FOODIE

FOOD INNOVATION AND ENGINEERING CONFERENCE

December 2-4, 2018

Napa, CA • Napa Valley Marriott Hotel & Spa

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TIPS FOR A SUCCESSFUL MEETING

Say **hello** to everyone.
You might make someone's day.

Introduce yourself to people you don't know.
They may be your next good friends.

Stop and **smile**.
You will brighten the room considerably.

Be **understanding**.
Everybody makes mistakes.

Help those with less experience.
We were all novices at some point.

Respect others.
We all have something valuable to contribute.

Value staff and volunteers.
They are here for you.

Be **kind**.
You will never like everybody, but you can be cordial to all.

Enjoy the meeting!
You can have fun while sharing,learning and networking.

Abstracts appear as submitted by their authors. Neither the American Institute of Chemical Engineers (AIChE) and its entities, nor the employers affiliated with the authors or presenting speakers, are responsible for the content of the abstracts.

WELCOME ADDRESS

Greetings!

We are thrilled to welcome you to the inaugural Food Innovation & Engineering Conference (FOODIE), being held at the Napa Valley Marriott Hotel and Spa in Napa, CA on December 2-4, 2018.

Modern consumers want food that is not only safe but also of high quality. They expect food suppliers to satisfy the consumers' personal wants and beliefs, as well as pay attention to ethical issues, sustainability, and more. The food industry needs to evolve to meet these needs. Using innovation and engineering, food producers, as well as restaurateurs and even home chefs, can develop technologies and methods to better satiate consumers. With the growing world population and the increasing demand for safe and healthy food, innovative careers are now available in a variety of sectors, including food processing, bioprocessing, ingredient manufacturing, food packaging, machinery, equipment, instrumentation control, and pharmaceutical, nutraceutical, and health care.

The FOODIE 2018 Conference will focus on the qualities and properties of finished food products, technology and methods for production and processing of food products, and innovative technology emerging topics within food industries.

We are pleased to host many esteemed speakers. There will be keynote addresses from Harold Schmitz (Mars, Incorporated; UC Davis) and Laura Kliman (Impossible Foods) as well as presentations from invited speakers including: Mark Burns, Angela Glassmeyer, Richard Hartel, Kathiravan Krishnamurthy, David Mills, Nicole Rawling, Vijay Singh, Leslie Shor, Bryan Tracy, and Greg Ziegler.

Along with this incredible line-up, FOODIE 2018 will be hosting three panel discussions: Advanced Manufacturing in the Food Industry, Novel Food Processing Technologies, and Engineers in Wine Making.

Please plan to attend our special featured events; it will be a great opportunity to network and collaborate with new peers over their work. Events include: a Cakebread Cellars In Depth Estate Tour And Tasting, a poster reception featuring Impossible™ products, a Wine Tasting during the Engineers in Wine Making Panel, and a Problem Discovery and Advanced Manufacturing in the Food Industry Workshop.

Finally, we would like to thank the Organizing Committee for their integral role in shaping and developing this conference and you for attending the conference. This conference is made possible by the participants and we hope you find your experience enjoyable and enriching.

Sincerely,

David E. Block
Professor and Chair
University of California, Davis

Katherine Gawel
Senior Commercialization Project Lead
Campbell Soup Company

John Kaiser
Senior Lecturer [C B E]
Iowa State University

Nitin Nitin
Professor and Engineer
University of California, Davis

CONFERENCE ORGANIZERS

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Katherine Gawel, *Campbell Soup Company*

John Kaiser, *Iowa State University*

Nitin Nitin, *University of California, Davis*

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Michael Rinker, *Pacific Northwest National Laboratory*

Leslie Shor, *University of Connecticut*

David Weitz, *Harvard University*

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WHITE DOG LABS

Advanced Manufacturing in the Food Industry

Jim Bielenberg, *RAPID*

David Block, *University of California Davis*

Miguel Corcio, *CESMII*

Robin Miles, *Lawrence Livermore National Laboratory*

Michael Rinker, *Pacific Northwest National Laboratory*

Novel Food Processing Technologies

Bala Balasubramaniam, *Ohio State University*

Ragab Khir, *University of California, Davis*

Kathiravan Krishnamurthy, *Illinois Institute of Technology*

Nitin Nitin, *University of California Davis*

Vijay Singh, *GOfermentor*

Engineers in Wine Making Panel Discussion

David Block, *University of California Davis*

Scott Kozel, *E. & J. Gallo Winery*

Steve Peck, *J. Lohr Vineyards and Wines*

Michael Rinker, *Pacific Northwest National Laboratory*

Kerry Shiels, *Cote Bonneville Estate Bottled DuBrul Vineyard*

David Warter, *E. & J. Gallo Winery*

TECHNICAL PROGRAM

Sunday, December 2, 2018	
8:00 AM to 9:00 AM	Registration
8:50 AM to 9:00 AM	Welcoming Remarks
9:00 AM to 10:00 AM	**Advanced Manufacturing in the Food Industry Panel**
10:00 AM to 12:00 PM	**Problem Discovery and Food Advanced Manufacturing Workshop**
12:00 PM to 1:00 PM	Reception/Poster Session
2:00 PM to 5:00 PM	Winery Tour (Ticketed Event)

Monday, December 3, 2018	
8:00 AM to 10:00 AM	Registration
8:50 AM to 9:00 AM	Opening Statement
9:00 AM to 9:45 AM	Food, Health and Sustainability: Innovation Challenges and Opportunities in a Multi-Trillion Dollar Legacy Sector Keynote Speaker: **Harold Schmitz**, *Mars, Incorporated*
9:45 AM to 10:15 AM	Inactivation of Listeria monocytogenes in liquids using a novel pulsed light system Invited Speaker: **Kathiravan Krishnamurthy**, *Illinois Institute of Technology*
10:15 AM to 10:30 AM	Protecting Innovation: The Many Flavors of Intellectual Property **Jeffrey D. Smyth and Jessica L.A. Marks**, *Finnegan, Henderson, Farabow, Garrett & Dunner, LLP*
10:30 AM to 11:00 AM	Break
11:00 AM to 11:30 AM	Milk oligosaccharides and their role in neonatal health: Lessons for tailored synbiotics Invited Speaker: **David Mills**, *University of California, Davis*
11:30 AM to 11:45 AM	Multiscale Design of a Dairy Beverage Product, By Partial Substitution of MILK for *Candida Utilis* Aqueous Extract and Subsequent Supplementation with Oleic Acid **Andres Gonzalez Barrios,** *Universidad de los Andes*
11:45 AM to 12:00 PM	Enzymatic Hydrolysis of Whey Proteins for Obtaining Antioxidant Peptide Fractions **Andres Gonzalez Barrios**, *Universidad de los Andes*
12:00 PM to 1:00 PM	**Novel Food Processing Technologies Panel**
1:00 PM to 2:30 PM	Lunch
2:30 PM to 3:00 PM	Innovations in Natural Food Colors Invited Speaker: **Greg Ziegler**, *Pennsylvania State University*
3:00 PM to 3:30 PM	Single-Cell Protein and Specifically ProTyton^{TM} - An Advanced Nutrition Protein Ingredient Platform for Animals and Humans Invited Speaker: **Bryan Tracy,** *White Dog Labs*
3:30 PM to 3:45 PM	The New Normal: Beneficial Reuse of Food and Beverage Waste to Energy **Colin Moy**, *East Bay Municipal Utility District*
3:45 PM to 4:00 PM	Renewable Activated Carbons from Food Waste **Julia A. Valla**, *University of Connecticut*

4:00 PM to 4:15 PM	Demonstrating the Potential for on-Site Electricity Generation from Food Waste Using Containerized Anaerobic Digestion Units **Sara A. Pace**, *University of California, Davis*
4:15 PM to 4:45 PM	Break
4:45 PM to 5:00 PM	Effects of PEF Treatment on Physicochemical Properties and Retrogradation Behaviors of Glutinous Rice Grain and Its Starch **Shuang Qiu**, *Cornell University*
5:00 PM to 5:15 PM	Is Steam an Important Component of Your Recipe? **Neil Davies**, *Spirax Sarco*
5:15 PM to 5:30 PM	How Changing Recipes without Considering Processing Equipment Can Wreak Havoc in the Final Product **Carrie Hartford**, *Jenike & Johanson, Inc.*
5:30 PM to 5:45 PM	High Intensity Production of a Natural Sweetener Protein in Continuous Perfusion Bioreactor Cultures of Recombinant Yeast Cells **Dhinakar Kompala**, *Sudhin Biopharma Co*

Tuesday, December 4, 2018	
8:00 AM to 10:00 AM	Registration
9:00 AM to 9:15 AM	Opening Statement
9:15 AM to 10:00 AM	The Future of Food: Doing the Impossible Keynote Speaker: **Laura Kliman**, *Impossible Foods*
10:00 AM to 10:30 AM	Regulating Clean Meat: Current Status and Next Steps Invited Speaker: **Nicole Rawling**, *The Good Food Institute*
10:30 AM to 10:45 AM	Power of Mung Bean Protein: Functional Properties, Application in Egg-Free Products and Sustainability Impact **Meng Li**, *JUST Inc.*
10:45 AM to 11:00 AM	Techno-Economic Analysis of a Plant-Based Platform for Manufacturing Antimicrobial Proteins for Food Safety **Matthew McNulty**, *University of California, Davis*
11:00 AM to 11:15 AM	Green Renewable Sustainable Antibacterial Food Grease to Ensure Consumer Safety **Guerry Grune**, *Duke University*
11:15 AM to 11:45 AM	Break
11:45 AM to 12:15 PM	Tasty Ice Cream: Structures, Rheology and Sensory Invited Speaker: **Richard Hartel**, *University of Wisconsin-Madison*
12:15 PM to 12:45 PM	Making Sense of Consumer Trends: Disruption and Contradiction Invited Speaker: **Angela Glassmeyer**, *Mane SA*
12:45 PM to 2:15 PM	Lunch
2:15 PM to 2:45 PM	Food and Microfluidics: Control, Sensing, and Chemical Analysis Invited Speaker: **Mark Burns**, *University of Michigan*
2:45 PM to 3:15 PM	Soil-based Biotechnology for More Sustainable Agriculture Invited Speaker: **Leslie Shor**, *University of Connecticut*
3:15 PM to 3:30 PM	Soil Moisture Retention Promotion Via Microbes Activities **Yi-Syuan Guo**, *University of Connecticut*

3:30 PM to 4:00 PM	A Chemical Engineer Reimagines Winemaking Invited Speaker: **Vijay Singh**, *GOfermentor*
4:00 PM to 4:15 PM	Creation and Predictions of a Reactor Engineering Model for Red Wine Fermentations **Konrad Miller**, *University of California, Davis*
4:15 PM to 4:45 PM	Break
4:45 PM to 6:15 PM	**Engineers in Wine Making Panel**
6:15 PM to 6:30 PM	Closing Remarks

POSTER TITLES

1. **Investigating the Kinetics of Continuous Beer Fermentation.**
Nadine Koen*, Renee Butler, and Michael Heying*
Chemistry & Biochemistry, California Polytechnic State University, San Luis Obispo, CA

2. **Sustainable Enzymes Synthesis By Anaerobic Digestion of Cassava Residue.**
Sammy Aso
Brookings, SD

3. **Using a Genome-Scale Metabolic Model for S. Cerevisiae to Facilitate Understanding of the Differences in Metabolism between Commercial Wine Yeast Strains.**
Ardic O. Arikal[1]*, William T. Scott Jr.*[1]*, Ayca Ozcan*[2]*, and David E. Block*[1]
(1)Department of Chemical Engineering and Material Science, University of California, Davis, Davis, CA, (2)Department of Viticulture and Enology, University of California, Davis, Davis, CA

4. **Sprout production using a novel kinetic hydroponics system.**
Kathiravan Krishnamurthy[1]*, Mehdi Azozoma*[1]*, Beatriz Dos Santos*[1]*, Michael Leyden*[1]*, and Fouad Teymour*[2]
(1)Illinois Institute of Technology, Bedford Park, IL, (2)Chemical and Biological Engineering, Illinois Institute of Technology, Chicago, IL

5. **An Interdisciplinary Research Experience for Undergraduates in Food Safety, Food Engineering, and Nutrition.**
Kathiravan Krishnamurthy
Illinois Institute of Technology, Bedford Park, IL

Keynote Speakers Biographies

Laura Kliman

Impossible Foods

Laura is a Senior Flavor Scientist at Impossible Foods, creating delicious plant-based meats through a deep understanding of chemistry and food. Her research involves understanding flavor generation using plant-based ingredients, focusing on minimizing off-flavors by identification of undesirable precursors and flavor reaction pathways. She also studies how various matrices affect flavor chemistry, release, and perception in order to develop improved flavor systems and products.

Laura received her Ph.D. in Organic Chemistry from Boston College and her bachelor's degree in Chemistry with a minor in Environmental Science from Boston University. In addition to her academic research, she also has a variety of publications and patents from her work in the pharmaceutical and biofuel industries. Her dedication to environmental sustainability started at a young age and inspired her work with the Sierra Club and MASSPIRG on clear air and water campaigns. Her love of science education led her to volunteer with Citizen Schools and Beyond Benign teaching green chemistry to K-12 students. At Impossible Foods, she combines her background in chemistry with her love of food and sustainability to move towards the mission of saving meat and the earth.

Harold H. Schmitz

Mars, Incorporated (Retired); University of California, Davis

Harold is a Senior Scholar in the Graduate School of Management at the University of California, Davis. Harold recently retired as Chief Science Officer for Mars, Incorporated and Director of the Mars Advanced Research Institute following 25 years with the company. During his career in Mars, Harold held positions within the company in Scientific and Regulatory Affairs, Fundamental Research, Analytical and Applied Sciences, Corporate Innovation and Corporate Staff. Prior to joining Mars in 1993, he was a U.S. Department of Agriculture National Needs Research Fellow at North Carolina State University's Department of Food Science. He received his Master of Science degree in Food Science from the University of Illinois and his Doctoral degree in Food Science, with a minor in organic chemistry, from North Carolina State University. He received his undergraduate degree from the University of Arkansas in 1987, and in 2011 was honored as Outstanding Alumnus of the Dale Bumpers College of Agriculture, Food and Life Sciences. During 2014 – 17, Harold served as the Art and Carlyse Ciocca Visiting Professor of Entrepreneurship and Innovation at the Graduate School of Management at UC Davis.

Harold has authored and co-authored many peer-reviewed articles and book chapters, given numerous invited presentations, organized and/or chaired scientific meetings and is a co-inventor on several granted patents, with emphasis on exploring the relationship between vascular biology and dietary constituents, and generally the metabolism and function of dietary components in modulating human health. His focus on multi-disciplinary and multi-sectoral collaborations formed the basis of his interactions with the Executive Committee of the National Academy of Sciences Government-University-Industry Research Roundtable during 2003 – 2013, and he was an active member of the National Research Advisory Board at Washington University in St Louis during 2007 – 15. Harold has led the Mars partnership in the annual meetings of the Lindau Nobel Foundation since 2007, and since 2017 with the Heidelberg Laureate Foundation associated with the Turing Award, Abel and Nevanlinna Prizes, and Fields Medal.

In 2018, Harold was elected as a lifetime member in the Council on Foreign Relations, reflecting his current focus on food, health and agriculture and the urgent need for collaboration and innovation to improve global health and environmental sustainability.

Invited Speaker Biographies

Mark Burns

University of Michigan

Prof. Mark A. Burns is the Executive Director of Mcubed and Research Innovation in the Office of the Vice President for Research, the T. C. Chang Professor of Engineering, and a Professor in both Chemical Engineering and Biomedical Engineering at the University of Michigan. He joined the University of Michigan in 1990 after teaching at the University of Massachusetts for 4 years. He obtained his MS and PhD degrees in Chemical and Biochemical Engineering from the University of Pennsylvania, and his BS degree from the University of Notre Dame.

Prof. Burns has over 300 publications, patents, and presentations. He is a Fellow of the American Institute for Medical and Biological Engineering and a Fellow of the National Academy of Inventors. He has won numerous awards including the Food, Pharmaceutical, and Bioengineering Division Award from AIChE. Prof. Burns is also the Executive Director of the innovative seed-funding program at Michigan called Mcubed, a program that has generated over $100M of external research funding.

Angela Glassmeyer

MANE, Inc.

As a Marketing Manager at MANE, Inc., Angela researches and presents on consumer trends and flavors for multiple categories, including snacks, bakery, confection, culinary, oral care, and pharma. She has also served as an Executive Board Member of the Ohio Valley Institute of Food Technologists since 2016.

Richard Hartel

University of Wisconsin-Madison

Dr. Hartel has been teaching Food Engineering at the University of Wisconsin-Madison for over 30 years and conducting research on a variety of projects related to phase transitions in foods.

Research

The primary area of research encompasses food engineering with a particular emphasis on phase transitions in foods. Crystallization and glass transitions play an important role in determining textural and physical properties of many food products. Understanding these phase transitions is critical to proper design, development, and control of many food processes. In particular, our research group studies crystallization of ice (freeze concentration, recrystallization in frozen desserts), sugars (refining, confectionery applications) and lipids (milk fat fractionation, mixed lipid crystallization in chocolates and confections) as well as glass transition events of importance to stability and shelf life of foods. This work involves the fundamental understanding of the physical chemistry of these phase transitions, kinetics, and applications of this understanding to real products. In general, we apply these principles to food products like ice cream, confections, chocolate and compound coatings, and dairy products.

Kathiravan Krishnamurthy

Illinois Institute of Technology

Kathiravan is an assistant professor of food science and nutrition at the Illinois Institute of technology. Kathiravan has experience in nonthermal food processes, pulsed light processing and modeling and simulation.

Research

Dr. Krishnamurthy's research focus includes but not limited to applications of novel food processing technologies (high-pressure processing, ultrasound, cold plasma, microwave heating, UV-light, and pulsed light processing) for sterilization, pasteurization, and/or value addition; heat transfer; modeling/simulation.

David A. Mills

University of California, Davis

David Mills is a Professor in the Departments of Food Science & Technology and Viticulture & Enology at the University of California at Davis. Dr. Mills studies the molecular biology and ecology of bacteria that play an active role in gut health or fermented foods and beverages. In the last 20 years Dr. Mills has mentored over 30 graduate students and postdocs and published more than 180 papers, including seminal work on lactic acid bacterial and bifidobacterial genomics. At UC Davis, Dr. Mills has worked to define, investigate and translate the beneficial aspects of human milk and its role in human health. Dr. Mills has previously served as a Distinguished Lecturer for the American Society for Microbiology and currently serves as an editor for the journal mSystems. In 2012 he was named the Peter J. Shields Chair in Dairy Food Science and in 2015 he was elected a Fellow in the American Academy of Microbiology. Dr. Mills also serves on the Advisory Boards of several food and health-focused companies and his research has helped launch two startup companies.

Nicole Rawling

The Good Food Institute

Nicole is the Director of International Engagement at The Good Food Institute. In that role, she works with governments, scientists, companies, investors, entrepreneurs, and nonprofits worldwide to support the development of plant-based and clean meat. Nicole has a B.S. in international affairs from Georgetown School of Foreign Service and a law degree from Northwestern University School of Law. She spent eight years at an international law firm advising Fortune 500 companies and executives in internal investigations and securities issues. Before joining The Good Food Institute team, she also worked with animal protection nonprofits in both litigation and governance.

Vijay Singh

GOfermentor

Schering-Plough 1982 – 1999 – responsible for Development and manufacturing of biopharmaceuticals, including one of the first recombinant DNA drugs – interferon.

In 1996, developed a novel way of culturing cells in disposable bags. Left Schering-Plough in 1999 to found Wave Biotech to manufacture and market this device known as the Wave Bioreactor. This became very popular world-wide for R&D and manufacture of vaccines, antibodies, viruses …

Sold Wave Biotech in 2007 to do “other” things. In 2013, Started to apply chemical engineering and disposable technology to process of wine making. This resulted in a novel device that makes winemaking easy, requires almost no water, minimal labor and little investment. In 2014 set up a commercial winery – Sky Acres Winery to test and develop the winemaking machine now named the GOfermentor. This winery has won numerous awards over the last 3 years. In 2017 started the commercial manufacture and sale of the GOfermentor. The latest project is to develop a home version of the GOfermentor.

Dr Singh has over 20 patents in diverse fields ranging from wine making, biotechnology, gunsights, hydroponics and mixing.

Leslie Shor
University of Connecticut
Leslie Shor leads the Engineered Microhabitats research group at the University of Connecticut where she mentors students from across the bio, chemical, and environmental sciences and engineering fields. The Shor lab designs, builds, and employs engineered microhabitats to answer fundamental questions related to sustainable agriculture biotechnology. Current funding to her lab includes federal awards from the US Departments of Energy, Agriculture, and the National Science Foundation. Professor Shor has also received support from private industry, and was named a DuPont Young Professor. Leslie earned a BA in environmental sciences from the University of Virginia and a Ph.D. in chemical engineering from Rutgers University.

Bryan Tracy
White Dog Labs
Bryan Tracy, PhD, is the CEO and co-founder of White Dog Labs, Inc. (WDL) Previously he was CEO and co-founder of Elcriton, which was acquired in 2014. WDL is inventing and commercializing biochemical technologies to produce renewable chemicals and fuels through novel technologies that simultaneously consume carbohydrate and gaseous feedstocks in fermentation. WDL is particularly focused on bio-acetone, -isopropanol and –ethanol production. Bryan is an expert in genetic engineering of bacteria and fermentation process development with many peer-reviewed academic publications. He is also a supplemental faculty member at the University of Delaware, a technology to market consultant for the ARPA-E, founding member of the ACS GCI Biochemical Technology Leadership Roundtable, and board chair of the Delaware Sustainable Chemistry Alliance. Bryan is also passionate about public service and youth development, whereby he serves as board chair of the Forum for the Advancement of Minorities in Engineering (FAME), is an inaugural mentor in the Delaware Youth Leadership Network and is a Leadership Delaware fellow. Bryan received a BS in Chemical and Biomolecular Engineering from North Carolina State University, during which time he worked for Novozymes N/A, and a PhD from Northwestern University.

Gregory Ziegler
Pennsylvania State University
Greg Ziegler is professor of food science at Penn State University where for 29 years he has taught and conducted research on food process engineering. He earned his Ph.D. from Cornell University, a Master's of Science degree from Clemson University and his Bachelor's degree from Penn State. He was formerly employed by H.J. Heinz as a food technologist responsible for product and process development, and has consulted for the food and pharmaceutical industries. He is co-founder of Persea Naturals LLC and Fellow of IFT.

Research
Foods as composite materials. Physical properties and processing of polymeric and particulate foods, with an emphasis on chocolate and confectionery products. Supported by the William and Lois Dietrich Endowment in Food Bioprocessing to support the Food Characterization Laboratory. Faculty affiliate of the Intercollege Graduate Program in Materials (Materials Research Institute).

Panelist Biographies

V.M. (Bala) Balasubramaniam
Ohio State University
V.M. (Bala) Balasubramaniam, is a Professor of Food Engineering at The Ohio State University (OSU), Columbus, OH. Bala received B.S. in Agricultural Engineering at Tamil Nadu Agricultural University, India, M.S. in Post-harvest Technology from Asian Institute of Technology, Thailand and PhD in Food Engineering from The Ohio State University.

Prior joining OSU as a faculty member in 2002, Dr. Bala was working as a post-doctoral associate at University of Georgia Center for Food Safety and Quality Enhancement, Griffin, GA (1994-95) and Associate Research Professor at IIT National Center for Food Safety and Technology, Chicago, IL (1995-2002).

Dr. Bala's research focus has been on food process design, development and validation of various thermal and nonthermal based clean food manufacturing technologies that satisfy consumer demand for minimally processed foods with health promoting nutrients preserved. Particularly recent laboratory effort focuses on various innovative applications of high pressure based ultra shear technologies for the preservation of food and beverages.

Prof. Bala's team published more than one-hundred and five scientific research papers, twenty book chapters, four food processors factsheets and over one hundred seventy technical and invited presentations. Dr. Bala co-edited two books on high pressure processing and nonthermal processing.

Dr. Bala teaches Unit Operations in Food Process Engineering to undergraduate and graduate students pursuing Food Science and Technology and Food Ag Bio Engineering degree programs. Dr. Bala also contributes various technology transfers and education to food manufactures via short courses, webinars, workshops and pilot plant demonstrations.

Dr. Bala is a Fellow of Institute of Food Technologists (IFT) and International Union of Food Science and Technology (IUFoST). He is also recipient of 2018 College of Food Ag Env Science Innovator of the year award, 2017 IFT Calvert L Willey Distinguished Service Award, 2016 AITAA distinguished alumni award for academic and research excellence, 2011 OARDC faculty research award, and 2006 Hormel Sprit in Innovation. He serves in the editorial board of various food engineering related journals and serves as the Editor-in-Chief for Wiley's Journal of Food Process Engineering.

Jim Bielenberg
RAPID Manufacturing Institute
Jim Bielenberg, PhD, is the Chief Technology Officer of the Rapid Advancement in Process Intensification Deployment (RAPID) Manufacturing Institute. He has spent the last 15 years working in various areas of new technology development, including 12 years working at ExxonMobil.

He is a co-inventor on over a dozen technology patents across chemicals technology, refining technology, coal gasification, and biofuels processing. He received his BS from the Univ. of Nebraska and a PhD from the Massachusetts Institute of Technology (MIT), both in chemical engineering. He is a member of AIChE.

David E. Block
Pennsylvania State University
Since joining the Chemical Engineering faculty in 1996, Professor Block's research has been focused on technology for wine fermentations and biopharmaceutical fermentation optimization based on historical process data and artificial intelligence. More recently, his work has included applications to biofuel production including the study of increased alcohol tolerance in microorganisms and of bio-based fuels.

Dr. Block teaches Biotech Facility Design and Regulatory Compliance in the Department of Chemical Engineering and Materials Science and Wine Technology and Winery Systems and Advances in the Science of Winemaking in the Department of Viticulture and Enology.

Before joining UC Davis, he worked in the Biopharmaceuticals Department at Hoffmann-La Roche in Nutley, New Jersey, from 1991-1996. At Roche, Block was in charge of a fermentation process development group and also a team leader for control systems in new manufacturing facilities. In the latter capacity, he helped to design, build, validate and maintain multiple new facilities.

Block holds a B.S.E. and Ph.D. in chemical engineering from the University of Pennsylvania and the University of Minnesota, respectively.

Miguel Corcio
CESMII
Miguel has over 30 years of experience as a technical leader in industrial automation, electricity, manufacturing execution systems and related engineering activities in manufacturing. His comprehensive technical experience includes functional leadership and guidance, capital investment planning & execution, compliance, building engineering capabilities, that also includes operational support. He also has extensive knowledge on standardization, continuous improvements, operation innovations, technology evaluation and deployment of IoT platforms and solutions for the manufacturing industry. His expertise in the manufacturing industry allows him to work with manufacturing facilities to achieve high performance targets, flexibility, cost improvements, and substantial energy consumption reductions that improve the overall manufacturing performance. Currently, as the Director of Technical Projects at CESMII (Clean Energy Smart Manufacturing Innovation Institute), Miguel is leading the development and execution of a comprehensive strategic evaluation plan that involves a technical investigation of areas and test beds in Smart Manufacturing, MES systems, and large-scale deployment to improve precision, performance, efficiency and growth of U.S. manufacturing.

Ragab Khir
Suez Canal University; University of California, Davis
Dr. Ragab Khir is an Associate Professor of Food Engineering, Department of Agricultural Engineering, Faculty of Agriculture, Suez Canal University, Ismailia, Egypt, and Project Scientist at Department of Biological and Agricultural Engineering, University of California, Davis, USA.

Dr. Khir research interests are focusing on developing infrared radiation (IR) heating technologies for food processing that has promising merits including improved product quality and safety, increasing energy and processing efficiency, and reducing water and chemical usage, improving consistency and accuracy of rice milling appraisals, and characterizing properties of food products. He has led research to demonstrate and commercialize the newly developed IR food processing technologies for improved food healthfulness, quality, and safety while saving energy and water during food processing.

Dr. Khir has authored and co-authored more than 140 publications, including books, book chapters, technical reports, proceeding papers and posters, and peer-reviewed articles published and cited in internationally recognized and peer-reviewed journals. He has presented his achievements as a plenary session speaker at many international conferences and as invited speakers at many occasions. He has made significant contribution in the research and development of new food and agricultural processing and postharvest technologies for producing nutritious, healthy and safe foods. He has received the Technology Transfer Award in 2017 from Federal Laboratory Consortium for his outstanding commercialization success in developing and commercial implementation of new infrared heating technologies. He also received 2018 Research and Development Award from IFT for his outstanding contributions to the profession and accomplishments to advance food science and the food industry. Dr. Khir is a member of American Society of Agricultural and Biological Engineers (ASABE), Institute of Food Technologists (IFT), International Commission of Agricultural Engineers (CIGR), and Egyptian Society of Agricultural Engineering.

Robin Miles

Lawrence Livermore National Laboratory

Robin Miles is the Interim Director for the HPC4Manfacturing and HPC4Materials programs. These programs are funded by the DOE Energy Offices and establish sophisticated modeling and simulation projects between national laboratory principal investigators with High Performance Computing expertise and industrial partners to reduce industrial energy use and to increase the competitiveness of US manufactures. Approximately 70 projects have been funded to date with participation from 9 national laboratories.

Robin earned a B.S. in mechanical engineering from the Massachusetts Institute of Technology, a M.S. in mechanical engineering from Stanford University, and a M.B.A. from the University of California at Berkeley. Robin started working at Lawrence Livermore National Laboratory (LLNL) after working at several Silicon Valley start-up companies such as Redwood Microsystems and K2 Optronics where she led product development teams. At LLNL Robin developed micro-fluidic-based instrumentation for the chemical and biological detection programs. She was also involved in building targets for fusion experiments and led the team working on target manufacture and delivery for concept fusion electric plants. Robin is currently a Deputy Division Leader within the LLNL Engineering directorate and was formerly the Project Manager for the HPC4Mfg/Mtls program. She is the author of several patents and publications.

Nitin Nitin

University of California, Davis

Dr. Nitin is interested in using a combination of interdisciplinary approaches encompassing biomolecular engineering, mathematical modeling, material science and molecular imaging to study the following key research areas.

Research

The research interests of the laboratory can be broadly classified into two main categories:

(a) Food Engineering Research: The goal of this research plan is to develop technologies for addressing key issues in areas of food safety and food for health initiatives (e.g. development and validation of non-thermal food processing operations for food safety;

engineering of food formulations to improve the bioavailability of nutraceuticals). These projects will provide students with skills in areas of molecular imaging, spectroscopy, mathematical modeling, molecular biology, microbiology and material science with a strong foundation in food engineering.

(b) Biological/Biomedical Engineering Research: The goal of this research is to develop molecular imaging technologies from a single cell level to a whole body imaging. These imaging technologies will enable early stage detection of diseases, novel delivery vehicles for therapeutic applications and quantification of molecular processes for a fundamental understanding of pathophysiology. These projects will provide students with skills in areas of molecular imaging, mathematical modeling, molecular biology and material science with a strong foundation in bioengineering.

Steve Peck

J. Lohr Vineyards & Wine

As the director of winemaking for J. Lohr Vineyards & Wines, Steve Peck combines a gifted palate, a passion for viticulture and a comprehensive technical knowledge of winemaking practices.

Born and raised in California, Steve began cultivating his love of viticulture and winemaking as a teenager while traveling to vineyards and working alongside his uncle. A dedicated home winemaker, Steve's uncle taught him the importance of hands-on attention to detail at every step of the winemaking process. This early exposure to vineyards and winemaking inspired Steve to enroll at the University of California, Davis. While studying chemical engineering and fermentation sciences, Steve put himself through school as part of the team at Joseph Phelps Vineyards. This three-year experience augmented Steve's academic studies with a practical understanding of premium Napa Valley winemaking methods.

After earning his degree, Steve pursued opportunities in the biotech industry, working for Merck and Co. and Genencor International. Throughout this period, Steve remained dedicated to the art of winemaking, crafting his own red wines nearly every vintage, including several Cabernet Sauvignons made from Paso Robles grapes. Eager to return to a career in winemaking, Steve joined Five Rivers Winery as winemaker in 2001. In addition to his role as winemaker for Five Rivers, Steve was also responsible for producing the red wines for Jekel Vineyards beginning with the 2004 vintage. In these capacities, Steve had the opportunity to work with an extensive array of vineyards in Monterey County, Paso Robles and Santa Barbara County, and was responsible for orchestrating harvest scheduling for dozens of growers. During this period, Steve consistently earned acclaim for his red wines.

In 2007, Steve was appointed winemaker for the full portfolio of J. Lohr red wines including J. Lohr Estates, the J. Lohr Vineyard Series,

J. Lohr Gesture and the J. Lohr Cuvée Series, as well as red wines for Cypress Vineyards and Crosspoint. In 2018, Steve was promoted to director of winemaking for all J. Lohr wines. Working with President and COO Jeff Meier, Steve strives to maintain the flavorful character of each wine by focusing on the natural characteristics embodied in J. Lohr's estate vineyards. "Steve is inquisitive and intuitive," says Jeff," which are fundamental qualities in a superior winemaker. On top of that, he's a genuinely personable leader with a great technical mind and a real passion for winemaking."

Michael Rinker

Pacific Northwest National Laboratory

Mr. Rinker is the Manager of the Energy Efficiency and Renewable Energy market sector within Pacific Northwest National Laboratory's Energy and Environment Directorate. In this role, he is responsible for development and execution of EED's strategy in buildings and Federal Energy Management Programs; biomass technologies; vehicle technologies, fuel cell technologies, and advanced manufacturing; and renewable energy. Mr. Rinker's prior roles include serving as the technical group manager for Engineering Mechanics and Structural Materials, consisting of more than 60 staff, as well as relationship manager to the DOE Office of Energy Efficiency and Renewable Energy's fuel cell technologies and advanced manufacturing programs. Additionally, he served as the project manager for the Micro Combined Heat and Power Fuel Cell Deployment project. His expertise extends to environmental cleanup, in the areas of underground storage tank structural integrity and remote systems for waste cleanup. Mr. Rinker holds a bachelor's degree in Civil Engineering and a master's degree in Applied Mechanics, both from the University of Wyoming.

Kerry Shiels

Côte Bonneville

Kerry is the winemaker for Côte Bonneville. She began making wine in middle and high school in a series of science projects. After earning her engineering degree from Northwestern University in Chicago, she worked in Torino, Italy in Fiat's management development program. She was then transferred to Case New Holland (CNH) world headquarters in Chicago before deciding to enter the world of wine.

Kerry received her master's degree in Viticulture and Enology from UC Davis, and then assumed the winemaker title in August 2009. She has been immersed in DuBrul Vineyard and Côte Bonneville since the inception, but especially since 2005, when she left engineering.

Kerry gained experience in Napa, California, Argentina, and Australia. She has worked in all aspects of winemaking at Joseph Phelps Vineyards, Folio Fine Wine Partners, Robert Mondavi Winery, Tahbilk, and Tapiz, before returning to Côte Bonneville full time.

David Warter

Master Distiller, E & J Distillers

David Warter graduated from Stanford University with a Chemical Engineering degree in 1998. After a season of professional rugby, David joined the E&J Gallo Winery in 1999 as a sales representative in Gallo’s technical management development program. In 2001, he moved to Modesto to become a process engineer for Gallo. In 2002, he returned to school where he earned both an MS in Viticulture and Enology and an MBA from the University of California, Davis in 2004. David then started with Gallo’s winemaking team after graduation. From 2010 through 2012, David managed Gallo’s finance team responsible for Wine and Grape Supply. He joined Gallo’s distillation team in 2012.

David has traveled around the US, Mexico and the Caribbean to make vodka, gin, tequila, rum and whiskey. His team manages three different distilleries in California which primarily focus on brandy. David has an appreciation for spirits across the price spectrum making products ranging from $10-$500 per bottle.

Monday, December 3, 2018

Food, Health and Sustainability: Innovation Challenges and Opportunities in a Multi-Trillion Dollar Legacy Sector.

Harold Schmitz
Mars, Inc., Davis, CA

Food, health and sustainability are linked in a way that profoundly impacts every person on Earth. This impact extends to personal, national, regional and global economics as the food industry comprises a value chain comprising trillions of dollars (USD) globally. Owing to the essential importance of food for human survival, the food industry is one of the oldest industries and has undergone several transformations throughout history. During the past 150 years, the food sector has leveraged a wide array of advances in science, technology, marketing, distribution, operations, finance and policy to become industrialized and interconnected at a global scale that can be difficult to fully 'grok'. Within this global business milieu, innovation, in the sense of new products and services entering the market, is an industry constant. However, innovation that can be clearly classified as transformational at global scale is more rare and dynamic in its appearance rate over time. Currently, it can be argued that the state of the global food sector in terms of innovation dynamism is defined, and constrained, by an ecosystem of legacy companies, universities and government institutions that are juxtaposed with a change mandate imposed by global market forces driven by increasing consumer and government interests in both health and sustainability. This tension reveals a clear opportunity for transformative innovation and disruption of the status quo by industry incumbents and/or insurgents. The innovation landscape is a highly complex ecosystem of individuals, companies, private equity firms, venture capitalists, universities, foundations, government institutions, and NGO's, each of which differs culturally by nation and region. The purpose of this presentation is to highlight challenges and opportunities regarding transformative innovation in the global food sector, with the hope that better understanding these will enable development of more effective strategies by those who wish to participate in this historical moment.

Inactivation of *Listeria monocytogenes* in liquids using a novel pulsed light system.

Kathiravan Krishnamurthy, *Huixing Wang, Sargun Malik, Hanman Chang, Jenna Kailin, Sarah O'Donnell, and Lea Gray*
Illinois Institute of Technology, Bedford Park, IL

Pulsed light systems currently available in the market operate at a fixed pulse width and frequency and these conditions might not be optimized for microbial inactivation. A novel pulsed light system (Model#X-1100; Xenon Corporation, USA) enables the researchers to adjust various parameters including pulse width (100-7000 µsec), voltage (1000-3000 V), frequency (0.1-20 Hz), % of energy (0-100%), and energy (up to 9 J/cm^2/pulse of optical energy or 2433 J/pulse of electrical energy).

This study evaluated the effect of various pulsed light parameters (treatment time, voltage, frequency, energy/pulse) for inactivation of *Listeria monocytogenes* in buffered peptone water (BPW), apple juice, and apple cider. A 4-mL of sample (~2.5-mm depth) in a quartz Petri dish (5-cm diameter), artificially inoculated with *Listeria monocytogenes*, was exposed to various pulsed light treatment conditions.

The results indicated that the impact of these factors vary as many of these factors are inter-related. In general, increasing the frequency, input voltage, pulse width, and % of energy, increased the microbial reduction at the tested conditions ($p<0.05$). For instance, reductions of 1.21 and 5.47 $\log_{10}$ CFU/mL were obtained in BPW and reductions of 1.35 and 4.70 $\log_{10}$ CFU/mL was acquired in apple juice, at 0.1 and 0.82 Hz, respectively, for a 20-sec treatment at 2500 V (50% energy, 700 µsec pulse width). Increased energy per pulse resulted in increased microbial reduction. For instance, reductions of 2.30, 5.59, 6.69, and 6.69 log_{10} CFU/mL were obtained at 645, 1241, 1837, and 2433 J/pulse of electrical energy, respectively, in apple juice. Similarly, reductions of 5.34, 6.45, 6.02, and 6.56 log_{10} CFU/mL were obtained at 645, 1241, 1837, and 2433 J/pulse, respectively in BPW. Absorption of pulsed light energy resulted in temperature increase in the products. For instance, temperature increase of up to 11°C was observed at the treated conditions.

Protecting Innovation: The Many Flavors of Intellectual Property.

Jeffrey D. Smyth[1] *and* ***Jessica L.A. Marks***[2]

(1)Finnegan, Henderson, Farabow, Garrett & Dunner, LLP, Palo Alto, CA, (2)Finnegan, Henderson, Farabow, Garrett & Dunner, LLP, Reston, VA

The global food and beverage industry accounts for trillions of dollars, and the recent move toward sustainable food production puts pressure on companies to innovate. As substantial resources are invested in developing new products and processes that are healthier, more environmentally friendly, and more sustainable, intellectual property rights can protect these investments and distinguish a company from the competition. Intellectual property also serves a critical role in attracting funding and partnerships. Those developing new sustainable products benefit from a high-level understanding of intellectual property.

A United States utility patent is obtained from the U.S. Patent and Trademark Office (“USPTO”) and protects any new or improved product, process, or machine. U.S. utility patents can protect new products and also should be considered for new manufacturing methods and machines. The USPTO also grants design patents (protecting ornamental designs) and plant patents (protecting new plant varieties). Obtaining a patent requires providing a description of the invention to the USPTO (before publicly disclosure) and a demonstration that the invention is new and directed to eligible subject matter. In exchange, the USPTO grants the right to exclusively use the invention for a period of time.

Trade secret protection is another form of intellectual property useful for protecting products or processes of manufacture. Unlike patents, trade secrets do not require registration with the government, but instead remain protected for as long as the invention remains a secret. Companies should take steps to ensure their trade secrets are protected.

Finally, companies can also protect their brand through trademarks, which cover unique words, phrases, or symbols that identify the source of a product. A strong recognizable trademark is valuable in distinguishing a food and beverage product from other similar products on the shelf. The USPTO issues trademarks and they never expire as long as they are in use.

Milk oligosaccharides and their role in neonatal health: Lessons for tailored synbiotics.

David A. Mills

Department of Food Science & Technology, University of California, Davis, Davis, CA

Human milk contains numerous components that shape the microbial content of the developing infant gastrointestinal tract. A prominent feature of milk is an array of oligosaccharides and glycoconjugates that serve a passive immune function by sequestering and deflecting pathogens while simultaneously enriching a protective, "milk-oriented microbiota" often dominated by bifidobacteria. Recent research suggests the timing of establishment, and proper function of, the neonate gut microbiota is critical for infant development. This community is initially established through environmental transfer to the gut and subsequently shaped by diet (milk) and host genetics. Once established, infant gut communities dominated by bifidobacteria exhibit low residual milk glycans and higher levels of short chain fatty acids in the feces, suggesting a strongly saccharolytic activity. The mechanistic basis for milk glycan consumption by bifidobacteria has been the subject of active research. Different infant-borne bifidobacteria contain specific glycosidases and transport systems required to utilize milk oligosaccharides and glycoconjugates. In aggregate, these studies suggest a co-evolutionary relationship between mammalian milk glycans, infant-borne bifidobacteria and the infant host resulting in a programmed enrichment of a protective bifidobacterial-dominant community during a critical stage of infant development. Disruption of this programmed enrichment, by poor environmental transfer, antibiotic use, or infection, can lead to a "poorly functioning" milk-oriented microbiota that may pose a risk for negative health outcomes. Further analysis of this naturally evolved system will shed light on effective pre- and probiotic tools that support and ensure a protective gut microbiota for at-risk infants.

Multiscale Design of a Dairy Beverage Product, By Partial Substitution of MILK for *Candida Utilis* Aqueous Extract and Subsequent Supplementation with Oleic Acid.

Hugo Mauricio Buitrago Mora Sr.[1], Silvia Restrepo Restrepo[1], María Arango Piñeros[1], Diego Espinoza Moreno[1], Miguel Angel Fernandez Niño[1], and ***Andrés Fernando González Barrios[2]***

(1)Universidad de los Andes, Bogotá DC, Colombia, (2)Chemical Engineering, Grupo de Diseño de Productos y Procesos (GDPP) Universidad de los Andes, Bogotá, Colombia

Yogurts and fermented dairy beverages (FDB) are high-demand products worldwide. Recently, several studies have used yogurts for transporting different bioactive compounds such as fatty acids and antioxidants, thus improving their functional characteristics and contributing to the consumer's health. Likewise, it was supplemented with fungi extract and algae in order to incorporate bioactive compounds. *Candida utilis* is well known to be an excellent protein source due to its high protein content and its bioactive compounds. Here, an aqueous extract of *C. utilis* (CUAE) has been used to produce a dairy beverage product doing a partial substitution of milk protein and subsequent supplementation with microcapsules containing oleic acid. The changes in the structural properties of FDB was evaluated in the fermentation process, pH, aggregate size, microstructure and changes in rheological properties and after 21 days in storage. Furthermore, a 3D structure in-silco model of k-casein was obtained and the bond energy with some components from the FDB was determinate through MD simulations. The partial substitution showed high acidification rate, lower viscosity, similar microstructure and a characteristic aggregation profile for each sample as compare to the control. Nevertheless, based on our results, a high and a low substitution limits were determined, showing that 30% substitution of the sample had high viscosity (1,23 Pa*s) that a 20% FDB substituted for whey (0,821 Pa*s). Microcapsules incorporation and storage decreases the viscosity of FDB and affected aggregate size, thus changing its microstructure. Our results also allowed us to determine the optimal amount of microcapsules. MD simulations showed that glutathione may be part of structure of micro-gel but microcapsule components showed a disadvantage to the bond interaction. Overall, our results indicate that CUAE can be used to design a FDB and a specific amount of microcapsules whit oleic acid can be incorporated thus modifying its structural properties.

Enzymatic Hydrolysis of Whey Proteins for Obtaining Antioxidant Peptide Fractions.

Jesus Morales Garcia[1], Jorge Duitama Castellanos[2], and ***Andrés Fernando González Barrios[1]***
(1)Chemical engineering Department, Grupo de diseño de productos y procesos (GDPP), Universidad de los Andes, Bogotá, Colombia, (2)Systems and Computer Engineering Department, Universidad de los Andes, Bogotá, Colombia

The nutraceuticals have long been involved in the relationship between nutrition and health, which are not only used as nutritional supplements, but their functional components are also added to foods. Increasing the nutraceutical market has led to the interest of researchers for new sightings enabling its development. Accordingly, many strategies have recently emerged in the discovery and development of food-derived bioactive peptides, where food protein sources have been used including byproducts and food wastes. Enzymatic hydrolysis of whey proteins is a mechanism that can be used to add value to this byproduct of cheese manufacturing. This research was motivated by the wasted whey in Colombia and the interest of their encrypted antioxidant peptides. In this work, the enzyme Alcalase 2.4 L (from *Bacillus licheniformis*) and Flavourzyme (from *Aspergillus oryzae*) were used to produce the hydrolysates of the whey proteins at different conditions of the process such as enzyme-substrate ratio E/S, time of hydrolysis, temperature and pH. An orthogonal design of Taguchi (3^4) was carried out containing nine treatments with three replications for each enzyme. The measured antioxidant capacity is the response variable by ABTS and FRAP assays. Preliminary results reveal the importance of the process variables in the enzymatic hydrolysis of whey proteins to produce antioxidant peptides. Concurrently, it is important to carry out peptidomic analysis to validate effects of the process variables in the release of whey peptides in order to corelate released set peptides to the antioxidant assays ABTS and FRAP through an additive model.

Innovations in Natural Food Colors.

Greg Ziegler
Food Science, Penn State University, University Park, PA

Consumer desires for clean-label foods are driving a shift from FD&C certified “artificial” food colors to those “exempt from certification,” i.e. “natural” food colors. This talk will review the current state of the food color industry and examine some recent technical innovations in natural food colors, with a focus on novel materials from food processing byproducts. A novel natural food color from avocado seeds will be introduced.

Single-Cell Protein and Specifically ProTyton™ - An Advanced Nutrition Protein Ingredient Platform for Animals and Humans.

Bryan P. Tracy

White Dog Labs, New Castle, DE

Population growth and the massively increasing middle class require new, advanced nutrition sources of protein ingredients to sate global demand. Single-cell protein (SCP) and specifically White Dog Lab's ProTyton™ platform has the potential to deliver more complete nutrition, health benefits, bio-security advantages, sustainable production metrics and cost advantaged economics with applications in animal feeds and human foods.

ProTyton is a microbiome derived, bacteria based SCP produced in repurposed corn based ethanol plants that delivers over 80wt% crude protein with nearly 50% essential amino acid on a dry weight basis in highly digestible form. The product has demonstrated efficacy for growth performance and health benefits in aquaculture applications, which I will describe in today's talk. Additionally, we are exploring applications in companion and human foods, essentially bringing the SCP back to the microbiomes they were derived from, to deliver cost effective nutrition and health in various forms of protein ingredients.

The New Normal: Beneficial Reuse of Food and Beverage Waste to Energy.

Colin Moy

Wastewater, Environmental Services Division, Resource Recovery, East Bay Municipal Utility District, Oakland, CA

The East Bay Municipal Utility District (EBMUD) has become the model for treating sustainably treating high strength organic feedstocks and generating renewable electricity at a waste water treatment plant. This program helps the environment, helps local businesses and helps reduce costs for EBMUD's ratepayers. This presentation will present a case study on this successful waste to energy program.

According to the U.S. Environmental Protection Agency (USEPA), approximately 15% of the materials in landfills are from food scraps and other food products, or approximately 30 million tons/year within California. An estimated 30 to 40% of this solid waste could be processed via composting or anaerobic digestion and reused. Because landfills have been identified as a large source of greenhouse gas emissions, several laws were passed in California and across the U.S. to help reduce these emissions from decaying organic materials and divert organic waste from landfills.

In 2002, EBMUD realized that high strength organics could be co-digested with municipal sludge to generate more renewable energy. Based on this, the EBMUD resource recovery program was born. As a result of this program, by 2013 EBMUD was the first wastewater treatment plant in North America to produce more power than it uses with a 30% surplus in electricity exported to the grid. Biogas is generated from a feedstock mix of approximately 65% high strength trucked waste and 35% municipal sludge. Feedstocks include animal rendering and blood, alkaline animal crematorium, dairy and cheese processing, beverage (brewery, winery, soda), edible oil processing wastes, restaurant grease traps (fats, oils, and grease), and pre-processed food scraps. EBMUD was one of the early adaptors to pilot study source separated food waste and currently receives 40 – 50 tons/day. Overall the program receives up to 4,000 trucks/month or about 20 million gallons/month, while operating 24/7 – 365.

***Renewable Activated Carbons from Food Waste*.**

Julia A. Valla[1], *Yu Lei*[2], *and David P. Gamliel*[1]
(1)Chemical & Biomolecular Engineering, University of Connecticut, Storrs Mansfield, CT, (2)Chemical and Biomolecular Engineering, University of Connecticut, Storss, CT

This study explores the production of renewable and sustainable carbons from waste biomass resources, for adsorption applications. Specifically, the research explores the production of carbons derived from **food waste** and their utilization as sorbents of aromatic contaminants in **water**.
In our lab, we receive the food waste from the Dining Halls of the University of Connecticut and after pretreatment, that includes washing, grinding and sieving, we perform pyrolysis and activation to turn the waste into carbons. The produced carbons are then characterized and they are tested as sorbents. Our goal is to understand how the conditions of pyrolysis and activation affect the properties of the carbons and, consequently, their effectiveness as sorbents and catalyst supports. During the pyrolysis reaction, temperature and residence time are the most important parameters that affect the yield and the properties of the produced biochar. Activation of the biochar is performed either using steam, physical activation, or using chemicals (e.g. H_3PO_4), chemical activation. During the former method of activation, temperature and residence time are, again, among the most important parameters that affect the surface area, the carbon content and the porosity of the produced carbons. During the latter method, the impregnation ratio between the chemical and the biochar is the most critical.
During this talk we will discuss the properties of the renewable activated carbons produced by food waste and how these properties are affected by the reaction conditions and the method of activation. Surface area, porosity, carbon content, surface functional groups, morphologies are the properties of interest which will be discussed. Then, we will discuss the potential of using the activated carbons produced by food waste, as sorbents of aromatic hydrocarbons in water.

Demonstrating the Potential for on-Site Electricity Generation from Food Waste Using Containerized Anaerobic Digestion Units.

Sara A. Pace[1], *Jill Brigham*[1,2], *Christopher W. Simmons*[1], *and Edward S. Spang*[1]
(1)Food Science and Technology, University of California, Davis, Davis, CA, (2)Viticulture and Enology, University of California, Davis, Davis, CA

Approximately 40% of food is lost or wasted across the food system life-cycle, from farm to retailer/restaurant to consumer. Current practices to dispose food waste involve trucking food waste from multiple sites to a central landfill, where greenhouse gases are released into the atmosphere from both the food waste as it degrades and during transportation. Anaerobic digestion (AD), a known alternative to landfills, converts food waste into electricity, heat, and fertilizer, and prevents methane from being released into the atmosphere as the waste degrades. However, traditional central anaerobic digesters require similar expensive and carbon-emitting transportation as landfills. This project proposes to assess the potential for a highly standardized and rapidly deployable decentralized AD solution as a competitive alternative to large-scale centralized AD facilities to optimize waste management, renewable electricity, heat, and fertilizer production for local California communities. By implementing on-site AD at locations where food waste is generated and electricity demand exists, it is possible to reduce/avoid non-renewable electricity consumption; transmission and distribution losses associated with electricity delivery across long distances on the grid; and the transport costs (e.g. monetary, environmental, and public health costs) of hauling food waste long distances to feed centralized AD facilities. A community-scale AD solution will be installed on-site to treat up to 6700 pounds of food waste daily and produce 64 kWe electricity. The system performance of the AD technology will be monitored, evaluated and enhanced to evaluate the potential economic, environmental, and health benefits compared to a centralized infrastructure. The electricity generation, heat output, and fertilizer production per unit of food waste input in the system will be measured, and the total electricity, natural gas, and fuel savings achieved from the operation will be estimated, based on assessments of total vehicle miles traveled per unit of food waste delivered to the AD system.

Effects of PEF Treatment on Physicochemical Properties and Retrogradation Behaviors of Glutinous Rice Grain and Its Starch.

Shuang Qiu[1]*, Olga I. Padilla-Zakour*[1]*, Kyle Kriner*[2]*, and Alireza Abbaspourrad*[3]
(1)Department of Food Science, Cornell University, Ithaca, NY, (2)Department of Food science, Cornell University, Ithaca, NY, (3)Department of Food Science, Cornell University

Pulsed electric field (PEF) processing is an emerging non-thermal technology that generates short pulses of high voltage electric field on materials. During the last two decades PEF processing received considerable attention due to its potential to improve food quality and stability, and it has been considered as an alternative to conventional methods in food processing. Compared with traditional thermal processes, the PEF technology provides advantages of shorter treatment time, less energy consumption and lower treatment temperature. To the best our knowledge, the application of PEF on whole rice grains has not been reported.

This study investigated glutinous rice grains treated with PEF at different levels of input energy from 2.4 kJ/cm^3 to 21.6 kJ/cm^3. The physicochemical properties, microstructure and gelatinization behavior of glutinous rice grains prepared with or without PEF treatment were studied. The PEF treated rice grains were also cooked to determine the texture properties and retrogradation behavior during storage. Micro-pores were created at the surface of PEF treated rice grains which was confirmed by SEM observation, and the porosity was increased from 7.3% to 9.8%. The crystallinity degree of rice grains was decreased after PEF treatment. The hardness value of PEF treated fresh-cooked rice grains was decreased by 51.7% compared to fresh-cooked rice grains without PEF treatment. Most importantly, the texture of the PEF treated rice was stable after 3 months of refrigerated storage at 4°C. The thermal properties of rice grains with PEF treatment showed significant reduction of retrogradation during storage compared to control sample. Results from the present study will enhance the understanding of the application of PEF on glutinous rice grains (waxy starch/amylopectin), and advance the utilization of PEF technology for industrial starch food processing.

Is Steam an Important Component of Your Recipe?

Neil Davies
Spirax Sarco, Blythewood, SC

Steam is regularly used in the food and drinks industry as a tool to transfer heat into the product, during cooking, peeling, pasteurizing, blanching and drying. Steam is also used as a method of sterilization for packaging and vacuum sealing. In many of these instances steam touches the food and beverage product, leaving the condensed steam in contact with, or part of the end product.

As a food and beverage manufacturer using steam, have you considered the contamination risks? If you're using steam directly, or indirectly, in contact with your food and beverage process have you considered the risk of exposing your finished product to potentially harmful and costly contamination? While steam is the most efficient method of transferring heat to your process, it is essential to ensure it is free from the following contaminants:

- Particulate contamination – rust, scale and other pipe debris
- Chemical contamination – from boiler chemicals or cross contamination.

Three grades of steam are commonly used in the food and drink industry; plant steam, filtered steam (culinary) and clean steam. Plant steam meets the demand for heat transfer applications, but also

contains contamination, and should not be recommended for direct contact applications. Filtered steam removes most of the particulates, but removes no chemical contamination within the steam or water droplets. Clean Steam eliminates potential risks of particulate and chemical contamination.
Where steam comes into contact with a food or drink process, manufacturers should consider asking the question “Is Steam part of my recipe?” A secondary question would read; “Does it makes sense for a manufacturer to assess and manage any potential risk of steam or condensate contamination?” If the answer to either of these questions is positive, a Hazard Analysis Critical Control Point (HACCP) steam quality audit may be the best practices path forward.

How Changing Recipes without Considering Processing Equipment Can Wreak Havoc in the Final Product.
Carrie Hartford
Engineering, Jenike & Johanson, Inc., San Luis Obispo, CA
The food market is changing – people desire quality ingredients, unique/creative foods, safe products, and functional foods to remain healthy and happy. To meet this need, recipes are changing. Recipes often include a wide variety of ingredients and sometimes with added vitamins. Some of these ingredients are free flowing, but others can be sticky. Also, material flow is not the only challenge – keeping the ingredients together in and of itself is also challenge. The way the bulk material is handled through the plant affects quality of the final product. At the end of the day, the final product must match the claims on the packaging, including weight requirements. Achieving a uniform blend is critical to produce on-spec products.
This talk will discuss issues such as:

- The implications of changing ingredients
- Blend uniformity
- Segregation of ingredients by particle size and density
- Assessing existing equipment for new recipes

As recipes change, the equipment used to handle the new recipes doesn’t necessarily change. But science is available to predict the flowability of the new recipe to determine if it will or will not work in the existing system. And there are ways to improve the equipment to handle a wider range of ingredients. By understanding and improving how the material flows through the system, product quality will improve and switching recipes will be easier.

High Intensity Production of a Natural Sweetener Protein in Continuous Perfusion Bioreactor Cultures of Recombinant Yeast Cells.
Dhinakar Kompala
Sudhin Biopharma Co, Superior, CO
We have developed a novel high cell density continuous production process for any secreted protein from yeast cells. This novel process is made possible with a unique cell retention device based on enhanced sedimentation of cells on inclined surfaces. This easily scalable device does not get clogged quickly like a membrane, have any moving parts to break down nor require any energy inputs.
This high intensity production process is demonstrated with a natural sweetener protein, brazzein, which is 500 - 2000 times sweeter than sucorose, thermostable, acid-tolerant and claimed in literature as closest in taste to sucrose of all the natural and artificial sweeteners tested. Our production process brings the cost of its manufacture lower than the traditional methods of manufacturing any protein. We hope this cheaper production process will help in reducing sugar consumption and related epidemics of obesity and diabetes.

Tuesday, December 4, 2018

The Future of Food: Doing the Impossible

Laura Kliman

Impossible Foods

The modern animal agricultural system is the single greatest threat to the environment. Impossible Foods set out to solve the world's meat problem – not by reducing how much we eat, but rather by changing how we get it. By bringing together chefs and food scientists, we've worked to define exactly what we love about the meat-eating experience, and how to recreate that experience without animals. Over the past 5 years, our R&D teams have studied meat at a molecular level and developed breakthrough technologies in flavor, texture and the overall meat-eating experience. Utilizing a combination of analytical and sensory techniques, including GC-olfactometry, we identified the most important building blocks of animal meat. Since then, we have been able to replace those building blocks with plant-based ingredients. Most notably, the synthesis of plant-based heme, the molecule that catalyzes meat's flavor chemistry, and makes it taste like meat.

The result is plant-based ground beef that even die-hard meat eaters love. Which means people can enjoy the foods they love, without the substantial strain on the environment. Compared to meat from animal agriculture, Impossible™ meat uses 74% less water, 95% less land, and creates 87% fewer greenhouse gas emissions.

Regulating Clean Meat: Current Status and Next Steps

Nicole Rawling

The Good Food Institute

New technology often requires new regulatory frameworks. Clean meat - also called cell-based or cultured meat - is no exception. The Good Food Institute is taking the lead on clean meat issues in the U.S. and around the world. Nicole Rawling, Esq. will speak to the questions that arise with regulation and jurisdiction and give an overview of the status of clean meat in the United States.

Power of Mung Bean Protein: Functional Properties, Application in Egg-Free Products and Sustainability Impact.

Meng Li

Food Science, JUST.INC, San Francisco, CA

Plant-based protein foods have gained popularity attributed to a growing awareness of their health benefits and lower environmental footprint compared to an animal meat-based diet. While various plant-based meat, dairy and beverages have emerged in the market, plant-based egg products have comparatively seen limited innovation. At JUST, we have developed a new range of plant based, egg free breakfast products (Just Egg Patty, Just Egg Scramble) enabled by our proprietary mung bean protein isolate with heat induced gelation properties similar to whole eggs.

This presentation will provide an overview of our mung bean protein isolation process, functional properties, application in egg-free products and a sustainability impact analysis.

Mung bean protein (MBP) is isolated from mung beans (*Vigna radiata*), a legume widely used in cuisines across Asia. Dehulled mung beans are alkaline extracted and acid precipitated using standard mechanical separation processes, and spray dried to prepare the protein isolate. Proteins isolated are largely seed storage vicilin type proteins with 8s globulin proteins identified as the major functional protein. MBP exhibits unique heat induced gelling property with an onset gelation temperature between 80 - 90 °C. Rheological tests showed that the gel elasticity and gel strength are comparable to whole eggs. Its thermal stability, measured using thermal shift assay, was highest at pH 5 and declined when shifted away from this pH. These thermal gelation properties enable MBP's use in our egg-free protein patty and liquid egg analogue. Texture profile analysis of our protein patty showed hardness, cohesiveness, and chewiness comparable to whole eggs. Finally, our sustainability analysis shows significantly lower water usage (surface and groundwater) and carbon footprint of Just Egg products compared to market basket of egg products.

Techno-Economic Analysis of a Plant-Based Platform for Manufacturing Antimicrobial Proteins for Food Safety.

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Foodborne illnesses burden key food industry stakeholders and healthcare systems worldwide. Standard abiotic food sanitizing treatments are insufficient to address this burden. Alternative biotic treatments promise comparable, or even higher, efficacy with lower impact to the food matrices than traditional solutions. We performed a comprehensive techno-economic evaluation of a plant-based platform with broad applicability for manufacturing non-antibiotic, antimicrobial proteins derived from bacteria and bacteriophages for use in food safety applications. Our analysis focused on recombinant, nature-identical molecules that are generally recognized as safe (GRAS) for human consumption when used in foods at low yet effective levels.

The cost sensitivity of the food industry is the most significant barrier to the adoption of new biotic food sanitizing treatments as food safety interventions. To capitalize on potential economic advantages and scalability, we evaluated a highly efficient transgenic plant-based production process developed by Nomad Bioscience GmbH, which can express a range of antimicrobial proteins at levels up to 5 g/kg plant fresh weight with demonstrated activity against major foodborne pathogens. A detailed process simulation model was developed to de-risk the business and commercial application of the technology as well as to help identify economic "hot spots," process operating parameters, unit operations, consumables, and/or raw materials that have the most significant impact on production costs and/or capital expenditures.

The process simulation was performed using SuperPro Designer® (Intelligen Inc, Scotch Plains, New Jersey, USA), a software tool for process simulation and flowsheet development that performs mass and energy balances, equipment sizing, batch scheduling/debottlenecking, capital investment and operating cost analysis, and profitability analysis. For the base case scenario, 500 kg antimicrobial product/year is produced at $6.60/g cost of goods sold with $13.1 million capital expenditures for facility construction. The final results of this techno-economic analysis (manufacturing costs, scenario analysis, alternative designs) will be discussed.

Green Renewable Sustainable Antibacterial Food Grease to Ensure Consumer Safety.

Guerry Grune
MEMP, Duke University, Durham, NC

The presentation will describe a replacement for petroleum jelly as a base for products suitable for most any application for which petroleum jelly can be used. The gel is a glycerine based composition comprising at least two substituents; plant derived glycerine and a plant based emulsifier. The emulsifier can be any known and/or commercially available glucoside containing substance. Other suitable emulsifiers together with glycerine and essential or vegetable based oils with or without inorganic fillers may be added to impart desirable mechanical and physio-chemical properties. In addition, temperature stabilizers and stiffening agents such as waxes and other inorganic fillers including silica and clays may also be added during manufacture. The composition includes glycerine preferably present in the range of 50-95 weight %. Use of chelated silver oxide with citric acid and glycerine has led to the commercialization of an antibacterial, antimicrobial food grease that prevents and in most cases eliminates infectious bacteria contamination of processed foods.

Tasty Ice Cream: Structures, Rheology and Sensory.

Richard W. Hartel
Food Science, University of Wisconsin-Madison, Madison, WI

Ice cream is a multi-phase material, with numerous small ice crystals, air cells and fat globule clusters contained within a liquid serum phase. When correctly produced, this complex structure imparts the desirable sensory attributes – controlled melting and flavor release with a smooth, creamy mouthfeel. But when not controlled properly, ice cream can be coarse, sandy and generally inedible. The relations between microstructure, rheology and sensory for different types of frozen desserts will be presented through discussion of several recent studies.

A recent survey of US commercial frozen desserts showed the wide variation in microstructure of products, from low-fat to premium. One unique finding was that sensory melt-down in the mouth did not correlate with the standard melt-down test, most likely because of the different conditions (temperature, shear, saliva, etc.) of the test. Further, sensory coarseness did not always correlate with ice crystal size. A subsequent study showed that both serum phase viscosity and the nature of fat globule clustering influenced sensory coarseness when ice crystals were large. That is, iciness is governed not just by ice crystal size, but also by the nature of the surrounding matrix.

With the innovation of high overrun products in the marketplace, the relations between microstructure, rheology and sensory attributes in such products have increased importance. Increasing overrun to 175% (from 80-100% in regular ice cream) causes a significant increase in stiffness (G', G") during extrusion from the freezer. The product has a smooth and creamy texture that resists melt-down at room temperature. It breaks down easily in the mouth from the high air content but also leaves a mouth-coating effect because of the high level of partial coalescence. Further, iciness is masked by the structures even as ice crystal size goes up during abusive storage.

Making Sense of Consumer Trends: Disruption and Contradiction.

Angela Glassmeyer
MANE, Inc., Lebanon, OH

Consumers say they want one thing, but oftentimes do the opposite. What does this look like in the market and how do we create products that consumers want? Explore five consumer trends and taste samples of products created with these trends in mind.

Food and Microfluidics:Control, Sensing, and Chemical Analysis.

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The potential uses of microfluidic devices in chemical processing and sensing is almost unlimited. Construction of such devices is currently relatively easy, and there are
a large number of published "chips" constructed from a variety of substrates showcasing different actuation, sensing, and control components. We have constructed devices for a

variety of applications from virus sensing for pathogen identification to valve actuation using pneumatic computing. Our collaborative team is currently investigating ways to use advanced sensing and control components to reduce water use in the production of wine and other specialty foods. For example, we have constructed a sensor that can measure fluid velocity, conductivity, pH, and oxidation-reduction potential (ORP). The sensor only occupies a volume of approximately two microliters and can be inserted into a process line transporting gallons per minute of liquid or into a small quiescent volume. We can use sensors like this combined with valves and other control hardware to perform precision irrigation of vineyards, conserving water and potentially providing a more robust and uniform crop. In my talk, I will present results from our work and discuss the successes and challenges we have encountered.

Soil-based Biotechnology for More Sustainable Agriculture

Leslie M. Shor, Ph.D.
Associate Professor, University of Connecticut

Research at the so-called "Food-Energy-Water (FEW) Nexus" by chemical engineers is typically focused after food products pass the farm gate. For example, chemical engineering technology in the food sector might aim to minimize the water or energy use in food processing, optimize food distribution, minimize waste, or improve beneficial re-use of waste products. However, primary production accounts for the vast majority of total water inputs into food, along with about half of total energy inputs. Water- and energy-saving innovations for primary food production are urgently needed, but this is easier said than done. Most of our food is produced in soil, a dynamic system of enormous complexity. In particular, the rhizosphere (the region of soil adjacent to growing plant roots) combines steep chemical gradients with multiphase transport phenomena and dynamic inter-kingdom collaboration among root zone microbes. As a result, the rhizosphere system is fascinating but nearly intractable experimentally. However, enabled by recent advances in fields ranging from additive manufacturing to protein engineering, the Shor lab is developing synthetic, functional micromodels that emulate key features of the rhizosphere system. Our micromodels enable systematic, replicated experiments to be linked directly with mechanistic modeling of fundamental pore-scale phenomena. In pioneering this approach, the Shor lab has also developed several new agriculture biotechnologies. We have employed our emulated soil micromodels to show how the microstructure of soil acts with microbial secretions to dramatically limit water evaporation at pore throats. These devices are being used to screen performance of candidate microbes or microbial products for improved performance in retaining soil moisture, or to understand the mechanisms whereby soil microbes retain and redistribute soil moisture. Other technology soil protists to facilitate transport of plant growth promoting rhizobacteria (PGPR) and/or nano-encapsulated agrochemicals and target delivery directly to the root tips of growing plants. This delivery and targeting technology may promote the expansion of no-till farming practices that dramatically reduce water demands and the climate impacts of farming. Moving forward, there is tremendous potential for a first-principles chemical engineering approach to accelerate development of soil-based biotechnology for more sustainable agriculture.

Soil Moisture Retention Promotion Via Microbes Activities.

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Microbial community function is linked inextricably with soil microstructure. Soil bacteria near plant roots secrete extracellular polymeric substances (EPS), a polymeric substance that helps regulate moisture and promotes plant growth. Moreover, water content at the pore-scale controls hydraulic connectivity and thereby modulates microbial access to aqueous and gaseous substrates. EPS promotes soil moisture three ways: (i) by serving as hydrogel, swelling during wet conditions and remaining hydrated during dry conditions, (ii) by altering soil surface properties through creating water repellent surfaces, and (iii) by promoting soil particle aggregates via capillary forces. EPS-mediated soil moisture retention at the pore scale is complex but can be systematically understood by controlling micro-scale geometry. Here, we employed emulated soil micromodels to quantify EPS-mediated moisture retention. EPS was collected from stationary-phase *Sinorhizobium meliloti* cultures and suspended at different concentrations in growth media salts or in artificial groundwater. Experimental results showed that the 0.25× EPS solution dried eight times slower than deionized water, and the 1× EPS solution dried 16 times slower than deionized water in identical soil micromodels. Also, the residual saturation of 0.25× and 1× EPS solutions were 6 ± 1% and 35 ± 21%, compared with a residual saturation of 0 for deionized water. Results in the emulated soil micromodel were also compared with drying experiments performed in uniform capillaries with macropore or micropore dimensions. We found no effect on rate or extent of moisture loss in the uniform macropore-scale capillaries, but studies using uniform micropore-scale capillaries confirmed the emulated soil micromodel results. We provide a systematic method to evaluate the performance of EPS solutions in modulating soil moisture, and show how EPS concentration reduces water loss and amplifies the variability of moisture content when acting in conjunction with micropore-scale physical features. We anticipate this work will help develop the sustainable agriculture biotechnology.

A Chemical Engineer Reimagines Winemaking

Vijay Singh
GOfermentor

I have a decades-long affinity for fermentations of all kinds. Aerobic, anerobic, thixotropic rheology, cell culture, viruses. Anything biological. In the 2000's, I invented the Wave Bioreactor disposable cell culture system. In this talk, I describe my approach to wine fermentation with a chemical engineers perspective. Wine making, dominated by tradition, is refreshingly innocent of chemical engineering. No mention of mixing, mass transfer, heat transfer, or reactor engineering. Even at industrial scale. The result – inefficient, non-automated, capital-intensive, and environmentally unsustainable. The last innovation in winemaking was the stainless-steel tank. So I take a look from chemical engineering standpoint of sanitation, water usage, oxidation,punching, pressing, and rheology. I will describe how this led to revolutionary new device to make wine – the GOfermentor – which is now a commercial product.

Creation and Predictions of a Reactor Engineering Model for Red Wine Fermentations.

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Red wine fermentations are performed in the presence of grape skins and seeds to ensure extraction of color and other phenolics. The presence of these solids results in two distinct phases in the fermentor, as the solids float to the top to form a "cap." Modeling of red wine fermentations is, therefore, complex and must consider spatial heterogeneity to predict fermentation kinetics. We have developed a reactor-engineering model for red wine fermentations that includes the fundamentals of fermentation kinetics, heat transfer, diffusion, and compressible fluid flow. To develop the heat transfer component of the model, the heat transfer properties of grapes were experimentally determined as a function of fermentation progression. COMSOL was used to solve all components of the model simultaneously utilizing a Finite Elements Analysis (FEA) approach. Predictions from this model were validated using prior experimental work. Model prediction and experimental data showed excellent agreement. The model was then used to predict spatial profiles of active yeast cell concentration and ethanol productivity, as well as liquid velocity profiles. Finally, the model was used to predict how these gradients would change with differences in initial bioavailable nitrogen concentration, a key parameter in predicting fermentation outcome in nitrogen-limited wine fermentations.

Investigating the Kinetics of Continuous Beer Fermentation.

Nadine Koen*, Renee Butler, and Michael Heying*
Chemistry & Biochemistry, California Polytechnic State University, San Luis Obispo, CA

Brewing has been utilized for thousands of years over many cultures. Most brewed liquids, whether made commercially or at home, are produced in a batch fashion. Despite the potential advantages offered by continuous reactors, beer brewing, with one former notable exception, takes place in batch reactors even on the largest scales. Continuous fermentation offers the potential for decreased production time, labor costs and more control of the reaction conditions on the industrial scale. In the laboratory, from the perspective of kinetic analysis, continuous fermentation at steady-state may provide simpler calculations through algebraic, rather than differential, equations. We are exploring beer fermentation in a cascade of continuous stirred-tank reactors (CSTRs) utilizing free flocculent yeast. We are investigating the conditions necessary for steady-state operation at different flowrates and temperatures. In the process we are determining the rate constants in Monod-type model equations based on concentrations of active yeast, total fermentable sugar and ethanol. The kinetic model and our analytical methods also include diacetyl, an off-flavor often associated with reduced fermentation times. We plan to utilize these kinetic equations to optimize the reaction conditions in our CSTRs to maximize the output and minimize the production of undesirable components. Future work also includes analysis of other flavor compounds along with sensory evaluation.

Sustainable Enzymes Synthesis By Anaerobic Digestion of Cassava Residue.

Sammy Aso
Brookings, SD

Starch is a crucial plant carbohydrate for human existence and progress. This is because starch and its derived products are important ingredients in numerous industries: baking, beverage, brewing, detergent, food, paper, paint, pharmaceutical, and textile. In converting starch to sugars like glucose and fructose, enzymatic hydrolysis with amylases is extensively used. Amylases account for 65% of global enzyme market due to advantages in reaction specificity, product stability and diverse industrial applications. However, amylase enzymes are expensive as a result of other factors, including variability in energy requirements, constant adjustment of processing conditions, and costly synthesis mediums and substrates. Because culture media and substrates are mandatory features in enzymes synthesis, use of no or low cost substrates such as cassava root processing residues would reduce cost of industrial enzymes and subsequently, lower the price of related biotech products. Objectives of the work presented here were to minimize cost of industrial amylase enzymes, and at the same time mitigate the environmental pollution occasioned by cassava root processing effluent disposal. These objectives were achieved by using cassava root peeling residue as substrate, and evaluating its potential (as sole ingredients source) for synthesis of bacterial amylase enzymes. Overall enzyme activity (EU) was quantified by estimating the amount of reducing sugars as glucose produced by hydrolysis action of crude enzyme solutions on unbuffered starch solution. Specific enzyme activities (as EU/protein) were also determined. Results showed the mean extracellular cell free enzyme activity to be 29.5 µg/(mL min). The mean activities for cell associated, and biofilm associated enzymes were respectively 2.6 µg/(mL min), and 9.2 µg/(mL min). Specific activities for the enzymes were in the range of 0.011 – 0.044 EU/µg protein for cell free enzymes; 0.012 – 0.033 EU/µg protein for cell associated enzymes; and 0.016 – 0.066 EU/µg protein for biofilm associated enzymes.

Using a Genome-Scale Metabolic Model for S. Cerevisiae to Facilitate Understanding of the Differences in Metabolism between Commercial Wine Yeast Strains.

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Two key metabolic activities relevant to industrial wine fermentations are nutrient utilization efficiency and tolerance to high ethanol concentrations exhibited by industrial yeast strains. Therefore, to study the details of yeast metabolism, is of great interest to develop ways to control stuck or sluggish fermentations. One approach is to use computational methods due to their advantage of being comprehensive and more economical compared to experimental methods. Many studies have been conducted to create genome-scale metabolic models of yeast. Despite progress in the field, most current models either focus on aerobic systems or lack the detailed lipid metabolism that has been shown experimentally to be highly correlated with nutrient utilization efficiency. Dynamic FBA (flux balance analysis) can be used to predict the flux distribution of all the metabolites within the cell over the course of an entire fermentation. Using this approach, it is possible to test the predictive capability of these models by comparing predictions with experimental fermentation data. Once the models fit dynamic data, they can be used to understand differences between commercial strains and suggest genetic modification strategies towards increasing strain ethanol tolerance and nutrient utilization efficiency. In this study, we improve the latest consensus genome scale model of yeast by incorporating additional lipid pathways. Previously, we showed that nutrient utilization efficiency and ethanol tolerance of 22 different industrial yeast strains were a strong function of their lipid composition while molecular mechanisms of these phenomena were not elucidated. By utilizing the latest consensus genome-scale metabolic reconstruction of yeast, which has the most comprehensive representation of fatty acid, glycerolipid, and glycerophospholipid metabolism, we can more accurately predict metabolic fluxes for various yeast strains. This information will not only help with elucidating differences in strain performances but also help with future studies for understanding aroma related compounds produced during wine making.

Sprout production using a novel kinetic hydroponics system.

Kathiravan Krishnamurthy[1]*, Mehdi Azozoma*[1]*, Beatriz Dos Santos*[1]*, Michael Leyden*[1]*, and Fouad Teymour*[2]
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A novel kinetic hydroponics system (KHS) was successfully designed for **growing the sprouts under water** within a small footprint. Principles of mass transfer, momentum transfer, and fluid flow were used for designing KHS. Each of the KHS units were evaluated and further improvements were made. The objectives of this study were to: i) develop a novel kinetic hydroponics system (KHS) to grow the sprouts under water, ii) evaluate natural microflora proliferation during alfalfa sprouts production at various conditions, iii) understanding the efficacy of sanitizers on microbial growth during sprouting, and iv) evaluate the shelf life of the sprouts grown using KHS.

The microbial load on sprouts and water were determined every day (initial load on seeds was also determined). Effect of calcium hypochlorite (150-200 ppm) and commercial Milton sterilizing tablets (a sodium dichloroisocyanurate and troclosene sodium based sanitizer; concentration suggested by the manufacturer was used) on aerobic bacteria, *Escherichia coli* O157:H7, *Listeria* spp., *Salmonella* spp., yeast, and molds in sprouts and water were determined.

The KHS system provided a higher yield (up to 225 gram of sprouts for every 20 gram of seeds) compared to traditional methods. As expected, increased sanitizer concentration increased the microbial reduction. At all the tested conditions, there were no *Escherichia coli* O157:H7, *Listeria* spp., *Salmonella* spp. found on the seeds or the final product. Shelf life studies indicated that KHS grown sprouts retained it freshness for more than 21 days at 4°C.
The KHS can potentially provide an effective sprouting system for use in households. These systems can be scalable to large scale commercial production.

An Interdisciplinary Research Experience for Undergraduates in Food Safety, Food Engineering, and Nutrition.

Kathiravan Krishnamurthy
Illinois Institute of Technology, Bedford Park, IL

This presentation is about a National Science Foundation funded REU (Research Experience for Undergraduates) program at the Illinois Institute of Technology. This REU focuses on training undergraduate students in food safety, food engineering, and nutrition. Students undergo rigorous mentoring and professional development training which will help them in fine-tuning the skill sets required to become successful scientists, engineers, and entrepreneurs. Eight mentors from Illinois Institute of Technology and the U.S. Food and Drug Administration are mentoring ten undergraduate students for a ten week period during the summer.
The primary goals of the proposed NSF REU site are: 1) to provide hands on research experiences to undergraduate students in food safety, food engineering, and nutrition, 2) to provide exposure to these fields, 3) to systematically train the students in transforming basic research ideas into practical applications aimed at solving real world problems for improving the safety and nutrition of our food supply through interactive seminars and discussions, 4) to systematically mentor the undergraduate students to hone their research and professional skills through mentoring workshops, student presentations/discussions, interaction with graduate students, and K-12 outreach, 5) to expose the students to broader fields of food science to enhance their knowledge in this field (with special emphasis on food safety, food engineering, and nutrition) through seminars and tours, and 6) to train the students on research and professional ethics. Projects are offered in a broad range of topics including applications of novel food process engineering technologies (high pressure processing, pulsed light processing, and cold plasma) for ensuring food safety and nutritional quality, addressing special issues in food safety such as with low moisture foods, understanding physiological chemistry of plant bioactives in humans, modeling & simulation of food processing technologies, developing affordable nutrition through kinetic hydroponics, and repurposing of food ingredients for controlling pathogenic biofilms.

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