely underestimated. This is compounded by the difficulty to eradicate this pest, particularly in indoor cultivation where it can proliferate across crop cycles. The current study is the first report of the life cycle of the HRM. We evaluated HRM populations in field plants treated with a variety of biological controls, and chemical controls compared to untreated plants. Our results showed varying levels of efficacy in reducing HRM population levels on treated plants. Experiments are underway to assess the impact of HRM on phytocannabinoids and yield. In a laboratory setting, we demonstrate that hot water immersion can eradicate HRM without causing phytotoxicity to hemp cuttings. Outcomes of this research will provide hemp producers and other stakeholders key pest management tools needed to produce hemp plants that are free of HRM.

THURSDAY, AUGUST 5, 2021

9:55 AM – 10:20 AM

Cannabis Water Activity Testing Validation Using a Resistive Electrolyte Sensor

Oral Presentation | Authors: Brady Carter, Katherine Evans | Chair: Sheldon Henderson

Water activity provides a determination of safety in cannabis and consequently is already a part of cannabis regulations in many states. Cannabis flower dried to the ideal water activity will not support mold growth while avoiding over-drying which can lead to the loss of terpenes and cannabinoids. The measurement of water activity is then a critical safety and quality test to be performed on dried cannabis flower. While there are several possible sensor technologies for measuring water activity in cannabis, the electrolytic resistive sensor is popular due to its low maintenance requirements and high accuracy. The purpose of this study was to assess the performance of the electrolytic sensor when testing cannabis dried flower and determine if filters are needed when testing cannabis. A cannabis flower sample dried to 0.580 aw by exposure to controlled humidity was tested with and without filters in place using a LabTouch water activity instrument from Novasina, IG. Saturated salt slurry standards at 0.753 aw and 0.843 aw were read both before and after running the cannabis product to determine if running the cannabis product caused any change in the readings of the sensor. The cannabis product was allowed to stay in the instrument exposed to the sensor overnight to ensure extended exposure. The results indicated that the difference in readings of the standards before and after the cannabis dried flower never deviated by more than +/- 0.001 aw both with and without a filter in place, which is well below the +/- 0.005 aw tolerance of the LabTouch instrument. In addition, the water readings on the cannabis flower were 0.590 aw with the filter in place and 0.585 aw with no filter, again within the +/- 0.005 aw tolerance of each other. In addition, the water activity readings taken without the filter better agreed with the controlled water activity of the dried cannabis flower sample. These testing results indicate that cannabis dried flower can be analyzed using a resistive electrolyte sensor and no filter is needed to conduct this testing.

Identifying Key Research Gaps Towards Development of Effective Arthropod Pest Management Systems in Cannabis Crops

Oral Presentation | Author: Whitney Crenshaw | Chairs: Punya Nachappa, Adrianna Szczepaniec

In the very short period that hemp and other Cannabis sativa crops have been legally grown in parts of the United States, the arthropods associated with the crops have been able to be well described, particularly in Colorado. This has allowed for the development of Integrated Pest Management systems for key pests. For some of these, notably corn earworm (Helicoverpa zea), systems can be readily adapted from other crops (e.g., organic sweet corn) and effective microbial pesticides are available. Pest management is presently far more hindered by data gaps associated with arthropods that are strictly associated with C. sativa. This is particularly true with Eurasian hemp borer (Grapholita delineana) a species that has very high potential to seriously impact hemp grown for seed and, to lesser extent, for CBD. Key needs for this species include basic life history studies, including use of alternate host plants, better understanding of potential biological controls, development of effective means of monitoring (e.g., pheromone trapping), and identification of effective chemical controls that have the potential for crop registration. Recent work with hemp russet mite (Aculops cannibicola) has resolved several research needs, but existing gaps hindering management include questions related to dormancy/diapause and how the species persists between crop cycles, improvements in detection, particularly of low populations, and means to effectively disinfest plants so that pest-free mother plants can be produced where clonal production is used. Cannabis aphid (Phorodon cannabis), the most common aphid associated with the crop and the only one restricted to it, requires study on how the insect (and particularly the honeydew it excretes) affects crop quality, how environmental conditions affect survival of dormant eggs produced at the end of a crop cycle following short day length, along with ways to better manage the insect with biological controls. Other insects/mites that are potential pests of hemp, but occur on a wide variety of other crops (e.g., rice root aphid, twospotted spider mite, broad mite, onion thrips, fire ants, grasshoppers) also have existing research needs to allow effective management and will also be discussed.

Cannabinoids and Water: Merge the Insolubles

Oral Presentation | Author: Harold Han | Chair: Matthew Elmes

Developing nano and micro emulsions his entire career, Harold holds a Ph.D in Surface Chemistry from NYU and is the author of two patents in emulsion chemistry. Prior to founding Vertosa, Harold was the senior emulsion scientist at Bio-Rad Laboratories, where his team scaled emulsification oil and supplied product to 90 countries. Previously, he founded a startup company in Silicon Valley.

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9:55 AM – 10:20 AM

Whole Farm and Enterprise Analysis Tool for Evaluating Hemp Production

Oral Presentation | Authors: Clark Seavert, Trent Teegerstrom, Maryfrances Miller, Paul Gutierrez, Oluwatobi Omotayo | Chair: Jason Quinn

The introduction of new crops into an existing cropping system is always a difficult balance between current production practices, existing commodity markets, and the economic impact on profits of a farm business. Additional challenges occur due to imperfect market information as local markets may not exist for the new crop. Past crop evaluations most likely included enterprise budgets with fixed inputs and resource allocations, so decisions about including a new crop were made without full consideration of changes to inputs and fixed assets, and these impacts on the profitability of a business. To effectively assess the potential adoption of new crops, the Authors developed the BENCO (Break-even for New Crop Options) Model, which allows producers to vary the level of acreages adopted, crop mixes, and changes in production inputs. The BENCO model creates an interactive enterprise budget for each current and future crop and determines the contributions of each crop to whole-farm net returns. Inputs that could impact adopting a new crop include water use and machinery costs, such as labor, fuel, repairs, and replacement costs. As producers look to adopt hemp, a holistic approach provides a more representative look at the break-even price and yield of all crops in the system. Using both the whole-farm analysis tool and the budget enterprise tools allows producers to make a more informed decision about the economics and overall fit of the crops into their operation. Adding additional information to new crop adoption decisions may have additional benefits of smoothing some of the volatility and disorder that characterized the first years of the hemp industry.

10:40 AM – 12:00 PM

The Varieties of Cannabis Regulatory Experiences: The intersection of standards, regulations, and research

Panel Discussion | Chair: Jahan Marcu

Researchers, licensed cannabis operators, financial institutions, and their cohorts seemed to be challenged by a labyrinth of federal roadblocks and ever-changing State regulations impacting cannabis clinical research and medical usage. Guidance documents and standards developed by globally recognized non-profit organizations have a precedence for providing clarity surrounding accepted best practices. Historically, standards groups are aided by experts from industry, academia and healthcare, providing the technical expertise and real-world experience that leads to the creation and adoption of guidance documents to allow governments to properly regulate the industry to protect public health and to allow researchers to conduct reproducible studies. Combining scientific research, policy, and industry guidance, the result is a robust and evolving set of standards that provide ever pressing solutions to a nascent industry. The combined presence of the panel, representing three standards groups. with active Cannabis standards development committees, will discuss their roles and hopes for cannabis and hemp industries. The panel will provide a distillation from peer-reviewed journal articles, consensus standards, and guidance documents. Attendees will be able to participate in a discussion that will better their understanding of the solutions that exist, and how they can support the application of expertise and data in guiding research and creating policy. We welcome attendees to bring their most pressing questions and issues for panelists to discuss.

12:00 PM – 1:30 PM

The Role of Endocannabinoid and Paracannabinoid Signals in Pain Regulation

Mechoulam Lecture | Speaker: Dr. Daniele Piomelli | Chair: Chad Kinney

Sponsored by Black Hills Energy

The endocannabinoid system is an important regulator of pain processing. Anandamide-mediated signaling at peripheral CB1 receptors may act as a 'gate' that limits entrance to incoming pain-related information. Analogous functions have been ascribed to paracannabinoid messengers – endogenous bioactive lipids that share key biogenetic and degradative steps with the endocannabinoids but do not interact with cannabinoid receptors (from Greek **παρά**, 'around'). The lecture will highlight the complementary roles of endocannabinoid and paracannabinoid signals in pain regulation.

Insights from a Led Retrofits and the Interactive Effects on Hvac Operation, Environmental Conditions, and Yield

Oral Presentation | Authors: Dan Banks, Nick Drury, Jake Mitchell, Damien Markiewicz | Chair: Jason Quinn

The energy efficiencies associated with the transition from HID to LED lighting for cannabis cultivation is well documented, however understanding how this impacts the facilities other systems is not well known. This study will evaluate the effects of transitioning from HID to LED lighting in both greenhouse and indoor cannabis cultivation operations. Lightshade, one of Colorado's largest vertically integrated, independently owned-and-operated cannabis businesses, is working to retrofit its Greenhouse and indoor facilities with LED lighting over the Spring of 2021. In addition, Lightshade is working with Resource Innovations to track energy usage and savings throughout these projects. Utility grade EGauge meters and JD Sensing CT's will be utilized for all energy consumption monitoring. All environmental conditions including temperature, humidity, CO2 will be monitored through Onset HOBO devices and/or Argus environmental monitoring syste Cannabis yield and potency data of harvest batches are tracked according to State compliance requirements and company policies. Pertinent data will be collected and then analyzed to show metrics such as g/kWh (per strain), DLI, lighting intensity, energy efficiency, energy cost/cultivation sq. ft, and other data that is useful to the cultivation facilities. Consistent with M&V protocols (e.g. IPMVP Core Concepts), the baseline energy analysis will be adjusted if the production or other significant drivers of energy consumption are different for the post-retrofit system as compared to the baseline. This work is ongoing, and we will have more results available closer to the conference, but once the program is completed, we anticipate to see annual savings of 889,272 kWh in the indoor facility and 1,003,281 kWh based on the lighting alone. In addition we will present changes in HVAC, dehumidification and ancillary equipment energy usage as well as facility environmental conditions, crop yield, and cannabinoid content.

Remote Potency Analysis for Quality Control of Hemp Derived Cannabinoids in Various Matrixes

Oral Presentation | Authors: Sheldon Henderson, John Michalek, Paul Peaden, Matthew Morse | Chair: Sheldon Henderson

Industrial hemp is a plant of the genus Cannabis and any part of the plant, whether growing or not, containing a delta-9 tetrahydrocannabinol (THC) concentration of no more than 0.3% on a dry weight basis. Cannabinoid concentrations are carefully monitored using contract or in-house laboratories utilizing high performance liquid chromatography (HPLC) to determine cannabinoid potency and for product labeling and meeting state and federal guidelines for THC in hemp. Significant changes in Cannabinoid concentrations during cultivation, processing or final packaging and may not be detected with traditional laboratory testing schedules. A point of need HPLC provides important information about crop potency to facilitate profitable harvesting decisions while adhering to federal regulations for THC levels in hemp. Miniaturization of an HPLC enables analytical determinations at the point-of-need. The HPLC used in this experiment: A lightweight (8 kg), and hand-portable HPLC-UV with capillary column for cannabinoid determination in the field. This HPLC consumes 1/1000th of the solvents of traditional HPLCs. This dramatically reduces the need for large solvent and waste bottles that inhibit transport of an HPLC to a field sampling site or placement in compact locations. This paper will demonstrate the ability of the compact and portable LC in a non-laboratory environment to determine cannabinoids– including CBDA, CBD, THC and THC-A. Matrixes include various in process phases or retail over the counter products, such as processed biomass, Over the counter hemp oil capsules or full spectrum cannabinoid drinks. A summary of Instrument performance includes data on retention time variability (RSD) and amount detected variability (RSD) and performance or comparative data to assess the performance of the portable HPLC to more traditional HPLC laboratory testing .

THURSDAY, AUGUST 5, 2021

10:45 AM – 11:10 AM

The Vector Ecology of Circulifer Tenellus and Its Association With Beet Curly Top Virus in Hemp

Oral Presentation | Authors: Judith Chiginsky, Ana Cristina Fulladolsa, Mark Steinglein, Whitney Cranshaw, Punya Nachappa
Chairs: Punya Nachappa, Adrianna Szczepaniec

Hemp (Cannabis sativa L.), is a rapidly growing industry in the United States. Colorado is one of the biggest hemp growing states having over doubled its acreage from 35,950 in 2018 to over 75,000 in 2019. However, the crop has been understudied in the U.S. since its production declined in the late 1950s and information on the biological and agricultural factors affecting hemp under current conditions is limited. Disease identification and management is an increasing challenge for hemp growers across the country. For instance, beet curly top virus (BCTV), which is transmitted by Circulifer tenellus (beet leafhopper), was recently shown to infect hemp plants in Colorado. Since its initial detection, we have confirmed the virus from 12 counties in Colorado, with several fields reporting disease incidence levels above 50%. We found BCTV-Worland and BCTV-CO strains and many mixed infections. Using next generation-based metagenomics we have characterized the virome of hemp. Life history and whole plant preference assays were performed in BCTV viruliferous and non-viruliferous beet leafhopper to understand the impact-if any, the virus has on vector behavior, survival and fecundity. A survey of beet leafhopper and BCTV was performed in hemp to understand their abundance and seasonality in Colorado. The results of this research will improve diagnostics through the development of and accessibility of species-specific primers. Accurate and efficient identification of viruses and viroids will help target control strategies through integrated pest management and interruption of transmission cycles, in turn reducing yield losses.

11:10 AM – 11:35 AM

Influence of Hemp Cultivars on Cannabis Aphid Reproduction and Development

Oral Presentation | Authors: Erika Peirce, Melissa Schreiner, William Jacob Pitt, Whitney Cranshaw, Punya Nachappa
Chairs: Punya Nachappa, Adrianna Szczepaniec

The cannabis aphid, Phorodon cannabis Passerini (Hemiptera: Aphididae), is native to Asia and was officially recorded in North America in 2015. As is the case with all pest species of aphids, the cannabis aphid has the potential to cause significant crop damage both directly by ingestion of phloem sap and indirectly by vectoring viruses that cause plant disease. There is evidence that cannabis aphids can cause considerable damage to indoor-grown hemp due to the absence of natural enemies and varying maturities of plants. Natural enemies vary in effectiveness at controlling aphid populations, and there are limited pesticides available for use on hemp, which adds importance to the search for other methods of aphid control. Employing cultivar resistance to aphids may be a viable way to control future aphid outbreaks, but this first requires an assessment of aphid fitness responses to various cultivars. For this study, we assessed the intrinsic rate of increase and multiple life history traits of the cannabis aphid on three different hemp cultivars. In this study, Hemp cultivars were Tiborszallasi (Tibor), American Victory (AV), and Unicorn. Unicorn was bred to have high CBD content, and the other two are fiber cultivars. Plants were grown in a growth chamber where a single aphid was placed into cages attached to leaves. For each aphid, we recorded each life stage length and the number of nymphs produced by the adult. We calculated population-specific parameters such as the intrinsic rate of increase, finite rate of increase, mean generation time, and doubling time. Adult survival was significantly longer on Tibor (10.19 ± 0.9 days, n=21) when compared to American Victory (6.43 ± 1.29 days, n=7) and Unicorn (5.31 ± 0.94 days, n =13). Intrinsic and finite rate of increase did not differ significantly between cultivars. Results show cannabis aphid development is affected by cultivar, suggesting a mechanism of resistance is involved. Further data is being collected to quantify differences in plant compounds between cultivars.

THURSDAY, AUGUST 5, 2021

11:10 AM – 11:35 AM

LC-MS/MSMethod With ESI and APCIi Ion Source for Analysis of Pesticides and Mycotoxins in Medium-chain Triglyceride Oil Cannabis Tinctures

Oral Presentation | Author: Avinash Dalmia | Chair: Sheldon Henderson

A novel LCMSMS method with dual ESI and APCI source was developed for analysis of 66 pesticides and 5 mycotoxins regulated by California state in medium-chain triglyceride (MCT) oil cannabis tinctures. The LOQs of all of pesticides and mycotoxins were well below California action limits of these analytes in cannabis based edible products. We analyzed 62 out of 66 pesticides and 5 mycotoxins on California list with ESI source. The rest of four pesticides (normally analyzed by GC-MS/MS) out of 66 pesticides on California list were analyzed in cannabis tincture matrix using APCI ion source with good selectivity, sensitivity and linearity. We would also elucidate the ionization mechanism of pentachloronitrobezene (PCNB) and other pesticides analyzed with our APCI method by analyzing its mass spectra and studying the effect of mobile phase composition on signal of PCNB and reagent ions such as superoxide. A simple, fast and cheap solvent extraction method was used for sample preparation to get good recovery and achieve high throughput for this analysis. A number of internal standards were added to our method to compensate for ion suppression effects from hydrophobic medium chain triglyceride (MCT) oil matrix for late eluting analytes. The ability to screen and quantitate all 66 pesticides, including the very hydrophobic and chlorinated compounds normally analyzed on a GC-MS/MS system, and the five mycotoxins, makes this method a novel way to screen and quantitate pesticides and mycotoxins in cannabis tincrtures with a single instrument.

Medical Vs. Recreational Marijuana Sales in Colorado During Covid-19 Pandemic

Oral Presentation | Authors: Monica Hernandez Comparan, Kim Turner | Chair: Jason Quinn

Given the unexpected rise of the pandemic, marijuana sales have surged. Measures put in place to purchase marijuana can be put to blame for this spike in sales, specifically the summer months(April-September). Everybody has different methods for coping and with an unexpected crisis, the sales of those methods can tend to increase. The purpose of this study includes three-folds: first to examine the trend over time of cannabis sales in Colorado from January 2014 through February 2021, second to explore the attributable factors that support the sales, and third to predict whether those factors will prolong the sales trend. Given that this sales trend has the ability to go on longer than expected, this could have a positive effect on the Colorado economy. This study includes data obtained from the Colorado Department of Revenue; detailing medical and retail marijuana sales from January 2014 to February 2021. Data reported is collected from State Sales and Retail Marijuana Tax Returns. Statistical analysis and Tableau have been applied to visualize and analyze the data. There is a slight increase in sales for medical marijuana, but a significant increase in retail sales. The most significant reason for the increase being the legalization and commercialization of marijuana dispensaries throughout the state. Covid and the systems implemented to sell cannabis, also contributed to the increased retail sales. Methods accompanied with Covid have attracted a consistent stream of traffic causing for this sales trend to stay. Due to the increase in total marijuana sales in the state of Colorado, there has been a substantial positive impact on the Colorado economy, thus allowing the state to improve its education and health care. The results assist the government agencies to make better decisions in terms of cannabis regulations and policies. Using Tableau to visualize the data, there have been increases overall in both categories of marijuana sales. Visualization also shows that there is an element of seasonality in sales, where more medical and retail sales are being made in summer months. In addition, retail marijuana sales are the main contributor to total marijuana sales in the state of Colorado.

THURSDAY, AUGUST 5, 2021

11:35 AM – 12:00 PM

Improving Data Quality and Sample Turn Around Time With an Fully Automated Pesticide Workflow Solution

Oral Presentation | Author: Toby Astill | Chair: Sheldon Henderson

New automated sample preparation, analytical and software workflows have been developed and verified to allow cannabis & CBD laboratories to complete the entire pesticide & mycotoxin assays quickly and accurately on one technology platform in the shortest time possible. Cannabis flower data will be presented to show the suitability of the process and methods in a cannabis laboratory following the California testing requirements for 66 pesticides and 5 mycotoxins; specifically the analyte recovery, sample throughput per shift, reproducibility across samples, and the benefit of operating with internal standards to reduce matrix interferences. In addition, the software framework needed for compliance (ISO, GMP, CFR Part 11) will be reviewed and discussed to address potential sources for error or inefficiency. References from both a compliance cannabis lab, and an internal CBD QC lab, will show that having a validated method, and SOP, for the testing of pesticides is key in ensuring the highest quality of cannabis reaches the consumer. Finally, the influence of the cannabis sample type, or matrix, tested will be discussed as the sample type matrix (flower, extracts, and edibles) has considerable effects on the data integrity.

The Cannabis Aphid (Phorodon Cannabis Passerini): a Newly Described Vector of Potato Virus y

Oral Presentation | Authors: William Jacob Pitt, Lisa Kairy, Punya Nachappa | Chairs: Punya Nachappa, Adrianna Szczepaniec

Hemp (Cannabis sativa L.) is capable of becoming infected with potato virus Y (PVY), a potyvirus vectored by over 50 species of aphids. Despite low transmission efficiencies, these aphids can be important contributors to PVY prevalence. Additionally, many of these aphids are specialists that host on a small range of plant species, as is the case with the cannabis aphid and hemp. With the increasing acreage of hemp in the western United States, we were interested to know if the cannabis aphid (Phorodon cannabis Passerini) is a vector of PVY. We conducted a field survey in Colorado during the 2020 growing season to determine PVY prevalence and observe cannabis aphid community dynamics. To determine transmission efficiencies and explore host plant-virus-vector relationships with the cannabis aphid, we conducted transmission assay and electrical penetration graph (EPG) experiments. Field results show that hemp was a prevalent crop and the cannabis aphid was the third most abundant aphid species during the early season. Results from laboratory experiments show that the cannabis aphid can acquire PVY from an infected host and can transmit the virus to hemp (60.5% efficiency) and potato (19.2% efficiency). Preliminary EPG analysis shows that within the first hour of feeding, aphids perform significantly more cell punctures (pd waveforms) on hemp than on potato, which may help explain the higher transmission in hemp than potato. This is the first report of the cannabis aphid as a vector for PVY. The results of this study may be useful in the development of management strategies for aphids and PVY and will further basic knowledge of host plant-virus-vector interactions.

1:30 PM – 2:50 PM

Additives in Cannabis Products

Panel Discussion | Chairs: Stephen Goldman

The vape associated lung injury (VALI) crises of recent times has taught us a lot about the risks involved in cannabis products currently for sale in the United States. The topic will discuss current trends, evaluate recent work done in the state of Colorado by the Additives subcommittee of the State's Science & Policy workgroup (CDPHE and MED collaboration) and what steps industry is taking to mitigate these risks.

The Sustainability of Cannabis and Hemp: Economics and Life Cycle Assessment

Panel Discussion | Chairs: Jason Quinn

The sustainability analysis of cannabis and hemp production represents a critical aspect of defining future research and development areas. Sustainability is divided into two interconnected areas: Techno-Economic Assessment (TEA) and Life Cycle Assessment (LCA). These assessment techniques can be used to understand critical operational decisions by growers and policy makers in terms of economics and environmental impact. This session will pull together experts in the area of sustainability to present results from the modeling of large scale cultivation systems. The session will identify critical areas for research focused on improving the economic viability and environmental impact of cannabis and hemp production.

Galling and Reproduction of the Southern Root-knot Nematode, Meloidogyne Incognita, on Hemp (cannabis Sativa) Cultivars

Oral Presentation | Authors: Ernest C. Bernard, Angela G. Chaffin | Chairs: Punya Nachappa, Adrianna Szczepaniec

Cultivation of hemp is rapidly expanding, especially of medicinal varieties with high levels of THC or CBD. Susceptibility of hemp to plant-parasitic nematodes, however, is poorly known due to lack of investigation for most of the past 100 years. A small greenhouse trial demonstrated a strong difference in susceptibility of a fiber cultivar ('Delores') and a CBD cultivar ('Wife') to root galling by the southern root-knot nematode, Meloidogyne incognita. This nematode causes serious economic loss on a wide range of crops and can parasitize more than 2,500 plant species. The difference in galling prompted more definitive greenhouse experiments. Fiber-type varieties were grown from seed, while CBD-rich selections were propagated by means of terminal cuttings. Young plants were transplanted into a 3:1 mix of sand:peat in 15-cm-diam. pots, then infested with 5,000 eggs/pot (Pi) of a stock M. incognita population. Supplemental light was provided to extend daylength and prevent flowering. All experiments were arranged in randomized block designs. 'Rutgers' tomato was used as a check on inoculum viability. Root systems were harvested 55–60 days after infestation and rated for galling, after which eggs were extracted and counted. Final egg reproduction (Rf) values were calculated: Rf = Pfinal/Pi; Rf-max (maximum) values are used for comparison. Galls were small, white and hard due to extensive production of disorganized vascular tissue and columns of stacked vascular parenchyma. Three fiber cultivars were all moderately galled, with Rf-max values of 10.4–11.1. For CBD cultivars, 'Charlotte's Web' was an excellent host with an Rf-max of 39.6, followed by four other cultivars (Cherry, OG, Suver Haze, T1) with Rf-max values of 10.5-16.8. 'Siskiyou Gold' (4.8) and 'Special Sauce' (8.8) were moderate hosts while 'ACDC' and 'Carolina' were poor hosts (Rf-max 3.1 and 2.4, respectively). 'Wife' was highly resistant with an Rf-max of 0.2. The wide range of reactions among hemp cultivars, from highly susceptible to nearly immune, will serve as a basis for developing resistant selections should M. incognita become a limiting factor in hemp production.

Preliminary Study Olfaction and Acute Cannabis Use

Oral Presentation | Authors: Denise A. Valenti, Allen Mello | Chair: Denise A. Valenti

Background - Cannabinoid receptors have been identified in the sensory olfactory epithelium, main olfactory bulb, piriform cortex as well as other brain regions. Cannabinoid receptors are involved not only in odor detection, but in olfactory learning and memory.

Methods - Using a novel test of olfaction we tested three male opportunistically dosed casual cannabis users. Participants were selected based on demographics and scheduling for a separate IRB approved protocol. We tested three college educated, fully employed being seen in sequence. The novel olfactory test used odorants selected from the McCormick line of food extracts. There were categories of odorant; citrus, sweet and pungent. We placed a small amount of the odorants in nine test tubes and used six-inch cotton swabs for each test. The participants arrived undosed, signed consent forms, filled out a frequency of use survey and had baseline testing of visual functions, eye tear biologic, blood pressure and heart rate. Testing consisted of demonstrating each odorant and then blindfolding the participant and slowly moving different odorants in from an initial distance of six cm. The distance, general response time and declared identification of the odorant were recorded. Participants left the lab after advising us where to have Uber pick them up after dosing with their own legal adult use cannabis. Upon return, blood was drawn and all the baseline data were administered again. Data obtained related to odorants were descriptive.

Results and Discussion - There were differences in knowledge of odorants among the three participants. Food experiences were the primary influences on initial knowledge. Undosed testing was unremarkable and there were no deficiencies identified. With dosed testing there were semantic word finding difficulties primarily within categories. There were deficiencies in discrimination within categories and this was most noticeable within the citrus grouping of orange, lemon and lime. However, distance of declared identification was most often either unchanged and in a few identifications, improved.

Conclusions - Cannabis may impact olfaction; but not necessarily detection, but the discrimination of food related odorants. Testing needs to take into consideration semantic difficulties that occur with marijuana use. Further research including addition of aversive odorants is warranted.

THURSDAY, AUGUST 5, 2021

2:00 PM - 2:25 PM

Challenges of Managing Fire Ants in Southern Hemp

Oral Presentation | Authors: Katelyn Kesheimer, Jessica Kelton | Chairs: Punya Nachappa, Adrianna Szczepaniec

Fire ants, Solenopsis invicta, are an agricultural and nuisance pest across the southeastern United States. These invasive ants can injure or kill livestock or humans and their large mounds often damage equipment. Fire ants are also pests on several crops including okra, citrus, and recently, hemp. They will form mounds at the base of or adjacent to hemp plants and feed. Their feeding and tunneling activity can cut off nutrients and water to the rest of the plant, leading to plant death. In Alabama's first year of legal hemp production in 2019, we received reports of outdoor hemp damaged by fire ants. Some producers reported losing over half their crop to fire ant damage. To help identify potential management strategies, we conducted fire ant trials on a grower-cooperative farm in 2020 and a university research station in 2021. We explored the use of a soil fumigant, Pic-Clor 60 EC, to suppress ant populations. Pic-Clor 60 is a multi-purpose soil fumigant used in pre-plant treatments with chloropicirin as the active ingredient. Plots that received the fumigant treatment had significantly lower fire ant forages compared to the untreated control or conventional bait treatment. Yield could not be assessed due to caterpillar and hurricane damage in the field. A second trial was conducted in 2021 using a conventional fire ant bait and an organic fire bait. Results and conclusions will be discussed.

Retinal Dysfunction With Acute Cannabis Use

Oral Presentation | Authors: Denise A. Valenti, Christopher Wu | Chair: Denise A. Valenti

Cannabinoid receptors have been found throughout the retinal layers and in various areas of the visual pathway. Existing literature reports a variety of responses depending on the physiological function or area of interest. It is widely known that chronic cannabis use has neurological consequences that contribute to overall impairment, our interest lies in the potential visual repercussions of acute cannabis use. Here, existing Frequency Doubling Technology is used to measure functional vision losses regarding contrast and temporal processing. The procedure consists of 10-degree striped squares of variable contrast flashed on a shielded screen. The stripes are of low spatial frequencies (0.25 c/deg) and undergo counterphase flickering at a high temporal frequency (25 Hz). Squares are flashed in 17 locations within a forty-degree field. Participants were tasked with clicking a button when the flashed square is perceived. By testing select areas of the visual field, we were able to determine each participant's visual threshold for contrast detection, test reliability was also calculated based on fixation losses, false positive errors, and false negative errors. Participants were required to make two separate visits. On the first visit, undosed baseline data were obtained with the Frequency Doubling Technology and related research questions. On the second visit, dosed participants were picked up with ride-share and visual assessment testing was repeated; blood tests and saliva swabs were also obtained. We analyzed thirteen sets of data out of a test population of twenty-one. Exclusion criteria were based on reliability scores calculated by the Frequency Doubling Technology on either visit. Three spots of the seventeen tested, were significant in the left eye with a P value less than 0.05 and four spots were significant in the right eye. Two points in each eye were the mirror points of the other, one superior nasal retina and the other inferior nasal retina. While the data remain limited, findings indicate potential visual dysfunction originating in the retina. The pattern of off macula, central dysfunction is a pattern of the distribution of star amacrine cells. Further studies are warranted.

2:25 PM - 2:50 PM

Controlling Arthropods Present in Hemp in Eastern Oregon

Oral Presentation | Authors: Silvia Rondon | Chair: Punya Nachappa

Several species of arthropod pests affect hemp below and above ground. Based on a preliminary survey in 2018 and 2019, below ground, wireworms were considered a key problem; above ground corn earworm, thrips, beet leafhoppers, and mites. Control options are limited especially against common pests in the region like Circulifer tenellus Baker or Tetranichus urticae Koch a.k.a. the beet leafhopper and spider mites respectively. The beet leafhopper is an emergent pest affecting hemp because is an efficient vector of Beet Curly Top Virus; spider mites are known field and greenhouse pests. In 2020, three products, Grandevo® (Marrone Bio Innovations, Inc.), Venerate® CG (Marrone Bio Innovations, Inc.), Requiem®EC (Certis USA/Bayer), and a control were tested in experiments under greenhouse conditions; field pressure did not warrant the collection of field data. Insecticides were applied a month after hemp plants were transplanted. Applications were made with a calibrated hand sprayer. After application, beet leafhoppers (n=5/plant) and spider mites (n=10/plant) were released in clip cages 1 h after treatment, and then counted 1, 3 and 7 DAT (days after treatment). Data collected were subjected to an analysis of variance (ANOVA) and results refer to percentage of mortality. In general, applications made with Requiem and Venerate delivered higher mortality rates against beet leafhoppers compared to the other products tested; for mites, all organic compounds caused mortality but with no statistical differences within group except for the untreated control.


Canon

POSTERS

Anaerobic Fermentation of Dietary Hempseed by a Mouse Fecal Slurry for Cytotoxicity Testing on Cultured Caco-2 Cancer Cells

Poster | Authors: Kayana A Casias, Annette M Gabaldon | Chair: Ruth Charbonneau

Plant foods rich in nutrients, including whole seeds and nuts, can be fermented by gut microbiota to produce bioactive metabolites with diverse health benefits. For example, Bacteroidetes produce lactic acid which maintains a healthy colon pH, while Firmicutes produce the short-chain fatty acid (SCFA) butyrate, which supports the growth and metabolism of healthy colonocytes while also being cytotoxic to cancerous colonocytes. Dietary hempseed (Cannabis sativa L.) contains large amounts of proteins, lipids, and dietary fibers; however, little is known about the bioactive properties of hempseed fermentation metabolites. Our overall goals are to identify methods for fermenting hempseed and testing for bioactive metabolites that are cytotoxic to cultured human colorectal carcinoma (Caco-2) cells. Butyrate is a good candidate SCFA to be produced through hempseed fermentation and we hypothesized that if produced in high enough concentrations, would exert cytotoxic effects on cultured Caco-2 cells. Previously (unpublished data), we showed that hempseed could be fermented by two single strains of Lactobacillus (L. plantarum ATCC 8014 and L. fermentum NCIMB 5221) while supporting bacterial growth and metabolism to produce bioactive compounds in the form of SCFAs. However, we were not able to test for bioactivity of the fermentation media. Here, we designed a second study to ferment hempseed under conditions that more closely represent the digestive tract. Notably, fermentation under strict anaerobic conditions for an extended period of 48 hours, using a mouse fecal slurry as the inoculum to ensure a diverse gut microbiome that is inclusive of the butyric acid-producing bacteria within the phylum Firmicutes. Preliminary results indicate that the mouse fecal slurry fermented the positive control carbohydrate in the media (glucose, 2%, w:v) under anaerobic conditions, as indicated by a sharp decrease in media pH from ~7.9 to ~5.0 over 48 hours. Media acidification suggested fermentation metabolites were produced by microbes in the mouse fecal slurry. The fermentation studies on whole ground hempseed (hempseed, 5%, w:v) are underway. Aliquots of the fermentation media are being collected for microbiome analysis, SCFA analysis, and cytotoxicity testing on cultured Caco-2 cells in vitro.

Chemical Profiling of Medical Cannabis Consumed by Patients With Chronic Pain

Poster | Authors: Yi Yang, Ewa Wasilewski, Rupali Vyawahare, Prabjit, Mahmood Tazari, Melissa M. Lewis-Bakker, Hance Clarke, Lakshmi Kotra | Chairs: Duncan I. Mackie, Adrianna Szczepaniec

Background - Chronic pain affects at least 30% of the world population, including approximately one-fifth of North American adults. Cannabis and several cannabinoids show efficacy in animal models of chronic pain. Medical cannabis is consumed by patients seeking relief from chronic pain. However, there is no clear understanding of the pharmacological effects of the hundreds of available varieties of medical cannabis. Additionally, anecdotal evidence suggests that whole cannabis extracts are more efficacious than any single cannabinoid alone.

Methods - We investigated cannabis consumed by a cohort of participants (n=22) with chronic pain and profiled the chemical compositions. Samples of medical cannabis were collected from participants, analyzed for total Δ9-tetrahydrocannabinol (TTHC) and total cannabidiol (TCBD) content, and profiled for human CB1 (hCB1R) and CB2 (hCB2R) receptor activities. Additionally, clinical parameters such as sex, age, cannabis dose, and pain scores were collected. The chemical composition, in-vitro receptor activities and clinical parameters were further analyzed.

Key Results - Approximately one-third of participants medicated exclusively with cannabis. 57% of medical cannabis samples contained ≥20% TTHC content with no appreciable TCBD, while 21% of samples contained ≥20% TCBD content. TCBD was positively associated with Pain Relief Score (PRS) and Pain Intensity Difference Score, and negatively associated with Brief Pain Inventory (BPI), Pain Disability Index, and Hospital Anxiety and Depression Scale (HADS) Depression scores. Meanwhile, TTHC exhibited positive association with PRS and negative associations with HADS scores. In general, cannabis samples exhibited higher potency as partial agonists at hCB1R than at hCB2R, and a significant proportion exhibited hCB2R antagonism. Versus pure phytocannabinoids, high-THC samples exhibited lower potency, while high-CBD samples exhibited higher potency as hCB1R agonists.

Conclusion - These results suggest patterns of preference for medical cannabis by each participant and provide some evidence for the interdependence of cannabinoids in bringing about the unique physiological responses of whole cannabis and cannabis extracts. Further in-depth investigation is required to delineate such interdependencies.

POSTERS

Development and Validation of an Hplc-qqq Method for Simultaneous Detection of Low Concentration Cannabinoids, Carbaryl, Boscalid, Permethrin, and Spinosad.

Poster | Authors: J Hunter Cuchiaro, Melissa Reynolds, Charles Johnson, Andrew Ralph Cooke, Leslie Buttorff | Chair: Sheldon Henderson,

Cannabis products contaminated by low-level pesticides can be rendered unsuitable for consumption. Carbaryl is a notable pesticide with an upper contamination limit of 50 ppb, and commonly assayed separately from cannabinoids during routine quality control analysis. Here, we present a high-pressure liquid chromatographic triple quadrupole mass spectrometric (HPLC-QQQ) method for simultaneous quantitation of >15 cannabinoids and the pesticides carbaryl, boscalid, permethrin, and spinosad with quantitation limits >5 ppb. A key outcome of this work is that pesticides and cannabinoids are simultaneously quantified, rather than the more conventional approach of performing separate analyses. The method will be evaluated for multiple matrices, including raw flower, CO2 and ethanol crude extracts, and commercially available finished products, using contaminated, clean, and spiked samples. This HPLC-QQQ method will improve upon existing detection methods by increasing both sensitivity and specificity for simultaneously detecting pesticides and cannabinoids at low concentrations for improved quality control analyses.

Effects of Cannabidiol (CBD) Treatment in a Mouse Model of Alzheimer's Disease Through Regulation of Trem2

Poster | Authors: Hesam Khodadadi, Evila Lopes Salles, John Morgan, David C. Hess, Kumar Vaibhav, Krishnan Dhandapani, Babak Baban| Chairs: Amy Uhernik, Jordan Tishler

Despite significant advancement in our understanding of Alzheimer's disease (AD), there is currently a marked lack of definitive treatment for AD. Cannabidiol (CBD) is a safe, non-psychoactive phytocannabinoid produced by cannabis plant. Increasing evidence from our laboratory and others suggest an immunomodulatory role for CBD in a variety of inflammatory conditions, including neurodegenerative diseases such as AD. Here we investigated whether CBD could ameliorate the symptoms of AD and cognitive impairment through regulation of TREM2 (Triggering Receptor expressed on Myeloid Cells 2) leading to more effective function of microglia and reduction of amyloid beta in AD.

5XFAD mice (model for familial AD) were used to evaluate their cognitive function and anxiety by using Open field and Morris water maze behavioral tests. All animals were sacrificed, and their meninges, brain and blood were collected for further flowcytometry analysis, immunohistochemistry and immunofluorescence imaging.

TREM2 expression was significantly elevated in CBD treated AD mice. Amyloid beta plaque formation was decreased. Behavioral tests showed improvement in CBD treated group compared to untreated subjects. Our findings suggest a possible alternative and therapeutic role for CBD in the treatment of AD. Further, these discoveries present evidence to support the beneficial role for TREM2 as a potential biomarker in the diagnosis and treatment of AD, opening a new horizon for research to find an effective therapeutic modality for AD.

Elucidating the Nature of the Links Between Cannabis Use and Attention Deficit/hyperactivity Disorder

Poster | Authors: Amanda Stueber, Carrie Cuttler | Chairs: Joanna Zeiger, William Silvers

Many individuals with mental health disorders use cannabis to self-medicate for their sympto Attention-deficit/hyperactivity disorder (ADHD) is a neurological disorder associated with increased cannabis use but, relative to other mental disorders (e.g., anxiety, psychosis, post-traumatic stress disorder), far less attention has been paid to examining cannabis use by people with ADHD. Nevertheless, there is some limited evidence to suggest that people with ADHD might use cannabis to self-medicate for their symptoms and that they perceive it to be beneficial for this purpose. The goal of this study was to better understand the nature of the relationships between cannabis use and A total of 1,382 undergraduate students completed an online survey measuring their ADHD symptoms, and cannabis use patterns. Participants who reported they have used cannabis to manage their ADHD were further asked to report their perceptions of whether acute and/or chronic cannabis use improves, worsens, or has no effect on their ADHD sympto Participants who reported they have been prescribed ADHD medication and use cannabis also reported their perception of how cannabis use affects the effectiveness of their medication, and ADHD medication side effects. Evidence from this study revealed that ADHD symptom severity is associated with consuming cannabis more frequently and with more severe symptoms of cannabis use disorder. Participants with ADHD reported that cannabis has acute detrimental effects on memory but beneficial effects on many of their other core symptoms of ADHD, including hyperactivity, impulsivity, restlessness, and mental frustration. While most participants on ADHD medications reported that cannabis does not influence their medication effectiveness, they did report that cannabis helps with many of the side effects associated with their ADHD medications including headaches, loss of appetite, sleep disturbances, moodiness/irritability, and anxiety. The knowledge gained from this study will help people with ADHD and their healthcare providers by providing them with a better understanding of the use of cannabis by individuals with ADHD including the possible risks and benefits of such use on cannabis use disorder, ADHD symptoms, and medication side effects.

POSTERS

Evaluating the Suitability of a Metal-organic Framework for Adsorptive Separations of Cannabinoids

Poster | Authors: J Hunter Cuchiaro, Jacob Deroo, Melissa Reynolds | Chair: Ruth Charbonneau

Cannabis flower and extracts are routinely analyzed for cannabinoid potency using high performance liquid chromatography (HPLC) coupled with diode array or mass spectrometry detection. The assay is facilitated by adsorptive separation of cannabinoids through a stationary phase, such as commercially available octyldecylsilate columns. Metal-organic frameworks (MOFs) are a class of porous, crystaline materials with high surface area-to-volume ratios, potentially rendering more efficient adsorptive separations of interest to the cannabis community by HPLC. In this work, we evaluate the surface area of a commercially available MOF, MIL-53(Al), accessible to cannabinoids for adsorption. We use cannabidiol, delta-9-tetrahydrocannabinol, and cannabinol as model analytes, comparing their adsorptive uptake to the MOF with adsorptive capacities of particles based on multiple theoretical available adsorption motifs. We use HPLC-DAD, HPLC-QQQ, FTIR, and BET to evaluate cannabinoid adsorption to the MOF. Preliminary data indicate that adsorption occurs at or very near the exterior MOF particle surfaces, rendering most of the material surface inaccessible for adsorption and thus, poorly suited for improved chromatographic separations of cannabinoids without modification of commercially available material.

Femur and L5 Vertebra Bone Mineral Density in Growing Female C57bl/6 Mice Fed a Long-term Hempseed-supplemented Diet

Poster | Authors: Chandler Sparks, Hailey Streff, Cynthia Blanton, Annette M. Gabaldón | Chairs: Massimo Bionaz, Serkan Ates

Food nutrients have the potential to greatly influence skeletal bone mineralization and mechanical strength. Studies on animal models (e.g. mice, rats) have investigated a variety of seed- or seed extract-supplemented diets on bone development and prevention of osteoporosis. These studies include pomegranate seed oil, chia seed, soya bean seed, fenugreek seed, and grape seed proanthocyanidins extract. Surprisingly, little is known about hempseed diet influences on skeletal bone mineral density (BMD) and strength. Hempseed is rich in macronutrients, vitamins, minerals, and health-promoting phytochemicals. Whole hempseed contains about 30% oil, including omega-3 and omega-6 polyunsaturated fatty acids, 25% protein, including albumin and edestin, 34% carbohydrate, and 10% insoluble dietary fiber. Micronutrients needed for bone formation, including calcium, phosphorous, magnesium, and vitamin K, are found in relatively high amounts. Here, we tested the hypothesis that BMD and mechanical strength of representative skeletal bones would be enhanced by a hempseed-supplemented diet in growing female C57BL/6 mice. Mice (n=8 per group) were fed either a 0 g/kg (0%-HS), 50 g/kg (5%-HS), or 150 g/kg (15%-HS) hempseed-supplemented base diet (AIN-93G) ad libitum from age five to thirty weeks. At monthly intervals, mice were DEXA scanned for BMD (g/cm2), bone mineral content (BMC, g), and bone area (cm2). DEXA whole-animal results were presented previously and revealed no significant diet influences. Here, we further investigated diet influences at the level of single bones, selecting cortical-rich femur bone and trabecular-rich lumbar vertebra (L5). Using whole-animal DEXA scans, a region of interest (ROI) was drawn independently around the right femur and L5 bone, and the change in value from age 5-wks to 29-wks was compared. Femur ΔBMD averaged 0.0323±0.0014 g/cm2 for the 0%-HS (control) group, with no significant diet influence ($p=0.8224$). Similarly, L5 ΔBMD averaged 0.0276±0.0019 g/cm2 for the 0%-HS (control) group, with no significant diet influence ($p=0.8764$). These results do not preclude the possibility that bone mechanical strength was altered by the hempseed diet, since mechanical strength is a function of complex interplay between microanatomy, extracellular matrix proteins, and mineralization. In progress are mechanical strength tests (femur, 3-point bending; L5, uniaxial compression) and micro-computed tomography for analysis of microanatomy.

POSTERS

Humoral and Cell-mediated Immune Response of Meat Goats Fed Varying Levels of Hempseed Meal

Poster | Authors: Frank William Abrahamsen, Nar Gurung, Woubit Abdela, Gopal Reddy | Chair: Ruth Charbonneau

Hempseed meal (HSM) is a byproduct of hemp oil production and is high in crude protein, fiber, and fat making it a potential feedstuff for ruminants. However, this feedstuff has not been evaluated as a supplementary feed for any ruminant livestock species, including meat goats, and is yet to be approved as a feed ingredient from the USDA/FDA and be defined by the Association of American Feed Control Officials. The objective of this study was to evaluate the effect of varying levels of hempseed meal supplementation (0, 10, 20, and 30% HSM supplementation) on antibody and cell-mediated immune responses, as well as the expression of some of the important immunoregulatory cytokines in peripheral blood mononuclear cells via RTqPCR. Cell-mediated immune response was evaluated on day 59 of the feeding period by measuring skinfold thickness at 48 hours following intradermal injection of phytohemagglutinin. A significant increase ($p<0.05$) was observed in skinfold thickness with increasing levels of supplementation as compared to the control group. Serum antibody titers to chicken ovalbumin were not significantly different between treatment groups as well levels of IL-2 and IL-4. Concentrations of IL-6 increased linearly with increasing level of supplementation ($p<0.05$), contrarily to the linear decrease that was observed for TNF-**α** ($p<0.05$). HSM supplementation had no significant effect on the expression of IL2 or IL6. However, significant differences were observed with the 30 % supplementation for IL4 and TNFA as compared to the Control group ($p<0.05$). Transcription of IL4 was down-regulated with 10 and 20 % but was up-regulated with 30 % HSM supplementation. Transcription of TNFA was down-regulated by 10 % but up-regulated by 20 and 30 % HSM supplementation. No significant differences were observed for cortisol concentration in blood serum or white blood cell counts. Results suggest that hempseed meal supplementation may improve cell-mediated immune response while having no effect on antibody-mediated immune response.

Impacts of Pollen Exclusion as a Management Practice for High-cbd Hemp Production.

Poster | Authors: Janina Bowen, Jacqueline Chaparro, Jessica Prenni, Mark Uchanski | Chair: Fred Shahbazi Raz

Production of high-CBD hemp (Cannabis sativa L.) is steadily increasing in Colorado and across the United States. However, the impact of management practices for this crop remain relatively unexplored. For example, there is high potential for fiber and grain cultivars of male hemp plants to pollinate female hemp plants grown in close proximity, but it is unknown how the cannabinoid content of high-CBD hemp flowers is affected by pollination. We hypothesized that high seed content following pollination will negatively impact the phytocannabinoid profile of the flower. In this study, 4 experimental pollen exclusion treatments were applied to two cultivars of high-CBD hemp, Cherry Uno and Wife. This experiment was first conducted over the 2019 field season and was repeated in 2020. Treatments included non-woven thick row cover (largest pore size approximately 50 micrometer), non-woven thin row cover (largest pore size approximately 200 micrometer), woven insect netting (average pore size 700x240 micrometer), and uncovered controls. Clones were transplanted on 6/13/19 and 6/10/20 at the Agricultural Research, Development and Education Center South (ARDEC South) at Colorado State University in Fort Collins, Colorado (lat. 40.611804 N; long. -104.997144 W; elevation 1525 meters). 5 cm inflorescence samples (2 inches per Colorado Department of Agriculture sampling protocol) were taken from each plant. Seeds and flower material were weighed separately before samples were homogenized in preparation for cannabinoid analysis. Extracts were analyzed by ultra-high performance liquid chromatography coupled with tandem mass spectrometry (UHPLC-MS/MS) to determine the quantitative profiles of 20 phytocannabinoids. Results indicate that pollen exclusion material with smaller pore sizes (i.e. thin and thick row cover) were successful in reducing pollination, while insect netting and uncovered controls had similar seed content. Differences in cannabinoid content between conditions will be discussed. (285 words)

POSTERS

Influence of a Hempseed-supplemented Diet on Growth Parameters, Feed Efficiency, and Gut Microbiome in Young Female C57bl6 Mice

Poster | Authors: Hailey Streff, Derrick W. Williams, Cynthia Blanton, Annette M Gabaldon | Chairs: Massimo Bionaz, Serkan Ates

Hempseed is a dietary aide for agricultural animals and humans because it is nutrient-dense, yet the physiological influences are not fully understood. Here, we chose a female C57BL/6 mouse model and designed a study to investigate the influence of a hempseed-supplemented (HS) diet on growth parameters, body composition, arterial blood pressure, feed efficiency, and gut microbiome. Mice were pair-housed with n=8 mice per group and were fed the diets from ages 5 to 29 weeks. Diets were prepared by Dyets, Inc. in pelleted form and provided to the mice ad libitum. The base diet, AIN-93G for growing mice, was supplemented with whole ground hempseed (CHII brand) in amounts of 0 g/kg (0%-HS), 50 g/kg (5%-HS) and 150 g/kg (15%-HS). The base diet contained casein (major protein), soybean oil (major lipid), cellulose (major dietary fiber), and had an energy content of 3760 kcal/kg. These macronutrients were adjusted in the HS diets to account for the naturally high hempseed content of proteins, lipids, and fiber. The diets were matched for macronutrients (% carbohydrate, lipid, protein) and energy density was kept as isocaloric as possible (3814 kcal/kg, 5%-HS diet and 3922 kcal/kg, 15%-HS diet). Mice, the amount of feed provided, and the amount remaining were weighed weekly. Feed efficiency (FE) was calculated as cumulative body weight gain (g) divided by cumulative food intake (g). Measurements were made monthly or bi-weekly of body composition (DEXA) and arterial blood pressure (CODA tail cuff), and fresh fecal samples were collected for microbiome analyses. We have completed the in vivo part of the study and the data revealed no significant hempseed diet influences on developmental changes in body composition or arterial blood pressure. However, preliminary analyses indicated that the 15%-HS diet led to a reduced feed efficiency. As a correlate to the FE results, mice fed the 15%-HS diet required more kcals consumed to gain 1 g of body weight as compared to other groups. The gut microbiome studies are underway to determine if there are shifts induced by the hempseed diet or with growth, and whether there are any associations between FE and the gut microbiome.

Inhibitory Effects of Hemp-fiber-blended Toothpaste on the Colonization of Oral Recorded with Live Q & A Bacteria

Poster | Authors: Sanghyuck Park, Eun-Soo Kim | Chairs: Madeleine (Mellie) Pullman, Dan Krause

Brushing with toothpaste is a common practice to prevent tooth decay, bad breath, and dental plaque. Toothpaste is mainly a chemical agent containing active ingredients such as aluminum hydroxide, calcium carbonate, zinc chloride, sodium fluoride, sodium tripolyphosphate, glycerol, xylitol, and various flavor agents. However, some ingredients can cause health concerns such as fluorosis and hormone regulation disorder.

Hemp fiber is one of the best natural fibers on the planet because of outstanding tensile strength and durability while also being much coarser than other fiber plants. It is also known for having an anti-microbial property. In this study, we investigated whether the fibers can improve the cleansing power when added in a powdered form to the toothpaste.

After brushing with a commercial toothpaste or hemp-fiber-blended toothpaste, the saliva samples were collected, diluted, and streaked onto petri dishes containing a Trytic Soy Agar medium. Colony counts were used to detect and count bacteria in saliva. We found that 75.3% of colonies were reduced when brushing was performed with a commercial toothpaste. In contrast, 96.2% of the colonies were reduced when tooth brushing was performed with the hemp-fiber-blended toothpaste.

Our microbial test clearly demonstrates the great reduction of oral bacteria by 21% when teeth were brushed with hemp fibers. The significant decrease was enabled mechanically and chemically. First, the powdered hemp fibers act like a "micro brush" that reach out to areas where a regular brush cannot. The complete or near complete removal of microbes from the blind spot is key for dental and oral health. The 'micro-brush' has proven to effectively eradicate the oral bacteria, and interestingly, more foams were generated during brushing with the micro hemp fibers. Secondly, the lowered number of microbial colonies were partly due to the antimicrobial property of the fibers that comprises phenolic compounds in plant cell wall areas as well as cannabinoids.

Hemp fibers, the "micro brush' can be a potent scrubbing agent. Our team believes there exists a wide range of industrial applications as an additive in not only toothpaste, but also in gum and mouth wash.

POSTERS

Neuro-structural Effects of Cannabis Use During Adolescence: a Systematic Review

Poster | Author: Seanna Roy | Chairs: Amy Uhernik, Jordan Tishler

Adolescence is a period known for risk behavior experimentation, including cannabis use. Current research is often contradictory and vague with regard to cannabis' neurodevelopmental effects. This project serves to answer questions surrounding what, if any, neurostructural effects are observed in adults who used cannabis prior to age 25 and to propose research and practice recommendations based on the findings. Rosenstock's 1988 Health Belief Model was chosen as a lens by which to interpret findings and generate recommendations with the goal of influencing the target audience's beliefs about cannabis' neurodevelopmental risks through education. University databases were utilized to assess current literature, resulting in the selection of 21 primary research studies. A critique of the literature was performed using a step- by-step guide, demonstrating gaps including an overall lack of longitudinal studies and small sample sizes. Synthesis of data resulted in inconclusiveness regarding most of the brain regions due to lack of research quantity, as well as evidence towards dose- dependent and age-dependent relationships between cannabis use and likelihood of neurostructural alterations. Further research is recommended to address the lack of research depth regarding specific brain regions and to further delineate the influence of variables. Inconclusive findings, methodological gaps, and the potential for neurodevelopmental detriment led to recommendations for providers to dissuade patients from any use; however, mitigating the risk of anticipated or actual substance use behaviors by emphasizing delaying onset of use and decreasing frequency of use is also recommended.

Plasma and Joint Tissue Pharmacokinetics of Oral Recorded with Live Q & A Cannabidiol in a Guinea Pig Model of Osteoarthritis

Poster | Authors: Alexa Spittler, Joel E. Helbling, Stephanie McGrath, Daniel L. Gustafson, Kelly S. Santangelo, Miranda J. Sadar| Chair: Ruth Charbonneau

Osteoarthritis (OA) is a degenerative joint disease that commonly causes symptoms of decreased and painful mobility. Due to a lack of safe and effective treatment options, many individuals are seeking alternative treatments for OA-related pain management. Cannabidiol (CBD), the non-psychotropic component of the cannabis plant, has gained widespread popularity as a treatment for OA due to its anti-inflammatory effects. However, there is minimal scientific evidence regarding dosing for OA and whether CBD can be detected in joint tissues. The aim of this study was to determine plasma and joint tissue pharmacokinetics after oral CBD oil administration in Dunkin Hartley guinea pigs. This strain spontaneously develops OA at 3 months of age, serving as a model for age-related (naturally-occurring/non-traumatic) OA in humans. Ten, 5-month-old male guinea pigs were randomly assigned to receive 25 (n=5) or 50 mg/kg (n=5) CBD oil once orally. Blood samples were collected at 0, 0.25, 0.5, 1, 2, 4, 8, 12, and 24 hr timepoints. To assess potential side effects on activity levels from CBD administration, open-field enclosure monitoring was performed before and after treatment. After euthanasia, knee cartilage and infrapatellar fat pads were collected to quantitate CBD. CBD concentrations were determined using a validated liquid chromatography-mass spectrometry method, and pharmacokinetic parameters were calculated using noncompartmental analysis. The area under the plasma concentration-versus-time curve was 379.5 and 873.7 hr*ng/mL, maximum plasma concentration was 42 and 96.8 ng/mL, time to maximum plasma concentration was 1.6 and 4.8 hr, and terminal half-life was 8.1 and 10.8 hr for the 25 and 50 mg/kg doses, respectively. CBD was detected in joint tissues of all animals, suggesting its potential to directly exert effects within the joint. No significant differences were present in total distance traveled, average speed, or time in red hut enclosure monitoring parameters between baseline and post-CBD timepoints. Larger doses and/or increased dosing frequency may be needed to achieve therapeutic plasma concentrations of CBD. These findings may be utilized for future studies to determine the efficacy of CBD for OA.

POSTERS

Quantitative Analysis of Chemical Composition of 125 Medical Cannabis Samples and Insights Into the Cannabinoid Biosynthetic Pathway

Poster | Authors: Yi Yang, Melissa M. Lewis-Bakker, Albert H.C. Wong, Hance Clarke, Lakshmi Kotra | Chair: Fred Shahbazi Raz

Background - Medical cannabis is a complex mixture of natural products, including cannabinoids. To date, more than 120 cannabinoids have been identified. Structurally, cannabinoids share an aryl alkyl group, the length of which is significant for their receptor activities. Cannabinoids are biosynthesized from geranyl pyrophosphate through a multi-branched pathway, utilizing four major types of reactions: enzyme catalysis, thermal reactions, oxidation and photo-irradiation. Cannabinoid families of different alkyl chain lengths are synthesized through discrete sections of the pathway, and the up and/or downregulation of specific branches within each section determine the unique cannabinoid compositions of cannabis cultivars.

Methods - From a collection of medical cannabis samples (n=125) consumed by patients collected over 18 months, we extracted each cannabis sample, and quantified the concentrations of 9 major cannabinoids in each extract. We then correlated the cannabinoid concentrations to each other to construct a matrix of the Pearson correlation coefficients.

Key Results - Cannabis extracts showed a significant variation in cannabinoid profiles, with one of four cannabinoids, viz. Δ9-tetrahydrocannabinol (Δ9-THC), cannabidiol (CBD), Δ9-tetrahydrocannabinolic acid (Δ9-THCA) and cannabidiolic acid (CBDA) present in the highest concentration in each extract. CBD levels exhibited a strong negative correlation to Δ9-THC levels ($r=-0.765$, $p<0.0001$), negative correlations to Δ9-tetrahydrocannabivarin (Δ9-THCV) ($r=-0.281$, $p=0.003$), cannabinol (CBN) ($r=-0.284$, $p=0.003$) and cannabigerol (CBG) ($r=-0.379$, $p<0.0001$) concentrations, as well as positive correlations to cannabidivarin (CBDV) ($r=0.272$, $p=0.004$) and cannabichromene (CBC) ($r=0.315$, $p=0.001$) concentrations. On the other hand, Δ9-THC exhibited positive correlations to Δ9-THCV ($r=0.265$, $p=0.006$), CBN ($r=0.189$, $p=0.05$) and CBG ($r=0.330$, $p=0.0004$) concentrations as well as negative correlations to CBDV ($r=-0.256$, $p=0.007$) and CBC ($r=-0.287$, $p=0.003$) concentrations. Additionally, Δ9-THCA and CBDA levels were negatively correlated ($r=-0.887$, $p<0.0001$), while Δ9-THCV and CBDV were positively correlated ($r=0.406$, $p<0.0001$).

Conclusion - The contrasting correlation profiles between Δ9-THC and CBD concentrations against other cannabinoids suggest that despite competition for geranyl pyrophosphate, there may be links between the regulation of certain branches of the biosynthetic pathway. Furthermore, these results may provide evidence for enzyme promiscuity between different pathway sections.

Reasons for Using Cannabis Among a Pilot Sample of Older Adult Regular Users.

Poster | Authors: Rachel E. Thayer, Gianni Giacoletto | Chairs: Joanna Zeiger, William Silvers

Cannabis use among aging adults has increased significantly, and the majority of older adults now support cannabis use for medical purposes. These shifting attitudes on acceptability of cannabis suggest that more aging adults will continue or initiate use. However, available questionnaires have largely been developed and validated in young adult populations. The current study collected measures of use characteristics among older adult cannabis users to explore use patterns and reasons, including differences between recreational and medical users. A total of N=26 adults 60 years and older who had used cannabis at least once per week for at least the last year completed questionnaires including mood and anxiety screens, 90-day Timeline Follow-back (TLFB), and the extended Marijuana Motives Measure (MMM). Items of the MMM form subscales for coping, enhancement, social, conformity, expansion, and routine reasons. Participants could also report their own reasons (e.g., medical uses). MMM subscale scores were correlated with TLFB cannabis and alcohol use and mood and anxiety sympto Group comparisons examined whether responses to TLFB and MMM differed between recreational and medical users. Cronbach's alpha for MMM was .88, demonstrating good internal consistency. Endorsement of routine reasons was significantly associated ($p<.05$) with years of regular use ($r=.46$), but no correlations were observed between MMM subscales and TLFB cannabis use days or estimated mgTHC/use day. However, MMM social, conformity, and routine subscales were significantly associated with TLFB alcohol drinks/drinking day ($r=.43$, .42, and .47, respectively). MMM coping and routine subscales were significantly associated with anxiety symptoms ($r=.59$ and .47, respectively), while coping and social subscales were associated with depression symptoms ($r=.61$ and .44, respectively). Recreational users (n=17) reported greater enhancement ($t24=4.36$, $p<.001$, Cohen's $d=1.80$), conformity ($t24=2.41$, $p<.05$, Cohen's $d=.99$), and expansion ($t24=3.02$, $p<.01$, Cohen's $d=1.24$) reasons compared to those with any medical use (n=9). Groups were not different in age, mood and anxiety symptoms, TLFB alcohol or cannabis use, or estimated years of regular use. Overall, the MMM showed good internal consistency in this sample of older adults, and subscales appeared to be uniquely associated with other variables of interest (e.g., mood) rather than TLFB cannabis use measures.

POSTERS

The Blocking Effect of Hemp Fabric on Mouse Skin Irradiated With Ultraviolet B

Poster | Authors: Eun-Soo Kim, Sanghyuck Park | Chair: Ruth Charbonneau

Among the three types of ultraviolet rays, ultraviolet B (UVB) causes the most harm, inducing various skin diseases and the death of skin cells. The UVB-blocking effect of hemp fabric, which has recently been discovered to be a powerful agent against UVB, was studied with the auricle skin of mice. Using the experimental condition of UVB irradiation and two different types of fabric, the mouse samples were divided into the following four groups: Group 1 (UVB exposed non-fabric-shield site, ENFS); Group 2 (UVB exposed hemp fabric-shield site, EHFS); Group 3 (UVB exposed polyester fabric-shield site, EPFS); and Group 4 (UVB unexposed non-fabric-shield site, UNFS) as the control. Two types of fabrics were used: hemp fabric provided by the Agriculture Technique Center, and commercially purchased polyester fabric. ICR 12-week-old female mice were used as the experimental animals. The mice were supplied with commercial feed and water ad libitum. The light/dark cycle was maintained according to natural day/night conditions. The ultraviolet source was a UVB lamp with a wavelength output of 280 - 360 nm. Each skin samples were fixed and dehydrated in a graded series of ethanol. The sectioned ribbons were stained with hematoxylin and eosin, and photographed using a light microscope. Statistical analyses were performed using the t-test. All samples exposed to UVB for 45h obviously resulted in morphologic changes of keratinocytes and some dermal cells. After chronic irradiation, the epidermis was 65 thick in ENFS, 33 thick in EHFS, 41 thick in EPFS, and 16 thick in UNFS. In conclusion, the thickness of the epidermis more than quadrupled in ENFS, 2.5-fold in EPFS, and doubled in EHFS compared to that of UNFS. According to the altered epidermal thickness, the blocking effect of hemp fabric was evaluated as 50% higher than that of polyester fabric. This result suggests that polyester fabric is not a proper material for protecting skin against UVBs, but hemp fabric is an excellent material for doing so.

The Effects of Cannabinoids in the Prevention of Chemotherapy-induced Neuropathic Pain

Poster | Authors: Erik Fleischel, Sara Jane Ward | Chair: Ruth Charbonneau

Treatment with conventional chemotherapeutic agents such as paclitaxel results in chemotherapy-induced neuropathic pain (CINP) in approximately 1/3 of patients. There is no drug that can safely and effectively attenuate symptoms of CINP. The psychoactive properties of Δ9-Tetrahydrocannabinol (THC), a component of Cannabis, has created concern for the safety of its use as a pain-reliever. However, Cannabis has been found to contain several other molecules that are believed to reduce painful symptoms while having no psychoactive effects. Among these molecules are β-Caryophyllene (BCP) and cannabidiol (CBD). These compounds have shown promising results in other preclinical models of pain and their effectiveness was tested in our model of CINP. C57Bl/6 mice were treated with paclitaxel (8.0 mg•kg-1, i.p., days 1, 3, 5, and 7) and were given BCP, CBD, or a combination of BCP and CBD 15 minutes prior to paclitaxel injection. Mechanical allodynia was assessed on days 0 and 14 using Von Frey Filaments. On days 14 and 15, mice were euthanized and the L1-L4 regions of the spinal cord were collected and then stained for Iba-1 and DAPI. The number of doubly-stained cells in the dorsal horn of the spinal cord were counted and their features were measured using ImageJ. Data was analyzed by one-way ANOVA ($p < 0.05$ was considered significant). BCP, CBD, or their combination prevented the onset of mechanical allodynia in a dose-dependent manner. Immunohistochemistry data revealed that paclitaxel treatment increased the size and immunofluorescence of microglia but did not change the overall number of microglia in the dorsal horn of the spinal cord. Cannabinoid treatment reduced the overall size of microglia but none of the experimental doses resembled the size or immunofluorescence of microglia in the vehicle control group. Our results suggest that BCP, CBD, and a combination of BCP and CBD may be useful in preventing the onset of chemotherapy-induced neuropathic pain. These treatments may affect the central sensitization of pain through glial cell signaling. Future experiments are required to elucidate the molecular mechanisms of treatments and explore a wider range of doses and cannabinoids to optimize efficacy.

POSTERS

The Potential of Whole Hempseed as a Prebiotic to Support Growth and Metabolism of Anticarcinogenic Probiotic Bacteria in Vitro

Poster | Authors: Krystal Hrbac, Annette Gabaldon | Chair: Ruth Charbonneau

We tested the hypothesis that whole hempseed can be fermented to support growth and metabolism of two probiotics, Lactobacillus plantarum ATCC-8014 and Lactobacillus fermentum NCIMB-5221. These probiotics were selected because of their ability to produce fermentation metabolites such as lactic acid (LA) and short chain fatty acids (SCFAs) which are protective against human colorectal carcinoma. Each probiotic was cultured in vitro under anaerobic conditions at 37ºC for 27 hours in a glucose-deficient MRS broth media containing 5% (w/v) whole hempseed powder. Growth curves were generated using colony-forming-unit (CFU) assays. Media pH was measured continuously as an index of fermentation and samples were collected at intervals for analysis of LA and SCFAs. Positive controls were 1% inulin, a fermentable fiber, and glucose, a readily fermentable monosaccharide, while the negative control was the basal media without added glucose or meat extract. Both probiotics grew significantly well in the 5% hempseed media ($p<0.05$) and growth curves were similar to those observed for the glucose media. For example, L. plantarum increased from 7.7±0.12 to 9.4±0.03 log CFUs/mL in 5% hempseed and from 7.7±0.1 to 9.67± 0.10 log CFUs/mL in glucose. The growth curves had characteristic exponential growth (0-12h) and stationary (12-27h) phases where secondary metabolites could potentially be produced. In fact, batch culture pH decreased significantly during 27h of fermentation for all three nutrients - glucose, 1% inulin, and 5% hempseed, suggesting probiotic synthesis of acidic metabolites. Glucose fermentation resulted in the greatest decrease in media pH and highest yield of total LA (D- and L-) as compared to 5% hempseed and 1% inulin, which did not produce significant LA concentrations. More interestingly, both probiotics generated significant concentrations of SCFAs from both glucose and 5% hempseed fermentation. Total SCFA concentrations increased by about 1500-2000 ug/mL in glucose and 5% hempseed media as compared to 500 ug/mL in 1% inulin and basal media. Notable SCFAs that increased with time during hempseed fermentation were acetic acid, isobutyric acid, and valeric acid. In conclusion, whole hempseed appears to be a promising dietary aide that is capable of supporting growth and metabolism of the two probiotic bacteria investigated.

The Role of Cannabidiol in Attenuating the Inflammatory Response in Cutaneous Wound Healing.

Poster | Authors: Evila Lopes Salles, Eunice Shin, Hesam Khodadadi, Jack C. Yu, Babak Baban | Chair: Ruth Charbonneau

Chronic wounds are a challenge to wound care professionals and consume a great deal of healthcare resources around the globe. In the United States alone, chronic wounds affect an estimated 2.4–4.5 million people. In recent years, Cannabidiol (CBD) has emerged as a potential therapeutic modality for a variety of diseases. Several studies have suggested that application of CBD-infused lotion decreases inflammation and accelerates the wound healing process in mice models. In this study, we tested for the first time, the potential of inhalant CBD in treating chronic wounds in a murine model and whether such treatment with CBD could alter the immune profile of the host. One 8-mm diameter dermal punch wound was created on the midline of the dorsal skin of each male mouse. After the procedure, the mice were randomly divided into two experimental groups – each mouse in the first group received 10mg of inhalant CBD daily, while each mouse in the second control group received inhalant placebo. Treatment was administered every day for a total of 12 days until wound closure was achieved. At the end of day 12, all mice were sacrificed and their tissues including blood and skin were collected and subjected to further analysis using immunohistochemistry as well as flow cytometry. Our findings showed that mice treated with inhalant CBD demonstrated an accelerated wound healing process with increased collagen production leading to earlier wound closure. In addition, inhalant CBD showed regulatory effects on the immune system and inflammatory indices. In conclusion, our studies showed that inhalant CBD may be targeted as a therapeutic modality in the treatment of chronic wounds.

POSTERS

Time- and Dose-dependent Influences of Anandamide (aea) Treatment on Cultured Hct116 Cancer Cell Viability and Energy Metabolism

Poster | Authors: Derrick W. Williams, Juan L. Rodriguez, Annette M Gabaldon | Chair: Ruth Charbonneau

This study investigated the time- and dose-dependent influences of anandamide (AEA) treatment on viability and energy metabolism in cultured human colorectal carcinoma cells (HCT116). We hypothesized that AEA would be cytotoxic to HCT116 cells and negatively alter energy metabolism, at least at higher concentrations based on previous studies in the literature. To test for cytotoxicity, HCT116 cells were seeded and allowed to adhere for 24h, then treated with AEA ranging in concentration from 1.7 nM to 1 mM for periods of 1h, 12h, or 24h. Resazurin assays for cell viability/metabolism were performed at each endpoint and dose-response curves were generated for analysis of the 50% lethal dose (LD50). A Seahorse XFe24 Metabolic Analyzer (Agilent) was used to perform the acute AEA drug treatment studies, which examined influences on oxidative metabolism and ATP synthesis (mitochondrial stress test) and glycolytic activity (glycolytic stress test). For each experiment, HCT116 cells were seeded and allowed to adhere for 24h, then a 20 min metabolic baseline was recorded. Cells were treated with AEA for ~2.5h, during which time the various reagents for metabolic assays were introduced. The major findings were that AEA induced both time- and dose-dependent cytotoxic effects. Specifically, LD50 values were 0.25 mM (1h), 0.42 mM (12h), and 36 μM (24h). Interestingly, when examined more closely, we found that at lower near-physiologic concentrations, AEA instead resulted in a moderate but significant increase in resorufin (the reduced product of resazurin) as compared to vehicle-treated controls ($p < 0.05$), thus indicating a stimulatory effect to increase HCT116 cell viability and/or energy metabolism. We also observed significant influences of AEA on oxidative and glycolytic metabolism in Seahorse assays. Specifically, at higher AEA concentrations, basal glycolysis was increased while a decrease was measured not only for ATP synthesis and basal oxygen consumption rate, but also for maximal oxygen consumption rate. However, again at lower near-physiologic concentrations, these alterations were improved or not affected when compared to vehicle-treated controls. In conclusion, high concentrations of AEA may be a therapeutic with cytotoxic effects on HCT116-type cancer cells; however, an interesting dose-dependent dichotomy at near-physiologic concentration ranges requires further investigation.

Utility of Specific-to-total Ige Ratios: the Golden Ratio for Cannabis Allergy?

Poster | Authors: Ine Ilona Decuyper, Hans-Peter Rihs, Christel Mertens, Athina Van Gasse, Jessy Elst, Margaretha Faber, Margo Hagendorens, Vito Sabato, Didier G. Ebo | Chair: Ruth Charbonneau

BACKGROUND - In the past decade, cannabis allergy (CA) has been recognized as an increasing health issue and its prevalence is likely underestimated because of cannabis's illegal status in many countries and the absence of reliable diagnostics.

METHODS - Here, we sought to investigate whether serological diagnosis of CA could benefit from an adjustment for TIGE by exploring SIGE hemp-to-TIGE, sIgE rCannabis sativa (Can s) 3-to-TIGE and rCan s 5-to-TIGE ratios. All three ratios were performed and compared between cannabis allergic patients and pollen and/or nsLTP sensitized controls. Only patients with a positive sIgE for each allergen were taken into account as negative results cannot benefit from additional ratios.

RESULTS and DISCUSSION - Specific IgE hemp-to-tIgE ratio differed significantly between CA patients and controls (cut-off 0.02, specificity 93% (95% confidence interval (CI), 85-98%)). A significant difference was also found for sIgE rCan s 5-to-tIgE (cut-off 0.01, 95% CI 61% (36-83%)), although small group numbers resulted in very wide confidence intervals. No additional benefit was found for sIgE rCan s 3-to-tIgE. When all three ratios were compared between CA patients with and without anaphylaxis, no significant difference was found either.

CONCLUSIONS - These results indicate that there is a place for sIgE-to-tIgE ratios in the diagnostic approach of CA. However, these should not be used to estimate the risk for cannabis related anaphylaxis. In the case of a definite history of cannabis related symptoms, we now recommend starting serological confirmatory testing with a sIgE hemp assay as a negative result significantly reduces the chance of IgE-mediated CA. A positive result, however, should be complemented by calculation of a sIgE hemp-to-tIgE value, as this will notably increase test specificity. Where available, it is still worthwhile using cannabis component resolved diagnostics as for example, it was previously shown that over two-thirds of CA patients who experienced anaphylaxis are Can s 3 sensitized. The utility of rCan s 5-to-tIgE is promising but should be further explored in larger groups as is the case for sIgE rCan s 2-to-tIgE and sIgE rCan s 4-to-tIgE which could not be explored in this analysis due to insufficient data.


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