In Vitro Cellular & Developmental Biology - Animal
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Plenary Symposia

PS-1

Applications of and Considerations for CRISPR/Cas9 Mediated Gene Conversion in Rodents. K. L. COOPER, H. A. Grunwald, and A. J. Weitzel. University of California San Diego, Division of Biological Sciences, 9500 Gilman Drive, La Jolla, CA 92093. Email: kcooper@ucsd.edu

Genetic elements that are inherited at super-Mendelian frequencies could be used in a 'gene drive' to spread an allele to high prevalence in a population with the goal of eliminating invasive species or disease vectors. We recently demonstrated that the gene conversion mechanism underlying a CRISPR–Cas9-mediated gene drive is feasible in mice. Although substantial technical hurdles remain, overcoming these could lead to strategies that might decrease the spread of rodent-borne Lyme disease or eliminate invasive populations of mice and rats that devastate island ecology. Perhaps more immediately achievable at moderate gene conversion efficiency, applications in a laboratory setting could produce complex genotypes that reduce the time and cost in both dollars and animal lives compared with Mendelian inheritance strategies. We will discuss what we have learned from early efforts to achieve CRISPR–Cas9-mediated gene conversion, potential for broader applications in the laboratory, current limitations, and plans for optimizing this potentially powerful technology.

PS-2

Chromosome Engineering for Crop Improvement. S. SVITASHEV. Corteva Agriscience, 8305 NW 62nd Avenue, Johnston, IA 50131. Email: sergei.svitashev@corteva.com

CRISPR–Cas is a powerful double-strand-break technology with wide-ranging applications from gene discovery to commercial product development. Thus far, this tool has been almost exclusively used for gene knockouts and gene deletions, with a few examples of specific edits and targeted gene insertions. One of the recent new applications of CRISPR–Cas9 technology is associated with targeted chromosomal rearrangements, including deletions, duplications, inversions and translocations. This approach allows unlocking genetic variations unavailable through conventional plant breeding, thus providing opportunities for the development of new varieties with improved phenotypes. Specific examples of chromosome engineering application will be discussed.

PS-3

CRISPR-Powered Microchips: A Paradigm Shift for Amplification-free DNA Detection. K. ARAN[1,2] and B. Goldsmith[2]. [1]Keck Graduate Institute, 535 Watson Drive, Claremont, CA 91711 and [2]Cardea Bio, 8969 Kenamar Dr Suite 104, San Diego, CA 92121. Email: kiana_aran@kgi.edu

The discovery of CRISPR technology has revolutionized the fields of transcriptional activation and repression, genome editing, gene-based therapeutics, and diagnostics. The applications of this technology have been rapidly expanding as researchers continue to discover new Cas enzymes, engineer high fidelity Cas orthologs, and modify and synthesize guide RNAs to efficiently direct these Cas enzymes to their targets. In this talk, we will introduce the first-generation DNA biosensors that combine CRISPR technology with the ultra-sensitivity of graphene-based field effect transistors (gFETs) to detect target DNA sequences within the whole genome without the need for DNA amplification. This technology, termed CRISPR-Chip™, utilizes the genome searching capability of Cas and reprogrammable RNA molecule to unzip the double-stranded DNA and bind to its target. This binding event causes a change in graphene conductivity which can be detected in real-time within the gFET construct. CRISPR-Chip was utilized to detect target genes within clinical samples obtained from patients with Duchenne Muscular Dystrophy (Cover of Nature BME-2019), and single cell point mutations in Sickle cell disease and ALS without the need for amplification (Nature BME 2021), within less than 30 minutes. The applications of this technology platform go beyond diagnostics. CRISPR-Chip can provide greater insights on the mechanism of CRISPR and can lead to safe and more effective utilization of this gene editing technology for therapeutic applications.

PS-4

Protein Reimagined: Transforming the Global Food System. BRUCE FRIEDRICH. The Good Food Institute, 1380 Monroe St. NW #229, Washington, DC 20010. Email: brucef@gfi.org

Conventional meat production is a significant contributor to some of the world's most pressing problems, including climate change, biodiversity loss, antibiotic resistance, pandemic risk, and unmitigated animal suffering. Yet even in areas of the world where the harms of meat are best understood, meat consumption is as high as it's ever been, and consumption is projected to double worldwide by 2050. Clearly, education about the harms of the meat industry is important, but just as clearly, education will not change the upward trajectory of meat production and consumption. If we can't change the demand for meat, we must change how it is made. We have the technology to cultivate meat directly from animal cells and create it from plants - and dramatically improve efficiency. Compared to conventional meat production, these alternative proteins emit up to 90% fewer greenhouse gases, require up to 95% less land, and they eliminate meat's contribution to antibiotic resistance, pandemic risk, and cruelty to animals. The Good Food Institute is a global network of nonprofit organizations developing the roadmap for a sustainable, secure, and just protein supply. Industry alone will not meet this challenge at the scale or speed we need. GFI is accelerating the transformation of the food system by identifying solutions and mobilizing resources to make alternative proteins the default way meat is made.

PS-5

Plant-based and Cell-cultured Seafood for a More Sustainable Future and Healthier Ocean. BRANDON CHEN. Finless Foods, Inc. Email: brandon@finlessfoods.com

Finless Foods is committed to creating a future where the ocean thrives. Founded in 2017 the company aims to create delicious, healthy, and accessible plant-based and cell-cultured seafood alternatives for all palates and dietary preferences, providing consumers with a range of responsibly produced food products to diversify their daily habits and pave the way toward a more sustainable future and healthier ocean. To ensure our mission is informed by expertise, Finless Foods created a first-of-its-kind Impact Board to serve as an internal brain trust of top ocean and sustainable seafood thought leaders. Currently, the company is gearing up to launch a plant-based tuna into food service nationally. The cell-cultured bluefin tuna product continues to advance toward pilot-scale production while the conversations with regulatory agencies are underway to ensure food safety and transparency to consumers.

PS-6

Leveraging Bioprocessing and Fermentation Technologies for the Generation of Cell-based Milk and Bioactive Ingredients. A. C. SCHNITZLER. TurtleTree Labs. Email: aletta@turtletree.com

As the global population grows, access to protein and nutrition alternatives that are made with lower environmental impact will become paramount. Despite only one third of dietary protein intake coming from meat and dairy products, the vast majority of agricultural land is dedicated to livestock. The emerging field of cellular agriculture aims to create highly accessible food sources that are nutritious, more ethical for animals, and more respectful of our planet. Approaches include a range of cell cultivation processes that utilize bioreactors rather than live animals to make meats and seafood, dairy products and bioactive ingredients. For dairy alternatives, critical to realizing this vision is development of microbial strains that can be leveraged to produce target nutritional ingredients, a deepened understanding of lactation cell biology, and re-envisioning the biomanufacturing process and supply chain. This presentation will review approaches for the generation of raw milk *in vitro*, the value and production of milk bioactives such as lactoferrin and milk oligosaccharides, as well as how the industry is addressing scalability and cost challenges.

PS-7

The Fall of Specialty Monoculture Farming, and the Rise of Cell Cultured Foods. ALAN PERLSTEIN and Tyler Voss. California Cultured, 630 Pena Dr., Ste. 400, Davis, CA 95618. Email: alan@cacultured.com

Monoculture farming has been used to mass produce foods in a reliable, efficient manner for centuries. Unfortunately, many of the inputs that have led to the success of monoculture farming, such as cheap labor, accessible water, and abundant fertilizers are rapidly disappearing. In addition, climate change is creating inhospitable growing conditions affecting the plants, the workers, and the surrounding regions. Cell cultured foods are products made by replicating an immature cell line through multiple passages until they are specialized enough to be grown in large tanks, where they mature and express the organoleptic profile of the desired crop. Although cell cultured food production is in its infancy, it is gaining traction as a potential solution to these issues of inputs and climate. The traditional production of cocoa highlights the challenge of these issues, such as child slavery, deforestation, and an increasingly difficult supply chain. Cell cultured cocoa development is currently underway and can provide some guidance on the difficulties facing scaling up the technology.

PS-8

The State of the Art of Artificial Intelligence in Healthcare. AZIZ NAZHA. Sidney Kimmel Cancer Center, Thomas Jefferson University, 233 S 10th St, Philadelphia, PA.19107. Email: azizn38@yahoo.com

In this Keynote, Dr. Nazha will discuss the basics of machine learning (ML) and how it is applied to healthcare, then he will discuss the various application of AI/ML in healthcare today. Finally, Dr. Nazha will discuss some of the current challenges of the application of AI in clinical practice and ways to overcome them.

PS-9

Transfer Learning in Plant Biology. WILLIAM LINK, Keith Decker, Jeongwoon Kim, Matt Marengo, Jose Juan Tapia, and Christina Taylor. Bayer Crop Science Division, 700 Chesterfield Pkwy W, Chesterfield, MO 63017. Email: william.link@bayer.com

Machine learning and deep learning have been making headlines for years now as these techniques have produced state of the art results in computer vision, natural language processing, and now in biology/protein folding with AlphaFold. But what exactly is deep learning? How can we apply it in plant biology? In this talk I'll give an overview of some work we're doing with machine learning and deep learning at Bayer Crop Science, and suggest transfer learning as a way to get around some of deep learning's limitations, with an example involving retraining Splice AI (Jaganathan, Kishore, et al. "Predicting splicing from primary sequence with deep learning." Cell 176.3 (2019): 535-548) to work in plant systems.

PS-11

Application of Genome Editing to Improve Nutritious, Fresh Produce Crops for the Consumer. RYAN RAPP. Pairwise, 807 East Main Street, Suite 4-100, Durham, NC 27701. Email: rrapp@pairwise.com

Pairwise is committed to bringing consumers more convenient and healthy options in the produce aisle. Our first product, a nutrient dense salad with great flavor, was made by multiplex editing in the allopolyploid *Brassica juncea* and gives consumers an alternative to kale or spinach. This presentation will describe the technical challenges that were overcome to create, characterize, and develop our leafy greens, as well as well as highlights from other crop portfolios at Pairwise.