



*Institute of*  
**Cannabis Research**  
COLORADO STATE UNIVERSITY PUEBLO

**ANNUAL REPORT**

**2022**



# TABLE OF CONTENTS

LETTER FROM THE DIRECTOR	03
MEET THE ICR STAFF	04-05
RESEARCH	06-09
PROJECT SPOTLIGHTS	10-11
EMERGING SCIENTIST SCHOLARS	12-13
VISITING RESEARCHERS	14-15
PARTNERSHIPS	16
LETTER FROM THE GOVERNING BOARD PRESIDENT	17
FY 2022 BUDGET REPORT	18
2022 CANNABIS RESEARCH CONFERENCE KEYNOTE SPEAKER	19
OUTREACH AND IMPACTS OF ICR	19-21
DISSEMINATION ACTIVITIES	22-23





# LETTER FROM THE DIRECTOR

**I**t seems like it was just a couple of months ago that I drafted the letter to accompany the Institute's previous Annual Report, and yet, here I am, reflecting once again, on another successful year of cannabis research, with one more conference in the books, and with a list of additional initiatives underway or completed. There are a lot of outstanding activities and accomplishments that are highlights of this past year, which puts me in the fortunate position of having to select a few to mention in this letter.

I will start with a focus on research, which after all is a key component of the ICR's role and mission in the State. This year saw the start of new research projects supported through the ICR launched by researchers throughout the State of Colorado. This represents the culmination of a lengthy process that included creating an application process and portal, recruiting subject matter experts to participate in the review process, and research contracts with awarded investigators. While the nuts and bolts of the process are critical, time consuming, and important to recognize, ultimately it will be the results of the research that will be most interesting. We eagerly anticipate the results as these multi-year projects proceed. I encourage you to read about each of these currently funded research projects in the pages of this report.

Most of the research supported through the Institute is being conducted at academic institutions across the state, and as a consequence the impact of the work goes beyond the research itself. As someone who has been associated with academia and higher education for almost 20 years as a profession and almost 30 years if I include my time as an undergraduate and graduate student, I recognize the importance that externally funded research has for providing opportunities for student researchers, at all levels in higher education, to develop the skills and passions necessary to become future research professionals. Recognizing the importance of student research the ICR launched the "Emerging Scientist Award" program with the enthusiastic support of the ICR's Governing Board. The program is supporting seven students joining the research programs of Investigators funded through the ICR that would

have otherwise not had the opportunity to participate on these projects. I am proud of the role that the ICR plays in Colorado in supporting the development of the next generation of researchers while meeting the core mission the State has laid out for the ICR.

The ICR has continued to mature and grow in many ways since it was launched six years ago. One area where this is very clear is with respect to partnerships. Strategic partnerships allows the impacts of the ICR locally, nationally, and globally to be magnified. Over this past year several key partnership initiatives were launched. The Cannabis Research Conference 2021 was the first conference in the series to be co-hosted with our partners at the Global Hemp Innovation Center at Oregon State University. The two monthly webinar series hosted by the ICR are now co-hosted with colleagues at the Lambert Center for the Study of Medicinal Cannabis and Hemp at Thomas Jefferson University and the Volcani Center for Agricultural Research in Israel. In this past year the ICR in collaboration with our host institution, Colorado State University Pueblo, launched a partnership with Vyripharm Biopharmaceuticals to establish an advanced testing laboratory on the campus under the direction of the ICR. These are just some of the partnerships the ICR is leveraging to enhance our impact and reach. I expect the range of partnerships that the ICR engages in will continue to grow and develop going forward.

As I wrap up my letter for the annual report this year, I wish to pose a question: Where do Coloradans want to see cannabis research in the future and what will it take to get there? I am confident that there will be a range of responses to that question, and the ICR exists to implement the State's vision for cannabis research. The ICR and its dedicated Staff and Governing Board, are eager to support cannabis research in Colorado and to keep the State at the forefront of developing new knowledge as it relates to cannabis, its impacts, and potential.

**Chad Kinney, Ph.D.**

Director, Institute of Cannabis Research



# MEET THE ICR STAFF

## Dr. Chad Kinney

### Director, ICR

Dr. Kinney joined the Chemistry Department at Colorado State University Pueblo in 2007 where he also served as Chair. Since 2018, Dr. Kinney has served as the Director of the Institute of Cannabis Research. Dr. Kinney's background is in Analytical and Environmental Chemistry, and has recently been interested in the extraction and isolation of phytochemicals from hemp as well as the chemical modification of cannabinoids having employed some of the same analytical techniques used in other areas of his research program. As Director of the ICR, Dr. Kinney oversees the day-to-day operations of the Institute to meet its role and mission in the State to support unbiased, quality cannabis related research and the broad dissemination of cannabis research results among various audiences. To accomplish this, Dr. Kinney works closely with the dedicated ICR Staff to execute initiatives, along with the Institute's Governing Board, and liaises with the State and other stakeholder groups and collaborators.



## Dr. John Williamson

### Senior Director of Research

Dr. John Williamson joined the CSU Pueblo serving as Senior Director of Research in 2019. He serves as the ICR's strategic development advisor pursuing research partnerships, collaborations, and external funding opportunities. John received his Ph.D. in medicinal chemistry and natural products chemistry from the University of Iowa. He served as a tenured professor of medicinal chemistry at the University of Mississippi for 25 years overseeing a drug discovery and development research program in infectious diseases, a branch chief of basic and mechanistic research at the National Institutes of Health in Bethesda, MD, and as a research consultant, for a variety of governmental agencies, private industry, Time-Warner's Health magazine, and dozens of universities across the country.



## Dr. Sanghyuck Park

### Senior Scientist

With extensive research experience in plant biology and genetics, Dr. Sanghyuck Park provides leadership with multi-tier ICR cannabis research projects. This research primarily involves cannabis genetics and chemistry and more recently, he has been focused on uncovering genetic regulations underlying agronomically important traits including cannabinoid/terpene biosynthesis. In addition, Dr. Park serves as a liaison with other entities to facilitate expanding existing knowledge on cannabis and translating this knowledge into applications that benefit society. In 2022, Dr. Park founded the ICR Hemp Cultivation Webinar Series and serves as a planning committee member for the Cannabis Research Conference (August 8-10, 2022).





## JoAnn Lopez

### Research Manager

JoAnn supports the Institute of Cannabis Research by offering fiscal oversight, strategic planning and twenty plus years' experience monitoring federal, state and local grants from pre-award to post-award. She supports the ICR's FY22 Request for Application by processing agreements and overseeing spending. She serves as one of the main points of contact for the Institute, its Governing Board, staff and collaborators. JoAnn has also worked with federal grants from the Department of Education, Department of Energy, and Department of Agriculture. She was the Director for a Trade Adjustment Assistance Community College and Career Training (TAACCCT) grant for \$14.2 million which was awarded by the U.S. Department of Labor to the Consortium for Healthcare Education Online (CHEO).



## Dr. Eun-Soo Kim

### Visiting Scholar

Dr. Kim joined the ICR as a visiting scholar in 2019 conducting a glandular trichome project. His background is in plant morphology and development. Dr. Kim previously served as a professor of plant biology at the Konkuk University, South Korea for 26 years studying economic plants such as cannabis, rosemary, hops, and ginseng. Dr. Kim published 45 peer-reviewed publications with 703 citations in total. He was a winner of the Great Research Award, presented only to the top ranking researchers selected from one thousand professors at the Konkuk University. Dr. Kim founded the Korea Hemp Institute in 2007 and served for 7 years as Director.



## Ashley Minnich

### Data Analyst and Technology Manager

Ashley joined the ICR in January of 2022, having previously managed departments and programs at multiple non-profit organizations in Pueblo, Colorado. An alumna of CSU Pueblo, Ashley brings her educational background in the sciences and her graduate-level expertise as an information professional to her position in the ICR. She manages the collection of data and information related to ICR functions, including the monthly webinar series and the statewide grant competition, and assists with fiscal oversight of the department. She also serves as the tech expert for the ICR by managing the department's website, email blasting, social media, and Zoom functions.



## Wendy Fairchild

### Administrative Assistant

Wendy Fairchild joined the ICR in 2018 and continues to enjoy working with the team to support and promote cannabis research. Wendy is the first line of contact between the ICR and University faculty, staff, students, and the general public, supports the ICR Staff and Governing Board by providing travel arrangements, creating reports, accounting, and writing and editing ICR materials. She oversees the creation of the ICR's Annual Report and the bi-monthly e-newsletter, as well as updating the ICR Website and social media pages, while pursuing more ways to continuously enhance marketing for the ICR. She is an alumna of CSU Pueblo, and after many years living in the Denver area, returned to Pueblo where she calls home.



# RESEARCH



## Short-term Effects of Cannabis use and Cannabinoids in Youth: A Sibling-Comparison Study

PI: Jarrod Ellingson



In the last 10 years, cannabis has become more accessible and more potent in tetrahydrocannabinol (THC) content. Prior studies have linked earlier cannabis use and greater THC potency to adverse mental health outcomes. However, these studies generally suffer from two important limitations. First, cannabis use has primarily been assessed in a pre-legalization environment, when THC potencies were lower. Second, most studies of adolescent cannabis use have not considered familial confounds, such as genetic or environmental factors. This study will recruit sibling pairs to examine the mental health

effects of cannabis while controlling for important familial factors. Specifically, we will test whether participants with heavier cannabis use have worse mental health functioning, on average, compared to their sibling. Within this study design, we will also examine the short-term effects of adolescent cannabis use, such as whether school week functioning is affected by weekend cannabis use. Short-term effects are important because they can help to identify mechanisms of long-term effects. Thus, this study will help to understand the mental effects of cannabis in adolescents, while controlling for family background factors.

## Cannabinoid Conversion to CBN During Hemp Extraction and Post-Extraction Fluorination of CBD and CBN for Increased Bioavailability

PI: Ken Olejar



Large numbers of therapies originate from compounds originating in plants. Cannabinoids produced by industrial hemp are a group of compounds that are emerging for potential medical use. One problem that exists with all-natural compounds is their bioavailability. Studies have shown that when many of these compounds are given at therapeutic levels, the levels actually found in the bloodstream are below therapeutic levels. As such, mechanisms for increasing the availability of these compounds are required. Fluorination of a compound

is a known method for increasing bioavailability. Using this technique, this project aims to increase the bioavailability of cannabidiol (CBD) and cannabinol (CBN). The obtained analogues of these cannabinoids will be tested for efficacy against a Rheumatoid arthritis model and in breast cancer. These two disease models were chosen because of the purported benefits of the cannabinoids against inflammation and use in pain management. It is therefore expected that the derived analogues obtained through fluorination will provide therapeutic possibilities by increasing the bioavailability for treating Rheumatoid Arthritis and breast cancer.

## Defining the Effects of CBD Consumption During Pregnancy on Fetal Neurodevelopment and Postnatal Anxiety

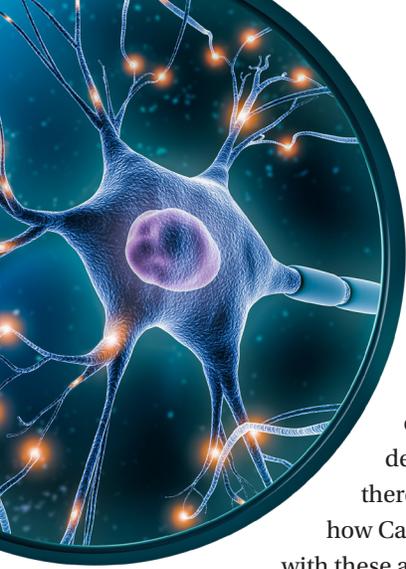
PI: Emily Bates



Morning sickness during pregnancy can be debilitating for a significant portion of women. Because there are not good remedies easily available and marijuana can help with nausea, women are drawn to using it, or the non-psychoactive component cannabidiol (CBD), thinking it is safe for their unborn child. CBD passes from the placenta to the fetus and crosses the blood-brain barrier. Retrospective clinical studies suggest that fetal marijuana exposure is associated with decreased birth

weight, poor birth outcomes, anxiety, and attention deficit, and hyperactivity disorder (ADHD). However, these studies do not include dosing information and there is no way to distinguish the impact of CBD from the psychoactive marijuana component, tetrahydrocannabinol (THC). Funding from the Institute of Cannabis Research will allow us to learn how fetal exposure to CBD affects brain development and anxiety behaviors.





## Microbiome-Mediated Effects of Cannabis and CBD on Neurotransmitter-Related Molecular Networks and Anxiety

PI: Nichole Reisdorph

Orally consumed Cannabis and extracted cannabidiol (CBD) products are becoming widely used supplements for a range of health disorders, including depression and anxiety. However, there is limited understanding regarding how Cannabis and CBD affect those living with these and other psychiatric conditions.

Personal reports and some early research studies suggest that the effects of orally consumed tetrahydrocannabinol (THC), CBD, and Cannabis are largely dependent on the individual. We hypothesize that some of this variability in a person's response is due to differences in an individual's gut microbiome composition. Therefore, our research will help

determine if an individual's gut microbiome plays a role in how he/she/they metabolize CBD, THC, and other Cannabis molecules when orally ingested. In addition, our research will help understand the effects of CBD and Cannabis on anxiety and depression by measuring important neurotransmitters known to be related to anxiety/depression. These include dopamine, serotonin, kynurenine, epinephrine, and several endocannabinoids. Results can be used to develop similar studies that focus on other conditions such as post-traumatic stress disorder (PTSD) and to determine if ingestion of a pro- or pre-biotic can influence an individual's response to CBD or Cannabis.



## Is What You See What You Get? A Systematic, Public Health-driven Analysis of Cannabis Product Label Claims VS. Actual Cannabinoid Content

PI's: Drs. Cinnamon Bidwell and Tyrell Towle, University of Colorado Boulder and MX, LLC

This project constitutes an independent and comprehensive evaluation of cannabis product label claims and testing infrastructure in the State of Colorado. The primary aim is to determine the actual cannabinoid potency (via independent testing in authentic cannabis products found in the Colorado Retail Cannabis marketplace) and compare to the claimed potency found on the label. Over the course of 3 years, 480 authentic cannabis products will be randomly selected and purchased from state-licensed retail dispensaries from four basic categories: flower/joints, edible/ingestible, concentrate, and other/infused. Each product will be independently and blindly analyzed for cannabinoid content, and, in later years of the study, relevant contaminants will also be determined. Should systematic deviations be detected, secondary analyses will disentangle whether these deviations occur across specific product types and whether inaccurate testing stems from specific state-licensed laboratories. Results will be rapidly disseminated to state policymakers and the public. In addition, repeated product testing each year of the three-year study will allow the determination of whether the testing accuracy improves over the course of the study. The resulting information will be highly relevant to our state's testing policies and procedures, as well

as to our patient and user community. The proposed work represents a collaboration among leading cannabis scientists at the University of Colorado Boulder (UCB) and MX, LLC, a Denver-based company with Marijuana Enforcement Division (MED) Occupational and Research and Development licenses. This landmark proposal is the first of its kind in two ways: First, no prior study has systematically tested the full range of cannabis products sold in our state retail market. The proposed work will allow a direct comparison of product content to product labels, enabling an independent quantification of any systematic biases that may exist across product types or testing facilities. Second, the project represents a novel collaboration among scientists bridging academia and the cannabis industry. Only MX, LLC has the state licenses to handle and analyze cannabis products for research purposes. In turn, Dr. Bidwell at UCB will serve as an independent academic partner, with the expertise to inform an unbiased, rigorous design, complete skilled data management, and analysis, and lead the investigative team in rapidly publishing and disseminating these critical, public health-relevant findings.



### Observational Study of the Effects of Acute Cannabis Use on Ocular Activity Relevant to Driving

PI: Ashley Brooks-Russell



Police officers have long recognized that changes to the eyes, such as changes to the pupils or eye movements, can be a sign of recent drug use. Emerging research has found that changes to eye movement may indicate recent cannabis use and even impairment

from cannabis. We will integrate eye-scanning technology into an existing driving simulator study to measure head position and eye movements while participants drive in a simulator after using cannabis. Successful completion of our research will inform future efforts to detect impairment related to cannabis while driving a vehicle or in an occupational setting.

### Exploring Intoxication During Acute Alcohol and Cannabis Co-Administration: A Focus on Cannabinoid Content and Order Effects

PI: Hollis Karoly



Cannabis is the most commonly used drug among people who drink alcohol, yet evidence on the effects of using these substances together is quite limited. Two important factors that might impact the relationship between cannabis and alcohol use are the specific type of cannabis used (i.e., THC/CBD content) as well as the order of use (i.e., using alcohol before cannabis or cannabis before alcohol). Another issue relevant for understanding this relationship is the increasing popularity of cannabis products called “concentrates” which contain very high concentrations of THC. No research has been conducted exploring the effects of these concentrates when combined with alcohol. This study aims to address these issues. We will recruit a community sample of individuals who regularly use alcohol and cannabis to participate in study sessions in our mobile laboratory. The sessions will involve individuals consuming

different cannabis concentrate products: (THC-dominant [5mg THC/0mg CBD], CBD-dominant [0mg THC/5mg CBD/], 1:1 THC/CBD [2.5mg THC/2.5mg CBD] and placebo [0mg THC/0mg CBD]) along with a moderate dose of alcohol. Half of the participants will use the alcohol before cannabis, and the other half will use the cannabis before alcohol. We will measure intoxication (e.g., balance performance, self-ratings of intoxication) and biological outcomes (e.g., breath alcohol level, heart rate) every 30 minutes for 4 hours after they use the cannabis and alcohol. We expect to see differences in these outcomes depending upon which cannabis concentrate product was consumed. We expect the greatest intoxication in those who used the THC-dominant concentrate and the least intoxication in the placebo group. We will also measure differences between those who used alcohol before cannabis and those who used cannabis before alcohol.

### Dissecting the Genetic Basis of Sex and Dioecy in Cannabis Sativa

PI: Nolan Kane



As hemp continues to become an ever more economically valuable/important crop, it becomes increasingly necessary to understand the mechanism of sex determination. Understanding these processes will help to develop new approaches, tools, and pipelines, which will propel Cannabis into the modern

era as a legitimate crop species. Using crosses between dioecious and monoecious hemp varieties expressing variable levels of male to female flowering ratios, we propose to,  
1. understand the evolution and function

of the X and Y chromosomes; 2. elucidate whether other genetic loci, autosomal and/or cytoplasmic, are important in sex determination; and 3. better characterize the effect of environment on sex expression plasticity. We will test the relative roles of cytoplasmic and nuclear factors in sex determination, quantitatively. The data collected from our crosses will be used to test the hypothesis that CMS mutations lead to gynodioecy in the absence of a Y chromosome, while the Y restores male fertility in a CMS background. This will aid breeders and growers in controlling the production of pollen-producing males and hermaphrodites, as well as understanding the early, ongoing evolution of a Y chromosome.





## Investigating the Effect of Cannabidiol and Cannabidiol-trazodone Combination Treatment on Naturally Occurring Canine Cognitive Dysfunction Syndrome as a Surrogate for Alzheimer's Disease

PI: Stephanie McGrath

The World Health Organization predicts that Alzheimer's disease (AD) and other dementias will be the second leading cause of death in the United States within the next decade. Unfortunately, multimodal treatment efforts, with drugs, vaccines, and stem cell therapies, have yet to be successful. Neurodegenerative disorders are associated with the accumulation and aggregation of misfolded disease-specific proteins in the brain followed by the irreversible loss of neurons. Canine cognitive dysfunction syndrome (CCD) is a well-recognized neurodegenerative disease in older dogs and serves as an ideal naturally occurring surrogate for AD in humans. To date, there are no broadly effective treatment options for dogs or humans suffering from cognitive decline, partially due to the inferior animal models used in past research. Pathophysiologic changes associated with AD include increased amyloid- (A) deposition leading to senile plaques, increased tau hyperphosphorylation leading

to neurofibrillary tangles, and significant neuroinflammation and oxidative stress leading to neurodegeneration and cognitive decline. Promising data have revealed that cannabidiol (CBD) and trazodone may have beneficial effects on various phases of the neurodegenerative process, which, given alone or in combination, could provide an effective preventive and therapeutic option in dogs, acting as a translational model for use in humans. We aim to enroll thirty client-owned dogs with naturally occurring cognitive dysfunction in a blinded, randomized, placebo-controlled clinical trial, with the objective of evaluating the effect and tolerability of CBD with and without trazodone on disease progression. The results of this in vivo study will set the foundation for human clinical trials.



## Quantification of Endo- and Phytocannabinoids with Comparison to Pain Medication Requirements and Surgical Outcomes for Patients Undergoing Abdominal Surgery for Cancer

PI: Camille Stewart, MD, Assistant Professor of Surgery, Division of Surgical Oncology, at the University of Colorado Anschutz Medical Campus

The use of cannabis is expanding in the United States. There is, however, a critical lacking in our understanding of how cannabis and its associated chemical compounds, called cannabinoids, affect patients after surgery. Patients undergoing abdominal surgery have substantial pain after surgery and often experience complications. Since we have found that cannabis is of interest to surgical patients diagnosed with cancer, they represent an ideal population to study. In our planned research, we will measure blood cannabinoid levels in daily cannabis users and non-users who undergo abdominal surgery for the treatment of cancer. Pain levels, pain medication requirements, and post-

surgery complications will also be assessed. We think that patients with higher blood levels of cannabinoids will have more pain and need more pain medication after surgery, but that they will have similar rates of post-surgery complications. The information gained from this research will help doctors and patients understand how cannabis use affects patients after surgery and help determine if cannabis use is safe to use around the time of surgery.



# PROJECT SPOTLIGHTS

The Institute of Cannabis Research funded 10 meritorious research projects from its FY22 Funding Competition.

Two of these projects are featured here.

# 1

## Defining the effects of CBD consumption during pregnancy on embryonic neurodevelopment and postnatal anxiety



Dr. Emily Bates, Associate Professor at University of Colorado Anschutz Medical Campus, in collaboration with Ms. Karli Swenson, graduate student and Certificate of Cannabis Research holder, have begun their medical & clinical study of the effect of CBD consumption during pregnancy on embryonic neurodevelopment and postnatal anxiety in mice.

Morning sickness during pregnancy can be debilitating for a significant portion of women. Due to the lack of good remedies, women are instead drawn to marijuana, or the non-psychoactive component cannabidiol (CBD), thinking it is safe for their unborn child. CBD passes from the placenta to the fetus and crosses the blood-brain barrier. Retrospective clinical studies suggest that fetal marijuana exposure is associated with decreased birth weight, poor birth outcomes, anxiety, and attention deficit and hyperactivity disorder (ADHD). However, these studies do not include dosing information and there is no way to distinguish the impact of CBD from the psychoactive marijuana component, tetrahydrocannabinol (THC). Funding from the Institute of Cannabis Research will allow us to learn how fetal exposure to CBD affects brain development and anxiety behaviors.

**Dr. Bates has emphasized the importance of the ICR funding to her research, and to the development of graduate student Ms. Swenson:**

“While the financial support from the ICR has been foundational in Karli’s ability to work on her doctoral thesis, the social and academic support from the ICR has been equally important to her career. Not only did the ICR fund an additional scholarship supplement that funded the purchasing of a new, high processing and high storage computer that allows her to efficiently analyze data, but the ICR also provided funding for travel to a conference to share her work with experts in various fields (both cannabis based, clinically based, and public health based). Through the overlap of the ICR with CU Anschutz’s Cannabis Research

Consortium (C2RC), we have met and been able to collaborate with established scientists who we are comfortable asking for technical or theoretical advice. We share research materials and share data to inform studies. The ICR also hosts monthly seminars that have been very helpful for us. A recent seminar by Dr. Yasmin Hurd focused on marijuana consumption during pregnancy and adolescence that was especially relevant to our studies. Funding from the ICR, its associated resources, and the collaborations that it has helped us begin are vital in Karli’s transition from a doctoral student to an independent scientist. In addition, these connections are important for my work as I apply my expertise into the field of cannabis research.”

Dr. Bates and Ms. Swenson intend to present research from the first year of the project at the Society for Birth Defects Research and Prevention Annual Conference and the 2022 Virtual Cannabis Research Conference to discuss their work showing that fetal CBD exposure impacts gene expression in the hypothalamus and affects postnatal behavior.



# 2

## Exploring Intoxication During Acute Alcohol and Cannabis Co-Administration: A Focus on Cannabinoid Content and Order Effects



Dr. Hollis Karoly, Assistant Professor at Colorado State University, has begun their public health & social impact study on the effects of the co-administration of cannabis and alcohol in humans. Cannabis is a commonly used drug among people who drink alcohol, yet evidence on acute effects of co-use has remained limited and inconsistent.

Two important factors that might impact the relationship between cannabis and alcohol use are the specific type of cannabis used (i.e., THC/CBD content) as well as the order of use (i.e., using alcohol before cannabis or cannabis before alcohol). Another issue relevant for understanding this relationship is the increasing popularity of cannabis products called “concentrates” which contain very high concentrations of THC. No research has been conducted exploring the effects of these concentrates when combined with alcohol. This study aims to address these issues. We will recruit a community sample of individuals who regularly use alcohol and cannabis to participate in study sessions in our mobile laboratory. The sessions will involve individuals consuming different cannabis concentrate products: (THC-dominant [5mg THC/0mg CBD], CBD-dominant [0mg THC/5mg CBD/], 1:1 THC/CBD [2.5mg THC/2.5mg CBD] and placebo [0mg THC/0mg CBD]) along with a moderate dose of alcohol. Half of the participants will ingest alcohol before using cannabis, and the other half will use cannabis before ingesting alcohol.

We will measure intoxication (e.g., balance performance, self-ratings of intoxication) and biological outcomes (e.g., breath alcohol level, heart rate) every 30 minutes for 4 hours after the use of cannabis and alcohol. We expect to see differences in these outcomes depending upon which cannabis concentrate product was consumed. We expect the greatest intoxication in those who used the THC-dominant concentrate and the least intoxication in the placebo group. We will also measure differences between those who used alcohol before cannabis and those who used cannabis before alcohol.

### Annual Update from the PI

As with many of the projects funded through ICR grants in the fall of 2021, much of the first year of Dr. Karoly’s research has been spent completing regulatory submissions such as IRB, finalizing study protocols, and hiring and training staff. Dr. Karoly’s project was no exception. Recruitment of human subjects for this study has also begun. Despite indicated challenges of conducting human research amidst the lingering effects of the COVID-19 pandemic, Dr. Karoly expressed pride in allowing extra time to be spent putting protections in place for her research staff. As reported in the spring of 2022, Dr. Karoly had confirmed 5 eligible study participants and



*Photos of Mobile Lab*

2 participants have been tested thus far. Recruitment and testing of more participants is planned for late-spring and summer.

Dr. Karoly, in collaboration with Research Assistant Emma Smith and Co-PI Dr. Bradley Conner, look forward to presenting research related to this projects at the Research Society on Marijuana Conference in Boston this year to discuss co-administration of cannabis concentrates and standard alcohol doses in human subjects in a mobile laboratory study.



# EMERGING SCIENTIST SCHOLARS

**A**n important goal of the Institute of Cannabis Research (ICR) is to see the development of student researchers through its funding of cannabis research throughout Colorado. Funds of \$25,000 were set aside to support a new Student Research Fellowship program. The ICR was able to support seven Emerging Scientists from the following Colorado Schools with awards up to \$5,000 for the period of January 2022-May 2022: Colorado University Boulder, Colorado University Denver, Colorado University Denver Anschutz Medical Center and Colorado State University Ft. Collins.

*What this means for the development of up and coming scientists in the field of cannabis research:*



**Emma Lamping**

*MD Student - Class of 2024  
University of Colorado School of Medicine*

“ Receiving the Emerging Scientist Award from ICR is very exciting for me. As a first-generation college student, receiving outside support to develop my research skills means a lot to me. I plan to use this award to help conduct meaningful research on how cannabis effects pain management for surgical patients. I will also use this opportunity to advance my knowledge of how to properly investigate scientific questions which will help prepare me to lead future research projects during my career. Thank you for this award and opportunity!

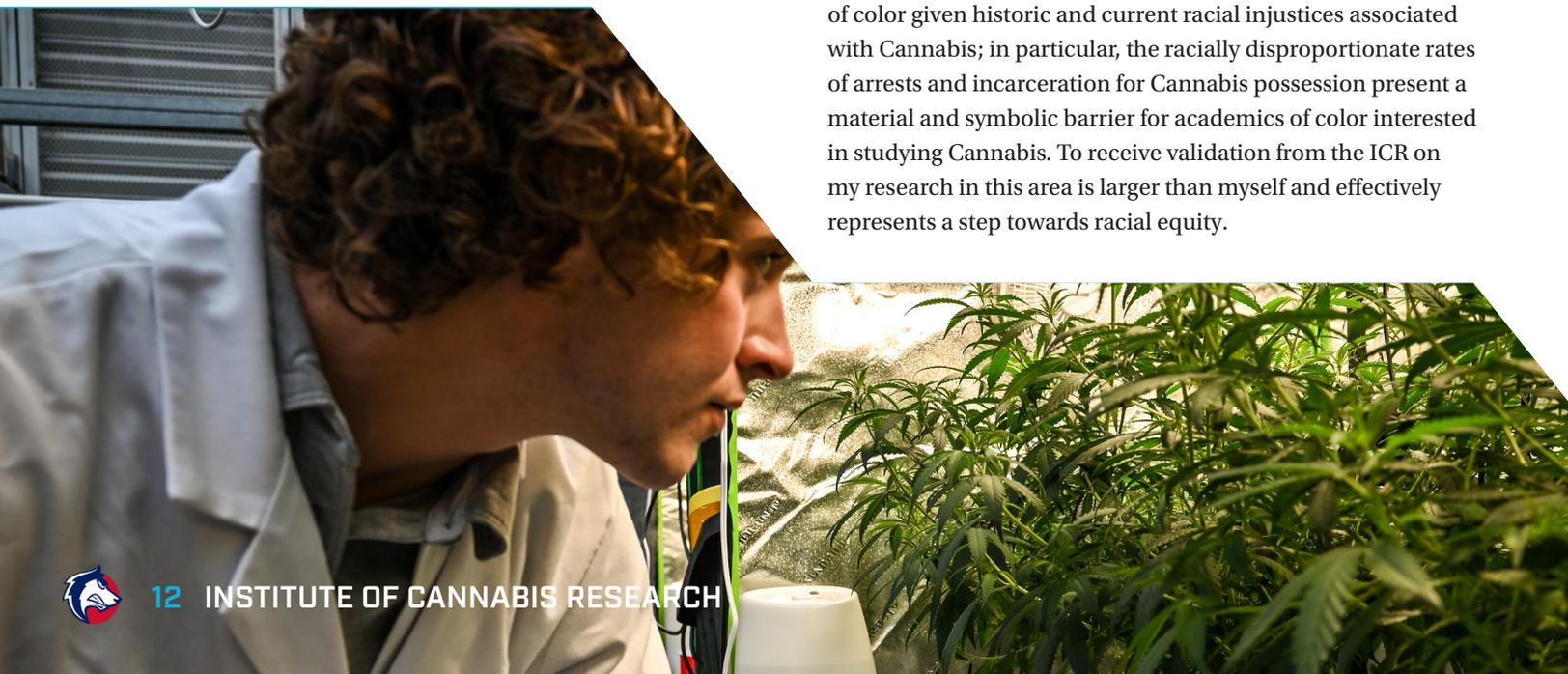
**Leonardo R. Orozco**

*PhD Student*



“ This emerging scientist award supports my PhD research on Cannabis at CU Boulder. This award will contribute to my ongoing research projects and doctoral dissertation by allowing me to establish mathematical models to understand the interaction between cannabinoid genes and validates the importance of mathematical models in the understanding of gene interactions. Being validated as an emerging scientist by the Institute of Cannabis Research is incredibly empowering and lends credence to the value I place on my work.

Additionally, this award is extremely meaningful as a person of color given historic and current racial injustices associated with Cannabis; in particular, the racially disproportionate rates of arrests and incarceration for Cannabis possession present a material and symbolic barrier for academics of color interested in studying Cannabis. To receive validation from the ICR on my research in this area is larger than myself and effectively represents a step towards racial equity.





### Karli Swenson

Ph.D. Candidate | Bates Lab  
Integrated Physiology Program  
Department of Pediatrics  
Section of Developmental Biology  
University of Colorado | Anschutz Medical Campus

“ The Emerging Scientist Award is critical for my development as an independent scientist within my lab. Not only did this award fund a new computer set up for big data analysis, but it’s funding my attendance at a major conference within my field. This funding is expediting my research and helping me understand how CBD consumption during pregnancy effects baby’s brain development. I am grateful for the support of the Institute of Cannabis Research and the wonderful researchers who are affiliated with it!

### Cianna Piercey

First year counseling PhD program  
Dept. of Psychology  
CSU Ft. Collins



“ As a recipient of the Emerging Scientist Award, I’ve gained hands-on experience with cannabis and alcohol administration procedures and Dr. Karoly’s novel mobile drug administration laboratory. Serving as a graduate research assistant on this study has been instrumental to my development as a cannabis researcher and paramount to achieving my long-term goal of directing my own lab one day. Ultimately, the Emerging Scientist Award has allowed me to contribute to innovative translational research on legal-market cannabis that will inform both policy and practice.

## INFORMATIONAL VIDEO: SCHOOL OF CREATIVITY AND PRACTICE



### Matthew Garcia, MFA

Assistant Professor  
School of Creativity + Practice

This project was a part of an initiative within the School of Creativity and Practice at Colorado State University Pueblo to connect art and media students with real world creative practice by directly collaborating with the community, non-profits, small businesses, and civic groups.

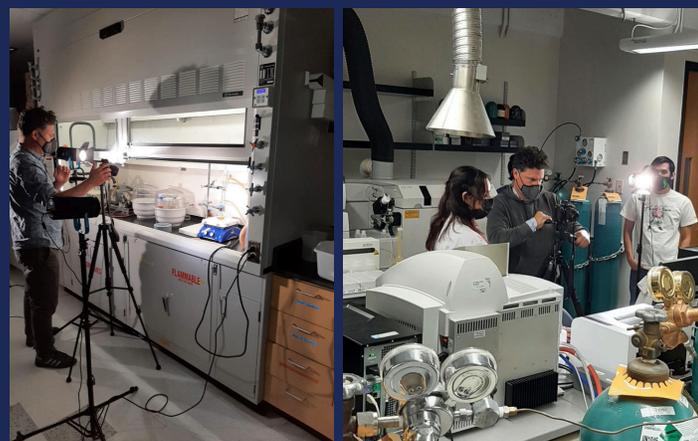
The project with the IRC was special in that media students had the opportunity to learn how the creative industry can be relevant and even important within the field the of science.

Check out the finished video here:

[youtube.com/watch?v=8CVZj65lBmY](https://youtube.com/watch?v=8CVZj65lBmY)



▲ Miguel Rodriguez, Celeste Santistevan, Laura Acevedo, Makayla Caldwell, Glorilecea Martel, Julius Carter, Sierra Sandoval, Brenden Vigil, Maxine Schuldt, and Tryston Medina



# VISITING RESEARCHERS



*Dr. Jerónimo González Cortés, Dr. Eunsoo Kim, and Research-Scholar Ingrid Carolina Corredor Perilla, Doctoral candidate*



## **Ingrid Carolina Corredor**

*Visiting Research-Scholar, Ingrid Carolina Corredor Perilla, Doctoral candidate in Agroecology, National University of Colombia, Bogotá and Visiting Researcher at the ICR-CSU Pueblo.*

As a visiting research scholar at the Institute of Cannabis Research (ICR) and under the direction of Dr. Sanghyuck Park, I am focused on two main research projects: The first evaluates the microbiome community's structure, abundance, and distribution in the soil's rhizosphere of two hemp cultivars, across the plant developmental stages. The second assesses the effects of low (20-50% RH), and high (60-90%RH) humidity conditions on plant development and cannabinoid profiles of hemp cultivars (Figure 1). Currently, we are collecting data and hope to be able to share results in the coming month.





### Dr. Jeronimo Gonzales Cortes

Jerónimo González Cortés is a Spanish experimental researcher in non-food crops, mainly energy crops and fiber crops, and biogenic residues. His research interests include biomass production, biomass logistic, energy use of biomass and bioproducts.

He is currently the Scientific Director of Agriculture Research Center Finca La Orden Valdesequera that belongs to the Scientific and Technological Research Center (CICYTEX) of Extremadura Region (Southwestern Spain) and lead the group of biomass and bioproducts in this Center. He has previously been leadership and collaborate in different European, National and Regional projects of this research topic. Jerónimo has also collaborated with SMEs agro-industry.

From March to May Jerónimo González is in ICR Pueblo for a short stay. The ICR laboratory is currently developing different projects, one of them includes the effects of the deficiency of nutrients in cannabis growth and cannabinoid production, in which the CICYTEX researcher knows the way of working in the ICR with hemp, the cannabinoids and the possible uses of hemp biomass for industrial purposes and medicinal. This visit with the ICR provides information on the cultivation of hemp in the State of Colorado, to study the innovations on this crop and its uses. Ultimately, we hope to facilitate an analysis of Colorado agriculture and relate this directly with the cultivation of hemp.



### Dr. Eunsoo Kim

Dr. Eun-Soo Kim joined the Institute of Cannabis Research (ICR) in December 2019 as a visiting scholar. During the previous 26 years, he was a professor of plant biology at Konkuk University in South Korea. In 2007 he founded The Korea Hemp Institute and served as its director for 7 years. Later in 2008, he received one

of the highest honors for professors at the University winning the prestigious Great Research Award which is awarded to only the very best professors at the University. His research at the ICR focuses on the investigation of the functional activities of three types of glandular trichomes related to the biosynthesis of cannabinoids. He has conducted histomorphological and immunochemical studies of glandular trichomes in fiber-type hemp varieties using anti-CBD monoclonal antibodies and scanning electron microscopy. He has also investigated the extracted secretory contents of the secretory cavity by the microcapillary method and analyzed these using high performance liquid chromatography (HPLC).

Simulaions of Low Humidity (appx. 40%) Chamber one (C1)

Simulaions of High Humidity (appx. 70%) Chamber two (C2)



Figure 1. Evaluation of high (30-50%RH) and low (60-90%RH) humidity conditions in hemp varieties of Cannabis sp (CBF project)



The Insitute of Cannabis research has provided me the ability to develop skills crucial to the emerging field of cannabis research. The opportunity to work hands on with the cannabis plant, alongside professors and staff, has enhanced my learning experience and critical thinking. It has enabled me to deepen my understanding of the science surrounding the Cannabis plant.”

- Ian Noonan

ICR Student



# PARTNERSHIPS

## National and International Collaborations

**T**he Institute continues to look for strategic partnerships that advance the role and mission of the ICR. Over the history of the ICR the Institute has worked to develop strategic partnerships that enhance the impact, reach, and scope of key initiatives with a focus on cannabis research and dissemination activities. For instance, the ICR collaborates with the Lambert Center for the study of Medicinal Cannabis and Hemp at Thomas Jefferson University and the Volcani Center for Agricultural Research in Israel on the two monthly webinar series hosted by the ICR. These two partnerships are new within the past year and serve to expand the available expertise and reach of the webinar series. Likewise the ICR is partnering with the Global Hemp Innovation Center (GHIC) at Oregon State University in hosting the annual Cannabis Research Conference. Given the fact that there are some differences in focus between the Institute and the GHIC,

our expertise and reach complements each other, which is then reflected in a more diverse conference programing. The ICR has been fortunate to secure research partnerships, both nationally and internationally, that have yielded resources to support cannabis research. In the past year the ICR has formalized partnerships with Vyripharm Biopharmaceuticals to set up an advanced cannabis testing laboratory and a partnership with Green Medicine, a research organization associated with St. Mary's Hospital in Seoul, Korea. In addition, ICR has built a research partnership with the international collaborator, GrowDoc in the artificial-intelligent associated disease diagnosis system development, and continues the partnership with Chuncheon Bioindustry Foundation (CBF) for additional collaborations in 2022 to 2024. The ICR will continue to look for strategic opportunities to grow its influence and impact through development of partnerships that advances its mission.

## ICR GOVERNING BOARD



The State appointed ICR Governing Board is comprised of eleven members. The key roles of the Governing Board are to guide the mission and budget of the ICR. Other roles of the Governing Board include advising institutions of higher education developing cannabis related curricula and providing input to the Colorado Commission on Higher Education on new cannabis-related degrees and certificates, as well as leading efforts to secure resources to support the mission of the ICR. The Board is invested in the long-term success and maximizing the impact of the ICR in supporting unbiased cannabis research in the state of Colorado. The Governing Board meets on a monthly basis, and Board meetings are open to the general public to attend. Information about Board meetings can be found on the ICR Website.

*Photo from recent meeting with many members of the Governing Board and guest: L to R - Mr. Scott McWhorter, Dr. Joanna Zeiger, Ms. Elyse Contreras, Mr. Sherard Rogers, Mr. Sal Pace, Dr. Chad Kinney, Mr. Ean Seeb, Guest, Dr. Cinnamon Bidwell, Chair, and Dr. Jon Reuter*





# LETTER FROM THE GOVERNING BOARD CHAIR



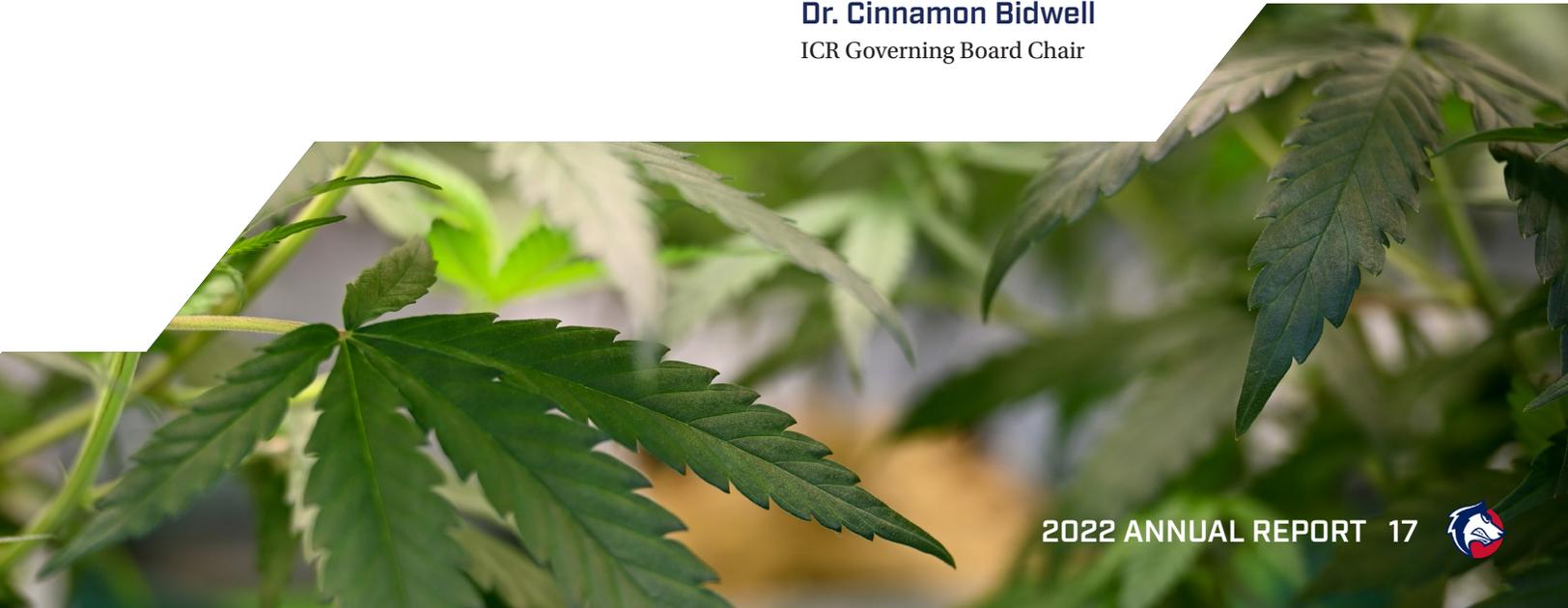
**S**erving as the Chair of the Institute of Cannabis Research (ICR) Governing Board for the past two and a half years, I have witnessed a maturing of the Institute as its role in Colorado has evolved.

The Board and I are very pleased with the trajectory of the Institute. The Board and the Institute are encouraged by the continued support of the State of Colorado to fund important cannabis research and engaging world-class researchers throughout the state.

We have overseen a robust research portfolio developed from this funding, and we hope to continue to engage researchers to meet the needs of the state going forward. Some highlights include research projects addressing the harms of high potency cannabis, public safety of cannabis in regards to driving, as well as clinically relevant research focused on important health outcomes such as cognitive disorders and post-surgery pain management. The ICR staff and I have worked closely with state agencies and the Governor's office to establish the infrastructure required to both evaluate and administer high quality cannabis research projects. Given the state's early vision and support for the ICR, the growth potential for the ICR and the State of Colorado as a national leader in cannabis research is exceptional.

The ICR has developed several national and international partnerships that have been established over these past few years to expand the scope and impact of the ICR. Some of these partnerships are around initiatives to see the results of cannabis research broadly and publicly disseminated. The ICR continues to co-host and see the Cannabis Research Conference (previously the Institute of Cannabis Research Conference) grow in stature and importance as one of the very few cannabis focused conferences that is truly a research conference. Even in the midst of the global pandemic requiring remote operation of the conference, attendance has grown, sponsorship and the number of exhibitors have increased, and the conference includes researchers from across the nation as well as some international researchers. The Cannabis Research Conference has become a destination conference for those working in this diverse area of research. As well, the ICR has been hosting a monthly cannabis research webinar series which has been very successful and well attended. This has spurred on the creation of an additional webinar series focused on cannabis cultivation, also offered each month. These successes underscore that expansive and rapid public dissemination of cannabis research is a core value of the ICR and demonstrate our dedication to good stewardship of the public dollars that fund our work.

**Dr. Cinnamon Bidwell**  
ICR Governing Board Chair

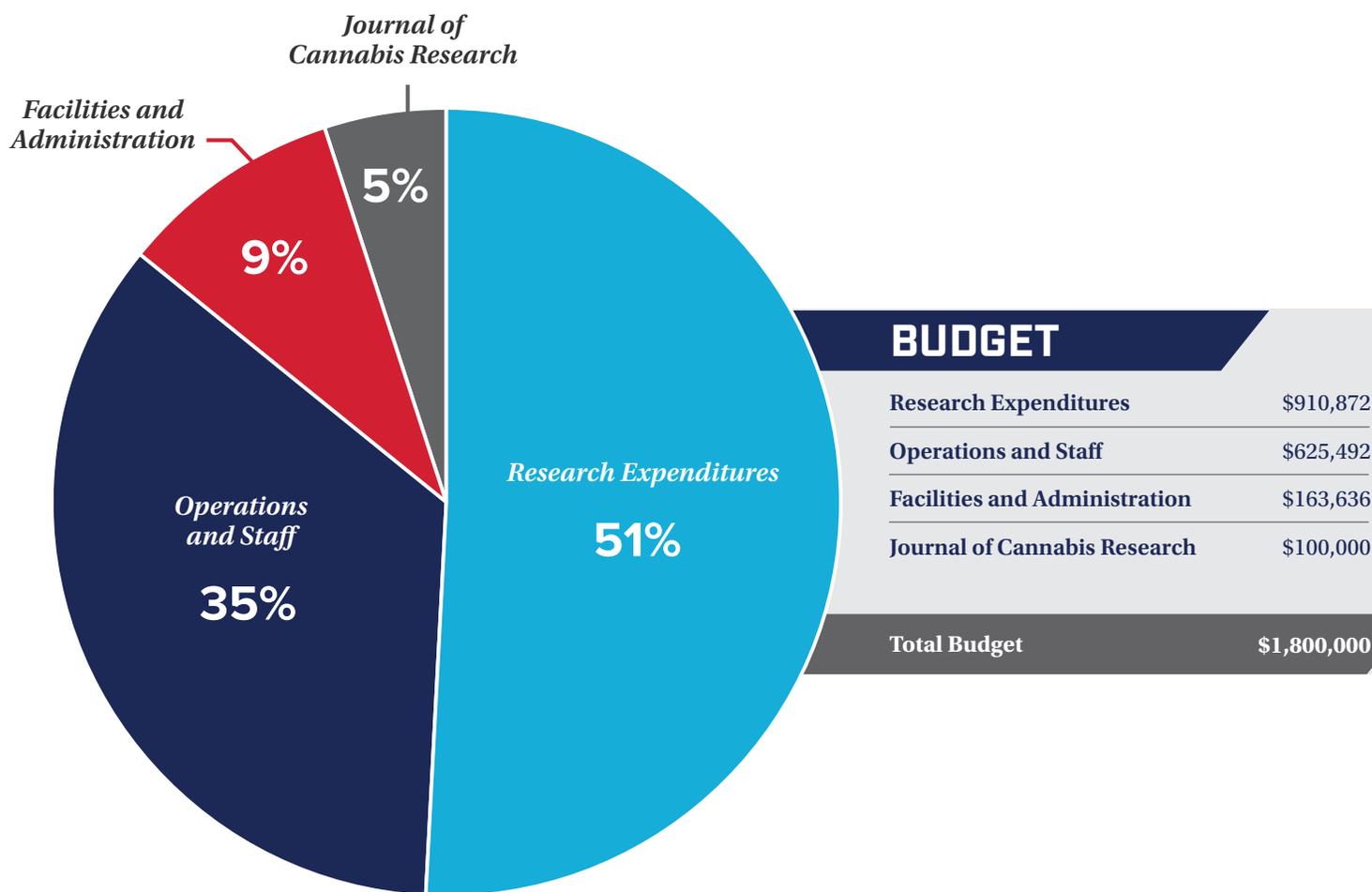


# FY 2022 BUDGET REPORT

**T**he annual budget for the ICR is used to implement the mission and vision of the Institute, which centers on supporting research and the dissemination of research results. Major budget categories consisted of research expenditures, operations expenses and staff salaries, facilities and administration costs, and costs associated with the Journal of Cannabis Research (JCR).

The largest individual component of the ICR's annual budget is related to the direct execution of cannabis research at institutions throughout Colorado.

The ICR saw an increase in budget allocations for research from the previous fiscal year, an indication of the recovery from the financial challenges of the previous year and impacts of the pandemic on research activities, which forced a temporary suspension of research projects in 2020 and did not allow for new research projects to be launched in FY 2021. Research expenditures consisted of more than 50% of the ICR's FY22 budget. To follow national best practices in research funding the ICR anticipates rolling forward some of the awarded research dollars (not to exceed 25%) to allow researchers to most appropriately responds to inherent uncertainties involved in conducting research.



# 2022 CANNABIS RESEARCH CONFERENCE KEYNOTE SPEAKER



Dr. Linda Parker

## Cannabis Research Conference 2022 and the Mechoulam Lecture Series

**F**or the second time in as many years, the Institute of Cannabis Research has partnered with the Global Hemp Innovation Center at Oregon State University to co-host the Cannabis Research Conference 2022.

This partnership has expanded our reach and scope and has attracted more attendees from across the nation and worldwide. The 6th annual Cannabis Research Conference (CRC) 2022 will be held as an interactive, virtual experience on August 8-10, 2022. This multi-disciplinary, three-day virtual conference attracts attendees both nationally and internationally. The Cannabis Research Conference explores the latest in cannabis science and innovation for applications in medicines, foods, materials, textiles, and more that can improve people's understanding of cannabis and potential applications. The 2022 Virtual Cannabis Research Conference attracts and connects some of the brightest innovators addressing many topics including Genetics, Growth, Culture, Human Health, Quality Control, Chemistry and Analytics, Livestock and Companion Animals, Business and Economic Development, Policy and Legal Landscape and Materials and Product Manufacturing as well as several other areas.

The ICR is proud to continue its support of the Mechoulam Lecture as one of the Keynote Addresses as part of this conference series. The Mechoulam Lecture series is named in honor of Dr. Raphael Mechoulam, who is widely recognized as the father of modern cannabis research. Dr. Mechoulam delivered the first lecture in this series at the first conference hosted by the ICR in the spring of 2017. The Mechoulam Lecture at Cannabis Research Conference 2022, will be delivered by Dr. Linda Parker. Dr. Mechoulam personally recommended Dr. Parker for this honor. Dr. Parker is the author of *Cannabinoids and the Brain* (MIT Press, 2017) and, along with Raphael Mechoulam and Erin Rock, *CBD: What does the Science Say?* (MIT Press, 2022). She is currently University Professor Emeritus at the University of Guelph, Ontario, Canada, where she held a Tier 1 Canada Research Chair until July 1, 2020 in Behavioral Neuroscience. She has over 200 publications most recently focused upon understanding how plant derived cannabinoids and the functioning of the endocannabinoid system and other fatty acid amides act in the brain to regulate nausea and vomiting, anxiety and addiction. She is past-President of the Canadian Consortium for the Investigation of Cannabinoids, having served on its executive board since 2007. She was awarded the Lifetime Achievement Award from the International Cannabinoid Research Society (2017) and the Medal of Merit from the University of Guelph (2022) for her contributions toward understanding the role of the endocannabinoid system in the regulation of nausea.

## OUTREACH & IMPACTS <sup>OF</sup> ICR

### WEBINARS

With the emerging requests for information on the advances being made in cannabis cultivation and risk management, the ICR launched a monthly Cannabis Cultivation Webinar series beginning in February 2022. This webinar series aims to provide current information on cannabis farming technology, cultivation challenges, risk management, and entrepreneurship, as well as serving as a source for networking with others in the field. The series is led by ICR Senior Scientist, Dr. Sanghyuck Park, and is co-chaired with Dr. Nirit Bernstein, Senior Researcher, Head of the Medical Cannabis Research Lab at the Volcani Center

in Israel. This series hosts renowned cannabis scientists and cultivation/industrial experts who bring insights into the world of cultivation strategies. The speakers provide information regarding many aspects of cannabis breeding, seed/oil production, disease diagnoses, pest control, harvest strategy, and postharvest management. Topic areas will be expanded to include cannabis chemistry, particularly as it affects cannabinoid production, extraction and quality control.

For registration, please visit the below link.

[csupueblo.edu/institute-of-cannabis-research/webinars/cannabis-cultivation-webinar-series.html](https://csupueblo.edu/institute-of-cannabis-research/webinars/cannabis-cultivation-webinar-series.html)



## CANNABIS RESEARCH WEBINAR SERIES

The Institute of Cannabis Research has hosted the Cannabis Research Webinar series since October 2020. The series focuses on allowing expert speakers on various cannabis-related endeavors to present their research and information. Additionally, the Institute of Cannabis Research intends to engage cannabis researchers globally by providing varying perspectives from the field.

Presenters for this webinar series have spoken on topics ranging from medical science and public policy to industrial perspectives to funding opportunities.

In September of 2021, the Institute of Cannabis Research at CSU Pueblo and the Lambert Center at Thomas Jefferson University began partnering on the webinar series. Each presentation is given on a regular schedule on the second Thursday of each

month. In addition, recordings of the webinars are made available on the ICR website shortly after the live presentation. The Cannabis Research Webinar series is intended to educate and engage an audience of researchers, students, and the public working in or interested in the science of cannabis. In addition, the webinars are used to educate the audience about the operations of the ICR, build the authority of the ICR in the industry, create new ICR partnerships, and provide a resource to cannabis and natural products degree programs.

A summary of the webinars from July 2021 to June 2022 can be found at this link:

[csupueblo.edu/institute-of-cannabis-research/webinars/cannabis-research-webinar-series.html](https://csupueblo.edu/institute-of-cannabis-research/webinars/cannabis-research-webinar-series.html)

## E-NEWSLETTER

The Institute of Cannabis Research e-newsletter continues to gain interest with an ever increasing audience. We have twice the number of subscribers to our e-newsletter as compared to our first issue in September of 2020. These bi-monthly newsletters spotlight activities of cannabis researchers throughout the state and beyond. Each issue also features news of our annual conference, members of our Governing Board, and articles published in the Journal of Cannabis Research. The e-newsletter

is another mechanism to keep stakeholders informed of important Institute news as well as share information important to the world of cannabis research. The e-newsletters are archived on the ICR website at:

[csupueblo.edu/institute-of-cannabis-research/outreach/index.html](https://csupueblo.edu/institute-of-cannabis-research/outreach/index.html)

## RFA - FY23 CANNABIS RESEARCH AWARD OPPORTUNITY

The ICR has a vision to support the advancement of knowledge and understanding of cannabis, broadly defined, by supporting unbiased, high-quality research. One method the ICR utilizes to realize this vision is through Research Award Opportunities. The second Research Award Opportunity was launched by the ICR in January and we have just accepted full applications for projects that have already submitted a Letter of Intention (LOI). Stay tuned for more information on the projects that will be

funded with this opportunity, as their anticipated start dates are for the fall of 2022. Once projects have been selected for award, summaries will be available to view on our website at this link:

[csupueblo.edu/institute-of-cannabis-research/research/research-studies/index.html](https://csupueblo.edu/institute-of-cannabis-research/research/research-studies/index.html)





# JOURNAL OF CANNABIS RESEARCH

**T**he Journal of Cannabis Research (JCR) began accepting manuscripts in Sept., 2018. Over this past 4th year of publication, the journal has continued its solid growth. We have a distinguished international editorial board comprising 34 prominent cannabis scientists from 10 countries on four continents. Our comprehensive system of 10 topic sections covers all aspects of cannabis, cannabinoid, and endocannabinoid science, both preclinical and clinical, as well as cannabis economics, regulation, and history. Manuscripts were submitted from 23 different countries on all continents except Antarctica (60% from North America). They were reviewed by 148 external peer reviewers from 25 countries on all continents except Antarctica. JCR is truly an international journal.

JCR remains one of only two international, multi-disciplinary journals in the cannabis field and the only one which is open-access. Anyone in the world can find our articles on our web site or on PubMed and read them without paying any fee. This makes our articles readily accessible to those in low-income countries or without access to an academic library. The enhanced visibility of articles published in JCR is an advantage to authors when deciding on where to submit their manuscripts for publication.

JCR started charging authors for publication of their manuscript on Jan. 1, 2022. This fee covers the costs of peer review and manuscript processing and can be paid from grant funds.

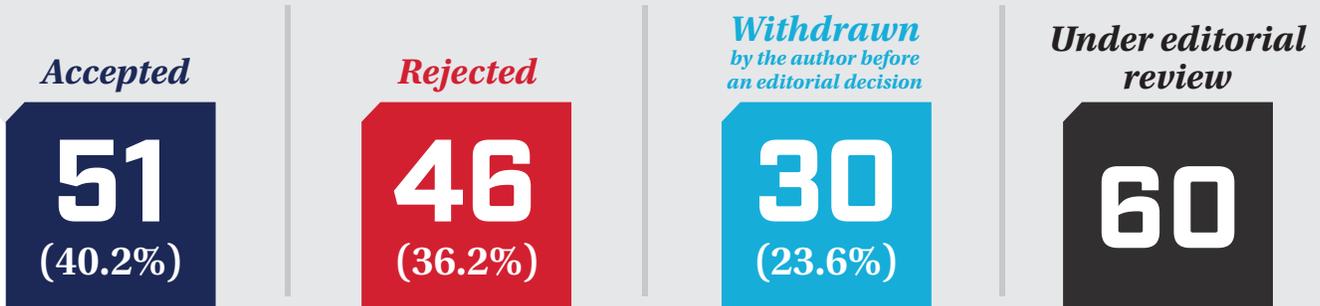
During FY 2021 (July 1, 2021 through May 30, 2022), 105 manuscripts were submitted to JCR and 127 manuscripts (including 22 submitted the prior year) had a final editorial decision.

Our manuscript acceptance rate of 40% is comparable to that of many established journals that receive a large number of manuscript submissions.

Our major challenge continues to be finding reliable reviewers for our diverse manuscripts. The inability to obtain timely external peer review is the primary reason that about half of manuscripts submitted this fiscal year remain under review without a final editorial decision.

**David A. Gorelick, MD, PhD, DLFAPA, FASAM**  
Director, Journal of Cannabis Research

*The outcome of editorial review was as follows:*



# DISSEMINATION ACTIVITIES

## Camille Stewart

*Quantification of Endo- and Phytocannabinoids with Comparison to Pain Medication Requirements and Surgical Outcomes for Patients Undergoing Abdominal Surgery for Cancer*

### Presentations:

Madsen, H., Carmichael, H., Del Chiaro, M., Gleisner, A., Schulick, R., Stewart, C. *Cannabis Use and Post-operative Complications in Patients Undergoing Pancreatic Resection*. Cannabis Research Conference, 2021.

## Emily Bates

*Defining the effects of CBD consumption during pregnancy on embryonic neurodevelopment and postnatal anxiety*

### Presentations

Swenson, K, O'Rourke, R., Bates, E. A. *Fetal Cannabidiol (CBD) Exposure Affects Hypothalamus Development and Glucose Tolerance*. Society for Birth Defects Research and Prevention Annual Conference, 2022.

Swenson, K., O'Rourke, R., Bates, E. A. *Fetal Cannabidiol (CBD) Exposure Affects Hypothalamus Development and Glucose Tolerance*. Cannabis Research Conference, 2022.

Swenson, K., & Bates, E. *The Effect of Fetal Cannabidiol (CBD) Exposure on Brain Development and Postnatal Behavior*. Society for Birth Defects Research and Prevention 62nd Annual Meeting, 2022.

Swenson, K., & Bates, E. *The Effect of Fetal Cannabidiol (CBD) Exposure on Brain Development and Postnatal Behavior*. Cannabis Research Conference [Submitted], 2022.

## Eun-Soo Kim

*Morphological comparison of trichomes in leaf and bract of Cannabis*

### Presentations

Kim, E. *Present State of Industrial Hemp in East Asia*. Cannabis Research Conference, 2021.

Kim, E. & Park, S.H. *The Blocking Effect of Hemp Fabric on Mouse Skin Irradiated with Ultraviolet B [Poster]*. Cannabis Research Conference, 2021.

Kim, E., Park, S.H., Kinney, C.A. *Ultrastructure of storage protein and lipid bodies in cotyledon cells of hemp seed*. 2022 Cannabis Research Conference, 2022. (Submitted)

### Publications

Kim, E., Choi, W., Park, S.H. (2021). *The Thickening and Modification of the Galactan-enriched Layer During Primary Phloem Fibre Development in Cannabis sativa*. *AoB Plants* 13(4). <https://doi.org/10.1093/aobpla/plab044>

Kim, E., Park, S.H., Kinney, C.A. (2022) *Immunofluorescence for lectins binding ligands on bast fiber of Cannabis sativa*. *Journal of Cannabis Research*. (In preparation)

Kim, E., Park, S.H., Kinney, C.A. (2022) *Micro-morphological study of storage substances of seed in Cannabis sativa*. *PLoS One*. (In preparation)

## Hollis Karoly

*Exploring Intoxication during Acute Alcohol and Cannabis Co-Administration: A Focus on Cannabinoid Content and Order Effects*

### Presentations

Smith, E., Conner, B., Karoly, H. *A Mobile Laboratory Study of Co-Administration of Cannabis Concentrates with a Standard Alcohol Dose in Human Subjects*. Research Society on Marijuana (RSMJ) Conference, 2022.



## Jarrold Ellingson

*Short-term effects of cannabis use and cannabinoids in youth: A sibling-comparison study*

### Presentations

Ellingson, J. M. *Familial factors explain some, but not all, mental health effects of cannabis use [Department Seminar]*. **Clinical Psychology, University of Colorado Boulder, 2021.**

---

## Kenneth Olejar

*Cannabinoid conversion to CBN during hemp extraction and post-extraction fluorination of CBD and CBN for increased bioavailability.*

### Presentations

Olejar, K. & Kinney, C. *Evaluation of thermo-chemical conversion temperatures of hemp (cannabis Sativa L.) biomass cannabinoid acids by pressurized liquid extraction.* **Cannabis Research Conference, 2021.**

### Publications

Olejar, K.J, & Sang, S.H. (2022) *Industry-Based Misconceptions Regarding Cross-Pollination of Cannabis spp.* *Front. Plant. Sci.* 26. <https://doi.org/10.3389/fpls.2022.793264>

Kenneth J Olejar, Min Hong, Sun-Yeop Lee, Tae-Hyung Kwon, Soo-Ung Lee, Chad A Kinney, Joon-Hee Han, Sanghyuck Park. (2022). *Ultrasonic-assisted Extraction of Cannabidiolic acid from Cannabis Biomass.* *Journal of Visualized Experiments.*

---

## Nichole Residorph

*Microbiome mediated effects of Cannabis and CBD on neurotransmitter-related molecular networks and anxiety*

### Presentations

Reisdorph, N. *Effects of Cannabis and CBD on Brain and Plasma Neurotransmitters in Mice.* **Cannabis Research Conference, 2021.**

Reisdorph, N. *Effects of Cannabis and CBD on Brain and Plasma Neurotransmitters in Mice [Poster]*. **Metabolomics Society Annual Meeting, 2021.**

---

## Nolan Kane

*Dissecting the genetic basis of sex and dioecy in Cannabis sativa*

### Presentations

Kane, N. *Uniting Historical Field Experiments and Modern Genomics to Prepare for Sustainable Future [Department Seminar]*. **W.K. Kellogg Biological Station, Michigan State University, 2022.**

## Sanghyuck Park

*Adaptive role of cannabinoids in plant defensive mechanism and Effects of abiotic stresses on Cannabis development and cannabinoids production*

### Presentations

Park, S.H. & Kim, E. *Inhibitory Effects of Hemp-fiber-blended Toothpaste on the Colonization of Oral Recorded with Live Q & A Bacteria [Poster]*. **Cannabis Research Conference, 2021.**

### Publications

Park, S.H., Pauli, C.S., Gostin, E.L., Staples, S.K., Seifried, D., Kinney, C., Vanden Heuvel & Kim, E. (2022). *Effects of short-term environmental stresses on the onset of cannabinoid production in young immature flowers of industrial hemp (Cannabis sativa L.).* **Journal of Cannabis Research, 4(1).** <https://doi.org/10.1186/s42238-021-00111-y>

Kyung-Hwa Jeon, Sanghyuck Park, Woong Jin Bae, Sae Woong Kim, Hyo Jung Park, Soomin Kim, Il Bum Park, Hyun-Je Park and Youngjoo Kwon. (2022). *Cannabidiol, a Regulator of Intracellular Calcium and Calpain.* **Cannabis and Cannabinoid Research.**

Sanghyuck Park\*, Samuel Koch, Katherine Richardson, Christopher Pauli, Joon-Hee Han, Tae-Hyung Kwon. (2022). *Tobacco Hornworm as an Insect Model System for Cannabinoid Pre-clinical Studies.* **Journal of Visualized Experiments.**

Trevor Regas, Joon-Hee Han, Christopher S. Pauli, and Sanghyuck Park. (2021). *Employing Aeroponic Systems for the Clonal Propagation of Cannabis.* **Journal of Visualized Experiments.**

---

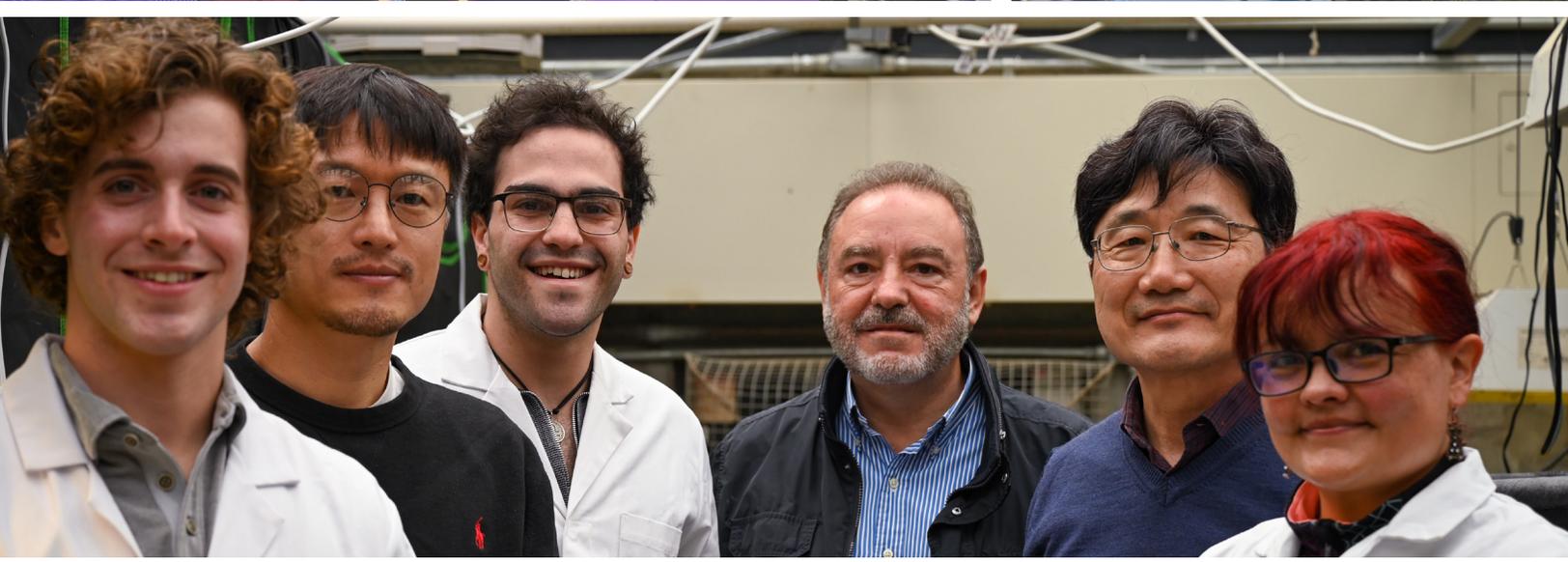
## Tyrell Towle

*Is what you see what you get? A systematic, public health-driven analysis of cannabis product label claims vs. actual cannabinoid content - MX*

### Presentations

Mackie, D. I. & Towle, T. *Minor Cannabinoids and Neuroinflammation: a New Approach to Treatments for Neurodegenerative Diseases.* **Cannabis Research Conference, 2021.**





[csupueblo.edu/institute-of-cannabis-research](https://csupueblo.edu/institute-of-cannabis-research)  
719.549.2294



*Institute of*  
**Cannabis Research**  
COLORADO STATE UNIVERSITY PUEBLO