Institute of Cannabis Research
COLORADO STATE UNIVERSITY PUEBLO

ANNUAL REPORT

2021

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LETTER FROM THE DIRECTOR

It is hard to believe that another year has concluded. Fiscal year 2021 has been a challenging one on many fronts for many individuals and organizations, and this is also true for the Institute of Cannabis Research (ICR). The global COVID pandemic has had broad impacts. The obvious impacts include a cessation of in-person meetings and conferences as well as working remotely sometimes with family distractions in the background and unstable internet/Wi-Fi at home. Perhaps the less obvious impact is the decrease in state funding in many areas necessitated the downturn in the economy that accompanied the pandemic. For the ICR the decrease in annual funding meant a commensurate decrease in the ability to fund cannabis research during the year. As well, over this past year I certainly found myself appreciating the efficiencies of working in an environment with colleagues being accessible and right around the corner in the next office, having ready access to a photocopier/scanner, and working where simple discussions do not require being scheduled on a virtual meeting platform. I am grateful for the fact that technology has allowed us to still be productive and stay safe in a world with a global pandemic, but truth be told, I look forward to a time when life is not so "virtual".

With the lamentations expressed I am pleased to focus on the positive outcomes from this past year. The ICR exists to support unbiased cannabis research and see the results of cannabis research broadly shared. Notable accomplishments this year includes launching the first state-wide competition for sponsored cannabis research overseen by the ICR. This required considerable effort by the ICR Staff to build and manage this process. This also required the participation of researchers in Colorado and across the country to volunteer their time and expertise to participate in the peer-review process that is the cornerstone of identifying the most innovative and meritorious research proposals (Thank you to those that served on the Review Panels!). Other firsts this year include the new ICR Webinar Series hosted the second Thursday of every month, which was launched this past October, and the new ICR e-Newsletter that is distributed every two months. If you have missed these items, they are archived on the ICR's website. The Journal of Cannabis Research, the official journal of the ICR, had an exceptional year under the continued guidance of Editor-in-Chief Dr. David Gorelick. The Journal saw continued growth in submissions and publications and is now indexed.

There is reason to be optimistic that the upcoming year will include a recovering economy, a recovery in funding for the ICR, and the start of several new cannabis research projects by researchers at institutions and organizations throughout the state. Cannabis is a broad topic and still with many unknowns and questions most of which can only be addressed with quality, unbiased research. The ICR hosted at CSU Pueblo is looking forward to supporting the research that is needed address outstanding questions and the researchers that will be conducting these studies. There is still a lot of good work to be done and the ICR, its Staff, and Governing Board continue to do their part.

In the upcoming year I hope you will join us at the annual Cannabis Research Conference, attend one of our scheduled webinars, or interact with us on social media. Please feel free to reach out to the ICR anytime with questions or comments (icr@csupueblo.edu).

Chad Kinney, Ph.D.
Director, Institute of Cannabis Research

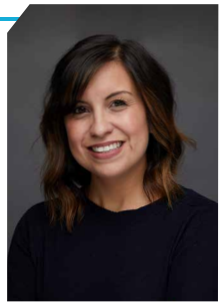
MEET THE ICR STAFF

Dr. Chad Kinney

Director, ICR

Dr. Kinney has served as the ICR Director since July of 2018, and had a been a faculty member at Colorado State University Pueblo since 2007. Dr. Kinney's background is in Analytical and Environmental Chemistry, and has employed some of the same analytical techniques used in other areas of his research program to the extraction and isolation of phytochemicals from hemp. As Director of the ICR, Dr. Kinney works closely with the ICR Staff to move forward Institute initiatives designed to meet its role and mission in the State of supporting unbiased, quality cannabis related research and the broad dissemination of cannabis research results among various audiences. He also works closely with the Institute's Governing Board, and liaises with other stakeholder groups and collaborators.

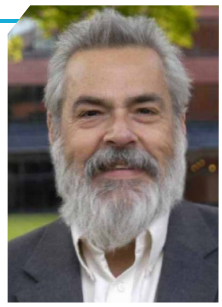
Nicole Quartiero



Assistant Director, ICR // Director of the Office of Research and Sponsored Programs

In addition to her operational role, Nicole tapped into her robust background in research administration to coordinate and oversee the ICR's first statewide grant competition in FY21. Additionally, Nicole works with the Director on potential research collaborations, fiscal oversight, strategic and conference planning. She serves as one of the main points of contact for the Institute, its Governing Board, staff and collaborators while offering high-level customer service with the occasional touch of comic relief.

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.

Sang-Hyuck Park

Senior Scientist // Research Liaison

With extensive research experience in plant biology and genetics, Dr. Sang-Hyuck 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 2020, Dr. Park founded the ICR Hemp Farmers Association (IHFA) and serves as co-chair of the 4th ICR conference program committee.

Amy Uhernik

Research Scientist

Amy has extensive research experience at the cellular, molecular, and pre-clinical levels of understanding the mechanisms that underlie nervous system function in health and neurodegenerative diseases. As a research scientist in the neuroscience lab, she is investigating how different cannabinoids affect learning and memory which may help to discern the therapeutic potential of cannabinoids for treating various neurological disorders. Amy was an essential part of the team that helped create and develop the Institute of Cannabis Research as it was being formed. She was the first employee of the ICR and she continues to play a role in assisting the ICR to achieve its objectives and mission.

Dr. Eun-Soo Kim

Visiting Scholar

Dr. Kim joined the ICR as a visiting scholar in December of 2019. 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 industrial plants such as Cannabis and ginseng. Dr. Kim published 40 peer-reviewed publications with 623 citations in total. He was a winner of the Great Research Award which was given to the best of best researcher selected from one thousand professors in the Konkuk University. Dr. Kim founded the Korea Hemp Institute in 2007 and served for 7 years as Director.

Xiao Cui

Data Analyst

Xiao Cui has extensive experience in project management and proficiency in SAS, R, Minitab, SQL, and Tableau. Ms. Cui's role at the ICR is to perform experimental design and statistical analysis to facilitate the ICR research. She has co-authored publications related to cannabis public health impacts and harm reduction. Ms. Cui audits and monitors the fiscal data for the ICR, and generates financial reports and dashboards to stakeholders. She also manages the ICR website and email blasting. As a member of the ICR conference committee, she is involved in the planning of the annual conference, managing the abstract submission and registration portal, as well as creating and analyzing post-conference surveys.

Wendy Fairchild

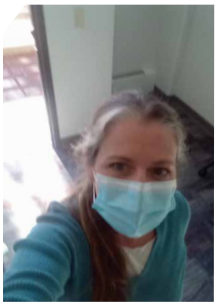
Administrative Assistant

As the Office Manager for the ICR, Wendy continues to work with the team to support the growing needs of the ICR. She continues to work with the team on reports, contracts, travel arrangements, planning and oversight of the annual conference, daily purchasing and accounting needs, directing incoming inquiries, and proof-reading and editing materials. Wendy regularly serves as the first contact for the ICR, and maintains a professional and enthusiastic rapport with current students, new student inquiries, professional contacts and the general public. She is beginning her tenth year working for her alma mater, CSU Pueblo.

RESEARCH
ONGOING & COMPLETING

An Ongoing Investigation Into the Effects of Medicinal Cannabis on Seizures in Adults with Medically Refractory Epilepsy

PI: Dr. Barbara Brett-Green, Psychology

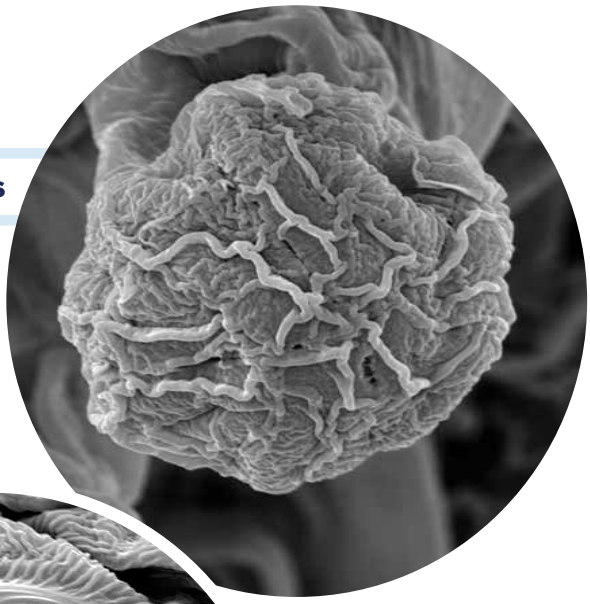


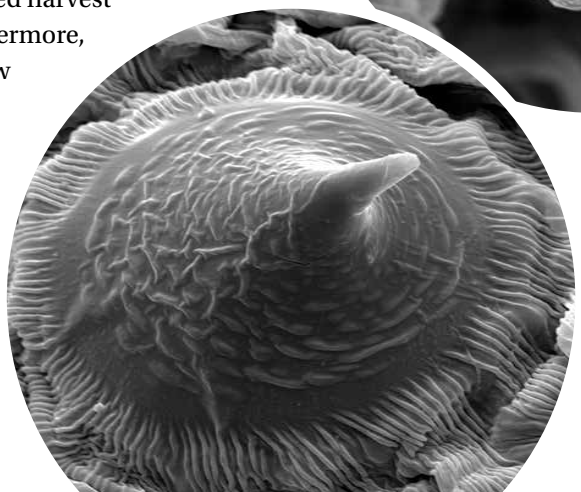
This observational study examines the effects of medicinal cannabis use on seizures and behavior in adults with medically refractory epilepsy who elect to use cannabidiol (CBD) as an adjunctive treatment. Participants are followed for one month prior to adding CBD to their treatment regime and for five months after. No cannabis is provided to the participants. Support for the participants medicinal cannabis use is provided by Realm of Caring. Participants wear a wireless physiological recording device that measures electrodermal activity, blood pulse volume, motion/acceleration, and temperature. This data is processed to produce seizure reports. Three times during the course of this study, participants fill out questionnaires assessing quality of life, seizure severity, anxiety/depression, and adverse events. They also provide urine samples that are processed for cannabinoid levels. Preliminary analysis of behavioral data indicates there is a statistically significant improvement in quality of life with CBD use, a statistically significant decrease in anxiety and a trend towards decreased depression, and a statistically significant decrease in side effects. Initial analysis of seizure reports is underway. Thus far, the analyses suggests there is no significant decrease in seizures, however, additional analyses are underway.

A Comparative Study of Glandular Trichomes in Hemp Varieties

PI: Dr. Eun-Soo Kim

This study was planned to define the trichome type using morphological comparison and microanalysis of secretory contents extracted from secretory cavities of glandular trichomes. The result will be critical information for molecular breeding, targeted engineering, and optimized harvest and processing of Cannabis. Furthermore, it will be helpful to understand how and where the cannabinoids are made, transported, modified, and accumulated in each type of glandular trichome. A glandular trichome (top), and a non-glandular trichome (bottom) is visible, respectively.





Comparative Impacts of Cannabidiol and Citalopram on the Neural Network Activity That Supports Fear Memory Acquisition in Mouse: *Informing Therapeutic Development for Learning and Memory Disorders*

PI: Jeff Smith, Professor of Biology, Colorado State University Pueblo
Co-PI: Amy Uhernik, MS, MBA, Institute of Cannabis Research

The broad objectives of the research were to compare the impact of cannabidiol (CBD) to that of the Selective Serotonin Reuptake inhibitor, citalopram (CIT) on cerebral processing during fear memory acquisition in mice, and to compare the drugs ability to alter fear learning-dependent intrinsic plasticity of individual neurons.

The specific aims were to compare the effect of CBD to CIT on fear learning-dependent functional neural network activity within 30 specific anatomical brain regions, and to compare the drug's effects on fear learning-dependent intrinsic plasticity within individual hippocampal and amygdalal neurons that have recently participated in processing the acquisition of fear memory.

The research is significant because of its demonstrated impact on fear memory, CBD has emerged as an alternative pharmacological treatment for disorders of fear learning and memory, such as Post Traumatic Stress Disorder (PTSD), to possibly replace prevalent and documented off-label prescription of SSRI's. However, while SSRI's have shown efficacy as therapeutics for this purpose, with a demonstrated neurobiological basis in modulating neural networks involved in emotive processing, it is not known whether CBD has an impact on neural processing whatsoever. Uncovering the comparative impact of CBD versus CIT on functional network activity and neuronal intrinsic plasticity in the networks that support the acquisition of fear memory is an essential first step towards understanding the neurobiological basis for using CBD to treat PTSD, or other memory disorders of learning and memory.

Summary/Progress Report

COVID19 restrictions which blocked our research team from campus greatly impeded our progress in the summer, the period when we are most productive. The move to remote operation led to the collapse of our mouse colony in the early fall. We re-established the colony by late fall but suffered a train of failed litters and sporadic interference with access to our research infrastructure which again greatly impeded our progress. We have adapted to these challenges by using our remaining budget to purchase mice which are supporting progress on the project as the fiscal year ends. We anticipate having an abbreviated set of publishable results by late fall 2021.

To further adapt to the COVID-related challenges we developed a project with a local optometrist Soraya Keshmiri, OD, with aims to study the impact of cannabinoid use on glaucoma. This is an observational study with aims to evaluate THC vs CBD, chronicity of use, and modes of delivery, on markers of disease progression.

RESEARCH
ONGOING & COMPLETING

Applications of Industrial Hemp

PI: Dr. Brian Vanden Heuvel, Biology

Cannabis has received much attention in recent years due to the recognition of its medicinal potential. With increasing legalization of Cannabis, an understanding of the plant's inherent defense mechanisms against pests will be essential to Cannabis farming practices. One of many studies our lab continues to research is the intrinsic evolutionary question, "Why does cannabis produce phytocannabinoids?" This question has yet to be fully understood, and something that we aim to answer. This information may help us gain valuable insight into CBD's defensive role as a secondary metabolite against herbivorous pests. Additionally, we have explored the use of novel extraction processes to extract and isolate cannabinoids from industrial hemp. This work has focused on the cannabinoids CBD and CBG, but would be expected to be applicable to other cannbinoids as well. Another application of hemp explored as part of this project is the extraction of biopolymers from hemp and use of those fibers in the production of electrospun nanofibers. Combined this various projects have resulted in multiple publications and presentations over the past year.

Effects of Dietary Hempseed on Growth Pattern, Body Composition, Bone Mineral Density, and Gut Microbiota in Mice

PI: Dr. Annette M. Gabaldon

Hempseed is increasingly being used as a dietary aide for both agricultural animals and humans because it is a nutrient-dense seed, yet the physiological influences are not fully understood. To begin, we chose a female C57BL/6 mouse model and designed a study to investigate the influence of a 0%, 5%, and 15% hempseed-supplemented diet on growth parameters, body composition, skeletal bone mineral density, arterial blood pressure, and the gut microbiome. The mice were maintained on the diets as they aged from 5 to 29 weeks and non-invasive measurements were made and feces collected monthly and/or bi-weekly. We have completed the in vivo part of the study and the data reveal no significant hempseed diet influences on growth and body composition of the mice. Although some seed diets can influence blood pressure, we did not observe this to be the case for hempseed in our experimental model. The gut microbiome studies are underway and we will soon understand whether or not the microbiome diversity is altered by dietary hempseed in the growing mice.

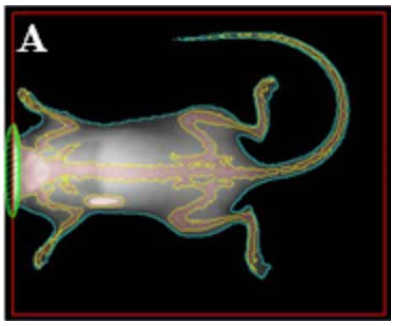
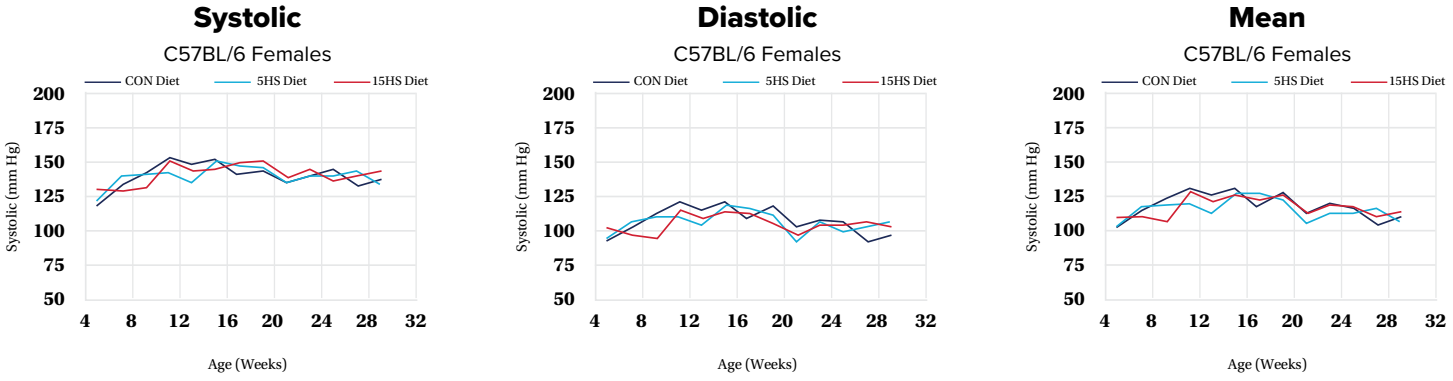


Fig. 1. Female C57BL/6 mouse DEXA scanning. Measured monthly using a Lunar Piximus DEXA scanner. The image is for one mouse scanned at the start of the study at age 5 weeks. Body composition (% fat and % lean tissue) and skeletal bone mineral density are determined.

Fig. 2. Female C57BL/6 mouse arterial blood pressure study. Measured bi-weekly using a CODA non-invasive blood pressure system (Kent Scientific). A tail cuff measures caudal artery blood pressure.



Anti-Cancer Potential of Fermented Dietary Hempseed Metabolites and the Role of CB Receptors in Human Colon Cancer Cell Caco2 Viability

PI: Dr. Annette M. Gabaldon

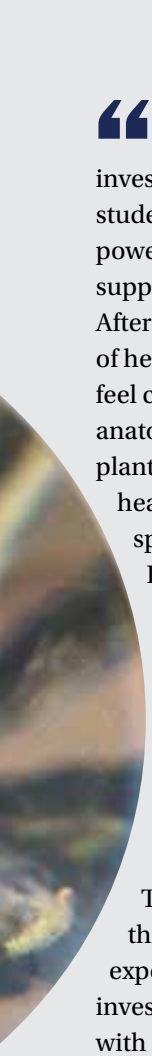
The gut microbial system plays an important role in the health of the animal. The beneficial bacterial microbes produce acidic metabolites like lactic acid that help maintain a healthy gut pH, and short chain fatty acids like butyric acid that are protective against colorectal cancer. Some fermentation metabolites can also function as signaling molecules, binding to receptors to influence cellular activities in the colon. We hypothesize that hempseed fermentation metabolites induce cytotoxic effects on cultured human colon cancer epithelial cells. Our model system uses cultured Caco2 cells and hempseed fermentation metabolites produced by inoculating a 5% hempseed media with a mouse fecal slurry and fermenting anaerobically for 48 hours. A fecal slurry ensures a diverse microbiome including phyla that generate butyric acid, notably cytotoxic to colon cancer cells. We are investigating treatment influences on cell viability, proliferation, and energy metabolism. This study is still in progress, but if the hypothesis is supported, importantly we will want to investigate other cell lines and non-cancerous colonocytes.

Front row: Gabaldon (left), Kayana Casias (right)
Back row: Hailey Streff (left), Zachary Giltner (middle), Chandler Sparks (right)

PROJECT SPOTLIGHT

National Essential Oil Hemp Project

The Institute of Cannabis Research (ICR) at Colorado State University Pueblo has participated the National Essential Oil Hemp Trial. This is a U.S. Department of Agriculture funded project being conducted out of the Global Hemp Innovation Center (GHIC) at Oregon State University. The project involves 16 sites in different regions of the United States including a site in Rocky Ford, Southeastern Colorado. All sites are producing the same varieties of industrial hemp, which are compliant varieties (< 0.3% total THC) to investigate geographical effects on hemp growth, particularly cannabinoid production.



“My participation in the National Essential Oil Hemp Trials with investigators from Oregon State University as a student research assistant provided me with a powerful opportunity to gain insight into many supply processes within the hemp industry. After monitoring the growth of several plots of hemp from adolescence to full growth, I feel confident in my understanding of the anatomy of a hemp plant and how to measure plant development. I was able to see both healthy development and how some hemp species undergo environmental stress. I also assisted Oregon State University with producing data for a data collection blockchain system that collects live supplier information. These experiences have given me a great insight into the current technology that exists within the hemp industry, which can prove beneficial to me in a future career path.

There was a strong sense of collaboration throughout this study. I was able to gain experience in working with the principal investigators at Oregon State University and with Dr. Sang-Hyuck Park and other student researchers here at CSU Pueblo. Dr. Park and I worked closely with Dr. Steiner from OSU to produce consistent and relevant data, meeting often to ensure the data collection is up to standard. During the process of observing hemp development, I was tasked with collecting samples from the field and sending them to OSU for analysis. This task required me to employ a small group of 6 student volunteers and teach them how to sample the plants and process them for delivery. Since I was the main student researcher on this project, Dr. Park assisted me in leading these students with teaching the correct procedures. This experiment also allowed me to practice researching independently. Travelling a few hours to the field each weekend and producing data was an excellent emulation of some of the responsibilities of research that I could see in the future. I would like to thank the ICR for this opportunity and would recommend this program to any other student looking for solid research experience.

- Darien Brown

As a national partner, ICR's Senior Scientist Dr. Park and the undergraduate researcher he mentored, Mr. Darien Brown, have closely monitored the entire life cycle of hemp varieties from seedling stage to bud maturation and assisted the GHIC with cannabinoid analysis. This national project will provide not only the insights into the interaction between genetic and environmental factors on hemp essential oil production, but also for new oil and fiber variety development.

PARTNERSHIPS

The international research collaboration between the Institute of Cannabis Research and the Chuncheon Bioindustry Foundation (CBF), South Korea, ended in March, 2021. During the year (Sep. 2020 – March, 2021), the ICR aided in the establishment of a cannabinoid extraction infrastructure for CBF, and also actively engaged in research in which different extraction methods were explored for high quality CBD production. The experimental results will be presented at the Cannabis Research Conference (CRC) hosted by the ICR (August 3-5, 2021) and published in peer-reviewed journal(s) this year. CBF and ICR have been in discussions regarding a new research project with an emphasis on minor cannabinoid production and their therapeutic functions. The ICR anticipates the future collaborative study to be successful and strengthen the research relationship between the two institutions.

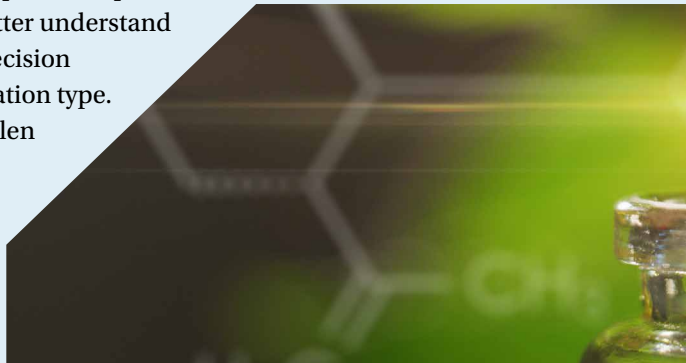
PROJECTS FUNDED BY PUEBLO COUNTY

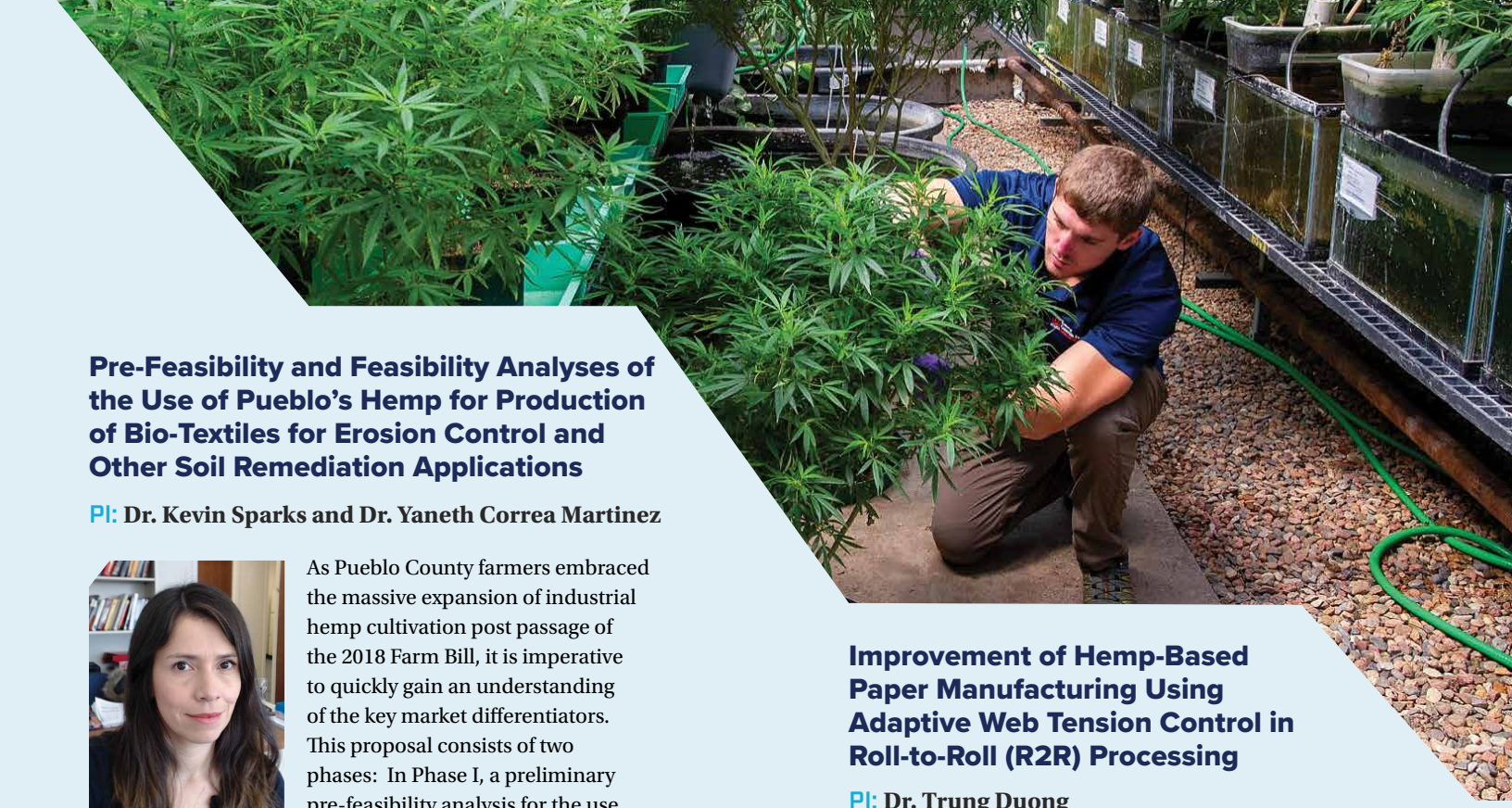
The ICR received a significant amount of funds from Pueblo County to support cannabis-based research in Pueblo, Colorado. All proposals were reviewed by the Board of County Commissioners and the top three proposals were funded. The funded projects are described here:

Factors Impacting Pollen Dispersion and Cannabinoid Production in Seeding Plants

PI: **Dr. Ken Olejar**

Pollen is essential for plants to transfer genes, however when species are similar, cross-pollination can occur resulting in unexpected changes in the resultant products. Environmental factors, as well as, plant morphology can impact pollen dispersion and instances of pollination. In cannabis, cultivation is desired as pollination can result in the progression to seed. It is assumed that production of seed diverts resources towards reproduction and away from cannabinoid production, however it is unclear if this occurs universally or merely selectively. This study will evaluate the interaction between meteorological conditions (i.e. wind, humidity, altitude, etc.) and pollen characteristics (i.e. size, weight, shape, etc.) on the pollen dispersion in Pueblo County. Additionally, pollen characteristics and plant cannabinoid production will be examined to improve upon existing models that examine only pollen dispersion. From this, the proposed work plans to establish a model demonstrating cannabis pollen dispersion in Pueblo County. This model will allow policy makers and stakeholders to better understand the pollen dispersion dynamics within the county, allowing for informed decision making regarding potential buffer zones and areas depending on the cultivation type. Additionally, the proposal seeks to correlate distance and pollination as pollen dispersion is merely one factor attributing to successful cross-pollination.





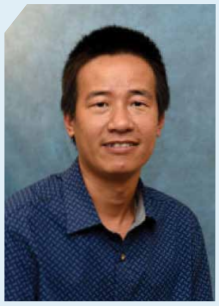
Pre-Feasibility and Feasibility Analyses of the Use of Pueblo's Hemp for Production of Bio-Textiles for Erosion Control and Other Soil Remediation Applications

PI: Dr. Kevin Sparks and Dr. Yaneth Correa Martinez

As Pueblo County farmers embraced the massive expansion of industrial hemp cultivation post passage of the 2018 Farm Bill, it is imperative to quickly gain an understanding of the key market differentiators. This proposal consists of two phases: In Phase I, a preliminary pre-feasibility analysis for the use of hemp grown in Pueblo County for the production of bio textiles is conducted. The market segment analyzed in this proposal is geotextiles for erosion control and other soil remediation applications. This study is the first step towards a comprehensive analysis of the technical and manufacturing requirements of this specific market segment and its dynamics. In Phase II, based on the findings of Phase I, both product and industry feasibility analyses will be provided. For the product feasibility analysis, an initial study of hemp and related products for use in the erosion control industry is conducted. It will provide a rubric to create guidelines for the selection and necessary performance criteria for hemp based products. The work is also expected to identify what tests may need to be performed as a basis of product comparison. It is anticipated this will then be utilized to develop a proposed budget for material property testing and to provide an initial quantification of the cost effectiveness of hemp products in the erosion control industry. The industry feasibility analysis will provide insights on the attractiveness of using hemp based geotextiles and will provide a preliminary measure of the potential value of using hemp-based geotextiles for erosion control and soil remediation.

Improvement of Hemp-Based Paper Manufacturing Using Adaptive Web Tension Control in Roll-to-Roll (R2R) Processing

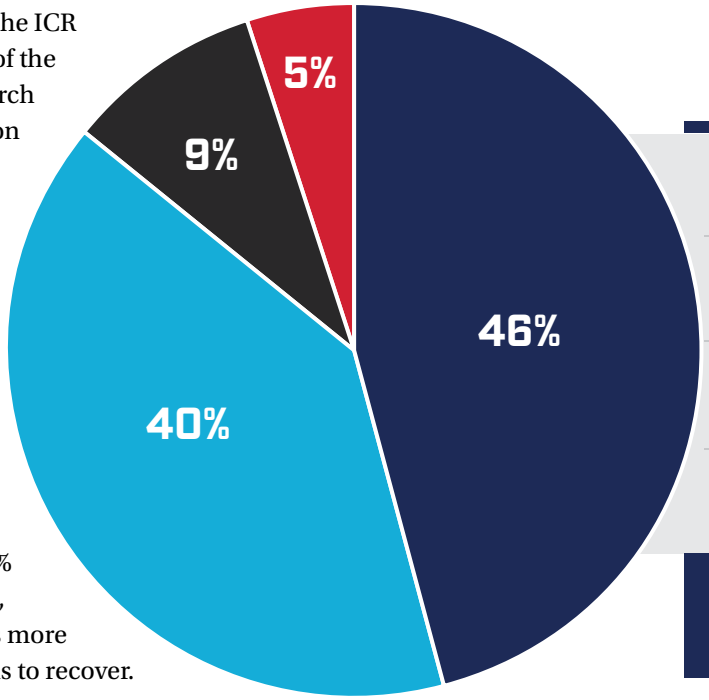
PI: Dr. Trung Duong



One challenge of the papermaking industry to meet the increasing production demand is that it is more difficult to obtain classic raw materials, mainly due to the stricter environmental protection regulations and the decreasing of the area of forest per capita. Researchers are looking for additional sources of fibers for papermaking, increasing paper recycling adaptation, developing of rapidly growing plantations, and/or using of non-wood plants. For the non-wood plants in papermaking, industrial hemp has a certain potential and currently gains more usage. However, more research into the application of industrial hemp for papermaking purposes and technological aspects of such manufacturing processes are needed. This research project aims to investigate the characteristics of hemp-based papers in a Roll-to-Roll (R2R) process and to design adaptive control schemes for control of web tension in R2R manufacturing systems. R2R systems are used to transport continuous and flexible substrate materials (called webs) on rollers from the unwind roll to the rewind roll. R2R is one important type of substrate-based manufacturing processes. Within R2R processes, other additive and subtractive processes can be used to build structures in a continuous manner. R2R is applied in numerous manufacturing fields, such as printing, coating, lamination, fibers and textiles, metal foils and sheet manufacturing, flexible solar panels, flexible/printed thin-film batteries, and flexible and large-area electronics devices.

FY21 BUDGET

The expenditures for the ICR reflects the mission of the ICR to support research and the dissemination of research results. The budget for Fiscal Year 21 was reduced compared to the previous few fiscal years as a result of the challenging financial situation that has accompanied the COVID-19 pandemic. As a result the ICR was required to limit expenditures in research and activities to disseminate research results, but still these expenditures represent over 50% of the FY21 budget. Fortunately, the financial outlook for FY22 is more favorable as the economy begins to recover.



Research Expenditures
$455,000

Operations and Administration
$404,000

Facilities and Administration
$91,000

Journal of Cannabis Research
$50,000

TOTAL EXPENSES:
$1,000,000

FY20 ROLL FORWARD

Beyond impacting the appropriation funding the ICR for FY21, the pandemic also caused significant disruption to research and projects. Most universities ceased in-person activities during the last quarter of FY20, which brought ongoing research to a halt. In addition the ICR had to postpone the conference it hosts from April 2019 to August 2020. Other research infrastructure projects were slowed due to closure of some manufacturing facilities making it difficult to source materials and supplies. The ICR worked with the State Controller's Office to roll forward just over $196,000 from FY20 to FY21 to allow interrupted projects to be completed when conditions allowed. These funds were expended as originally budgeted in FY20, but during FY21 and are in addition to the funds described in the figure above.

COMMITTEES & BOARDS

ICR Governing Board

The ICR Governing Board remained unchanged this year. The terms of the initial Governing Board are for two or three years to stager changes in the membership. 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 lead efforts to secure resources to support the mission of the ICR. The Governing Board meets on a monthly basis, and information related to Board meetings can be found on the ICR Website. 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 was initially convened in the fall of 2019 and is currently comprised of:

The Chancellor of the Colorado State University System or their Designee:
Dr. Timothy Mottet*, *President of Colorado State University Pueblo*

The Executive Director of the Colorado Commission on Higher Education or their designee:
Mr. Scott McWhorter*, *CEO Rocky Mountain Extraction Services*

The President of the University of Colorado or their designee:
Dr. Jon Reuter*, *Assistant Vice Chancellor of Research Integrity & Compliance University of Colorado Boulder*

The Executive Director of the Department of Public Health and Environment or their designee:
Ms. Mara Brosy-Wiwchar*, *Legislative Liaison Department of Public Health and Environment*

** Designee serves on board*

Three Appointed Scientists from relevant fields and employed at appropriate research-oriented institutions:
Dr. L. Cinnamon Bidwell (Board Chair),
University of Colorado Boulder

Dr. Maureen Leehey,
University of Colorado Anschutz Medical Campus

Dr. Suzanne A. Sisley, *Scottsdale Research Institute*

Four members associated with Cannabis-Related Industries within Colorado:
Dr. Malik Muhammad Hasan, *Neurologist and NuVue Pharma*
Mr. Sherard Marshon Rogers, *SRMG LLC*
Mr. Salvatore Pace, *SMP LLC*
Mr. John Desmond Lord, *CEO LivWell*

Steering Committee

The ICR Steering Committee, which has historically been involved in leading and guiding the ICR at CSU Pueblo, is comprised of representation from the campus Administration and Faculty invested in seeing the ICR be successful. The role of the Steering Committee to being more advisory and ensuring good communication with stakeholders on the CSU Pueblo campus, especially as it pertains to cannabis research on the campus and sponsorship of the Journal of Cannabis Research, the official journal of the ICR.

Community Liasion Board

The ICR Community Liaison Board (CLB), was started in 2018 and is made up of community members from the broader Pueblo area that represent a variety of stakeholder groups including public health and health care, education, law enforcement, and business sectors. This group serves to advise the ICR on the impacts of cannabis in the community, potential areas of research need, as well as perceptions related to the ICR and its activities. The CLB provides a collegial mechanism for information sharing between the ICR and regional stakeholders.

Scientific Research Advisory Board

The Science Research Advisory Board (SRAB) was created to enhance the ICR scientific research effectiveness, timeliness, and to suggest important research directions. Cannabis scientific research represents a dynamic and changing landscape and the SRAB is intended to assist the ICR in identifying and maintaining activities at the cutting edge of cannabis research. Board members provide input to the ICR regarding the direction of scientific cannabis research and possible research areas warranting attention by the ICR. The SRAB provided input on the request for applications for cannabis research funding for the first statewide competition for cannabis research support overseen by the ICR. The SRAB does not operate independently of the ICR or the ICR Director but serves as an advisory body.

UPCOMING CONFERENCE

The 2021 Cannabis Research Conference, renamed with the theme of "Exploring Cannabis Research Frontiers" will be held in August and in a virtual format. For the first time the ICR is partnering with another academic research center, the Global Hemp Innovation Center at Oregon State University in organizing the conference. This marks an important shift to expand the conference scope and national impact. This year the conference will consist of more than 30 session in topical areas ranging from Cannabis, the Brain, and Neurological Diseases to Sustainability. The Keynote addresses will be given by Dr. Daniele Piomelli of the University of California Irvine's Center for the Study of Cannabis and Chair of Neurosciences and Dr. Marilyn Huestis from Thomas Jefferson University's Institute for Emerging Health Professions and formerly with the National Institute on Drug Abuse. In addition to the robust program, the conference will host the first ever virtual exhibit hall featuring many different sponsors such as Cayman Chemical and GENTEC Scientific. For up to date information on the conference, programs and participating sponsors and vendors, please visit the Cannabis Research Conference website

OUTREACH & IMPACTS OF ICR

WEBINARS

Starting in October 2020, the ICR began a monthly webinar series to highlight the Institute and provide a service to cannabis researchers worldwide.

The seminars are held the second Thursday of the month at 1:00 PM MT, except for the month in which the ICR's annual Cannabis Research Conference falls (August 2021).

The webinars have focused on a variety of subjects from newer and more established investigators, new and traditional topics, academic and industrial perspectives, and funding opportunities. In addition, the ICR includes a particular interest in up-and-coming researchers in the State of Colorado, as evidenced by three of the last seven webinars.

To date, the webinars continue to be successful even though researchers in all disciplines have begun complaining about the onslaught of new webinar series in the pandemic era.

July 2021

Human Studies Probing Cannabis Constituents For Pain Relief: Looking Beyond Delta-9-THC

Dr. Ziva Cooper, Director of the UCLA Cannabis Research Initiative in the Jane and Terry Semel Institute for Neuroscience and Human Behavior and Associate Professor in the Department of Psychiatry and Biobehavioral Sciences and Department of Anesthesiology at the David Geffen School of Medicine

June 2021

A Deep Dive into Epidiolex

Dr. Clayton W. Snell, Greenwich Biosciences

May 2021

Academic and Business Perspectives of Compliance in Cannabis Research

Dr. Ajay Nayak, Department of Medicine at Thomas Jefferson University, Philadelphia, PA

Mr. George Hodgin, Biopharmaceutical Research Company, Castroville, CA

April 2021

Cannabinoids and Endocannabinoids in Human Breast Milk

Dr. Cristina Sempio, Department of Anesthesiology, University of Colorado Anschutz Medical Campus, Aurora, CO

March 2021

Phytocannabinoids, Terpenes, And Neuropathic Pain

Dr. Sara Jane Ward, Department of Pharmacology, Lewis Katz School of Medicine, Temple University, Philadelphia, PA

February 2021

Cannabis Impaired Driving and Questions About Tolerance

Dr. Ashley Brooks-Russell, Community and Behavioral Health, Colorado School of Public Health, University of Colorado Anschutz Medical Campus, Aurora, CO

December 2020

Cannabis Derived Products from The University of Mississippi

Dr. Mahmoud A. Elsohly, Marijuana Project at the University of Mississippi, ElSohly Laboratories, Inc., Department of Pharmaceutics, School of Pharmacy, University of Mississippi, Oxford, MS

November 2020

Cannabinoid Research Funding Opportunities at NCCIH

Dr. David Shurtleff, National Center for Complementary and Integrative Health (NCCIH), National Institutes of Health, Bethesda, MD

October 2020

Cannabis Use in Pets - Clinical Trials at Colorado State University

Dr. Stephanie Mcgrath, Department of Neurology/ Neurosurgery, College of Veterinary Medicine and Biomedical Science, Colorado State University, Fort Collins, CO

OUTREACH & IMPACTS OF ICR
CONTINUED

NEWSLETTER

In September the ICR published the first of several bimonthly e-newsletters with the final newsletter of the fiscal year distributed in May 2020. We have received very positive feedback and are considering publishing each month during the next fiscal year. Each newsletter highlights a guest contributor or current researcher in the field of cannabis, whether from CSU Pueblo or elsewhere. News of our annual conference is discussed in each issue, as are our monthly webinars, and articles in the Journal of Cannabis Research. We also introduce and spotlight one member of our Board of Governors in each issue. To read any of our e-newsletter issues please find them at:

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

STATEWIDE COMPETITION FOR CANNABIS RESEARCH FUNDING

Fiscal year 2022 will mark the first ever statewide grant funding initiative by the ICR. House Bill 19-1311 introduced the requirement of the ICR to fund a statewide grants competition. This was facilitated by the ICR staff and a robust and diverse set of scientific reviewers in 2021 with the receipt of 39 proposals in three main topical areas: Biology, Chemistry, Agronomy of Cannabis; Medical and Clinical Research; and Public Health and Social Impact. Awardees will receive grants for up to three years with a maximum of $250k in project funding to be issued beginning July 1, 2021. Please visit the ICR website for a summary of which innovative projects will be among the inaugural statewide ICR funding.

JOURNAL OF CANNABIS RESEARCH

The Journal of Cannabis Research (JCR) began accepting manuscripts in Sept., 2018. Over the past 3 years, the journal has established a solid foundation for future growth. We have a distinguished editorial board comprising 34 distinguished cannabis scientists from 8 countries in North America, Europe, the Middle East and South America. Our comprehensive system of 10 topic sections covers all aspects of cannabis, cannabinoid, and endocannabinoid science, as well as cannabis economics, regulation, and history. JCR is truly an international journal: FY2020 manuscripts were submitted from 21 countries throughout the globe, including North, Central, and South America; Europe; Middle East; Africa; Asia; and Australia and New Zealand. Two-thirds (67.5%) were from North America. In 3 years, JCR has become one of only two international, multi-disciplinary journals in the cannabis field.

A major accomplishment during fiscal year 2020 was inclusion of JCR in PubMed, one of the leadingJCR will be identified by a PubMed search of the relevant topic. Because PubMed can be searched at no charge by anyone, this inclusion greatly enhances the visibility of articles published in JCR. Inclusion in PubMed is a major criterion for authors when deciding on where to submit their manuscripts for publication.

During FY 2020 (July 1, 2020 through May 12, 2021), 123 manuscripts were submitted to JCR. The outcome of editorial review was as follows:

Accepted	*Rejected*	*Withdrawn* by the author before an editorial decision	*Under editorial review*
44 (35.8%)	10 (8.1%)	6 (4.9%)	63 (51.2%)

Our manuscript acceptance rate of 16.7% of manuscripts for which an editorial decision has been reached is comparable to that of many established, high-impact journals that receive a large number of manuscript submissions.

The major challenge for the future is 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
Editor in Chief

DISSEMINATION ACTIVITIES

Annette Gabaldon

Anti-Cancer Potential of Fermented Dietary Hempseed (CANNABIS SATIVA L.) Metabolites and the Role of CB Receptors in Human Colon Cancer Cell CACO2 Viability, Proliferation, and Energy Metabolism

Presentations:

Streff, H., Williams D., Blanton C., and Gabaldón A.M., Effects of Dietary Hempseed on Growth Patterns and Body Composition in Young Female C57BL6 Mice. Institute of Cannabis Research Conference, 2020.

Barbara Brett

An Ongoing Investigation into the Effects of Medicinal Cannabis on Seizures in Adults with Medically Refractory Epilepsy

Presentations:

Brett, B. Cannabinoid Effects on Adults with Medically Refractory Epilepsy: Behavioral Data. Institute of Cannabis Research Conference, 2020.

Brian Vanden Heuvel

Applications of Industrial Hemp

Publications:

Olejar, K.J., Hatfield, J., Arellano, C.J., Gurau, A.T., Seifried, D., Vanden Heuvel, B., Kinney, C.A. (2021) Thermo-chemical conversion of cannabis biomass and extraction by pressurized liquid extraction for the isolation of cannabidiol. *Industrial Crops and Products.*

Ramos, M.F., Boston, D., Kinney, C.A., Coblinski, J.A., de Oliveira Camargo, F.A. (2021). Sourcing *Cannabis sativa* L. by thermogravimetric analysis. *Science and Justice.* 61:401-409.

Olejar, K.J. and Kinney, C.A. (in Review) Evaluation of thermo-chemical conversion temperatures of cannabinoid acids in hemp (Cannabis sativa L.) biomass by pressurized liquid extraction. *Journal of Cannabis Research.*

Presentations:

Rivieros-Gonzalez, A., Bedoya-Valencia, L., Correa-Martinez, Y., Farrer, R. Experimentation on Removal of Heavy Metals from Water by using Single and Combined Filtration Systems with Hemp Based Fibers and Zeolites. Institute of Cannabis Research Conference, 2020.

Mutz, J., Highfill, B., Mendel, G., Farrer, R. Methods of Extraction of Biopolymers from Hemp Biomass and Production of Electrospun Nanofibers from Extracted Materials. Institute of Cannabis Research Conference, 2020.

Mendel, G., Highfill, B., Mutz, J., Farrer, R. Extraction of Cellulose from Hemp Biomass for the Production of Electrospun Nanofibers. Institute of Cannabis Research Conference, 2020.

Mutz, J., Mendel, G., Highfill, B., Farrer, R. The Creation of Electrospun Nanofibers Derived from Lignin and Cellulose Extracted from Hemp Biomass Using Deep Eutectic Solvents. Institute of Cannabis Research Conference, 2020.

Eun-Soo Kim

Formation of cannabinoids in glandular trichomes of *Cannabis*

Publications:

Wonkyun C., and Park S. H., (in press) The thickening and modification process of the galactan- enriched (Gn) layer during primary phloem fibre development in *Cannabis sativa* L. Annals of Botany. https://doi.org/10.1093/aobpla/plab044

Presentations:

Kim, E and Park, S. Protective effects of hemp sunscreen on hairless mouse skin exposed to chronic ultraviolet irradiation. CSU Ventures-Demo Day, 2021.

Kim, E. and Park, S. Inhibitory effects of hemp-fiber-blended toothpaste on the colonization of oral bacteria. CSU Ventures-Demo Day, 2021.

Kim, E., Park, S., Kinney, C.A. Manufacture of green hemp tofu. CSU Ventures-Demo Day, 2021.

Grant Application:

Park S. H., Juyun Cho, Kinney C., and Eun-Soo Kim: Artificial intelligence-assisted identification system of Cannabis varieties by image pattern of epicuticular wax on leaves. USDA, AFRI-FACT, #2020-08857, 2020.

Jeff Smith

Sexually Demorphic Effects of Cannabinoids on Cognitive and Reflexive Learning and Memory-Dependent Neuronal Network Activity in Mouse Hippocampus and Amygdala

Publications:

Montoya, Z.T., Uhernik, A.L., Smith, J.P. (2020). Comparison of cannabidiol to citalopram in targeting fear memory in female mice. *Journal of cannabis research*, 2(1), 48. https://doi.org/10.1186/s42238-020-00055-9.

Presentations:

Smith J.P., Uhernik, A., Montoya, Z.T. Comparison of Cannabidiol and Citalopram in targeting Fear Memory in Female Mice (Poster). Institute of Cannabis Research Conference 2020.

Smith J.P., Uhernik, A., Vigil, J. Hu-211 Sensitive, Cognitive Learning and Memory Processes Modulate Glun2b Surface Expression in the Mouse Brain (Poster). Institute of Cannabis Research Conference 2020.

Karen Yescavage

Cannabis Use Survey Instrument Development and Implementation

Publications:

Gribble L., Yescavage K., Schippers B., Sebring C., Peterson J. B., Kennedy M., and Herburger E. (in review) "No Bogarting!" Sharing the latest research on cannabis use and anxiety, PTSD, and cannabis use disorder. *El Río CSU Pueblo Student Research Journal.*

Laee Choi

Consumer perceptions and behaviors of the CBD products

Publications:

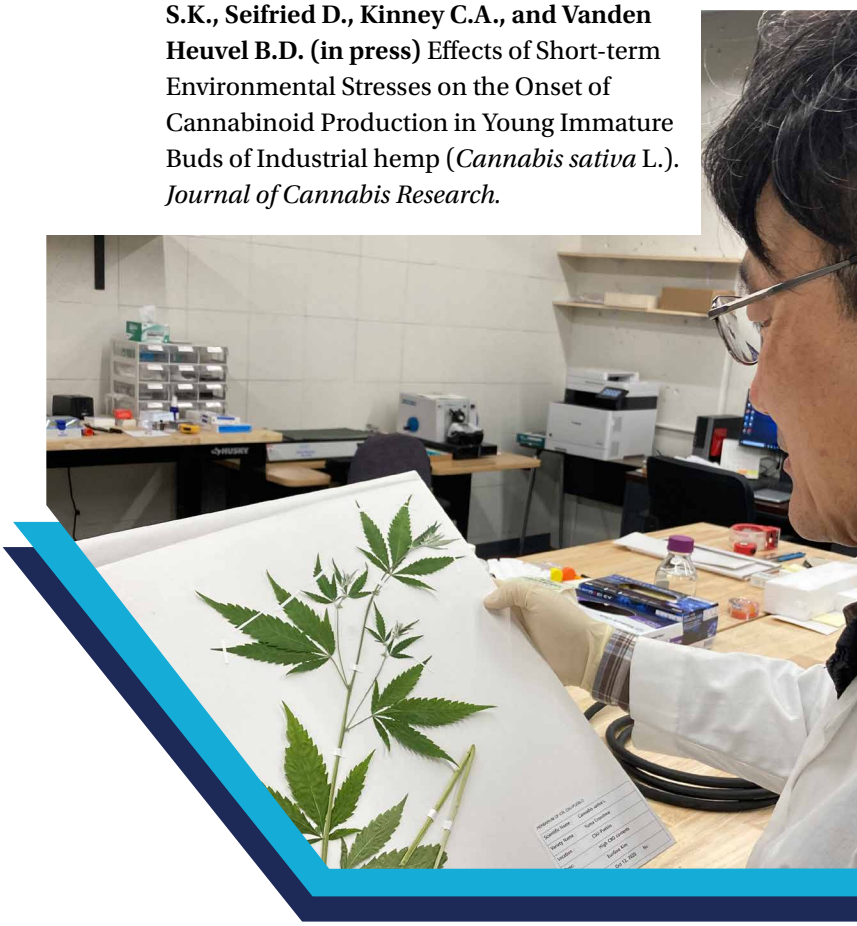
Choi, L.E., Hwang J.Y., Park, S.H. (2021) The Role of External Cues on Consumer Adoption of Cannabidiol (CBD) Products: A Health Belief Model Approach. American Marketing Association) Summer Conference, 2021.

Sang-Hyuck Park

Understanding Genomic Constituents of Cannabis and Genetic Regulation Underlying Cannabinoid Production

Publications:

Park S.H., Pauli C.S., Gostin E.L., Staples, S.K., Seifried D., Kinney C.A., and Vanden Heuvel B.D. (in press) Effects of Short-term Environmental Stresses on the Onset of Cannabinoid Production in Young Immature Buds of Industrial hemp (*Cannabis sativa* L.). *Journal of Cannabis Research.*



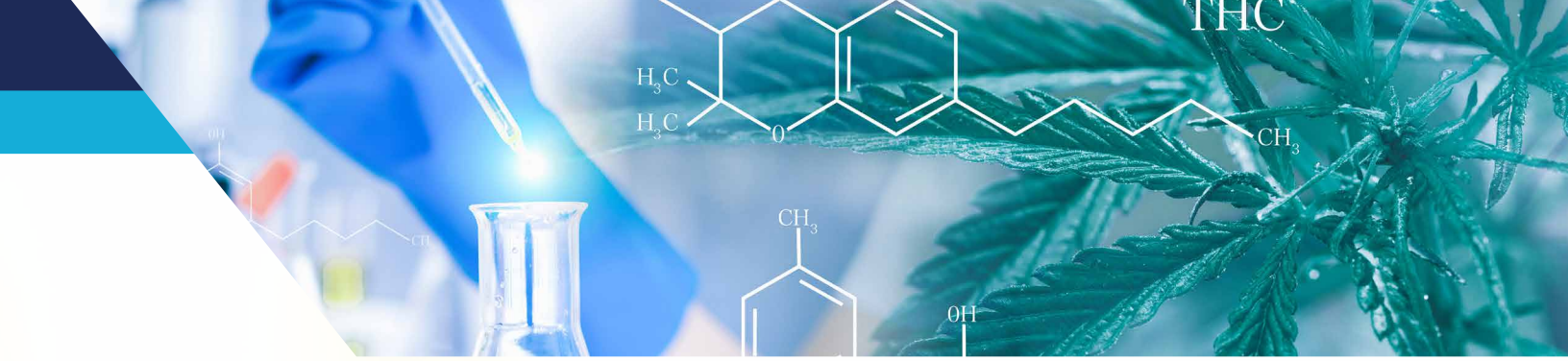
HEAR FROM STUDENTS

Samuel Koch

"I originally wanted to apply to a master's program at a university that provided meaningful research opportunities for students, and the ICR at Colorado State University Pueblo has provided me just that. I am thankful for Dr. Park and the ICR to provide me the opportunity to be a part of their research team. This is a lab where creative ideas can flourish and be put to practice.

Jessica Teller

"The experience has been really interesting! I have never done anything like this before, but it has taught me so much already about hemp and it's benefits. I cannot wait to continue learning and educating others on our findings.

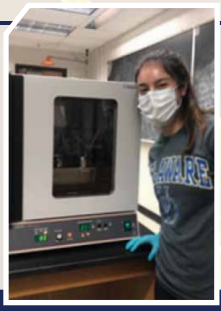


Chandler Sparks

"The opportunity to conduct research has allowed me to learn scientific skills beyond what could be offered in the classroom. I have had the ability to get hands-on experience with equipment, learned how to analyze data, and have been challenged to find information for topics where little information is available. Together, these experiences have given me the skills required to be an innovator in my field.

Trevor Regas

"The Institute of Cannabis Research at Colorado State University Pueblo is undoubtfully an incredibly opportunistic program not only for my own personal journey, but also for the collective efforts that occur on campus through a wide range of disciplines to broaden our current understanding of the Cannabis plant. From cannabis cultivation inside the greenhouse to chemical analysis in the chemistry building – there's no shortage of means to participate in research, enhance your skills and abilities, and have a lot of fun! It's been a sincere pleasure to collaborate with fellow scientists who share similar passions for science and Cannabis research. I'll forever be grateful for the wonderful memories I've made with everyone at CSUP. GO PACK!



Kayana Casias

"As a 3+2 graduate student in the biology program at CSU Pueblo, the ICR grant has allowed me to conduct research with support and resources. The impact that this experience in research has had on me as a student is immeasurable. A few of the invaluable skills that I have obtained over the years of research include critical thinking, problem solving, and troubleshooting. With the ICR grant I have the opportunity to contribute to scientific knowledge as well as develop new innovative techniques, and for that I will be forever grateful.

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