Institute of Cannabis Research
COLORADO STATE UNIVERSITY PUEBLO

ANNUAL REPORT

2023

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LETTER FROM THE GOVERNING BOARD CHAIR

Serving as the Chair of the Institute of Cannabis Research (ICR) Governing Board for the past three and a half years, has been a true honor. I have witnessed a maturing of the Institute as its role in Colorado has evolved. I and the Board 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. Soliciting applications through an annual state-wide research competition, we continue to receive applications from top researchers and top institutions across the state. Requests for funding total well over the amount that we can support. Some highlights of funded research include 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 Alzheimer's Disease and cancer. 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 of 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. The Cannabis Research Conference has become a destination conference for those working in this diverse area of research. We hope to see you at the conference in Denver being held August 3-5, 2023.

The Governing Board is comprised of members with a broad array of expertise and skills. The Board works closely with the ICR Staff to offer a broader set of perspectives, has help shape the direction of the ICR, and works to elevate the Institute in Colorado and beyond. The Board and the ICR are poised to respond to the cannabis research needs of the state and to leverage the infrastructure and expertise developed in the Institute to benefit the state. The Board is committed to the supporting the success of the Institute and elevating the state of Colorado in the realm of cannabis research.

Dr. Cinnamon Bidwell
Chair of the ICR Governing Board

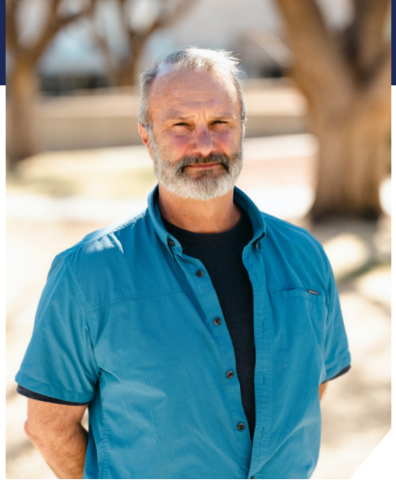
ABOUT THE ICR GOVERNING BOARD

The ICR has a governing Board which is appointed by the Governor of the state of Colorado as specified by Colorado HB 19-1311. The constituents include the Chancellor of the Colorado State University System or his or her designee (Timothy Mottet), the Executive Director of the Colorado Commission on Higher Education or his or her designee (Scott McWhorter), the President of the University of Colorado or his or her designee (Jon Reuter), the Executive Director of the Department of Public Health and Environment or his or her designee (Elyse Contreras), three scientists from relevant fields who have been employed at appropriate research-oriented institutions or entities (Cinnamon Bidwell, Joanna Zeiger, TBA), and four members associated with cannabis-related industries in Colorado (Sal Pace, Sherard Rogers, Malik Hasan, TBA).

ICR Governing Board Members

Back Row L-R: *Mr. Scott McWhorter, Dr. Chad Kinney (previous Director of the ICR), Dr. Tim Mottet, Dr. Jon Reuter, and Dr. Jeff Smith (Interim Director of the ICR).*

Front Row L-R: *Dr. Malik Hasan, Dr. Cinnamon Bidwell, Ms. Elyse Contreras, and Dr. Joanna Zeiger. Not pictured: Mr. Sal Pace, and Mr. Sherard Rogers. Dr.'s Kinney and Smith, pictured, are not Governing Board Members.*



LETTER FROM THE INTERIM DIRECTOR OF THE ICR

The ICR had a very successful year in fulfilling its mission, and continued to significantly increase the scope and quality of the institute's capacity to produce and administer high quality cannabis research and research dissemination for the people of Colorado. Highlights included:

- Significantly increasing the scope of ICR-funded research by supporting five new cannabis research projects which began this year with awards totaling $778,370.00. This brought the total number of ICR-sponsored research projects to 15 in total.
- Reviewing, refining, and implementing a best-national-practices proposal review process which resulted in a total of 47 applications proposing to do $6,914,456.00 in new research. These applications came from the top academic cannabis researchers at Colorado's best research institutions. The top-tier of these projects are slated for implementation next year.
- Securing an additional $1,000,000.00 from Colorado's Marijuana Cash Tax Fund to support up to five additional new projects next year. These funds will also double the capacity of the ICR to conduct its in-house cannabis research program.
- Conducting in-house cannabis research which resulted in the production of 11 research publications in the peer-reviewed scientific literature, 16 presentations at scientific conferences, formation of 7 international collaborations, training of 10 research students, and receipt of $265,000.00 in external funding which completely offset the cost of the ICR's research program to the state.
- Implementation of our 6th Annual Cannabis Research Conference, which was conducted in collaboration with the Global Hemp Innovation Center at Oregon State University, and planning for the 7th annual conference which will be held at the Auraria Campus in Denver this August 3-5. The conference will feature over 150 research presentations with keynote speakers from around the world.

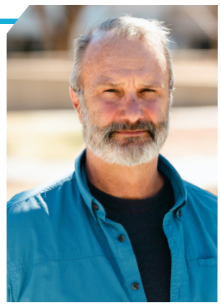
Colorado had the vision to create the ICR as cannabis legalization evolved in the state. Since its origination the institute has provided high quality research products which are fulfilling the responsibility of the state to provide the people of Colorado with evidence-based knowledge about the true harms and benefits of the cannabis products which are now legally produced and distributed in Colorado. As the cannabis industry is maturing in our state, declining revenues from cash sales of cannabis products have created a challenge for the legislature in meeting the budget demands necessary to sustain the research capacity of the ICR. Despite that, the legislature took its responsibility seriously, and not only sustained, but increased the research capacity of the ICR with added funding this year. It is this commitment of the Colorado legislature to its constituent citizenry that distinguishes Colorado as a national leader in how it addresses legal cannabis in our great state.

Jeffrey P Smith, PhD
Interim Director of the ICR
Professor of Biology
Colorado State University Pueblo

MEET THE ICR STAFF

Dr. Jeff Smith

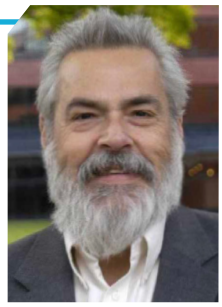
Interim Director, Institute of Cannabis Research



Dr. Smith is an accomplished neuroscientist with research expertise focused on learning and memory and neurodegenerative diseases. This includes multiple publications in cannabis-related research. Dr. Smith's connection to the ICR is not new. He was part of the team that created the vision which led to the establishment of the ICR in 2016, as well as helped provide early leadership of the ICR as a member of the Institute's Steering Committee. Further, Professor Smith is an experienced leader on the CSU Pueblo campus as a former Director of the graduate program in the Biology Department and Chair of the Biology Department. Dr. Smith brought this expertise and experience to bear as the interim Director of the ICR this year, which saw continued success, growth, and impact of the ICR in providing cannabis research and dissemination to the people of Colorado and beyond.

Dr. John Williamson

Executive Director of Research, Institute of Cannabis Research



Dr. Williamson joined CSU Pueblo as the Senior Director of Research in 2019. He serves as the ICR's strategic development advisor in pursuing research partnerships, collaborations, and external funding opportunities. Dr. Williamson 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 the drug discovery and development research program in infectious diseases. Dr. Williamson was also a branch chief of basic and mechanistic research at the National Institutes of Health in Bethesda, MD, and has served as a research consultant for a variety of governmental agencies, private industry, the media, and many universities across the country.

DuShunte Carmon

Grants Manager and Program Officer, Institute of Cannabis Research

DuShunte D. Carmon received BA's in both Sociology and Behavioral Science from San Jose State University in 1999, a MS Degree in Sociology/Criminal Justice from Clark Atlanta University in 2002, and a Paralegal Certification from Emory University in 2010. Mr. Carmon has taught courses at Morehouse College, Clark Atlanta University, University of Memphis, and Voorhees College. Mr. Carmon was a Field Researcher and Data Analyst for the State of Georgia, Department of Highway Safety, Seat Belt Study in 2001, as well as being a Research Associate for Morehouse College. Mr. Carmon has recently worked on projects involving virtual reality learning and has done philanthropic work.

Wendy Fairchild

Office Manager, Institute of Cannabis Research

Ms. Fairchild takes the lead in managing the ICR's website, creates, publishes, and distributes all in-house ICR outreach materials including the bi-monthly e-newsletter, webinar email blasts and notifications, news items, and manages the ICR's social media content. Ms. Fairchild has worked for the ICR as the Office Manager for five years, interfacing with the university faculty, staff, students, and public, and supports the administrative needs of the staff, governing board and grant-awarded principal investigators. Ms. Fairchild also assists with organizing the annual cannabis conference and contributes to the publication of the ICR's annual report.

Dr. SangHyuck Park

Senior Scientist, Institute of Cannabis Research

Dr. Park is the Senior Researcher for the ICR at CSU Pueblo. Dr. Park leads a multi-tiered research program which has published over a dozen peer-reviewed research articles on cannabis genetics, physiology, and cannabinoid chemistry. Over the past six years, Dr. Park has also served as a cannabis educator, teaching Botany and Cannabis Physiology and Growth courses for the Cannabis Biology and Chemistry (CBC) program at CSU Pueblo, and supervising a number of students seeking PHD, MS and undergraduate degrees. Dr. Park also collaborates with several visiting scholars from South Korea, Spain, and Colombia, who are engaged in a variety of cannabis research projects for the ICR at CSU-Pueblo. Additionally, Dr. Park has built several research collaborations between the ICR and several other institutions, including with agencies in the US, Israel, and South Korea.

Ingrid Arolina Corredor Perilla

Visiting PHD Student

Carolina Corredor is an Agricultural Microbiologist, with a master's degree in Biological Sciences. She is also a Ph.D. candidate in Agroecology from the National University of Colombia and has over 5 years' experience teaching fungal biology, biology, general microbiology, and agricultural microbiology at Los Andes University, Agrarian Foundation of Colombia, and the National University of Colombia. Currently, she is working with the ICR as a Visiting Scientist where she is investigating biotic and abiotic factors that affect cannabinoid production. She expects to defend her dissertation this fall.

Dr. Eun-Soo Kim

Visiting Scholar

Dr. Kim joined the ICR as a visiting scholar in 2019 conducting a glandular trichrome project. His background is in plant morphology and development. Dr. Kim previously served as a professor of plant biology at the Konkuk University in South Korea for 26 years studying economic aspects of 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. Dr. Kim submitted two manuscripts on behalf of the ICR to the journals AoB plants and Journal of Natural Fibers, the latter of which is in press.

SUMMARY OF ICR-FUNDED RESEARCH

FY23 Awardees

The following five researchers were added as new contributors to the repertoire of projects that the ICR funded this year. Projects began in October. With their addition, the total number of currently funded research projects is now fifteen.

1

Are Cannabinoids really helpful for treating traumatic brain injury?

Kent Hutchison, PhD
Institute of Cognitive Science,
University of Colorado Boulder

Cannabinoids, including both CBD and THC, have gained significant public attention as a potential alternative treatment for Traumatic brain injury (TBI). However, the limited scientific evidence does not support the growing perception that cannabinoids are useful for treating TBI or its closely related pain, sleep, mood, and anxiety disorders. Moreover, due to complex regulatory requirements, many individuals use medical cannabis on an "off-label" basis without the appropriate scientific research to show whether or not such use would be helpful. Therefore, Dr. Hutchinson's project is evaluating the potential therapeutic effects of widely available cannabinoid formulations on TBI-related deficits in cognitive function, anxiety, depression, sleep, and pain.

2

Purification and evaluation of minor cannabinoids for treating Alzheimer's disease

Duncan Mackie, PhD
Director of Pharmacology
& Experimental Therapeutics,
MedPharm Holdings

Cinnamon Bidwell, PhD
Institute of Cognitive Science Faculty,
Assistant Professor, University of Colorado Boulder

Previous research shows that cannabis stops inflammation by modifying the Endocannabinoid System (ECS) in immune cells. The ECS is uncontrolled in the brain's immune cells during the onset of most neurodegenerative diseases, like Alzheimer's disease. This mis-regulation is thought to be a major contributor the development of these devastating diseases. Therefore, in this research study, brain immune cells will be put in an inflammatory state by exposing them to the proteins thought to cause Alzheimer's disease, Amyloid Beta and Tau. Inflammation will then be tracked in the cells to determine whether cannabinoids can reduce the inflammation. Ultimately, this work will provide the foundational knowledge necessary to develop cannabis-based medicines for the treatment of Alzheimer's disease and many other neurological diseases with an inflammatory component.

Most exciting, early research findings in this study have shown that it is possible to successfully isolate minor cannabinoids from DEA approved cannabis sources and the researchers have begun characterizing inflammation in the brain immune cells. While this work is in the early stages, the successful isolation of cannabinoids and the ability to "read" the cellular signatures during inflammation are key steps towards identifying specific minor cannabinoids that can be developed into medicines for neurodegenerative diseases with an inflammatory component.

3

Does cannabidiol (CBD) treat or prevent combined autism and epilepsy?

Christopher Lowry, PhD
Assoc. Professor, Integrative Physiology, University of Colorado Boulder

Over 50% of children with autism show signs of epilepsy with up to 40% developing chronic epilepsy later in life. Similarly, one-third of children with epilepsy are also diagnosed with autism. While there is increasing scientific evidence that inflammation is a key component that causes autism/epilepsy, the necessary pre-clinical animal research to determine whether or not inflammation contributes to development of the disease or to its possible treatment is sorely lacking. Interestingly, cannabidiol (CBD) has been shown to have powerful anti-inflammatory effects in the brain, suggesting that CBD could possibly prevent or treat autism/epilepsy. Therefore, this study will determine whether autism/epilepsy is caused by neuro-inflammation, and whether or not CBD treatment can prevent the development of the disease. This work will be done in research mice who have a genetic pre-disposition to producing offspring that develop autism/epilepsy. An interesting and important component of this research study is that CBD is being delivered to the mice during or around pregnancy. The results of this work will improve our understanding of how inflammation contributes to autism/epilepsy and may lead to new treatments for the children of high-risk human mothers.

Jeremy is a contributor to Dr. Lowry's project and represents one of the many next-generation cannabis researchers for whom the ICR supports in training.

Are Cannabinoids really helpful for treating traumatic brain injury?

Jeremy Taylor, B.A.
Graduate Student, Department of Psychology and Neuroscience

I am extremely thankful for the opportunity given to me by Dr. Lowry, Dr. Barth, and Dr. Reuter to work on this project. I am also incredibly grateful to the Institute of Cannabis Research for providing the funds to our labs and research team. I was largely unaware of the wide array of positive effects that Cannabis can have on diseases and disorders until I started work on this project. We have promising results demonstrating that broad-spectrum Cannabidiol may mitigate the negative effects of prenatal and postnatal stress on long-term development in rats, which is very exciting for a multitude of reasons. This project has been the most challenging project I have worked on to date. Accordingly, I have learned an enormous amount in terms of experimental design, planning, and execution due to the large scale and extensive timeline. Lastly, this project has given me the chance to be exposed to techniques that I otherwise wouldn't have been, largely thanks to the inter-departmental collaboration that is required of a project this large.

4

Can cannabinoids work as pesticides to help with agricultural production in Colorado?

Punya Nachappa, PhD
Associate Professor, Entomology, Department of Agricultural Biology, Colorado State University

Understanding how plants respond to insect herbivores can provide new insights into plant-insect chemical communication and is important for creating new approaches to crop protection. Cannabinoids, which include Δ9-tetrahydrocannabinol (THC), cannabidiol (CBD), more than 100-related secondary metabolites, and also a variety of terpenes and phenolic compounds, are all found in cannabis plants. And are thought to be produced by cannabis plants, in part, to repel insects. To date, no study has analyzed the degree to which such cannabinoids confer pest resistance to C. sativa (hemp). Hence, the goal of this project is to understand how cannabinoids affect pests that prey on hemp plants. The research uses, and is developing, novel genetic tools and technology to evaluate this. Outcomes of the research will not only advance basic research in the field of plant-insect coevolution, but also have practical applications for creating genetic strains of hemp with improved pest resistance. These tools can be easily transferred to other hemp producing regions in the U.S.

Three significant points of this research:

A. Colorado continues to be the top hemp-producing state in the U.S, but productivity is severely limited by damage due to insect pests.

B. Despite the assumption that cannabinoids evolved as insect defense mechanisms, there is limited research addressing the role of cannabinoids as pesticides.

C. Understanding which cannabinoids confer pest resistance will help Colorado hemp growers to breed pest-resistant hemp.

Oliva Carter

"This project has allowed me to gain experience in multiple areas of research including plant biology, genetics, genomics and pest management. I have decided to join the CSU graduate school for my M.S program thanks to the experience working on this project".

Oliva Carter is an undergraduate student assisting in this research project. Her involvement in this project has motivated her to pursue a graduate degree in the field.

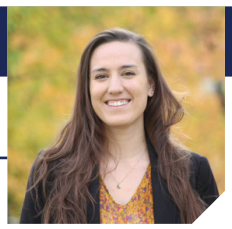
5

Health Effects of Heavy Metals in Cannabis Flower, Concentrates, Vape Devices, and Vape Emissions

Mike Van Dyke, PhD
Associate Professor, Center for Health, Work, and Environment, Colorado School of Public Health, University of Colorado Anschutz Medical Campus

Metal exposure from cannabis vaping poses significant public health concern. The percentage of individuals using cannabis by vaping has increased dramatically in the U.S. Past research has detected chromium, lead, tin, and nickel in cannabis vapors at higher concentrations than are found in tobacco smoke. Currently, cannabis is regulated for only four heavy metals (lead, cadmium, arsenic, and mercury) despite known health effects from other heavy metals likely to be present in cannabis products. Pharmaceutical products, on the other hand, are regulated for 24 heavy metal or "elemental" impurities. This research will evaluate the risk of health effects from cannabis smoking or vaping contaminated with heavy metals such as arsenic, lead, nickel, cadmium, manganese, uranium. It is the first known human health risk assessment to evaluate the large number of heavy metals that may be present in cannabis flower, concentrates and vape devices.

Francesca Macaluso
MPH Student



"The ICR grant funding for my role in this project has provided me the opportunity to pursue dissertation work that has clear and immediate public health impact in the world of vaping and cannabis use, all while continuing to develop my analytical and environmental health research skillsets. "

Francesca Macaluso is a Master's of Public Health student who is becoming an expert in cannabis-related health issues by contributing to this project.

FY22 AWARDEES

The following ten researchers continued in the second year of their research contributions to the increasing repertoire of ICR-funded cannabis research projects.

Are Cannabis product labels accurate in the state of Colorado?

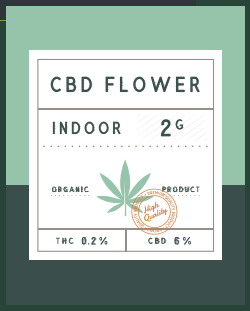
Cinnamon Bidwell, PhD
Institute of Cognitive Science Faculty,
Assistant Professor, University of Colorado Boulder

Duncan Mackie, PhD
Director of Pharmacology & Experimental Therapeutics, MedPharm Holdings

It is crucial for legal cannabis products to report accurate cannabinoid potency information and no study has independently evaluated the accuracy of labels on commercially available cannabis products in the state of Colorado. Therefore, this research is testing a wide variety of Colorado cannabis products and comparing the potency results to those listed on the product labels. The project is in collaboration with MedPharm Research, a licensed cannabis testing facility with the capacity to purchase, handle, and test cannabis purchased from the Colorado legal marketplace. The research team at the University of Colorado Boulder, on the other hand, is maintaining, managing, and analyzing the product data.

While this study is still in the early stages, findings suggest that product labeling for concentrates is achieving state defined accuracy goals, which is particularly important given their high potency status. More analysis of the discrepancies among the labeling claims versus actual cannabinoid content in flower is required. In addition, the regular presence of minor cannabinoids in recreational products suggests that monitoring the presence and studying the health effects of these cannabinoids is going to be important for the cannabis consumer going forward. This work will guide the improvement of the current legal-cannabis marketplace with a renewed focus on consumer safety.

The samples being evaluated here were purchased from the Colorado legal-cannabis marketplace as part of the ICR funded research. Samples were analyzed for total THC and select minor cannabinoid potency in Dr. Makie's laboratory.



Is what you see what you get?

In preliminary analyses from 58 cannabis products (29 flower-joints and 29 concentrates) product labels for THC potency were 48.3% accurate for flower, and 100% accurate for concentrates. Flower and concentrate products showed similar absolute differences of 3.48% for flower, and 3.09% for concentrates. When converted to percentages, the label and analyzed differences were 15.2% for flower and 4.13% for concentrates.

What's not on the label?

In most samples analyzed, one or more minor cannabinoids were identified, some making up more than 1.0% by mass of the product. Indeed, CBG was quantifiable in 93% of samples, CBGA in 67%, CBC 48%, THCv in 40%, and Δ-8 THC in 25% of samples.

Principal Investigator, Dr. Duncan Mackie (front), reviewing the most recent HPLC data with Dr. Colin Brook (rear).

Dissecting the Genetic Basis of Sex and Dioecy in Cannabis Sativa For the benefit of the Colorado Hemp Economy

Nolan Kane, PhD
Associate Professor, Ecology and Evolutionary Biology, University of Colorado Boulder

In his second year, Dr. Kane has begun to produce research products that allow the mapping of genes which interact with the sex chromosomes of cannabis. The mapping leads the way for an understanding of the genetics underlying why some hemp produces pollen, some produce seeds, and some produce both. This is important to farmers and growers because cannabis females produce the valuable medicinal flower that underlies most of the Colorado Cannabis industry. This female flower loses much of its value if pollinated. Thus, any pollen production is extremely costly, causing dramatic loss of profit for producers. Thus, this important work is helping to improve the economic outlook for the Colorado hemp industry, which is the largest in the country, as well as the outlook for the greater cannabis industry at large.

The lab's biggest finding so far was published last year, and showed the major parts of the genome that contribute to sex determination: *Mitochondrial genomes do not appear to regulate flowering pattern/ reproductive strategy in Cannabis sativa. Z. Attia, C. Pogoda, D. Vergara, and N.C. Kane, AoB PLANTS, Vol. 14, Issue 3, June 2022, plab068, https://doi.org/10.1093/aobpla/plab068.*

In addition to this publication, the researchers have generated thousands of seeds for new genotypes of hemp and are currently characterizing these genotypes and comparing them to other Cannabis and related genera (especially hops) to understand the relationship in their sex-determining mechanisms. Some of these new genomes produced, for the first time in Cannabis, X and Y chromosomes from male, female and hermaphrodite plants. A second publication describing these findings is in progress.

Leonardo Orozco

"ICR funding has been instrumental in all of my research. The existence of ICR should be a model for other states, as it drives research, innovation and training, incentivizing Colorado institutions to invest in Cannabis science."

Leonardo Orozco is a leader for the project as part of his PhD dissertation. Leo is a native Spanish speaker, and the first person in his family to seek an advanced degree.

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

Karoly Hollis
Assistant Professor, Department of Psychology, Colorado State University

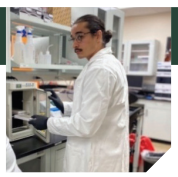
This research is one of the only existing studies to date that is focused on measuring how legal-market cannabis concentrates (which contain very high levels of THC) impact people's mood and motor performance. This is important because since in Colorado have access to these high-THC products at dispensaries, but there is very little data showing how these products impact people's cognitive, psychological, and motor function.

The study is also the only project ever to study the effects of combining cannabis concentrates with a dose of alcohol. People frequently co-use alcohol and cannabis, but there is very limited data on how combining alcohol with very high potency cannabis products might impact people's mood and ability to function.

The study is also collecting blood samples to quantify the amount of THC in each participant's blood before and after using cannabis concentrates along with alcohol. This will serve as an objective measure of THC exposure to control for the fact that people may use different amounts of THC during the study.

This research project also involves a PhD student who will go on to be a leading cannabis researcher for Colorado in the future.

Eleftherios Hetelekides



"Through my work leading this complex human research study, I have developed organizational and leadership skills that will continue to serve me throughout my PhD program and my career. I have also been learning phlebotomy to collect blood samples from study participants, which we will analyze along with various other subjective and objective measures of cannabis and alcohol intoxication. I have thoroughly enjoyed learning this methodology for collecting data, and I look forward to analyzing the data and relating these objective measures like blood-THC content to relevant psychological outcome variables."

Chemical modification of cannabinoids and extraction processes to make new therapeutics for treating human disease

Ken Olejar, PhD
Colorado State University Pueblo, Chemistry Department

Cannabinoids produced by industrial hemp are important for potential medical use. One problem, however, is that when these compounds are administered, the levels actually found in the bloodstream are often below therapeutic levels. As such, mechanisms for increasing the bio-availability of these compounds are required. Dr. Olejar's research is, therefore, aimed at producing novel cannabinoids with increased bioavailability. These new compounds will go on to be tested for their potential medicinal value.

So far, the project has created two novel cannabinoids based on CBD. These new compounds are currently being tested for their possible benefits in rheumatoid arthritis and breast cancer.

The researchers have also developed a new method for synthesis of minor cannabinoids from hemp during the extraction process. This method reduces the environmental impact of the extraction and purification process, with the added benefit that the minor cannabinoids are produced in the hemp plant. This technology will ultimately be able to provide safe and pure minor cannabinoids for research and disease prevention.

The project has also created five additional molecules which are being isolated and characterized to determine their possible efficacy for use in disease states. Exploring the potential health benefits of these new cannabinoids will ultimately increasing the options that Coloradans will have for accessing safe and well-tested therapeutics that were previously non-existent.

Dr. Olejar employs a post-doctoral researcher, Dr. Urvashi, who is being further trained as she assists with this important new drug development project.

Dr. Urvashi
Colorado State University Pueblo, Chemistry Department

"Working on the current research, which is funded by the Institute for Cannabis Research, is allowing me to develop the abilities required to become a competent and advanced synthetic cannabis chemist. This is expanding my present understanding and expertise of physiologically relevant heterocyclic (-N, -O) compounds and their separation. The project is assisting and supporting me, in the acquisition of competence, in addition to novel late-stage functionalization techniques and operative abilities in analytical instrumentation. Furthermore, this opens additional avenues for new funding opportunities besides the currently available cannabis opportunities. The supervision has provided the instruction required to develop proficiency in comprehending the variables that affect synthetic cannabis chemistry."

Effects of Acute Cannabis Use on Ocular Activity for Preventing Impaired Driving

Ashley Brooks-Russell PhD
Associate Professor, Director (IVPC), Colorado School of Public Health, University of Colorado Anschutz Medical Campus

This research project is testing innovative approaches to identify and help prevent cannabis impaired driving. The project uses human eye tracking to detect the impact of Cannabis intoxication on involuntary eye movements. These eye movements can be tracked using in-vehicle Driver Monitoring Systems, to identify and prevent impaired driving. (This is similar to the passive anti-drunk driving technology that is emerging in the auto industry.) This research involves an international collaboration with Seeing Machines, and integrates their driving monitoring technology with the projects driving simulator.

So far, head position and eye movement data from participants driving in the simulator has been collected before and after they smoke cannabis. Importantly, the study recruits participants with a range of cannabis use histories, ranging from occasionally to daily, and they use real-world cannabis products including high THC concentrate products.

The results from this study will support the development and refinement of passive driver monitoring systems that can identify drug impairment among drivers before it leads to a motor vehicle crash injury or fatality.

Effects of Cannabidiol and Cannabidiol-trazodone Treatment on Alzheimer's Disease

Stephanie McGrath, PhD
Associate Professor, Neurology, Colorado State University

This unique research project is studying the potential use of CBD as a treatment for dementia in dogs which have a naturally occurring form of dementia. This is an ideal research model for Alzheimer's disease, and using it has potential to increase the chance of translating the results of the study to human medicine, when compared to rodent studies which often don't translate well to in human clinical trials.

Cannabis use and Suicidal Tendencies in Colorado's Youth

Jarrod Ellingson, PhD
Assistant Professor, Psychiatry-Substance Dependence, University of Colorado School of Medicine

Limited research has suggested a possible association between cannabis use and suicidal tendencies; however, no studies to date have controlled for genetic influences, which confounds a clear interpretation of results. Therefore, this unique study compares siblings who differ on their cannabis use to control for genetic variability. In addition, most studies on cannabis use have not considered product potency or the content of minor cannabinoids, which differ greatly for legal-market cannabis products as compared to those in non-legal states. To address this, the study measures levels of a spectrum of cannabinoids in the blood stream, and evaluates their relationship to a variety of human health outcomes.

Most notably, this work has discovered that cannabis use is associated with suicidality, even after controlling for genetic factors. Future research will be needed to determine whether this suicidality is caused by cannabis consumption, or whether people with suicidal tendencies gravitate towards cannabis use.

This study is training a next-generation cannabis researcher as an integral part of the work.

Elisa Stern

"I have been centrally involved in a study examining the relationship between adolescent cannabis use and later life suicidality. This ICR funded project has allowed me to receive fantastic mentorship, under which I have learned advanced behavioral genetic statistical analytic methods, among other skills. I am grateful to have had the opportunity to contribute to such meaningful research and am enthusiastic about using what I have learned from this experience throughout my career."

Comparison of Cannabinoids to Pain Medication for Surgical Outcomes with Patients Undergoing Abdominal Cancer Surgery

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

This project is determining if post-operative pain medication requirements are different between chronic users and non-users of cannabis products who undergo abdominal cancer surgery. The research compares blood levels of endo- and phyto-cannabinoid concentrations in chronic users versus non-users of cannabis products, and evaluates post-operative complications.

The research has already shown that many patients who undergo abdominal surgery for the treatment of cancer are chronic cannabinoid users but that some patients who reported chronic cannabinoid use did not have detectable levels of cannabinoids at the time of surgery. Further, some patients who reported non-use did have detectable levels of cannabinoids at the time of surgery. This highlights the importance of plasma analysis for detecting cannabinoids in studies focusing on these substances, rather than relying on patient self-report.

Most notably, preliminary results are showing that chronic cannabinoid users have higher reported pain levels and require more opioids after surgery compared to non-users.

Interesting facts related to this research:

Severe pain is a common symptom after surgery, and cancer, and both conditions can have medical cannabis prescribed as a treatment in Colorado. As of March 2023, 55,159 patients reported using medical cannabis for severe pain, and 2,405 patients reported using medical cannabis for treatment of cancer in Colorado. Colorado legalized medicinal cannabis more than 20 years ago and is has the 2nd highest number of cannabis consumers per capita in the United States at 28%. This clearly demonstrates a considerable level of interest, and a possible risk of enhanced pain with cannabis treatment, by our patients.

Of the seven students involved in this research, three are general surgery residents at the University of Colorado (Helen Madsen, MD, Elliott Yee, MD, and Michael Kirsch, MD), two pharmacy graduate students at the University of Colorado (Michelle Adkins, PharmD, and Owen Miller, Pharm D), one nurse practitioner student at the University of Colorado (Cameron Carpizo, RN), and one medical student at the University of Colorado (Emma Lamping, BS) is also involved. Emma was the recipient of the ICR's Emerging Scientist Award which supports cannabis research students across Colorado. Two students are highlighted to the right.

Elliott Yee, MD

"Working with Dr. Stewart on how cannabis can affect pain medication requirements after surgery is very exciting - can't wait for the final results!"

Cameron Carpizo, RN

"This has been my first research position. I am involved in the screening and enrollment portion of Dr. Stewart's cannabis studies. It has been really interesting to learn from our oncology patients regarding their usage of cannabis. I look forward to hearing the results of the studies I am assisting with, to better understand how cannabis effects our patients."

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

Emily Bates, PhD
Associate Professor, Pediatrics-Developmental Biology, University of Colorado Anschutz Medical Campus

Pregnant women sometimes use cannabis to alleviate their nausea, vomiting, anxiety, and pain. In Colorado, up to 22.4% of pregnant patients test positive for cannabis at labor and delivery. An additional population utilizes the non-psychoactive component of cannabis, cannabidiol (CBD), because marketing sometimes suggests it could help these symptoms and it is perceived to be safe. However, CBD crosses the placenta, circulates in the fetal blood steam, and accumulates in fetal tissues such as the brain and liver, and unfortunately, little is known about the safety of consuming CBD while pregnant.

This study using pregnant mice that consumed CBD, has found that the female offspring have decreased problem-solving ability and changes in neurological function. It also discovered that fetal CBD exposure increased pain sensitivity in male offspring, and most notably, that it increased blood sugar levels and caused insulin resistance, the hallmarks of diabetes. These findings are important because they show CBD consumption during pregnancy may produce long-term health risks for the children of mothers who consumed it.

This research Project has included two research students. Karli Swenson is featured below.

Karli Swenson

"Without funding from the ICR, I would have been unable to pursue my passion of researching the effect of cannabis consumption during pregnancy on fetal development. This funding allowed our lab to discover novel insights about the impact that fetal CBD exposure has on a developing fetus and continues to allow us to ask scientific questions that help inform our clinical and public health colleagues."

Microbiome-Mediated Effects of Cannabis and CBD on Anxiety

Nichole Reisdorph, PhD
Professor Mass Spectrometry Facility Director, Department of Pharmaceutical Sciences, University of Colorado Anschutz Medical Campus

It is known that neurological function in the digestive tract has a profound influence on mood and anxiety-related behaviors including depression, however, the nervous system of the digestive tract, known as the enteric nervous system, is very complex and a much better understanding of how it influences mood-behavior is needed for the development of useful therapeutics. Therefore, this project is determining how regular ingestion of Cannabis effects the enteric nervous system's contribution to anxiety-behavior in a rodent model. Most interestingly, the study is showing ways that the make-up of the microbiome in the digestive-tract can influence these health outcomes. The research measures both anxiety-behavior, the composition of the microbiome in the digestive tract, and levels of mood-related neurotransmitters and endocannabinoids in mice who are fed Cannabis.

Early results are showing that consuming small amounts of Cannabis, for only two weeks, changes the composition of the gut microbiome and increases anxiety in females, but not males. This is leading to an understanding that ingesting Cannabis, by changing the gut microbiome, which in-turn affects the production of mood-altering neurotransmitters in the digestive tract, can impact anxiety-like behavior. It also, like other ICR-sponsored research, is painting a picture of how cannabis can have markedly different effects on health depending on gender. This is paving the way for future work that will determine whether the presence of certain bacteria in the microbiome of people might be important for predicting how they will react to cannabis as a possible therapy for anxiety-related disorders.

One added, and very interesting result of this work, is it showed that ingestion of cannabis reduced the natural production of endocannabinoids in the blood and brain. This suggests that individuals may adjust to regular Cannabis consumption with a reduction in their own endocannabinoid production. The endocannabinoid system is a natural and powerful part of how everyone's nervous function is regulated. It is known to be critical for helping to control mood, anxiety, depression, and many other very important health benchmarks. Therefore, understanding how the endocannabinoid system reacts to phyto-cannabinoids delivered to the digestive tract is critical to understanding the overall health impacts of cannabis.

This study involves a number of collaborators and students, including Mr. Nate Andersen, a graduate student at the University of Colorado Boulder, who helped design and conduct these studies under the guidance of a behavioral expert, Dr. Nicolas Busquet at CU-AMC and Dr. Christopher Lowry, one of the recently-funder ICR researchers featured above.

Nathan Andersen, M.S., Ph.D. Student
Dept Integrative Physiology, University of Colorado Boulder, and Recipient of the ICR's Emerging Scientist grant

"I am profoundly grateful for the ongoing opportunity to be involved with this project. With guidance from Dr. Lowry, I have been able to bring some small modicum of my own developing expertise into this incredibly important and vastly understudied area of research. It's incredibly exciting to work on something that has the potential to impact so many people in a positive way and to work with world experts in several scientific techniques. The collaborative nature of Dr. Reisdorph's project and research style has enabled me to receive training and mentorship from several expert scientists at every level of research, from experimental design to data analysis. I aspire to one day reach the caliber of work that they each put forth and their mentorship is directly giving me the tools I'll need to do so. Most importantly to me, working on this project gives me the chance to contribute to something that could truly help countless people by increasing our understanding of the health impacts of oral Cannabis use"

ICR INTERNAL RESEARCH

Dr. Sang Park is a highly accomplished plant molecular biologist who has led cannabis and cannabinoid research projects at the Institute of Cannabis Research (ICR) since 2017. His primary objective is to investigate the impact of environmental factors on cannabis growth and cannabinoid production, with the aim of developing an ideal cultivation system that maximizes cannabinoid quality and quantity. In collaboration with Chuncheon Bioindustry Foundation in South Korea, Dr. Park's team has identified significant effects of relative humidity (RH) on plant development, particularly high RH elongating stem growth and delaying flowering of cannabis, which also affects cannabinoid profiles.

Dr. Park's research also focuses on nutrient deficiencies in cannabis plants, with the aim of optimizing essential nutrient requirements in specific growth phases to increase cannabinoid yields while minimizing nutrient waste and chemical toxicity caused by excess application. He is also exploring the role of cannabis soil microbial communities in promoting plant growth and development, aiming to use soilborne Bacilli strains to enhance cannabis seed germination, increase soil phosphorus bioavailability, and regulate the microbial pathogen F. oxysporum.

In addition to his cannabis research, Dr. Park is investigating the therapeutic functions of cannabinoids using a non-traditional model system. He has used the tobacco hornworm as an alternative model system to test phytocannabinoids, discovering that cannabidiol has a dual function as an insecticidal agent and can rescue insects from alcohol intoxication. Dr. Park believes that this model system could provide an alternative tool for high-throughput investigation of cannabinoids.

Dr. Park is committed to sharing his knowledge through teaching, research publications, attending conferences and seminars, and mentoring students in CSUP research programs. He is also a research liaison at ICR, building collaborations with countries such as South Korea, Spain, Israel, and Canada. Currently, he chairs the hemp cultivation webinar series sponsored by ICR and the Volcani Institute in Israel. Dr. Park welcomes any research collaboration to advance cannabis sciences for future generations. Interested parties may contact him at Sanghyuck.park@csupueblo.edu for further inquiries.

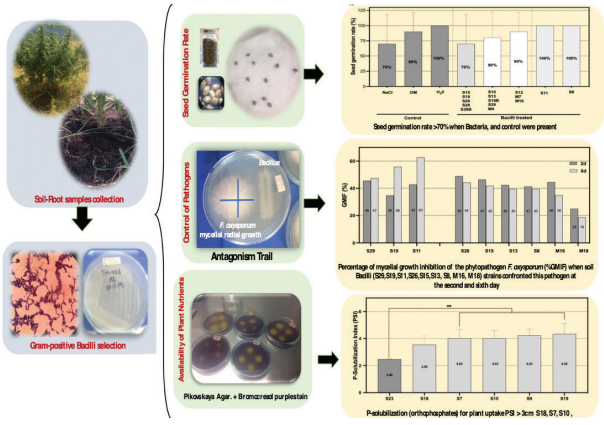
ICR INTERNAL RESEARCH

VISITING RESEARCHER

Carolina Corredor Perilla

Important soil bacteria functions in Seed Germination of Cannabis, Phosphorus solubilization and Mycelial Growth Inhibition of Fusarium sp. in Cannabis sativa. L.

Microbial inhabitants of Cannabis soils may accomplish relevant functions to improve plant development, pathogen control, and nutrient availability. This study was performed in Cannabis soils, assessing if the soil culturable bacteria next to plant roots showed prospective beneficial properties for Cannabis development. We isolated 265 microorganisms in total. We chose only Gram-positive Bacilli to determine the effects of these bacteria in Cannabis seed germination, phosphorus Bioavailability and control of a Cannabis pathogen. The results showed that 10 Bacilli strains exhibited seed germination rates superior to the 80% showing potentials properties to stimulate seed germination after eight-month storage, and a seed pretreatment. Nine Bacilli showed a significant mycelial growth reduction of Fusarium sp. with a range of 62.8% and 25% after a 6-day trial. Six Bacilli strains increased the solubilization of phosphorus for plant use by reaching an index of P-solubilization between 2.48-4.35 mm in petri dishes.



This study showed that there are soil-root bacteria from Cannabis cultivars that have beneficial activities corresponding to the stimulation of seed germination after long storage and pretreatments (10 Bacilli, n=31,); Some Bacilli were able to increase the bioavailability of phosphorus (six Bacilli, n=31, $P<0.05$) and regulated the mycelial growth of F. oxysporum (9 Bacilli, n=31, $P<0.05$). These preliminary results showed the possible benefits of soil Bacilli strains in Cannabis cultivation. These potential bacteria could be worthy to further study their direct interactions and effectiveness in Cannabis cultivars, with the prospective vision of an industrial scale as possible biostimulants of Cannabis.

International collaboration with South Korea on hemp research

The Chuncheon Bioindustry Foundation (CBF) is an institute that supports and develops the bio-industry in Chuncheon City and Gangwon Province, South Korea. In February 2019, ICR signed an MOU with CBF to collaborate on research topics of mutual interest and benefit. As a result of this continued collaboration, the ICR research team, led by Dr. Sang Park, participated in the CBF national grant proposal titled "Developing R&D Infrastructure for the Industrial Uses of Hemp and its Derivatives in South Korea." The proposal included three university/research institutes and seven industrial partners.

On May 14, 2021, the CBF's research grant proposal was selected as one of only three awardees among the nine provinces' applications, and CBF will receive a total of $13M. CBF will lead the five-year project through partnerships with national universities and research institutes in South Korea, exploring cannabinoid therapeutic potentials and industrializing hemp products and derivatives. As a part of the national project, ICR will engage in the hemp breeding program and infrastructure development processes required for cannabinoid production.

ICR INTERNAL RESEARCH STUDENT RESEARCHERS

Christopher Moody

Discovery Scholar Program at CSUP and the winner of Demo Day contest at Colorado State University – Fort Collins in the category for the Most Innovative Product Idea

"The opportunity I have had to work with the Institute of Cannabis Research has allowed me to learn more about cannabis and grow my business. Also, thank you, Dr. Park, for your constant encouragement, guidance, and belief in my vision"

Chaylen Richards

Discovery Scholars Program at CSUP

"Having been given the opportunity to join in on cutting edge research regarding Cannabis and cannabinoids at CSUP has been a dream come true. Working with Dr. Park, the Senior Scientist of the ICR, I have been involved in studying the central precursor cannabinoid molecule cannabigerolic acid (CBGA) using Tobacco Hornworms (Manduca sexta) as an insect model showing results indicative of its possible insecticidal properties. The direct hands-on experience in using laboratory equipment, researching, presenting at symposiums, and writing papers for journal submission has been invaluable in the process of preparing me for a career in research. The people I've met have inspired me to continue pursuing research in Cannabis and its boundless possibilities ranging from pharmaceutical, textile, and industrial applications and I look forward to the discoveries along the way!"

EMERGING SCIENTIST SCHOLARS

ICR is additionally supporting students who have received the ICR's Emerging Scientist Award this year. This award represents one of the many ways the ICR is supporting the highest quality education for the next generation of cannabis researchers in the state of Colorado.

Renée Martin-Willett

"With this award, I will be able to dedicate a greater portion of time to my interests in the neurobiology of aging, an important track of research in my training. I will also be presenting recent findings at the 33rd Annual International Cannabinoid Research Society Symposium in Toronto, Ontario this June."

Lillian Folts

"The Emerging Scientist Award from the Institute of Cannabis Research has been incredibly impactful to my career development and training as a developmental biologist. This scholarship is enabling me to present my research and network with scientists in my field at two national conferences, the Society for Developmental Biology Annual Meeting and the Institute of Cannabis Annual Conference. Additionally, the funds from the Emerging Scientist Award have allowed me to perform experiments that earned me authorship on two manuscripts, one of which was recently published in Molecular Psychiatry and the other is set to be submitted for publication soon. The Emerging Scientist Award has provided me with career development and scientific training opportunities that would otherwise be inaccessible.

Ashley Master

"Thanks to funding from ICR, I've been able to more fully dedicate my time and energy to a novel and fascinating study on the accuracy of cannabis product labels. The stipend has been so helpful in relieving the financial stress of grad school!"

FY 2023 BUDGET REPORT

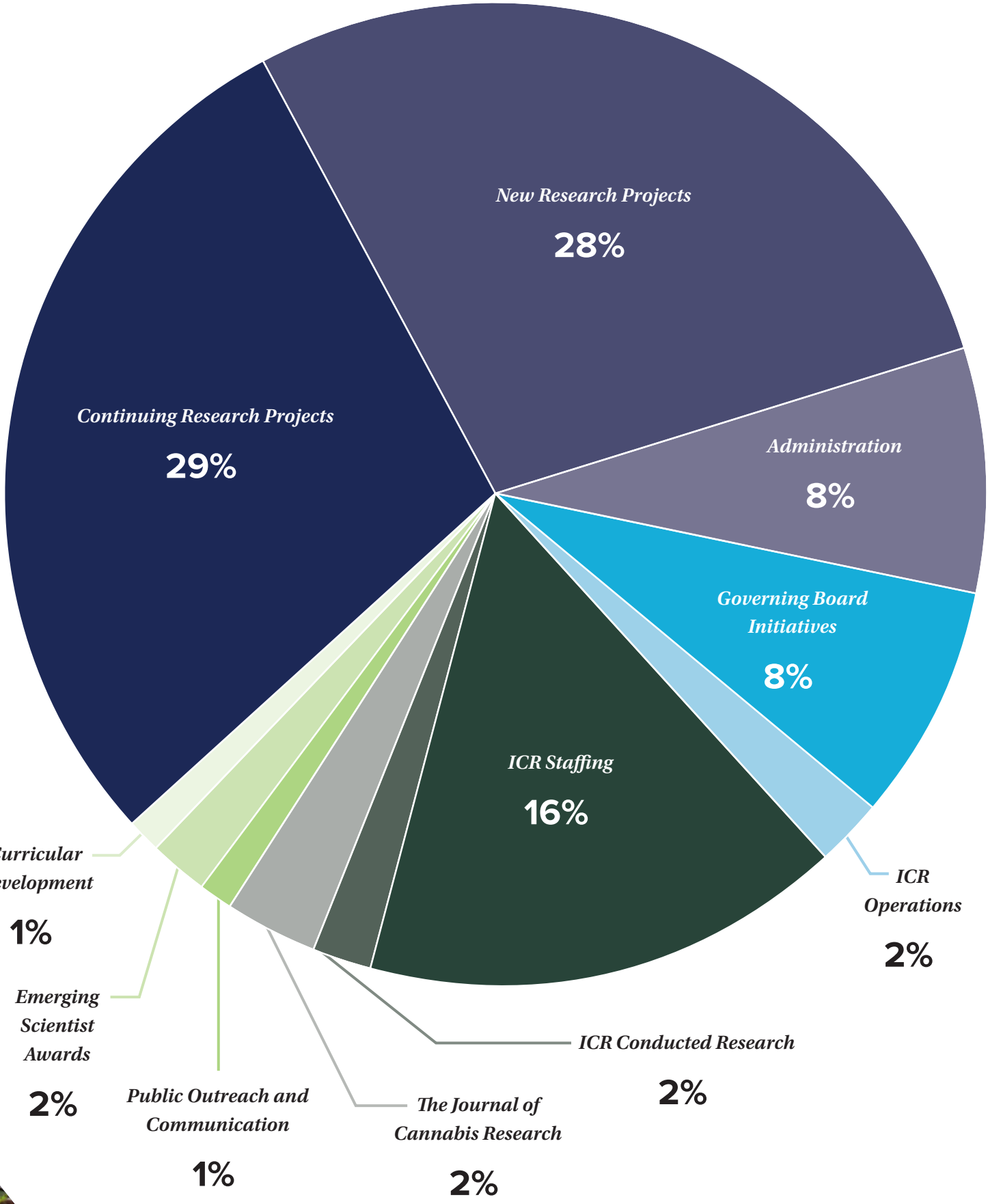
The ICR received 2.8M in funding from the state of Colorado to fund cannabis research this year. The annual budget is used to support the mission of the ICR as outlined in Colorado HB19-1311,

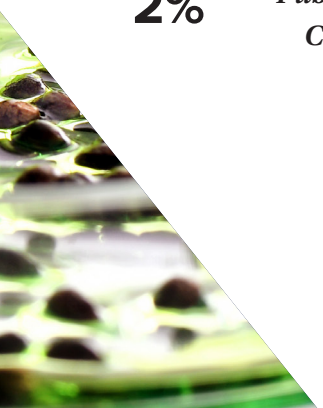
"TO CONDUCT RESEARCH RELATED TO CANNABIS, INCLUDING CLINICAL RESEARCH, BIOTECHNOLOGIES, CLINICAL STUDIES, THE EFFICACIES OF MEDICAL MARIJUANA, AND ECONOMIC DEVELOPMENT ASSOCIATED WITH CANNABIS IN COLORADO, AND TO PUBLICLY DISSEMINATE THE RESULTS OF THE RESEARCH."

Over two thirds of the budget was allocated for cannabis research as reflected in the combined budget categories of: ***Continuing Research Projects, New Research Projects, Governing Board Initiatives, and ICR Conducted Research.*** The remaining one third of the budget was spent on the following:

ICR staffing and administration necessary to implement the competitive research proposal review process and project administration, 26%; student support and educational initiatives, 3%; the Journal of Cannabis research and public outreach, 3%.

The Colorado legislature this year increased the annual budget of the ICR by 1M. This increase will be realized in the annual ICR budget next year, which will total 3.8M. The additional budget will be allocated to funding new research projects which will be conducted by Colorado's best and brightest cannabis researchers following the ICR's rigorous application and scientific review process. It will also support an entirely new line of research which the ICR will conduct at its laboratories at CSU-Pueblo. This will double the internal research capacity of the ICR and expand its scope or research highlighted above (see p16-18) to include biomedical/analytical types of research.


New Research Projects
28%
Administration
8%
Governing Board Initiatives
8%
ICR Operations
2%
ICR Conducted Research
2%
The Journal of Cannabis Research
2%
Public Outreach and Communication
1%
Emerging Scientist Awards
2%
Curricular Development
1%
ICR Staffing
16%
Continuing Research Projects
29%



2023 CANNABIS RESEARCH CONFERENCE
KEYNOTE SPEAKERS

Cannabis Research Conference 2023 and the Mechoulam Lecture Series

Esther Shohami, PhD received her doctorate in Physiology from the Hebrew University (HU), Jerusalem, Israel and did her post-doc at MC-Gill University in Montreal, Canada. She later joined the HU School of Pharmacy at the faculty of medicine and is currently a Professor Emerita in Pharmacology at the HU Institute for Drug Research. Between 2006 - 2011 she served as the Dean of students at her University, and between 2012-2014 as the president of the Israel Society for Neuroscience. She is a member of the executive board of the International Neurotrauma Society (INTS) and serves on the editorial boards of J. Neurotrauma. She also served as a council member of the US National Neurotrauma Society and on the editorial board of J. CBF & M.

Prof. Shohami has published more than 220 articles, reviews, and book chapters. Her research is focused on experimental traumatic brain injury (TBI) in rodents and addresses mechanisms of injury (e.g, inflammation, oxidative stress, the glutamate NMDAR) and endogenous neuroprotection (e.g. endocannabinoids and heat-acclimation induced preconditioning). Currently, her work focuses on the effects of TBI on cognitive functions and on mechanisms involved in ameliorating these TBI-induced deficits. She also studies the involvement of the endocannabinoid system in the pathophysiology and rehabilitation after TBI and is involved in developing cannabinoid-like novel drugs for TBI.

Keynote Lecture

Sofia Thanhauser is the author of Worn: A People's History of Clothing (Pantheon, 2022). She teaches in the writing department at Pratt Institute. She has received fellowships from the Fulbright Program, MacDowell, and Ucross Foundation. Her writing has appeared in The Guardian, Vox, Essay Daily, and The Establishment, among other publications.

Featured Speaker

Sergiy Kovalenkov is one of the most renowned hemp builders in the world and has been part of the hemp-building industry for more than 12 years.

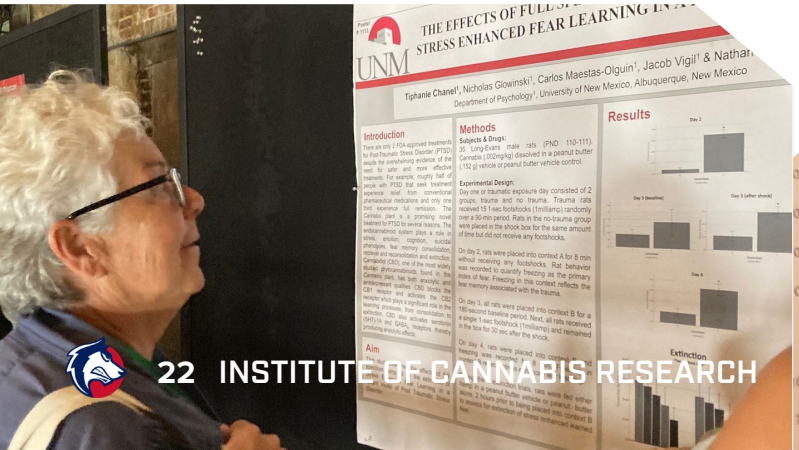
In 2015, he founded "Hempire UA" in Ukraine, the company which has developed a 100% natural "Fifth Element" binder that, when mixed with hemp and water, would create one of the lightest, carbon-negative hempcrete insulation on the planet, called Hempire Mix. Until the Russian invasion in 2022, under Sergiy's command, Hempire has been one of the leaders in the hempcrete industry, picking up high recognition and numerous awards during international green tech and environmental contests while successfully supplying the Ukrainian and EU markets with its innovative products. Over the last few years, Hempire has constantly been working towards bringing new products to the market, such as: new hemp-based insulation panels with natural adhesives, pre-bagged hemp-lime plaster, and hemp-clay pasters. Many projects have been completed using Hempire products.

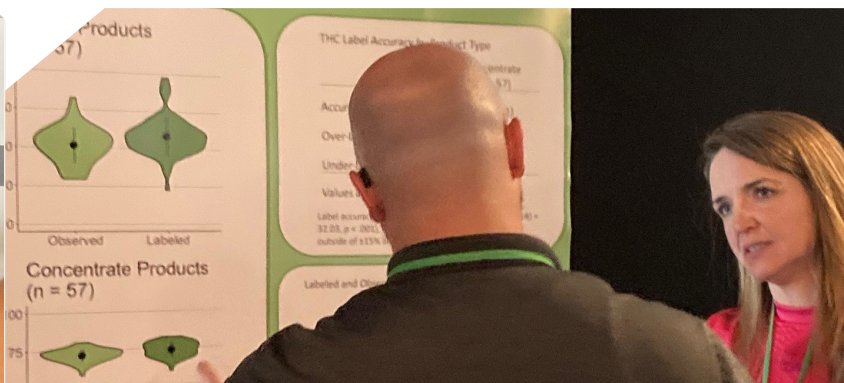
In 2018 Sergiy founded Hempire USA in California to start the company's activities on the North American market. Now the company offers exclusive binder production and distribution licenses across different states as the industry recovers after COVID restrictions.

Mr. Kovalenkov possesses vast experience and knowledge in the field of energy efficiency and green building. He is frequently invited as a speaker to numerous hemp, green tech, and environmental conferences in the following countries: the USA, Canada, Japan, Italy, China, the UK, and others.

Sergiy is one of the founders of the US Hemp Building Association and was occupying the position of director of the Education Committee, that is focusing on providing the North American building industry with essential information on hemp-based construction materials.

Now Sergiy, along with Hempire, is focusing on helping companies worldwide set up hemp pro- cessing and manufacturing facilities to speed up the construction industry's transition towards more sustainable products.





OUTREACH & IMPACTS OF ICR

E-NEWSLETTER

The ICR bimonthly e-newsletter has been steadily building momentum for the past 4 years. Our distribution list is now over 4000 subscribers and growing each month. We continue to spotlight our partnerships and highlight the research taking place here at CSU Pueblo. We also feature state funded research being performed at regional institutions across Colorado including CSU Ft. Collins, Anschutz, and the University of Colorado. Twice a month we host two webinar series with the best and the brightest researchers from across the state, nation, and globe who speak about medical, agricultural, pharmacological and many other topics of interest in the cannabis space. We have partnerships in Israel, South Korea, doctoral candidates from as far away as Colombia and Brazil, and have had visiting researchers from Spain, South Korea and ??? Our annual conference is one of the only one of it's type in the country focused on cannabis research and the newsletter aids in the distribution of this information and offers another opportunity to register and/or sponsor this event. We are affiliated with the Journal of Cannabis Research and highlight articles from this research publication within our newsletter for anyone to link to and read. This newsletter is archived on our website **csupueblo.edu/institute-of-cannabis-research/outreach/index.html** and anyone is welcome to sign up to receive this in their email box.

WEBINARS

Cultivation Webinar Series

Since the kickoff of the hemp cultivation webinar in February 2022, we have had the privilege of hosting over 15 renowned professors and attracting more than 750 attendees from countries worldwide. The webinar has covered a wide range of topics, including cannabis physiology, pharmacology, cultivation, risk management, and resource utilization. These webinar series have provided valuable information on both the basics of cultivation and highlighted the importance and utilization of agricultural by-products, including cannabinoids, seeds, fibers, etc.

Our main partner, the Volcani Institute in Israel, has played a pivotal role in organizing the webinar and extending its global reach by connecting with international partners. Working closely with the Volcani Center, ICR aims to engage with more cannabis cultivators, researchers, and industrial experts worldwide, contributing not only to the advancement of cannabis science but also to agricultural practices, given the increasing demand for cannabis cultivation.

We cordially invite you to join our monthly webinar series, where we delve into the exciting world of cannabis sciences. Your participation and feedback will be invaluable to anyone who is eager to learn about this emerging crop and its potential applications in medicine, agriculture, and industry.

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.

Presenters for this webinar series speak on topics ranging from medical science and public policy to industrial perspectives to cannabis research funding opportunities. These webinars are co-sponsored by the Institute of Cannabis Research at CSU Pueblo and the Lambert Center at Thomas Jefferson University. This webinar series regularly schedules a presentation on the second Thursday of each month at 1 PM Mountain time, held on Zoom. Recordings of the webinars are made available on our website shortly after the live presentation.

Recent webinars have included Dr. Jessica S. Kruger, speaking on "The Alphabet Soup of Alternative Cannabinoids," Dr. Adie

Rae Wilson-Poe, providing an overview on "The Unintended Negative Impact of Adult-Use Cannabis Legalization on The Wellbeing of Medical Cannabis Patients;" Dr. Shawn Hauser, addressing a "Cannabis Legislative and Policy Update," Dr. Jordan Tishler, addressing "Why We Need A More Medical Medical-Cannabis System," Dr. Cinnamon Bidwell, providing an overview of "Cannabis Psychopharmacology and Harm Reduction," Dr. Cecilia Hillard, on her research with "the role of endocannabinoid signaling in the regulation of mood and responses to stress," as a few examples.

The webinar is free and open to the public, and registration and past webinars are archived at **csupueblo.edu/institute-of-cannabis-research/webinars/cannabis-research-webinar-series.html**

csupueblo.edu/institute-of-cannabis-research/research/research-studies/index.html

JOURNAL OF CANNABIS RESEARCH

The Journal of Cannabis Research (JCR) began accepting manuscripts in Sept., 2018. This 5th year of publication continues the journal's solid growth and international scope. We have a distinguished international editorial board comprising 36 prominent cannabis scientists from 10 countries on five continents. Our 10 topic sections comprehensively cover all aspects of cannabis, cannabinoid, and endocannabinoid science, both preclinical and clinical, as well as cannabis economics, regulation, and history.

JCR is the only international, multi-disciplinary journal in the cannabis field that is open-access. Anyone in the world can find our articles on our web site or on PubMed and read them without paying a fee. This makes our articles readily accessible to those in low-income countries or without access to an academic library. In FY 2022, JCR articles were downloaded 144,140 times, an average of 3,793 downloads per article. They had 950 altmetric mentions, averaging 28 mentions per article. The enhanced visibility and international reach of articles published in JCR is an advantage to authors when deciding on where to submit their manuscripts for publication.

During FY 2022 (July 1, 2022 through April 30, 2022), 58 manuscripts were submitted from 16 different countries (half from the US) on all continents except Antarctica. Our manuscript acceptance rate of 44% is comparable to that of many established journals.

JCR is now included in 3 major online indexing services: PubMed, Web of Science, and Scopus. We expect to have assigned performance metrics (e.g., Impact Factor) sometime next year. JCR is a member of two respected international societies: Committee on Publication Ethics and International Society of Addiction Journal Editors. This membership is evidence of the trust in which JCR is held by other scholarly journals.

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

JCR: AIMS

Disseminate high-quality, peer-reviewed cannabis knowledge to a broad, international, multi-disciplinary audience, including:

- biomedical, agricultural, environmental, and social scientists
- clinicians
- economists & business experts
- lawyers
- ethicists
- public health and public policy experts
- public officials

Provide outlet for scholars of all disciplines and levels of professional standing to contribute to cannabis knowledge.

Provide forum for multidisciplinary collaboration and innovation in the cannabis field.

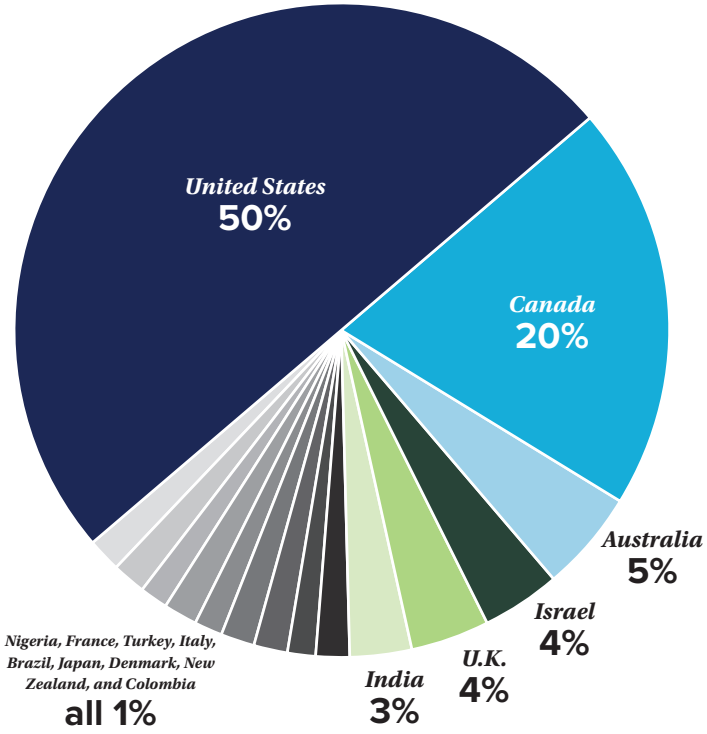
JCR: SCOPE AGRICULTURE AND PLANT BIOLOGY

- Cannabis and cannabinoids: biochemistry and genetics
- Cannabis and cannabinoids: preclinical pharmacology
- Cannabis and cannabinoids clinical pharmacology
- Endocannabinoid system
- Cannabis-related disorders
- Epidemiology and public health
- Medical cannabis
- Commerce, business, and environment
- History, regulation, and public policy

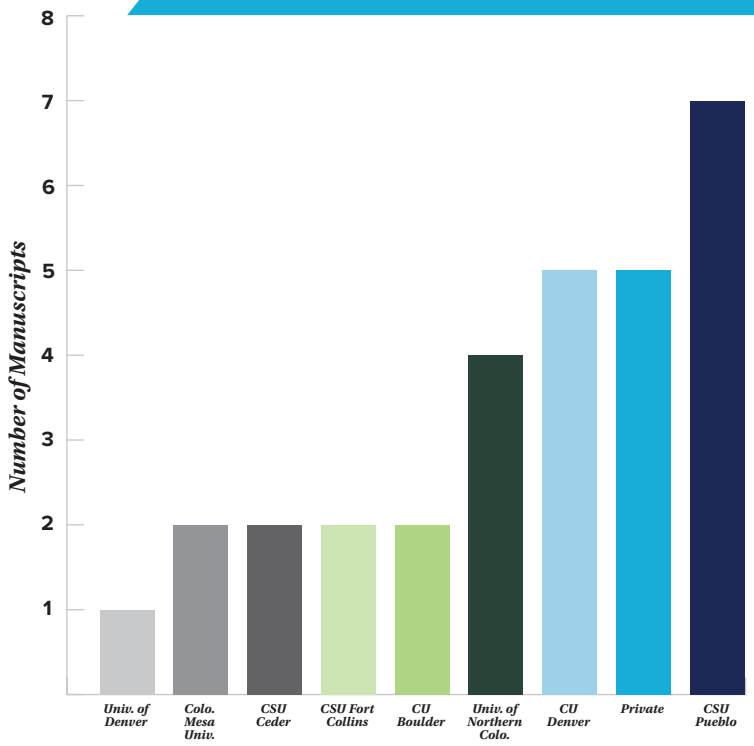
The Journal of Cannabis Research is the only multidisciplinary, international, open-access, cannabis-focused journal: 470 manuscripts submitted, 178 manuscripts accepted.

Please find the link to the Journal of Cannabis Research here: **jcannabisresearch.biomedcentral.com**

GEOGRAPHIC DISTRIBUTION OF SUBMITTED MANUSCRIPTS



30 JCR ACCEPTED MANUSCRIPTS FROM COLORADO AUTHORS



THE OUTCOME OF FINAL EDITORIAL REVIEW FOR MANUSCRIPTS SUBMITTED IN FY2022

Accepted	*Rejected*	*Withdrawn* by the author before an editorial decision	*Under editorial review*
16 (44%)	17 (47%)	3 (8%)	22

DISSEMINATION ACTIVITIES

The cannabis research which the ICR administers and conducts is published in leading peer-reviewed scientific journals and presented at scientific conferences. This new scientific knowledge is thereby made available to the greater scientific community on a local, national, and international level and so is available to guide best practices in cannabis related decision-making processes based on solid science.

The ICR's initial research projects, first funded in 2021, are just maturing to the point of producing high quality peer-reviewed research publications. The following publications were produced by ICR-funded researchers in Colorado this year:

Swenson, K. S., Gomez Wulschner, L. E., Hoelscher, V. M., Folts, L., Korth, K. M., Oh, W. C., & Bates, E. A. (2023). Fetal cannabidiol (CBD) exposure alters thermal pain sensitivity, problem-solving, and prefrontal cortex excitability. Molecular psychiatry, 10.1038/s41380-023-02130-y. Advance online publication. https://doi.org/10.1038/s41380-023-02130-y.

Karoly, H. C., Prince, M. A., Emery, N. N., Smith, E. E.*, Piercey, C. J.*, & Conner, B. T. (2022). Protocol for a mobile laboratory study of co-administration of cannabis concentrates with a standardalcohol dose in humans. Plos one, 17(11), e0277123.

Arkell, T. R., Brooks-Russell, A., Downey, L. A., Shiferaw, B., Brown, T., Sherrick, J., & Hayley, A. C. (2022). Effects of psychotropic drugs on ocular parameters relevant to traffic safety: A systematic review. Neuroscience & Biobehavioral Reviews, 104831.

In addition, ICR researchers report having several articles under peer-review for publication in the near future. Selected titles include:

Fetal Cannabidiol (CBD) Exposure Induces Offspring Diabetes in a Sex and Dose Dependent Manner.

Marijuana for Morning Sickness: The Current State of Cannabis Consumption During Pregnancy.

Effects of oral Cannabis and intraperitoneal THC:CBD dosing on mouse physiology and brain and plasma neurochemicals and endocannabinoids.

Metabolomics reveals differences in Cannabis metabolomes following a variety of preparation methods.

ICR researchers also presented several abstracts at scientific conferences. Such presentations typically precede peer-reviewed publications like those listed above:

Swenson, K.S., The effect of fetal cannabidiol (CBD) exposure on offspring neurodevelopment, behavior, and metabolism. Middle Atlantic Reproduction and Teratology Association. October 7, 2022.

Swenson, K.S., How fetal cannabidiol (CBD) exposure impacts offspring behavior and neurodevelopment. Colorado Cannabis Research Consortium. July 28, 2022.

Bates, Emily, Marijuana for morning sickness: Is CBD consumption safe during pregnancy? Oral seminar presentation, Department of Pharmacology, University of Colorado Anschutz Medical Campus, August 22, 2022.

Bates, Emily, Marijuana for morning sickness: Is CBD consumption safe during pregnancy? Denver Community College Cannabis Studies Program Seminar, Oct. 3, 2022.

Bates, Emily, Marijuana for morning sickness: Is CBD consumption safe during pregnancy? Cell, Stem Cell, Development Retreat, Breckenridge, CO, Oct. 7, 2022.

Bates, Emily, Fetal CBD exposure impacts neurodevelopment and postnatal behaviors, Pregnancy Neonatal Research Conference (PNRC) Nov. 10, 2022.

Swenson, K.S., The Effect of Fetal Cannabidiol (CBD) Exposure on Brain Development and Postnatal Behavior. Institute of Cannabis Research 6th Annual Conference, oral presentation. August 20, 2022.

Bates, Emily, Fetal Cannabidiol (CBD) Exposure Affects Hypothalamus Development and Glucose Tolerance, Institute of Cannabis Research 6th Annual Conference, August 21, 2022.

Swenson, K.S., Johnson, A., Sandy, S., Clinical care recommendations for labor and delivery patients who screen positive for cannabis use. Colorado Perinatal Care Quality Collaborative November coaching call. Oral presentation, November 10, 2022.

Swenson, K.S., Bates E.A., Marijuana for morning sickness: How gestational cannabidiol (CBD) consumption effects offspring development. University of Colorado Anschutz Medical Campus Perinatal Research Center. Oral presentation, October 20, 2022.

Swenson, K.S., The Effect of Fetal Cannabidiol (CBD) Exposure on Brain Development and Postnatal Behavior. Society for Neuroscience annual conference, poster presentation. November 15, 2022.

Swenson, K.S., The Effect of Fetal Cannabidiol (CBD) Exposure on Brain Development and Postnatal Behavior. Society for Neuroscience annual conference, Society for Neuroscience NeuroAssociates diversity poster session, poster presentation. November 12, 2022.

Swenson, K.S., The Effect of Fetal Cannabidiol (CBD) Exposure on Offspring Metabolism. Ludeman Family Center for Women's Health Research, National Conference on Sex Differences Across the Lifespan: A Focus on Metabolism, poster presentation. October 13, 2022. -Won Best Poster Award.

Swenson, K.S., The Effect of Fetal Cannabidiol (CBD) Exposure on Brain Development and Postnatal Behavior. Society for Developmental Biology, poster presentation. July 18, 2022.

Swenson, K.S., Gomez Wulschner, L., Hoelscher, V., Oh, W.C., Bates, E.A., Fetal Cannabidiol (CBD) Exposure Decreases Offspring Cognition and Alters Prefrontal Cortex Development in a Sex Dependent Manner. Children's Hospital Colorado Pediatric Research Forum. December 16, 2022

Minne, C., Swenson, K.S., Bates, E.A., Fetal Cannabidiol (CBD) Exposure Alters Offspring Adipose and Pancreatic Development in a Sex Dependent Manner. Children's Hospital Colorado Pediatric Research Forum. December 16, 2022.

Swenson, K.S., Gomez Wulschner, L., Hoelscher, V., Folts, L., Oh, W.C., Bates, E.A., Fetal Cannabidiol (CBD) Exposure Decreases Offspring Cognition and Alters Prefrontal Cortex Development in a Sex Dependent Manner. Front Range Neuroscience Symposium. December 15, 2022.

Swenson, K.S., Gomez Wulschner, L., Hoelscher, V., Oh, W.C., Bates, E.A., Fetal Cannabidiol (CBD) Exposure Decreases Offspring Cognition and Alters Prefrontal Cortex Development in a Sex Dependent Manner. University of Colorado Student Research Forum. December 13, 2022.

Swenson, K.S., Marijuana for morning sickness: How, when, and where pregnant people receive information about safety or risk of consuming cannabis. University of Colorado Anschutz Medical Campus School of Public Health research exchange conference. September 23, 2022.

Swenson, K.S., Marijuana for morning sickness: How, when, and where pregnant people receive information about safety or risk of consuming cannabis. Colorado State University and University of Colorado Research Summit. September 14, 2022.

Korth, K., Swenson, K.S., Bates, E.A. Marijuana use in pregnancy: Understanding how gestational cannabidiol (CBD) effects compulsivity and postnatal tissues. Undergraduate Summer Research Symposium. July 29, 2022.

Swenson, K.S., The Effect of Fetal Cannabidiol (CBD) Exposure on Offspring Metabolism. Diabetes Research Center, University of Colorado | Anschutz Medical Campus, poster presentation. July 29th, 2022.

Folts, L., Swenson, K. S., O'Rourke, R., Bates, E.A. The effect of fetal cannabidiol (CBD) exposure on offspring metabolism. Colorado Clinical and Translational Sciences Institute Annual Winter Pediatric Research Poster Session. Dec. 16, 2022.

Folts, L., Swenson, K. S., Korth, K., Moss, I., O'Rourke, R., E.A. Bates. Gestational cannabidiol (CBD) consumption impacts offspring hypothalamus development and metabolism in a sex-specific manner. University of Colorado Anschutz Medical Campus Annual Student Research Forum. Dec. 13, 2022-Best Cell and Developmental Biology Poster Award – first place.

Karoly HC (2022, July). Observational Laboratory Methods for Studying Co-Administration of Alcohol and Legal Market Cannabis Products. Symposium presented (Chair) at the annual meeting of the Research Society on Marijuana, Boston, MA.

Piercey, CJ, Conner, BT, Prince, MA, Emery, NN & Karoly, HC. Exploring the Effects of Co-Administration of Cannabis Concentrates with a Standard Alcohol Dose: A Focus on Cannabinoid Content and Order Effects. Symposium talk presented at the annual meeting of the Research Society on Marijuana, Boston, MA. (2022).

Piercey, C.*, Knox, T**, Prince, M., Emery, N., Conner, B. T., & Karoly, H. (2022, August). Exploring alcohol and cannabis co-administration in human participants. Poster presentation at the Virtual 2022 Cannabis Research Conference.

Brooks-Russell, A. "Cannabis Impaired Driving" Presentation to the Colorado Multiple Institutional Review Board. September, 2022. CU Anschutz.

Brooks-Russell, A. "Effect of tolerance to cannabis on psychomotor performance," International Conference on Traffic and Transport Psychology. August, 2022, Gothenburg, Sweden.

Oral administration of Cannabis results in changes to the metabolome, neurochemicals, and endocannabinoids of mice. (2022) Nichole Reisdorph, Katrina Doenges, Cassandra Levens, Jon Manke, Michael Armstrong, Kevin Quinn, Kristine Kuhn. Institute of Cannabis Research 6th Annual Conference.

Kirsch M, Paglia H, Araujo TB, Madsen H, Rodriguez Franco S, Hammermesh M, Weiss R, Gleisner AL, Schulick RD, Del Chiaro M, Stewart CL. Cannabis Use and Postoperative Outcomes in Patients Undergoing Hepatectomy. Americas Hepatopancreaticobiliary Association annual meeting, 2023, Miami Fl.

The ICR conducts its own research which was disseminated at several research conferences and published in several peer-reviewed journal articles this year. These dissemination activities reflect research products of the ICR's current internal research program at CSU-Pueblo.

Publications:

Eun-Soo Kim, Tae-Hyung Kwon, and Sang-Hyuck Park* (2023) "Structural Characteristics of Shells in a Fibrous Cultivar of Cannabis sativa L" Journal of Natural Fibers *Corresponding author

Ellingson, J. M., Hinckley, J. D., Ross, J. M., Schacht, J. P., Bidwell, L. C., Bryan, A. D., Hopfer, C. J., Riggs, P., & Hutchison, K. E. (2021). The neurocognitive effects of cannabis across the lifespan. Current Behavioral Neuroscience Reports, 8, 124-133. PMCID: PMC9377647 NIHMSID: NIHMS1792283 PMID: 35979200

Kyung-Hwa Jeon, Sang-Hyuck 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

Kenneth J. Olejar and Sang-Hyuck Park* (2022) "Industrial based misconceptions regarding cross-pollination of Cannabis spp." Frontiers in Plant Sciences *First co-author and corresponding author

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

Sang-Hyuck 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 *Corresponding author

Sang-Hyuck Park*, Christopher S. Pauli , Eric L. Gostin, S. Kyle Staples, Dustin Seifried, Chad Kinney, and Brian D. Vanden Heuvel (2022) "Effects of Short-term Environmental Stresses on the Onset of Cannabinoid Production in Young Immature Flowers of Industrial Hemp (Cannabis sativa L.)", submitted to Journal of Cannabis Research * Corresponding author

Presentations:

Sang-Hyuck Park, "Cannabis: A Historical Perspective, Dispelling Misconceptions, and Exploring Medicinal Potential"- Atomy Co. Ltd. – Pharmaceutical Company, Gongju, South Korea (May 2023)

Sang-Hyuck Park, "Cannabis and Therapeutic Implications of Cannabinoids" - School of Pharmacy, JeonBuk National University, South Korea (May 2023)

Sang-Hyuck Park, "US Medical Cannabis Research and Current Regulatory Status" - 2023 Symposium and Annual Meeting of the Korean Society of Medicinal Crop Sciences, Chuncheon, South Korea (May 2023)

Sang-Hyuck Park, "Current Regulatory Status and Advancements in Medicinal Cannabis Research in US" - Founding Conference of Asia-Pacific Cannabis Research Association, Busan, South Korea (March 2023)

Sang-Hyuck Park, "Current Regulatory Status and Medicinal Cannabis Research in US" - Korean Pharmaceutical Acupuncture Society, Seoul, Korea (Nov. 2022)

Sang-Hyuck Park, "Current Regulatory Status and Cannabis Research Trend in US" - 2nd Conference of Korean Cannabis Research Association, Seoul, South Korea (Nov. 2022)

Sang-Hyuck Park, "Current Regulatory Status and Cannabis Research Trend in US" - 2022 Fall International Convention of Pharmaceutical Society of Korea (Oct. 2022)

Sang-Hyuck Park, "Cannabis and Cannabinoids Research at Institute of Cannabis Research" – Gangwon Green Bio International Symposium, Chuncheon, South Korea (Sept. 2022)

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