WHISTLER CENTER FOR CARBOHYDRATE RESEARCH

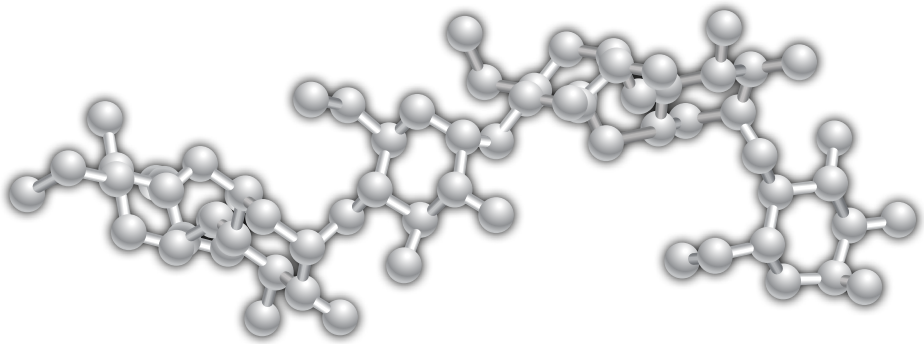


2024

PURDUE UNIVERSITY

Food Science

ANNUAL REPORT



3-D view of starch structure.

WHISTLER CENTER FOR CARBOHYDRATE RESEARCH

2024 ANNUAL REPORT



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SPECIAL THANKS
TO OUR 2024 INDUSTRIAL MEMBERS

Archer Daniels Midland, Cargill, General Mills, Nagase Viita Co., Ltd., Mars Wrigley and Mondelēz International

Director's Statement



Welcome to our 2024 annual report for the Whistler Center for Carbohydrate Research. A number of events and trends in the last year have changed the landscape of industry and public perception of carbohydrates and, in some sense, what we eat. The somewhat negative perception of carbohydrates in the diet seems to be changing to one where some carbohydrate-based foods can be considered healthy and remain a major part of diets.

At the Whistler Center, we continue our long-term research programs on carbohydrates and health, formulation science related to processed foods, and fundamental studies on carbohydrate assemblages, interaction with other food ingredients, and texturizers. For instance, over the past 15 years we have been studying the potential of carbohydrates to activate (directly and indirectly) the GLP-1-associated gut-brain axis for reducing food intake and weight management. This has been demonstrated in animals and, within the next year, in a collaborative clinical study with Indiana University School of Medicine. The Whistler Center has significant research programs in dietary fiber carbohydrates and the gut microbiome that show promise in the modulation of the gut microbiota for improved health. For years, we have conducted studies on how to incorporate fibers and other carbohydrates into processed foods and with good functional properties. And we do so much more, with 16 faculty having active research programs that cover a broad range of carbohydrate-based topics.

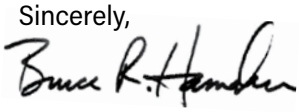
In recognition that we can always do things better and be more responsive to our member companies and to the public, in 2024 we formed an executive advisory committee consisting of Whistler Center alumni and select faculty and staff. The purpose was to critically look at the Center's operating structure, our services and our communications. Faculty are taking on more responsibility for operations, we are increasing our presence through social media, and we have rethought how we organize ourselves into research themes. You will see in the following pages new thematic areas — Components for Healthy Processed Foods, Innovations in Processed Food Quality, Sustainability and Clean-Label, and Healthy Outcomes.

Those familiar with our annual report will notice that we are utilizing a new format this year. Content has been reorganized for quicker navigation by placing research descriptions earlier in the report and organizing components by research themes. Research summaries now directly reference the students and publications related to the described studies, and the publications include brief written statements to highlight the impactful findings of the studies. This new format allows you to quickly identify the articles and faculty and students to contact if you desire more detailed information on particular topics.

We had high productivity in 2024, with 93 refereed journal publications, ~50 faculty-led research projects, numerous domestic and international presentations, and the obtainment of competitive grant funding. Our carbohydrate education services continued as before with our October 2 ½-day short course, six webinars and our annual technical conference following our spring board meeting. We were honored to have Professor Manuel Coimbra from the University of Aveiro, Portugal, as our 2024 Belfort Lecturer. Numerous recognitions and honors were garnered by our students, postdocs and faculty.

Please peruse our 2024 annual report and feel free to contact me, Owen Jones (assistant director) or Melissa Jones (coordinator) with any questions you might have. You may also get in touch directly with our faculty members. We are happy to discuss our services and potential membership in the Whistler Center.

Sincerely,



Bruce R. Hamaker
Distinguished Professor of Food Science, Roy L. Whistler Chair, Director

ABOUT THE CENTER

Whistler Center for Carbohydrate Research is an industry-focused university research center that conducts fundamental research related to practical applications of carbohydrates.

► GLOBAL LEADER IN CARBOHYDRATE RESEARCH

The Center provides world-class excellence in carbohydrate science through arranged research projects, consultation, analytical services and education.

► MISSION: TO ENHANCE THE FUNCTION AND HEALTH OF CARBOHYDRATES IN FOOD

- Carbohydrates for satiety and weight control
- Prebiotic fibers for positive health outcomes
- Sugar reduction/replacement
- Structures for improved texture and delivery
- Phytochemical-carbohydrate interactions
- Technological- and data-driven tools to address emerging needs

► EDUCATOR IN THE SCIENCE OF CARBOHYDRATES

- 3-day Short Course for essential training
- 6 new webinars each year on advanced topics
- Annual technical conference
- Invited lectures by renowned scientists

► FACILITIES OF EXCELLENCE

- 12 chemistry laboratories for structure and mechanics of carbohydrates
- 4 laboratories specializing in gut microbiota and microbial bioengineering
- Dedicated space in pilot plants across 3 separate universities

IMPACTFUL SCIENTIFIC CONTRIBUTIONS

- Paradigm-shifting views of how dietary fibers target changes in the gut microbiome
- Methods to reduce starch digestion rate for ileal activation of gut-brain axis
- New xylitol synthesis process scaled to industrial level
- Resolution of atomic structures of polysaccharide chains, e.g., gellan gum
- New approach to interpret Fourier-Transform-Infrared Spectroscopy spectra of food materials
- Structural basis for slowly digestible starch to increase amount in processed foods
- Effects of acetylation, oxidation, and annealing on structure and function of bean starch
- Structural basis for effect of monosaccharides, oligosaccharides, and polyols on sugar swelling and resulting paste viscoelasticity
- Deliquescence phenomena in carbohydrate-based powders
- Systematic studies on alternative sugar/oligosaccharide effect on starch gelatinization
- Fundamental studies of fibers and gums on expansion in extruded products
- Mathematical models to describe coalescence of dispersions and instability in foams
- Dendritic starch-derived structures for controlled delivery of hydrophobic bioactive molecules
- Polysaccharide associations impact size development and stability of dispersed protein aggregates
- Reduction in intestinal inflammation by anthocyanins within dietary fiber mixtures
- Rheological methodology related to extruded meat analogues and doughs

MEMBER OPPORTUNITIES

Partnering with the Whistler Center for Carbohydrate Research offers your company a strategic advantage in its research and development (R&D) endeavors.

As a member, you will gain access to a collaborative network of leading scientists, cutting-edge facilities and state-of-the-art technologies focused on carbohydrate research. This partnership accelerates the development of novel products, processes and technologies, ultimately contributing to a competitive edge in the market.

Additionally, you will benefit from shared knowledge, reducing individual research costs and fostering a collaborative environment that stimulates breakthroughs. By aligning with the Whistler Center, your company will position itself at the forefront of carbohydrate-related advancements, ensuring a robust R&D pipeline and staying ahead in industries where carbohydrates play a crucial role.

EDUCATION AND LEARNING

- **Annual Short Course**, held in October averaging 15 lectures over 2.5 days
- **Webinars**, 6 offered per year
- Annual **Belfort Endowed Lecture** and Technical Conference held in May
- Discuss scientific posters with researchers at our annual **Board Meeting**: over 35 posters in 2024

ANALYTICAL SERVICES

- Reduced-cost analysis of carbohydrate-containing samples
- Services available include, but are not limited to:
  - Structural characterization of polysaccharides and oligosaccharides
  - Rheological characterization of pastes, gels and mixtures
  - Calorimetry to identify transition temperatures

RESEARCH

OPPORTUNITIES AND PROJECTS

- Conduct short or long-term research at the Whistler Center
- Send industrial researchers to the Whistler Center for collaborative research
- Get involved in Whistler Center-funded pre-competitive projects as an advisory member

LEVERAGE KNOWLEDGE

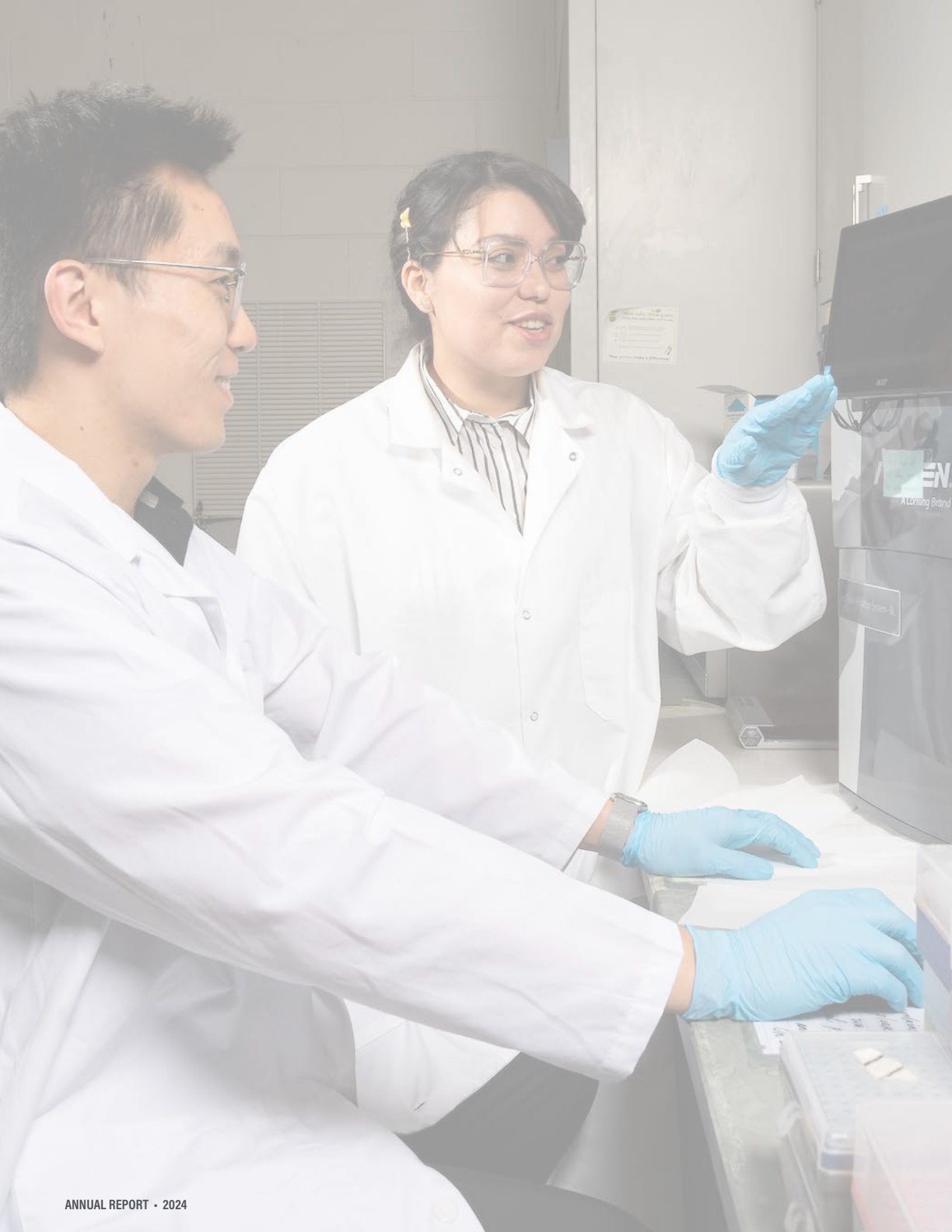
- Whistler Center has received more than $15 million in competitive grant funding for research within the last 8 years
- 17 faculty members with over 50 research projects in 2024, as summarized in the annual report

PERSONALIZED INTERACTIONS

- Brainstorm industry-relevant solutions with faculty
- Analytical services for carbohydrate characterizations
- Yearly visit of our faculty to your site
- Interface with students and postdoctoral scientists

BECOME A MEMBER TODAY

Scan the QR code to learn more!



RESEARCH SUMMARIES

COMPONENTS FOR HEALTHY PROCESSED FOODS

Bruce Hamaker

Ongoing research of B. Hamaker continues to address how the structure of polysaccharides and interactions with other ingredients affects glycemic response, sensations of satiety, and the makeup of the gut microbiome. Grains and oilseeds naturally contain a mixture of starch, non-starch polysaccharides in the form of dietary fiber, proteins and organic acids. To understand the effects of such compositional complexity, in a paper Meihui Yu, ***Nuseybe Bulut***, Xinruo Zhao and ***Rosa Lopez*** showed that resistant starch and interactions with caffeic acid significantly impacted digestibility and gut microbiota composition of corn starch [1].

Legumes are another important source of nutritionally valuable polysaccharides and proteins, and a recent study with researchers in Peru identified nutritional components within Andean legumes [2]. B. Hamaker's expertise in starch fine structure and functionality, with collaborators Eric Bertoft and Andreas Blennow, has also resulted in a recent perspective article with a focus on the structural models of amylopectin [3].

Shifts in the populations within the gut microbiota shifts are promoted by consumption of dietary fibers, and the relative growth of those bacteria is dependent upon the physicochemical structure of those dietary fiber polysaccharides. Accordingly, T. Cantu-Jungles has collaborated with B. Hamaker to identify how polysaccharides from dietary fibers within various foods contribute to targeted growth of specific microbes [4, 5] or microbial groups [6]. This approach can ultimately be utilized to promote consistent shifts in the gut microbiome across individuals [7].

A few projects are underway to determine the response of microbial communities to dietary fiber mixtures with controlled structural composition and have been shared as presentations at meetings. For instance, ***Lauren Sofia Yepes Fernandez*** has been working on designing a new mixture to promote a specific group of beneficial bacteria (*Clostridium Cluster XIVa)* related to health. ***Gabriel Galeano Garcia*** is investigating methodologies to improve fiber combinations for optimal gut microbial outcomes. ***Miranda Ramos Campos*** is studying the impact of a designed fiber mixture in a clinical trial of individuals with irritable bowel syndrome compared to a standard probiotic approach (*L. rhamnosus*). ***Nuseybe Bulut*** finished a study showing that different chemical and physical structures from pectin targeted different beneficial gut bacteria and had good techno-functional properties. These projects envision the use of prebiotic dietary fibers and dietary fiber mixtures with specific structure to promote beneficial gut microbes related to health based upon their ability to utilize and compete for these substrates.

Steve Lindemann

S. Lindemann's group continues to identify how variation in fiber structure targets to specific microbiota, and how natural variation in fibers derived from different botanical sources and/or produced using processing (e.g. milling) or engineering (either de novo enzymatic synthesis or modification of isolated fibers) can be targeted to microbiota. Drawing upon previous work on processing of brans and natural variation in solubilized arabinoxylans, their lab is exploring targeted enzymatic modifications of polysaccharides (chiefly, arabinoxylans), identification of botanical source and genotype variability in polysaccharide targeting to microbiota, physical processing of brans for targeting to distinct microbial taxa, and synthesis of novel polysaccharides. He also collaborates with others to identify microbiome targeting of fibers derived from non-traditional botanical sources.

Key advances in the past year include: 1) dextran branch density [8] and molecular weight strongly governs its targeting to microbiota, 2) cereal source variation and tissue type drives substantial variation in arabinoxylan structure, 3) microbial growth synergies on fiber depend upon the specific pairing of microbes, and 4) discovery of targeting of novel food fibers to microbiota [9, 10]. The results support ingredient design for inclusion into foods for improved health via the microbiome and permit us to begin to draw relationships among structural parameters of fibers and microbiome function in ways that allow prediction of how fibers may perform solely upon their structures. Optimization of fiber structures for improved functionality supports also improved health outcomes at lower inclusion rates. Staff involved in this effort were ***Miguel Alvarez***, ***Rwivoo Baruah***, ***Sajal Bhattarai***, ***Marcelo Guerrero***, ***Victoria Gutierrez***, ***Anurag Pujari***, ***Adam Quinn***, ***Rajsri Raghunath*** and ***Tianming Yao***.

Mario Martinez

M. Martinez' group has used polymer science and multi-omic approaches to understand the binding of natural polyphenolics to polysaccharide-rich matrices and its implications on metabolic response. Recent studies undertaken by ***Ivan Lopez-Rodulfo***, ***Pablo Gallego-Lobillo***, ***Julia Bechtner***, ***Fang Fang***, ***Adriana Maribel Aguilar-Torres*** and ***Mario Franco*** studied apple components to identify how processes and carbohydrase enzymes can impact polyphenol bioaccessibility. Substantial pomace is produced during cold-pressing of apples in the preparation of apple juice. Pomace was found to be a substantial reservoir of polyphenols that strongly interacted with plant cell walls during oro-gastric digestion, but polyphenol structure-based bioaccessibility clusters were only observed in bulk apple, highlighting the importance of the plant cell wall supramolecular structure at overrunning the effects of polyphenol chemical makeup on non-covalent binding and bioaccessibility [11].

Another study utilized rat small intestine extract as an affordable source of mammalian α- and ß-glycosidases and tested its efficacy among whole apple, apple juice, and apple pomace [12]. After treatment, content of bioaccessible polyphenol ß-O-glycosides and α-O-glycosides was significantly lower, resulting in a concomitant generation of the aglycone forms (phloretin, quercetin, ferulic acid, caffeic acid and p-coumaric acid). However, the concentration of aglycones was much lower than the reduction in the concentration of glycosylated polyphenols, strongly suggesting that polyphenols bind to the rat small intestine extract. Matrix-devoid whole apple extract, or pomace extract, exhibited higher polyphenol bioaccessibility than whole apple or pomace, likely due to reduced interactions between polyphenols and the food matrix. Importantly, these differences in bioaccessibility diminished with the glycosidases, suggesting that α-glycosidases cleaved cell wall α-glucans and disrupted the matrix structure.

Ensuring the health of foods also requires accurate digestion models, so the team has evaluated polyphenol accessibility from apple products using static versus semi-dynamic INFOGEST digestion models [13]. In the semi-dynamic model, overhead stirring with a paddle resulted in excessive intragastric chyme homogenization and elevated browning, leading to degradation of most polyphenol subgroups, especially those sensitive to oxygen, such as hydroxybenzoic acids, hydroxycinnamic acids, and flavanols. Magnetic stirring was superior and facilitated sample flushing in the gastric digestion vessel for low-oxygen conditions. Calorie-driven emptying for low-calorie, fiber-rich foods in the semi-dynamic setup led to unacceptably high variance in determined bioaccessible polyphenol concentrations, so a minimum gastric emptying time between 25 and 30 minutes is recommended for homogeneous sampling. Using various apple fractions, the semi-dynamic setup with magnetic stirring and a fixed gastric emptying rate of 140 minutes showed greater extraction of polyphenol subgroups with a strong affinity for binding to plant cell wall material, compared to the static model. However, in the absence of the apple matrix, no notable differences in bioaccessibility were observed between the two methods, suggesting that the static setup may be preferable in matrix-free conditions due to its simplicity and higher sample throughput.

Work in M. Martinez's laboratory has also sought greater understanding of how dietary fibers are integrated within the structure of baked goods in terms of desirable dough performance. ***Maria Franco*** and ***Julia Spotti*** showed that arabinoxylan-rich psyllium husk (PSY) possesses an outstanding antistaling effect in wheat bread crumb due to its balanced interplay with the water dynamics [14]. Replacing 10% wheat flour with PSY required up to twofold more water to reach optimum dough hydration, with the additional water primarily located at the intergranular space as part of the continuous network formed by gluten, starch and arabinoxylan. Greater dough hydration resulted in greater gluten plasticization, but there was no effect on amylopectin retrogradation. Crumb-to-crust moisture loss was impaired, and there was a dose-dependent decrease of crumb staling with PSY integration. Moreover, PSY provided dough elasticity and stability and crumb resilience, which was related to the high propensity of PSY molecules to self-assemble via hydrogen bond junctions. This first study uncovers the mechanistic role of PSY in breadmaking and expands its interest as moisture holder and gelling agent with direct implications on wheat biopolymer plasticization and elasticity, respectively. PSY is easily accessible and affordable due to its simple fractionation

using solvent-free processing steps. Hence, the mechanistic understanding provided in this work could inspire innovative ideas in the design of hydrocolloid ingredients from non-refined, resource-efficient plant tissues, as well as low-staling bread formulations. Apart from these highlighted studies, M. Martinez has contributed a few other publications to the field of healthy processed foods [15-17].

Lisa Mauer

The function of starch is intricately related to the complex structure of the starch granule and the extent of structural transformations during product formulation, production, and shelf-life. L. Mauer's group takes a materials science approach to manipulate and investigate food ingredient structures and functions, water-solid interactions, and amorphization and crystallization tendencies. Ongoing studies include investigations of the roles of sugars, oligosaccharides, and other small molecules on the functional properties of starch, including how oligosaccharides may be useful for sugar reduction strategies [18]. The mechanisms by which molecules influence the gelatinization, pasting, and retrogradation of starch are of both scientific and practical interest, since these phenomena affect the structure, texture, and functionality of starch-containing food and industrial applications. The findings of the work are useful for developing formulation strategies, designing new small molecule ingredients, and physically modifying starch. L. Mauer has also contributed a book chapter on moisture and solids analysis to a popular undergraduate textbook [19].

Eun Joong Oh

Functional bowel disorders, including irritable bowel syndrome, are often exacerbated by the ingestion of poorly digested carbohydrates, such as fructans. E.J. Oh's research group is exploring the fermentation of non-traditional carbon sources, such as fructans, by leveraging metabolically engineered yeast strains. Such engineered baker's yeast strains can be utilized to mitigate symptoms associated with functional bowel disorders by selectively degrading unwanted fructans during dough fermentation. In collaboration with S. Simsek, this project will contribute strategies that enhance the secretion of invertase, the key enzyme responsible for fructan hydrolysis. ***Fransheska Semidey*** and ***Deokyeol Jung*** have optimized signal peptides and generated targeted mutations in the SUC2 (invertase) gene to identify yeast variants with improved invertase secretion and specificity for fructans. This approach has the potential to alleviate symptoms of irritable bowel syndrome and promote gut health, offering a novel application of yeast biotechnology in improving dietary outcomes.

Lavanya Reddivari

It is poorly understood how interactions between flavonoids and dietary fiber modulate gut bacteria composition and their production of metabolites, which may ultimately impact gut health. L. Reddivari's research seeks to identify the criteria for the selection of bioactive and dietary fiber combinations with high efficacy and tolerance based upon their testable physicochemical properties. In order to determine how milling and fraction selection in grains and legumes impacts the natural polyphenols and their bioactive efficacy, ***Edward Moncada***, ***Joanna Hicks*** and ***Sara Eckrote*** studied refined and whole grain fractions of corn, wheat, pea and bean phenotypes with low or high levels of polyphenols on gut health. The team is currently evaluating total phenolics and anthocyanins, α-amylase inhibition, metabolic outcomes such as short-chain fatty acids (SCFAs) production through *in-vitro* fermentation, glycemic index *in-vivo*, and promotion of GLP-1 secretion using enteroendocrine cells. In collaborative study with B. Hamaker, ***Paola Andino*** and ***Edward Moncada***, effects of four different dietary fibers at 15% of dietary intake on tolerance and efficacy in treating Ulcerative Colitis were determined among IL-10 -/- germ-free mice [20]. Short-term consumption of resistant maltodextrin and chicory inulin led to intolerance symptoms in mice colonized with colitis-associated and fiber-intolerant microbiota, including body weight loss, diarrhea, and rectal prolapse. Prolonged consumption of high methoxyl pectin demonstrated anti-inflammatory effects, improved colon morphology, increased alpha diversity, and reduced IL-6 levels in mice with UC-associated microbiota. Overall, extended consumption of complex fibers like pectin and wheat bran were well-tolerated, while exposure to less complex fibers like inulin and resistant maltodextrin exacerbated inflammation.

COMPONENTS FOR HEALTHY PROCESSED FOODS (CONT.)

A separate project is also underway to identify beneficial effects of consuming blueberry anthocyanins when they are complexed with an indigestible polysaccharide isolated from the blueberry matrix in terms of alleviating ulcerative colitis in eight-week-old IL-10 KO (C57BL/6) mice. After treatment with dextran sulfate sodium to induce ulcerative colitis, supplementation in the diet with the blueberry anthocyanin-polysaccharide complex restored colon length, whereas supplementation with either both complexes or freeze-dried blueberry significantly reduced IL-6, IL-1ß, and TNF-α expression compared to controls, suggesting a reduction in inflammation. Furthermore, complex supplementation partially restored occludin and claudin-1 tight junction mRNA expression, suggesting decreased colonic permeability. Catalase levels were restored, further suggesting reduced oxidative stress.

Vignesh Nathan has been identifying whether consumption of commercial lactobacillus probiotics with blueberry polyphenols further alleviates ulcerative colitis symptoms. However, mice with ulcerative colitis induced by dextran sulfate sodium did not show any improvement after prolonged consumption of blueberry polyphenols and *Lactobacillus rhamnosus* GG. This could be attributed to the low colonization ability, and current research is underway to determine if a next-generation probiotic with high adhesion may have a more profound effect.

RESEARCH SUMMARIES

INNOVATIONS IN PROCESSED FOOD QUALITY

Jim BeMiller

J. BeMiller continues to offer insightful research ideas and commentary in the field of carbohydrate science. He is a valuable source for consultation on starch and polysaccharide structure, leveraging his decades of expertise. In the past year, he has contributed a chapter on Carbohydrate Analysis to one of the most utilized undergraduate-level Food Analysis textbooks [21].

Osvaldo Campanella

Historically, food processing engineering has faced challenges in improving the texture, stability and nutritional quality of food products while minimizing waste and enhancing sustainability. O. Campanella's recent research builds on these foundational issues by exploring innovative strategies such as protein-polysaccharide interactions and advanced encapsulation technologies to address both functional food development and environmental concerns in the food industry. Stability of heat-sensitive components is not always assured during extrusion operations. To resolve this concern for a specific bioactive component, ***Lorena Pinho*** evaluated the stability of carotenoids during extrusion treatments to identify conditions for greater content and functionality [22]. Heat-driven reactions are a valuable approach to improving the value of ingredients, and research conducted by ***Dila Donmez*** has explored the encapsulation of fish oil in a matrix formed by the Maillard reaction between soy lecithin and dextrose to improve its oxidative stability [23]. The results demonstrated that encapsulation effectively protected fish oil from oxidative degradation, with the highest stability achieved under specific conditions.

Materials, such as carbohydrate-rich food materials modified by chemical reactions or heating, typically require characterization by calorimetric methods. ***Shengyue Shen*** evaluated improved smoothing methods to assess data from such calorimetric experiments [24]. In the area of enzyme technology, O. Campanella has also contributed to recent reviews on the utility of alternansucrase [25].

Bruce Hamaker

B. Hamaker's expertise in carbohydrate structural determination has contributed to global collaborations using biotechnology or processing to enhance polysaccharide structure. Research with a group in South Korea was performed to produce a sucrose isomer, turanose, using a bacterial amylosucrase adhered to silica particles [26]. In a collaborative project with Jiangnan University, glucanotransferase was used to modify starch structure, where linear chains were most efficiently converted into products with α-1,3 linkages [27]. This was a suitable enzymatic strategy to decrease digestibility of the starch products.

In another project, B. Hamaker's experience with structure and protein structure in maize was utilized in determining the effect of drying processes to mitigate rancidity [28]. He continues to contribute to knowledge on the polysaccharides and proteins within various crops. Along with other global experts, an editorial perspective was prepared on breeding tools for tropical roots, tubers and bananas [29].

Owen Jones

Functionality of protein and polysaccharide ingredients is highly dependent on their dispersion and colloidal structure within complex aqueous mixtures, and O. Jones continues to assess how physical treatments or interactions affect these biopolymers. Although plant-based proteins are in greater demand, dairy proteins remain an essential ingredient for many foods and beverages. Polysaccharide gums are used in combination with dairy proteins for emulsion or foam products, yet their relative contributions to emulsification/foaming or final viscosity is difficult to predict because of their complex colloidal behaviors. In a recent publication, ***Rui Zhu*** showed that gellan gum, a large-molecular weight anionic polysaccharide with strong viscosifying behaviors, associated with whey protein in low-acid conditions and then reduced aggregate size during thermal treatment in aqueous mixtures [30]. Adhesion of gellan gum to the aggregated whey protein and resulting improvements in foam stability has led to conceptual plans for improved foaming properties among agglomerated legume

proteins. This extends from a recent project with collaborators S. Simsek and O. Campanella in which ***Anael Kimble*** used reactive extrusion with hydrolytic enzymes to increase functionality of the protein from bean flours. Her ongoing experiments are identifying structural aspects of protein and saponin fractions from beans, as well as their contribution to foaming behaviors.

Jozef Kokini

Rheological and *in silico* methods remain valuable approaches to characterize carbohydrate materials, as well as other biopolymers relevant to foods. J. Kokini has contributed to further development in analytical approaches in rheometry and computer-assisted predictions. His group has continued research on large-oscillatory amplitude rheological assessment of wheat-based dough systems [31, 32]. Studies have also been performed on *in silico* prediction of bacterial enzyme binding behaviors and computer models to identify visually desirable aspects in baked good formulations with plant-based egg wash [33, 34].

Ganesan Narsimhan

Despite its common use, biomanufacturing industries employ trial-and-error approaches to tune the viscoelastic and flow properties of starch pastes, so predictive models are needed to quantitatively describe the swelling and rupture of starch granules as they are heated in water. In accordance with this need, G. Narsimhan is studying the effect of xanthan concentration on equilibrium swelling of normal maize, waxy maize and normal rice starch at 80°C for 0.1% (very dilute) and 5% starch suspensions. Xanthan gum enhanced starch swelling at lower concentrations, which plateaued at higher xanthan concentrations for dilute starch suspensions. This effect is mainly due to decrease in starch gelatinization temperature in the presence of xanthan. At concentrated starch suspensions, however, swelling continues to increase with xanthan concentration, with this increase being more pronounced at lower xanthan concentrations. This behavior is believed to be mainly due to the effect of depletion forces resulting from the exclusion of xanthan in thin film separating deformed granules.

Brad Reuhs

B. Reuhs continues to be an instrumental component of the center's analytical capabilities regarding carbohydrate fine structure. In the past year, he has contributed significantly to research on dietary fiber structural characterization in gut microbiome studies [4]. He has also contributed to two chapters in a frequently utilized undergraduate food analysis textbook [35, 36].

Yuan Yao

Emulsifiers are essential for the stability of many products, yet there are limited options for emulsifier ingredients in product formulations due to costs or the preference of consumers for "clean-label" ingredients. To address this, Y. Yao continues research on extracts of su1 from sweet corn as emulsifying ingredients. ***Kamrun Nahar*** and ***Zannatun Noor*** have shown that the extracts have similar or even superior capabilities as Pickering stabilizers when compared to acacia gum and OSA-starch. ***Zannatun Noor*** has also utilized phytoglycogen from corn, a natural starch-based dendrimer, to increase solubility of retinol, a major active ingredient in skin care. Emulsions and phytoglycogen can act as carriers for hydrophobic bioactive compounds, and molecular probes can assist in characterizing the microenvironment of emulsified droplets or delivery vehicle cavities. Molecular rotor 9-(2-carboxy-2-cyanovinyl)-julolidine was utilized as a probe for microviscosity in such dispersions. Their utility as a probe in emulsifiers has been completed and will be published within the next year.

RESEARCH SUMMARIES

SUSTAINABILITY AND CLEAN-LABEL

Osvaldo Campanella

O. Campanella continued research on food waste valorization by improving the function of plant-based ingredients for use in sustainable food products. One of the key challenges in replicating the textural qualities of meat products is replacing animal fat in plant-based meats. ***Chong Teng*** evaluated the textural utility of an alginate-based emulsion gel component for use as a fat analog in plant-based meat formulations [37].

Several projects have been carried out to improve the physical properties and digestibility of protein ingredients derived from pea and corn. A series of studies performed by ***Dan Zhang*** determined the physical functionality, structure and digestibility of pea protein following processing operations as influenced by pH, ions, pectin or polyphenols [38, 39]. Similarly, ***Guido Rolandelli*** evaluated alkaline pH treatments combined with calcium incorporation on dough mixtures of pea protein with corn protein [40]. He extended this work in a collaboration with B. Hamaker to the use of pea and corn proteins in high moisture extrusion [41]. This effort has extended to understanding the effects of proteolysis and ions on pea protein gels prepared with cellulose gum [42].

Beans present another promising source of sustainable ingredients, particularly in the form of soluble dietary fiber. ***Ana Magallanes Lopez*** explored how the classification of milled bean fractions and cooking processes influences the physical function and dietary fiber content of bean flours [43]. Additionally, meat byproducts are a major waste stream with potentially valuable protein. To address this, ***Chih Chun Kuo*** investigated fermentation processes involving acid whey and these byproducts to produce valuable peptides [44]. She is continuing expanding this work to valorize fish waste.

Steve Lindemann

S. Lindemann's group established a new effort to upcycle agricultural residues for improved economic and environmental sustainability. Given the large quantities of waste streams, especially for brans, generated in food processing, valorization of these products may assist in improving overall profitability. Key advancements in this area in 2024 were 1) development of a fermentation-based system aimed at improving the nutrition quality and serving as a mechanism to transfer healthy gut bacteria to swine, with the goal of reducing morbidity and mortality associated with weaning stress, and 2) discovery of microbial targeting for novel fibers derived from agricultural waste streams [45]. Commercialization of such fibers may allow the modulation of health outcomes using otherwise low-value feedstocks as inputs and improve overall process profitability. Staff involved in these projects were ***Miguel Alvarez***, ***Rwivoo Baruah*** and ***Anurag Pujari***.

Mario Martinez

M. Martinez's team has established green chemistry routes and/or technologies to transform polysaccharides into high-performing biomaterials, incorporate polysaccharides into high-performing bioplastics, and evaluate the chemical safety of polysaccharide-based bioplastics as food contact packaging materials. Emmanouil D. Tsochatzis, ***Natalia Prieto***, ***Guillermo Portillo-Perez***, Wenqiang Bai, ***Wanxiang Guo*** and ***Kasper Skov*** used catalyst-free reactions using polycarboxilic acids or deep eutectic solvents to modify starch [46]. Reaction optimization in these solvents resulted in no side products, fast reaction rates (36 minutes), high degrees of substitution (2.87), and high starch loads (20 wt%). Based on previous work with deep eutectic solvents for the acetylation of pure wheat starch, an additional study used the solvents to acetylate macromolecules within bread particles [47]. A high degree of substitution with acyl groups was achieved within 36 minutes, while starch was only degraded to a minimum average molecular weight of 2.62×10^6 g/mol. Thermogravimetric analysis suggested a potential enhancement in hydrophobicity and glass transition temperature in the reacted samples.

In a related study, stale bread was upcycled into flexible self-standing films by combining milled bread waste with a simple plasticizer [48]. Films were flexible and semi-transparent with 2,2-diphenyl-1-picrylhydrazyl-radical scavenging capacity and even greater elongation at break than films made from wheat flour. Milled bread waste was also upcycled into xerogels or aerogels by gelatinization and drying in partial vacuum or supercritical carbon dioxide, respectively [49].

In another set of studies, the team utilized pectins from different sources to create films with acetylated starch [50]. Prepared starch-pectin films showed comparable mechanical strength and stiffness to some high-performance petroleum-based plastics, such as conventional oil-based poly(propylene) and poly(ethylene) films. When compared to films made with citrus peel pectin, sugar beet pectin showed higher miscibility and compatibility with acetylated starch in the hot-pressed films, especially with highly acetylated starch. Migration of semi- and non-volatile compounds from these films or from films made with pure pea starch or acetylate pea starch was negligible, indicating that they are safe for food contact packaging. Apart from these highlighted projects, M. Martinez has contributed several other publications in the area of sustainability [51-56].

Eun Joong Oh

Lignocellulosic biomass is a significant waste stream for a variety of industries utilizing plant material. A key challenge in bioprocessing such renewable biomass lies in effectively integrating metabolic pathways to enhance stress tolerance, productivity and the synthesis of diverse bioproducts. By utilizing advanced CRISPR/Cas9 genome-editing techniques, E.J. Oh continues to develop yeast strains to efficiently metabolizes carbon sources derived from lignocellulosic biomass. ***Dahye Lee***, ***Chenhai Li*** and ***Deokyeol Jung*** are utilizing the yeast *Issatchenkia orientalis* as a promising microbial chassis for enhanced organic acid biosynthesis, specifically by identifying strains to convert biomass into 3-hydroxypropionic acid. Such strains must have acid-resistance to tolerate acetate-rich conditions and utilize the acetate as a substrate.

Senay Simsek

S. Simsek's group has developed a research program focused on the integration of cereal and crop quality with the structure-function relationships of carbohydrates to improve sustainability. Development of sustainable and clean-label foods utilizing carbohydrates and waste streams from industrial processes is an ongoing effort in their laboratory. Recent studies have illustrated the importance of arabinoxylan as a functional ingredient in bread formulations [57] and the impact of the biochemical processes occurring during bread making on arabinoxylan structure [58, 59] due to sourdough and yeast fermentation. These studies with ***Kristin Whitney*** and other collaborators highlight the changes to arabinoxylan and associated ferulic acids in bread making as well as how arabinoxylan from other sources can be supplemented to produce clean label high fiber bread.

Other research projects have focused on improving wheat-based products through use of carbohydrates such as ß-cyclodextrin [60] or roasting as a sustainable processing practice [61, 62]. Projects utilizing arabinoxylans from corn processing waste by ***Kristin Whitney*** and visiting students Abdul Alahmed and ***Marcos Leon-Bejerano*** sought to produce sustainable and biodegradable packaging materials, including those utilizing electrospun fibers [63, 64].

Along with ***Kristin Whitney*** and O. Campanella, S. Simsek also worked on nutritional and health benefits of legume products [43]. Projects are also underway to demonstrate sustainable utilization of components from hemp seed or amaranth, and one publication has so far resulted [65]. As part of this objective, ***Elise Whitley*** and ***Kristin Whitney*** utilized enzymatic treatment of industrial hemp cake to produce plant-based proteins with high dietary fiber. These studies highlight the benefits of fiber from grains and legumes that can improve public health outcomes. In terms of educational writing, S. Simsek and B. Reuhs recently summarized characterization of carbohydrates using nuclear magnetic resonance for a popular student textbook [36].

Yuan Yao

Many plant-based meat analogue products utilize carbohydrate gums, particularly methylcellulose, to improve the texture and integrity to the extruded plant-based proteins. Methylcellulose is not perceived favorably by consumers, so identifying suitable replacements would benefit perception of plant-based meat alternatives. Recent work in Y. Yao's laboratory has developed protein-based binder ingredients with comparable functionality to methylcellulose in model patty systems. This work, performed by ***Zhuoran Chen***, has been assembled into a recent patent application.

RESEARCH SUMMARIES

HEALTHY OUTCOMES

Thaisa Cantu-Jungles and Bruce Hamaker

Dietary fibers can interact with other food components in modulating the gut microbiome. T. Cantu-Jungles and B. Hamaker have studied the effects of food components beyond dietary fiber on gut microbiota modulation and how they interact with fibers to modify the gut microbiome. The effects of fiber-polyphenol interactions on the gut microbiome have been evaluated by ***Nuseybe Bulut*** through a series of *in vitro* studies which showed that certain polyphenol-fiber combinations can shape the gut microbiome in specific directions. Moreover, studies on fiber-protein blends have shown the potential of proteins in modulating the gut microbiome and increasing butyrate production by the gut microbiota [66]. Additionally, a study by ***Yony Roman-Ochoa*** showed that dietary fibers can help mitigate the adverse effects of stressors present in foods on the gut microbiome, such as heavy metals [67], with certain fibers being more effective than others in reducing these harmful impacts. Overall, this research demonstrates that fiber interactions are nutrient-specific and largely depend on the fiber's physicochemical properties.

Tzu-Wen Cross

Research in T.-W. Cross' laboratory continued in the identification of links between the gut microbiome, hormonal changes, and metabolic dysfunction in women. The decline in ovarian hormones affects the gut microbiome, increasing the risk of metabolic diseases such as obesity and cardiometabolic syndrome. Recent work showed a clear relation between gut microbiome and menopause-related disease states, implying potential routes for microbiome-related therapies in post-menopausal women [68]. Another study showed gut microbiome shifts when oral contraceptives were used in combination with regular exercise [69].

Research on equol production from soy isoflavones demonstrated the influence of gut bacteria on the health benefits of soy consumption [70]. Her laboratory has contributed to studies on microbiome relationships with kidney disease [71] and lactose tolerance [72]. She was also involved in studies on the relationship between diet and microbiome, including diets incorporating dietary fiber [73, 74]. Furthermore, T.-W. Cross served as a guest editor for a special issue of Nutrients focusing on the influence of prebiotics and probiotics on human health.

Mario Ferruzzi

M. Ferruzzi's program continued research on dietary bioactives in food materials and how they are impacted by food processing. His studies explored how maternal diet affects the concentrations of carotenoids and polyphenol metabolites in human milk, with notable findings related to maternal FUT2 secretor status [75, 76] and other health aspects [77-79]. Additionally, he investigated how the body digests and absorbs starch and phenolic compounds from phenolic-rich flours and carbohydrate-rich foods subjected to physical treatments, such as vacuum oven drying and freeze-drying after pre-treatment with ferulic acid [80-82]. As a global leader in chemistry-guided human nutrition, he contributed to an editorial publication on science-based frameworks to classify processed foods with the ultimate aid of guiding future research and health policies [83]. Work has also been performed on general dietary balance, such as fat consumption, on gut microbiome, insulin resistance, and short-chain fatty acid production [84, 85].

Bruce Hamaker

Dietary impacts of carbohydrates on the gut microbiota, gut-related hormones, satiety and health outcomes remain an essential aspect of B. Hamaker's research program. ***Rosa Lopez*** has continued the group's research on using starch and other dietary carbohydrates with digestion directed to the small intestine ileum to activate the GLP-1-associated gut-brain axis for reducing food intake. With funding from the Heartland Children's Nutrition Collaborative, and with collaborators at Indiana University School of Medicine Pediatric Division, they will be doing clinical and animal studies to test GLP-1 activating carbohydrates. Another study from the past year demonstrated the capacity for components of traditional foods rich in polysaccharides to improve aspects associated with gut health. A clinical study of ***Marian de Campos Costa*** and ***Fernando de Barros*** showed that kombucha, a fermented tea product, significantly altered the microbiota composition in obese individuals [86, 87]. This could imply therapeutic benefits of such traditional fermented products for the treatment of obesity-related symptoms if these microbiome compositions are instrumental in health aspects beyond the gut.

Collaborative research with L. Reddivari and performed by ***Edward Moncada*** also showed that certain polysaccharides common in the dietary fiber fraction of fruits and grains provided greater butyrate production and gut barrier integrity [88].

Steve Lindemann

S. Lindemann's laboratory continues to broadly research the interactions between dietary components (especially fibers and cereal-derived phenolics), microbiome community structure, microbiome function and health outcomes. Major emphases were 1) establishment of a cell culture-based system to screen microbial fermenta of fibers for influences on epithelial and immune function, 2) investigation into wheat bran phenolic biotransformation and uptake of products by epithelia (using the aforementioned model), 3) development of a functional biosensor to measure human microbiome fermentative function on identical playing fields across individuals, 4) determining the extent to which *in vitro* fermentation results relate to in vivo community structure and function changes, and 5) measurement of human microbiome resilience to fiber (inulin) supplementation (required to design clinical trials).

In addition, collaborative studies were performed to identify the extent to which dietary patterns influence health [74, 89]. Specifically, studies sought to identify the extent to which whole grain vs. refined grain intake influences health outcomes in prediabetes and how obesity influences microbial metabolism of inulins and fatty acids. This work aims to establish parameters for better testing of fibers in humans and measuring health-relevant parameters in humans, which may speed up the testing process for novel and modified fibers and assist in designing studies maximally likely to reveal health outcomes upon which claims could be made. Scientists involved in these projects were ***Peter Jackson***, ***Mariana Guzmán***, ***Adam Quinn*** and ***Yuxin Wang***.

Lavanya Reddivari

Dietary flavonoids and fibers protect against intestinal mucus degradation, chronic inflammation, and gut barrier dysfunction because they are transformed into potent anti-inflammatory metabolites by gut bacteria. Emerging evidence from L. Reddivari's research suggests that the therapeutic effects of these bioactives differ significantly based on gut microbial composition and gut inflammation. Using mice models, ***Jose Haro Reyes*** carried out a study to determine the effect of healthy human-associated microbiota transplanted into the mice gut on the anti-colitic activity of diets rich in anthocyanins (3-hydroxyflavanoids) and phlobaphenes (3-deoxyflavanoids). In general, diets containing anthocyanins improved barrier function parameters. However, the recipient's microbiota composition had a significant impact on diet effects [90, 91]. Aside from these findings, L. Reddivari collaborated in projects on other aspects of gut health and inflammation [70, 92, 93].

ANNOTATED PUBLICATIONS

COMPONENTS FOR HEALTHY PROCESSED FOODS

[1] M. Yu, **N. Bulut**, X. Zhao, **R.J. López Rivera,** Y. Li, **B.R. Hamaker** (2024). Modulation of gut microbiota by the complex of caffeic acid and corn starch, *Journal of Agricultural and Food Chemistry*, 72,(51), 28412-28424.

Fourier transform infrared spectroscopy and X-ray diffraction analysis revealed hydrogen bonding in coheated samples and enhanced V-complex formation with high-pressure homogenization. Fermentation of the digested complex with human feces increased the yield of acetate, butyrate, and total short-chain fatty acids, which was more pronounced in homogenized complexes.

[2] G.T. Choque-Delgado, A.R. Condo-Mamani, M.G. Quispe-Sucso, **B.R. Hamaker** (2024). Nutritional and functional value of Andean native legumes and their potential industrial application, *Plant Foods for Human Nutrition*, 79,(4), 719-729.

[3] E. Bertoft, A. Blennow, **B.R. Hamaker** (2024). Perspectives on starch structure, function, and synthesis in relation to the backbone model of Amylopectin, *Biomacromolecules*, 25,(9), 5389-5401.

[4] H. Xu, N.A. Pudlo, **T.M. Cantu-Jungles**, **Y.E. Tuncil**, X. Nie, A. Kaur, **B.L. Reuhs**, E.C. Martens, **B.R. Hamaker** (2024). When simplicity triumphs: niche specialization of gut bacteria exists even for simple fiber structures, *ISME Communications*, 4,(1).

A study on corn bran arabinoxylan (CAX) and its hydrolyzates examined how gut bacteria compete based on fiber complexity, revealing that different *Bacteroides spp* exhibit distinct growth preferences. While *Bacteroides cellulosilyticus* thrived on both complex and simple structures, *Bacteroides ovatus* only grew well on simpler structures, highlighting how dietary fiber composition influences bacterial competition and gut microbiome dynamics.

[5] M. Zavadinack, **T.M. Cantu-Jungles**, H. Abreu, O.K. Ozturk, L.M.C. Cordeiro, R.A. de Freitas, **B.R. Hamaker**, M. Iacomini (2024). (1 → 3),(1 → 6) and (1 → 3)-ß-D-glucan physico-chemical features drive their fermentation profile by the human gut microbiota, *Carbohydrate Polymers*, *327*, 121678.

The physicochemical properties of (1→3),(1→6)-ß-D-glucans, particularly solubility and branching pattern, were shown to dictate their fermentation profile by the human gut microbiota. This study underscores the importance of selecting dietary fibers with specific physicochemical properties to strategically modulate the gut microbiome to promote human health.

[6] **T. Cantu-Jungles**, D. Hall, C. Goetz, A. Keshavarzian, **B. Hamaker** (2024). Designed dietary fiber prebiotics for gut-brain axis health, *Current Developments in Nutrition*, *8*.

We have designed a prebiotic fiber blend to promotes complementary groups of microbes in the large intestine. In a clinical trial with Parkinson's disease individuals, these were demonstrated to improve gut microbiota composition, reduce gut leakiness, and reduce inflammation in the gut and in the brain in only 10 days of supplementation. These results indicate that fiber blends can be designed to promote gut and whole-body health.

[7] **T. Cantu-Jungles,** M. Zavadinack, **N. Bulut**, T. Johnson, M. Iacomini, **B. Hamaker** (2024). Circumventing interindividual variability: Dietary fibers of high specificity allow predictable shifts in the gut microbiota, *Current Developments in Nutrition, 8*.

A new classification of dietary fibers based on their specificity to gut microbes is proposed, which is linked to their physicochemical properties. In an in vitro fecal fermentation study, we showed that high-specificity fibers (more complex in physicochemical features), but not low-specificity ones, produce intense and consistent responses across different individuals.

COMPONENTS FOR HEALTHY PROCESSED FOODS (CONT.)

[8] A. Yaşar, H.-J. Ryu, E. Esen, İ. Sarıoğlan, **D. Deemer**, B. Çetin, S.-H. Yoo, **S.R. Lindemann**, **B.-H. Lee**, **Y.E. Tunçil** (2024). The branching ratio of enzymatically synthesized α-glucans impacts microbiome and metabolic outcomes of in vitro fecal fermentation, *Carbohydrate Polymers, 335*, 122087.

This paper demonstrates that changes in the branch density of a synthesized dextran imparted by different enzyme stoichiometries retarget the fiber to different microbiota, especially with respect to *Bacteroides spp*.

[9] **S. Arioglu-Tuncil**, **D. Deemer**, **S.R. Lindemann**, **Y.E. Tunçil** (2025). Coconut (L.) and carob (L.) flours dietary fibers differentially impact fecal microbiota composition and metabolic outputs in vitro, *Food Science & Nutrition, 13*,(1), e4724.

Here we demonstrate that fibers from understudied sources (coconut and carob) have differential impacts on community structure and short-chain fatty acid production in fecal fermentations. Coconut flour dietary fibers promoted butyrate-producing bacteria including *Roseburia* and *Coprococcus*, whereas carob flour dietary fibers stimulated *Prevotella spp*. Coconut flours were found to be as butyrogenic as inulins, though slower.

[10] Ö.F. Çelik, E. Daştan, Ö.F. Çetiner, O. Baş, Z. Bulut, B. Zhang, **S.R. Lindemann**, M.İ. Tugay, M. Değermenci, B. Suvarıklı-Alan, M. Nizamlıoğlu, **Y.E. Tunçil** (2025). Gut microbiome and tissue morphology modulatory effects of hazelnut (natural, roasted, and skin) fibers in different colonic segments of mice, *eFood, 6*,(1), e70031.

Here, we demonstrated that hazelnut dietary fibers derived from nuts and skins are influenced by roasting processes. Mice were fed natural hazelnut, roasted hazelnut, or hazelnut skin dietary fibers for 6 weeks. 16S rRNA sequencing revealed hazelnut fibers promoted Lactobacillus animalis, L. gasseri, and Akkermansia muciniphila, with variations among hazelnut types, and colon segment and sex. Furthermore, hazelnut skin fibers increased crypt height in the distal colon.

[11] **I.M. Lopez-Rodulfo**, E.D. Tsochatzis, E.W. Stentoft, P. Martinez-Carrasco, **J.D. Bechtner**, **M.M. Martinez** (2024). Partitioning and in vitro bioaccessibility of apple polyphenols during mechanical and physiological extraction: A hierarchical clustering analysis with LC-ESI-QTOF-MS/MS, *Food Chemistry,* 8320.

The food matrix intricately controls polyphenol release during digestion, limiting dihydrochalcones, mono-/dimeric flavanols, and hydroxycinnamic acids while boosting flavonol bioaccessibility. Hierarchical clustering of polyphenol subclasses reveals specific interactions with apple cell wall polysaccharides during cold pressing and digestion. This insight enhances understanding of polyphenol behavior, offering opportunities to optimize nutritional delivery in functional foods.

[12] **P. Gallego-Lobillo**, **I.M. Lopez-Rodulfo**, **M.M. Martinez** (2025). Rat small intestine extract as a source of mammalian α- and ß-glycosidases to study polyphenol bioaccessibility and deglycosylation in vitro: A case study with matrix-devoid and matrix-defined apple fractions, *Food Research International, 199,* 115346.

This study investigated the effect of rat small intestine extract (RSIE) as an affordable source of mammalian α- and ß-glycosidases in different food matrices: matrix-devoid whole apple extract, whole apple, apple juice, and apple pomace. Using the INFOGEST 2.0 model, transepithelial polyphenol absorption, UHPLC-ESI-QTOF-MS/MS, and the inclusion of RSIE at the 15 U*mL–1 maltase activity reported in the human epithelium, the role of RSIE in polyphenol bioaccessibility and deglycosylation was explored.

[13] **I.M. Lopez-Rodulfo**, E.W. Stentoft, **M.M. Martinez** (2025). Comparative assessment of polyphenol bioaccessibility in cold-pressed apple fractions using static and semi-dynamic digestion models, *Food Research International, 202*, 115743.

Semi-dynamic digestion protocol was standardized for the analysis of phytochemical thoroughly tracking polyphenol subclasses concentrations through the oro-gastro-intestinal digestion employing high resolution mass spectrometry. Adaptations on agitation set-up and gastric-emptying time were implemented, and analyzed employing a series of apple food matrix: whole apple, pomace, juice and apple polyphenol extract.

[14] **M. Franco**, **M.J. Spotti**, M. Gomez, **M.M. Martinez** (2024). Understanding the influence of the arabinoxylan-rich psyllium (plantago ovata) husk on dough elasticity and bread staling: Interplay between biopolymer and water dynamics, *Food Hydrocolloids, 154*, 110099.

The addition of psyllium husk to wheat bread increased water absorption and retained more free water within the dough, delaying crumb hardening and loss of cohesiveness during storage. It did not interfere with amylopectin retrogradation or gluten plasticization, but enhanced crumb resilience and elasticity, suggesting its potential to reduce bread staling.

[15] Navneet, **M.M. Martinez**, I.J. Joye (2024). Heat-treated bean flour: Exploring techno-functionality via starch-protein structure-function analysis, *Food Hydrocolloids, 157,* 110416.

[16] **N.P. Vidal**, M.C. Charlampita, **M.J. Spotti**, **M.M. Martinez** (2024). Multifunctional phloroglucinol-loaded pea starch coating for refrigerated salmon, *Food Packaging and Shelf Life, 43*, 101277.

[17] **K.B. Skov**, S. Suwal, M. Corredig, **M.M. Martinez** (2024). New milk protein anisotropic structures formed by high moisture extrusion, *Food Hydrocolloids, 149,* 109645.

[18] T.J. Woodbury, **L.J. Mauer** (2024). Investigation of oligosaccharides and allulose as sucrose replacers in low-moisture wire-cut cookies, *Food Research International, 192,* 114844.

Effects of allulose and various OS [fructo-oligosaccharides (FOS), galacto-oligosaccharides (GOS), lactosucrose (LOS), isomalto-oligosaccharides (IMO), Promitor 70R (P70R), and xylo-oligosaccharides (XOS)] on the baking performance attributes of wire-cut cookie doughs and cookies were assessed in terms of appearance, spread, color, texture, and % moisture loss after baking. Ability of OS to match Tgel of the starch with sucrose produced reduced-sugar cookies with similar appearance, color, and spread attributes compared to the sucrose control. Cookies containing allulose were the least similar to the control, and OS recommended as sucrose replacers in cookies based on principal component analysis groupings were: XOS > IMO > LOS > and GOS.

[19] **L.J. Mauer** (2024). Moisture and total solids analysis, in: *B.P. Ismail, S.S. Nielsen (Eds.), Nielsen's Food Analysis, Springer International Publishing, Cham*, pp. 233-260.

Moisture assays can be one of the most important analyses performed on a food product and yet one of the most difficult from which to obtain accurate and precise data. This chapter describes direct and indirect methods for moisture content analysis, as well as water activity measurement and moisture sorption isotherms.

[20] **E. Moncada**, **N. Bulut**, S. Li, T. Johnson, **B. Hamaker**, **L. Reddivari** (2024). Dietary fiber's physicochemical properties and gut bacterial dysbiosis determine fiber metabolism in the gut, *Nutrients, 16*,(15), 2446.

Gut bacterial dysbiosis has been shown to be highly influential in the metabolism of the fibers. The findings demonstrated the role of dietary fiber's physicochemical properties in fiber fermentation and their role in fiber selection for UC patients to obtain potential health benefits with minimal intolerance.

INNOVATIONS IN PROCESSED FOOD QUALITY

[21] K.C. Huber, **J.N. BeMiller** (2024). Carbohydrate analysis, in: *B.P. Ismail, S.S. Nielsen (Eds.), Nielsen's Food Analysis, Springer International Publishing, Cham*, pp. 303-329.

[22] **L.S. Pinho**, P.M. Lima, **F. Fang**, J.L. Cooperstone, C.S. Favaro-Trindade, **O.H. Campanella** (2024). Effect of extrusion process conditions on extrudates enriched with carotenoids encapsulated by different methods using gum arabic and vegetable fat as carriers, *International Journal of Biological Macromolecules, 267,* 131200.

[23] **D. Donmez**, J. Limon, J.P. Russi, A.E. Relling, K. Riedl, M. Manubolu, **O.H. Campanella** (2024). Encapsulation of fish oil, a triglyceride rich in polyunsaturated fatty acids, within a maillard reacted lecithin-dextrose matrix, *Journal of Agriculture and Food Research, 18*, 101283.

INNOVATIONS IN PROCESSED FOOD QUALITY (CONT.)

[24] S. Shan, D.R. Heldman, **O.H. Campanella** (2024). Specific heat smoothing methods for numerical heat transfer analysis involving phase change in a Model Food System, *Food Engineering Reviews, 16*,(1), 116-128.

[25] G. Chen, I.M. Khan, T. Zhang, **O.H. Campanella**, M. Miao (2024). Alternansucrase as a key enabling tool of biotransformation from molecular features to applications: A review, *International Journal of Biological Macromolecules, 279*, 135096.

[26] B.-Y. Choi, D.-H. Seo, **B.R. Hamaker**, S.-H. Yoo (2024). Enhanced production of turanose using a mutant amylosucrase from Bifidobacterium thermophilum immobilized on silica carriers, *International Journal of Biological Macromolecules, 282*, 136981.

Turanose (α-d-glucopyranosyl-(1→3)-α-d-fructose) is a rare disaccharide that is a potential low-calorigenic sweetener. This novel sucrose isomer has been efficiently synthesized by the amylosucrase from Bifidobacterium thermophilum (BtAS). The BtAS variant was immobilized on porosity-controlled silica carrier, and its enzymatic properties were thoroughly investigated.

[27] Y. Yang, Y. Sun, T. Zhang, **B.R. Hamaker**, M. Miao (2024). Insights into the catalytic properties of 4,3-α-glucanotransferase to guide the biofabrication of α-glucans with low digestibility, *Food & Function, 15*,(16), 8274-8285.

Three starches with different amylose contents were modified by 4,3-α-glucanotransferase to identify conversion rates, resulting structure, and digestibility. Enzyme catalysis increased the amount of α-1,3 glycosidic linkages in products (highest 33.5%), the digestibility of 4,3-α-GTase derived α-glucans conformed to a first-order two-phase equation, and the equilibrium digestibility was controlled between 43.2–72.1%.

[28] J.R.N. Taylor, H.L. de Kock, E. Makule, **B.R. Hamaker**, P. Milani (2024). Reduction in rancidity development in fortified whole-grain maize meal by hot-air drying of the grain, *Cereal Chemistry, 101*,(2), 323-333.

This work investigated whether rancidity development in micronutrient-fortified WGMM is retarded by drying the grain of safe moisture content to below a set level using a commercial hot-air grain dryer before milling. Drying maize grain to 11.6% moisture substantially retards rancidity development in fortified whole grain development, probably by inactivating the grain's lipase and oxidative enzymes.

[29] D. Dufour, H. Ceballos, C. Hershey, **B. Hamaker**, J. Lorenzen (2024). Tropical roots, tubers and bananas: new breeding tools and methods to meet consumer preferences, *Journal of the Science of Food and Agriculture, 104*,(8), 4481-4484.

[30] **R. Zhu**, **O.G. Jones** (2024). Effect of high acyl gellan gum and pH on the structural and foaming properties of heated whey protein suspensions, *Food Chemistry, 449*, 139255.

Association and formation of heat-treated complexes were assessed in mixtures of whey protein and gellan gum, which is a much larger anionic polysaccharide than has been studied in past experiments. Innovations in the study include improved isolation of gellan gum and analytical approaches for association that accommodate higher baseline turbidity. Gellan gum was as effective at association and reduction in thermal aggregate size as more strongly charged polysaccharides.

[31] G. Yazar, **J.L. Kokini**, B. Smith (2024). Impact of endogenous lipids on mechanical properties of wheat gluten fractions, gliadin and glutenin, under small, medium, and large deformations, *Lipidology, 1*,(1), 30-51.

The removal of lipids reduced gliadin's water absorption and increased glutenin's affinity for water, altering their viscoelastic properties during mixing and deformation. Lipid removal led to higher shear-thinning in gliadin and reduced elasticity in glutenin, highlighting the critical role of endogenous lipids in balancing gluten protein behavior under strain.

[32] G. Yazar, B. Smith, **J.L. Kokini** (2024). Effects of mixing and large-amplitude oscillatory shear deformations on microstructural properties of gliadin and glutenin as captured by stop-flow frequency sweeps in small-amplitude oscillatory shear, *Foods, 13*,(20), 3232.

Prolonged mixing increased the elasticity of gliadin, while glutenin's elasticity remained constant but showed decay after large deformations. These findings highlight how mixing time and strain magnitude influence the mechanical properties of gluten proteins, with gliadin becoming more elastic and glutenin experiencing structural weakening under prolonged mixing.

[33] D. Liu, H.D.B. Helmick, **J.L. Kokini**, A.K. Bhunia (2024). Protocol to reveal the binding partner of secreted housekeeping enzymes in Listeria monocytogenes via in silico prediction to in vivo validation, *STAR Protocols, 5,*(1), 102839.

This study reveals the binding partner of a secreted housekeeping enzyme, alcohol acetaldehyde dehydrogenase (Listeria adhesion protein), in Listeria monocytogenes through *in silico* modeling and *in vivo* experiments.

[34] K. Benbow, H. Helmick, **J.L. Kokini** (2024). Plant-based egg washes for use in baked goods: Machine learning and visual parameter analysis, *Journal of Food Science, 89*,(11), 7059-7075.

Pea protein-glycerol coatings were tested as sustainable alternatives to egg washes for baked goods, with results showing that all formulations provided higher gloss, especially at an 80%/20% ratio. Color differences were minimal at lower application weights, and machine learning models effectively estimated color under varying lighting conditions, supporting pea protein's potential as an egg wash replacement.

[35] B.P. Ismail, **B.L. Reuhs** (2024). High-performance liquid chromatography, in: *B.P. Ismail, S.S. Nielsen (Eds.), Nielsen's Food Analysis, Springer International Publishing, Cham*, pp. 193-205.

[36] **S. Simsek**, **B.L. Reuhs** (2024). Nuclear Magnetic Resonance, in: *B.P. Ismail, S.S. Nielsen (Eds.), Nielsen's Food Analysis, Springer International Publishing, Cham*, pp. 135-146.

SUSTAINABILITY AND CLEAN-LABEL

[37] C. Teng, D. Chen, **O.H. Campanella** (2024). Structural and textural properties of a novel animal fat-trimming analog based on salted butter and alginate, *LWT, 192*, 115538.

Fat analog material prepared by emulsion gels of alginate and salted butter indicated consistent lipid structure. Texture profile analysis showed decreased cohesiveness, springiness, and chewiness with increased butter content, whereas hardness was first reduced and then increased.

[38] D. Chen, S. Stone, J. Ilavsky, **O. Campanella** (2024). Effect of polyphenols on the rheology, microstructure and in vitro digestion of pea protein gels at various pH, *Food Hydrocolloids, 151,* 109827.

Pea proteins became less heat resistant in the presence of green tea polyphenols at pH5 and pH7, but not at pH8.5. In vitro digestion found the soluble protein content of digesta of pea protein-polyphenol gels had a 5–8.5 % decrement with the presence of larger peptides when compared to pea protein gels.

[39] D. Zhang, D. Chen, **O.H. Campanella** (2024). Effect of pH on the gelling properties of pea protein-pectin dispersions, *Food Hydrocolloids, 151*, 109731.

The storage modulus of pea protein gels at pH 5.5 increased with 0.5% of LM pectin, whereas 1% of LM pectin led to a decreased elasticity and water holding capacity. At pH 7 and 8.5, the addition of LM pectin increased the size of protein aggregates due to the segregative phase separation of negatively charged pea proteins and LM pectins. Use of these properties is being used to develop high moisture extrusion process to increase the texture and the nutrition qualities of plant based foods.

SUSTAINABILITY AND CLEAN-LABEL

(CONT.)

[40] G. Rolandelli, S. Shan, **O.H. Campanella** (2024). Effects of alkalinization and addition of pea protein as a co-protein to zein for the development of gluten-free doughs, *Food Hydrocolloids, 146,* 109313.

Gluten-free doughs prepared with pea protein isolate and zein under alkaline conditions. Small and large deformation rheological tests indicated that the combination of pea protein and the alkaline treatment of zein improved the gluten-free rheological properties, leading to a similar rheological performance to the control containing gluten. The sole addition of pea protein to zein, or the alkaline deamidation of zein alone, did not generate doughs with desirable rheological behaviors.

[41] G. Rolandelli, O.K. Ozturk, A.M.V. Giraldo, **B.R. Hamaker**, **O.H. Campanella** (2024). Textural improvement of pea protein-based high-moisture extrudates with corn zein and rice starch, *International Journal of Biological Macromolecules, 281,* 135960.

[42] N. Nourmohammadi, **O.H. Campanella**, D. Chen (2024). Effect of limited proteolysis and CaCl2 on the rheology, microstructure and in vitro digestibility of pea protein-carboxymethyl cellulose mixed gel, *Food Research International, 188*, 114474.

[43] A.M. Magallanes López, **O.H. Campanella**, **S. Simsek** (2024). Effects of cooking and market classes on nutritional and antioxidant properties of dry bean flours and soluble dietary fiber-rich fractions, *Bioactive Carbohydrates and Dietary Fibre, 32*, 100454.

The study highlights the significant influence of market class and cooking process on the nutritional and antioxidant properties of dry beans, suggesting their potential contributions to dietary health.

[44] **C.-C. Kuo**, D. Chen, R. Jiménez-Flores, M. Wick, **O. Campanella** (2024). Valorization of byproducts from meat and dairy industries through fermentation to produce peptides, *Sustainable Food Technology, 2,*(5), 1469-1475.

[45] Z. Alkay, **M.A.A. Gonzales**, E. Esen, İ. Sarıoğlan, **S. Arioglu-Tuncil**, E. Dertli, **S.R. Lindemann**, **Y.E. Tunçil** (2024). In vitro fecal microbiota modulation properties of pectin and xyloglucan from hazelnut (Corylus avellana L.) skin, an industrial byproduct, and their incorporation into biscuit formula, *International Journal of Biological Macromolecules, 279*, 135383.

Here, we demonstrate targeting of different fiber fractions extracted from hazelnut skin in vitro. Further, this paper demonstrates utility of these fibers when added to formulations.

[46] **G.A. Portillo-Perez, K.B. Skov**, **M.M. Martinez** (2024). Starch esterification using deep eutectic solvents as chaotropic agents and reaction promoters, *Green Chemistry, 26,*(4), 2225-2240.

An efficient and sustainable starch esterification was performed with acetic anhydride (AA), avoiding initiators and optimizing molar ratios, time, and temperature. The reaction system comprising 1:1 molar ChCl : urea and AA showed good miscibility at 100 °C after 30 minutes, representing a seemingly homogeneous reaction system while better preserving starch molar mass. Reaction optimization resulted in no side products, fast reaction rates (36 minutes), high DS (2.87) and starch loads (20 wt%), and increased reaction throughput and atom economy.

[47] **K.B. Skov**, **G.A. Portillo-Perez**, **M.M. Martinez** (2025). Deep eutectic solvent-assisted starch acetylation within stale bread particles to improve water resistance, *International Journal of Biological Macromolecules, 288*, 138603.

Using deep eutectic solvents (DES) as reaction promoters for the acetylation of pure wheat starch, this study explored combinations of reaction time, temperature and acetic anhydride: bread molar ratios to acetylate macromolecules within bread particles relying solely on macromolecule solvation and the slightly basic environment provided by the eutectic mixture. High degree of substitution with acyl groups (DSacyl, 0.73–1.09 as quantified by 1H NMR and confirmed by 13C NMR, and FTIR) was achieved within a short timeframe of 36 minutes and < 16 acetic anhydride:bread molar ratio.

[48] **W. Guo**, **M.J. Spotti**, **G. Portillo-Perez**, J.C. Bonilla, W. Bai, **M.M. Martinez** (2024). Molecular changes and interactions of wheat flour biopolymers during bread-making: Implications to upcycle bread waste into bioplastics, *Carbohydrate Polymers, 342*, 122414.

This study investigates the molecular and supramolecular transformations of wheat endosperm biopolymers during bread-making and their implications for repurposing stale white bread into self-standing films. The researchers found that bread baking significantly reduces the molecular weight of amylose and water-extractable arabinoxylans, while shortening amylose chain length, leading to the formation of flexible, transparent films with high light-blocking properties and radical scavenging ability. These findings provide a pathway to convert bread waste into biodegradable bioplastics, addressing the demand for sustainable materials in food packaging.

[49] **W. Guo**, T. Budtova, **M.M. Martinez** (2025). Upcycling stale bread into (meso)porous materials: Xerogels and aerogels, *Food Hydrocolloids, 160*, 110807.

This study explores the upcycling of stale bread into bio-based, low-density, porous materials through gelatinization and drying, using either supercritical CO_2 (aerogels) or low-vacuum drying (xerogels). The findings reveal that xerogels and aerogels exhibit similar porosity characteristics (with differences of less than 10%), indicating that cost-effective low-vacuum drying can be used to produce mesoporous materials from stale bread. This innovative approach opens avenues for integrating stale bread with other polymers to develop non-biodegradable porous materials for various applications.

[50] **W. Bai**, **G. Portillo-Perez**, S. Petronilho, I. Gonçalves, **M.M. Martinez** (2024). Exploring novel organocatalytic-acetylated pea starch blends in the development of hot-pressed bioplastics, *International Journal of Biological Macromolecules, 258*, 128740.

The feasibility of thermomechanically compounding organocatalytically acetylated pea starch (APS), produced at two different degrees of substitution with alkanoyl groups (DSacyl, 0.39 and 1.00), with native pea starch (NPS), high (HMP) and low methoxyl (LMP) citrus pectin, and sugar beet pectin (SBP, a naturally acetylated pectin) for developing hot-pressed bioplastics was studied. APS (any DSacyl) significantly increased the visible/UV light opacity of NPS-based films and decreased their water vapor transmission rate (WVTR, by ca. 11 %) and surface water wettability (by ca. 3 times). In comparison to NPS-APS films, pectin-APS showed higher visible/UV light absorption, tensile strength (ca.2.9–4.4 vs ca.2.4 MPa), and Young's modulus (ca.96–116 vs ca.60–70 MPa), with SBP-APS presenting significantly lower water wettability than the rest of the films.

[51] D.J. Gonzalez-Serrano, I.E. Benmebarek, M. Hadidi, **J.D. Bechtner**, **M.M. Martinez**, B. Cabañas, A. Moreno (2025). Optimization of microwave-assisted hydrothermal extraction of homogalacturonan-rich, low methoxyl pectin from discarded garlic peels: Comparative macromolecular and functional analysis with conventional extraction, *Food Hydrocolloids, 166*, 111324.

[52] T.H. Pham, R. Thomas, C. Schwab, **M.M. Martinez**, **N.P. Vidal** (2024). Unraveling the neutral and polar lipidome of Nordic brown macroalgae: A sustainable source of functional lipids, *Food Chemistry, 459*, 140415.

[53] S. Petronilho, **M.M. Martinez** (2024). Rethinking agri-food and marine waste and byproducts for circular and sustainable bio-based food packaging, *MDPI*-Multidisciplinary *Digital Publishing Institute*, p. 252.

[54] M. Guo, K. Xu, J. Yee, J.R. Dutcher, **M.M. Martinez**, L. Roman (2024). Comparative rheology and antioxidant potential of high-methoxyl sugar acid gels of unrefined powder and acid-extracted pectin from two hawthorn (crataegus pinnatifida) fruit cultivars, *LWT, 203*, 116331.

[55] F. Nasrollahzadeh, N. Alexi, **K.B. Skov**, L. Roman, K. Sfyra, **M.M. Martinez** (2024). Texture profiling of muscle meat benchmarks and plant-based analogues: An instrumental and sensory design approach with focus on correlations, *Food Hydrocolloids, 151*, 109829.

[56] F. Aghababaei, D.J. McClements, **M.M. Martinez**, M. Hadidi (2024). Electrospun plant protein-based nanofibers in food packaging, *Food Chemistry, 432*, 137236.

SUSTAINABILITY AND CLEAN-LABEL

(CONT.)

[57] **M. Hussain**, **S. Simsek** (2024). Impact of ferulated arabinoxylans from maize bran on farinograph and pasting properties of wheat flour blends, *Foods, 13*,(21), 3414.

Ferulated arabinoxylan (FAX) addition profoundly influences the rheological and pasting properties of wheat flour. The results underscore the value of FAXs as a functional ingredient with bioactive properties that could be effectively leveraged to enhance the nutritional profile and modify the structural characteristics of baked products.

[58] J. Kulathunga, **K. Whitney**, **S. Simsek** (2024). Changes to structural and compositional features of water-soluble arabinoxylans in sourdough bread, *Journal of Agricultural and Food Chemistry, 72*,(36), 20056-20063.

Transforming flour into sourdough bread resulted in the molecular degradation of AX, significantly reducing its molecular weight and leading to a more heterogeneous fine structure. This detailed characterization of AX's alterations during food processing provides insights into evaluating its potential health benefits in whole-grain products.

[59] Y. Nishitsuji, **K. Whitney**, K. Hayakawa, **S. Simsek** (2024). Dynamic changes in ferulic acid and diferulic acids in wheat flour doughs during the breadmaking process, *Food Chemistry, 443*, 138524.

This research identified four specific wheat-derived diferulic acids: 8–5′-DFA, 5–5′-DFA, 8-O-4′-DFA, and 8–5′-DFA (benzofuran form), tracking their variations throughout breadmaking. The notable upsurge in diferulic acid levels in the early fermentation stages suggests that the cleavage of ferulic acid moieties may not be the primary factor contributing to the reduction in AX molecular weight.

[60] K. Iduoku, M. Ngongang, J. Kulathunga, A. Daghighi, G. Casanola-Martin, **S. Simsek**, B. Rasulev (2024). Phenolic acid–ß-cyclodextrin complexation study to mask bitterness in wheat bran: A Machine Learning-Based QSAR Study, *Foods, 13*,(13), 2147.

The models revealed several factors responsible for binding with cyclodextrin, showing positive contributions toward the binding affinity values, including such features as the presence of six-membered rings in the molecule, branching, electronegativity values, and polar surface area.

[61] J. van Rooyen, J.A. Delcour, S.A. Oyeyinka, **S. Simsek**, M. Kidd, M. Manley (2024). Prior roasting of wheat impacts on the functionality of flour prepared from it: Part 1. Wheat flour viscosifying properties, *Cereal Chemistry, 101*,(3), 530-543.

Roasting induces structural changes in wheat. Flour produced from roasted wheat can be used to produce gel structures with increased viscosities. Dry thermal treatment improves the viscosifying properties of flour milled from roasted wheat.

[62] J. van Rooyen, J.A. Delcour, S.A. Oyeyinka, **S. Simsek**, M. Kidd, M. Manley (2024). Prior roasting of wheat impacts on the functionality of flour prepared from it: Part 2. Wheat protein functionality, *Cereal Chemistry, 101*,(3), 544-553.

Effective control of wheat roasting conditions proved to be essential to avoid the irreversible loss of flour functionality as deduced from the flour ethanol and lactic acid solvent retention capacity and mixography data. Response surface models predicted roasting at 108°C and 80 Hz (135 s) to maintain protein integrity. The microstructure of flour and isolated starch as well as X-ray diffraction patterns revealed starch to be relatively unaffected by this heat treatment.

[63] A. Alahmed, **S. Simsek** (2024). Improving biodegradable films from corn bran arabinoxylan for hydrophobic material and green food packaging, *Foods, 13*,(12), 1914.

Modified wet milled corn bran arabinoxylan (AX) film was more hydrophobic, and the modified DDGS AX film was more biodegradable than the modified dry milled corn bran AX film. Overall, surface modifications have potential for improving hydrophobicity of biopolymer films.

[64] A. Alahmed, **S. Simsek** (2024). Enhancing mechanical properties of corn bran arabinoxylan films for sustainable food packaging, *Foods, 13*,(9), 1314.

Collectively, surface modifications have rendered the arabinoxylan (AX) films with heightened mechanical properties — namely tensile strength, tear tolerance, and puncture resistance — thereby enhancing their suitability as robust food packaging materials. Among these, the modified AX film derived from dry milled corn bran exhibited superior physical and mechanical characteristics compared to films made from corn byproducts.

[65] E. Vidal Torres, E. Valencia, **S. Simsek**, A.M.L. Ramírez (2024). Amaranth: Multipurpose agroindustrial crop, *Agronomy, 14*,(10), 2323.

Amaranths are an excellent source of nutrients, containing a balanced set of amino acids in both the leaves and grains. Lysine, an amino acid often limited in cereals, is significantly higher in amaranths. Additionally, protein percentages in the leaves of Elena and Aurelia were notably higher (by 3 percentage units) compared to the leafy Callaloo. At the same time, the grains averaged 19% protein, much higher than any cereal grain.

HEALTHY OUTCOMES

[66] R. Jackson, **T. Yao**, **N. Bulut**, **T.M. Cantu-Jungles**, **B.R. Hamaker** (2024). Protein combined with certain dietary fibers increases butyrate production in gut microbiota fermentation, *Food & Function, 15*,(6), 3186-3198.

Certain fiber-protein combinations were shown to boost butyrate production during an in vitro fecal fermentation demonstrating prebiotic potential. This is especially relevant given the rising protein-to-fiber ratio entering the large intestine and may be particularly significant for plant proteins, which tend to be less digestible in the upper GI and therefore reach the large intestine in higher amounts compared to animal proteins.

[67] Y. Román-Ochoa, **T. M. Cantu-Jungles**, G.T. Choque Delgado, **N. Bulut**, T.R. Tejada, H.R. Yucra, A.E. Duran, **B.R. Hamaker** (2024). Specific dietary fibers prevent heavy metal disruption of the human gut microbiota in vitro, *Food Research International, 176*, 113858.

Our findings suggest that dietary fibers play a role in mitigating the adverse effects of heavy metal exposure on gut microbiota health and may have implications for the development of dietary interventions to reduce dysbiosis associated with heavy metal exposure.

[68] **T.-W.L. Cross**, S.A.M. R., L. Ching-Yen, H.N. M., B.A. P., P.S. J., N.E. R., L.B. R., W.M. A., V.E. I., S. Jan, R.M. R., R.F. E., K.S. and Swanson (2024). Gut microbiome responds to alteration in female sex hormone status and exacerbates metabolic dysfunction, *Gut Microbes, 16*,(1), 2295429.

Ovariectomy, simulating menopause, led to increased gut permeability, inflammation, and metabolic dysfunction, which were worsened by a high-fat diet. Fecal microbiota transplantation from ovariectomized mice induced weight gain and metabolic dysfunction in recipient mice, highlighting the gut microbiome's role in hormone-related metabolic disorders and its potential as a therapeutic target for menopause-related diseases.

[69] A. Organski, A. Reddivari, K.N. Fuller, J.P. Thyfault, **T.-W.L. Cross** (2024). Oral contraceptive usage impacts exercise-induced changes in the gut microbiota, *Current Developments in Nutrition, 8*.

12 weeks of oral contraceptives use did not drastically impact the gut microbiota. However, a significant interaction between exercise and contraceptives on the gut microbiota was present whereby exercise-induced changes in microbial taxa associated with energy expenditure may be diminished.

[70] L.M. Leonard, A.M.R. Simpson, S. Li, **L. Reddivari**, **T.-W.L. Cross** (2024). A gnotobiotic mouse model with divergent equol-producing phenotypes: Potential for determining microbial-driven health impacts of soy isoflavone daidzein, *Nutrients, 16*,(7), 1079.

The gnotobiotic mouse model system designed in this study can successfully establish microbiomes with divergent equol-producing phenotypes in vivo and be utilized to establish a causal relationship between equol and the consumption of soy isoflavones.

HEALTHY OUTCOMES *(CONT.)*

[71] G.N. Wiese, A. Biruete, E.R. Stremke, **S.R. Lindemann**, A. Jannasch, R.N. Moorthi, S.M. Moe, K.S. Swanson, **T.W. Cross**, K.M. Hill Gallant (2024). Gut microbiota and uremic retention solutes in adults with moderate CKD: A 6-day controlled feeding study, *Journal of Renal Nutrition, 34*,(1), 26-34.

The relationship was determined between gut microbiota composition and uremic retention solutes in adults with moderate chronic kidney disease. The findings suggest that specific alterations in gut microbiota may influence the accumulation of these solutes, potentially impacting disease progression and patient health.

[72] M. Ramakrishnan, **T.-W.L. Cross**, A.K. Wilcox, A.C. Organski, R.L. Rhine, S.M. Saiprasad, A.M.R. Simpson, D.J. Tancredi, M.J. Van Haute, C.M. Christensen, Z.T. Lewis, T.A. Auchtung, J. Walter, R. Hutkins, D.A. Savaiano (2024). Two-week supplementation of *bifidobacterium adolescentis* iVS-1 reduces fecal urgency and diarrhea and enhances overall lactose tolerance in lactose maldigesters, *medRxiv*, 2024.12.16.24319107.

A clinical trial investigated the effects of daily supplementation with *Bifidobacterium adolescentis* iVS-1 over two weeks in individuals with lactose intolerance. The study found that participants receiving iVS-1 experienced a significant reduction in overall gastrointestinal symptoms, particularly fecal urgency and diarrhea, suggesting that this probiotic strain may effectively alleviate symptoms associated with lactose maldigestion.

[73] C.-Y. Teng, N.-J. Kao, N.T.K. Nguyen, C.-I. Lin, **T.-W.L. Cross**, S.-H. Lin (2024). Effects of xylo-oligosaccharide on gut microbiota, brain protein expression, and lipid profile induced by high-fat diet, *The Journal of Nutritional Biochemistry, 129*, 109640.

Xylooligosaccharide supplementation improved spatial learning and memory function, decreased amyloid plaque accumulation, increased brain-derived neurotrophic factor levels, and improved neuroinflammation status in the hippocampus. Additionally, supplementation inhibited weight gain, decreased epididymal fat weight, and improved fasting blood sugar and blood lipid levels.

[74] **Y. Wang**, **T.-W.L. Cross**, **S.R. Lindemann**, M. Tang, W.W. Campbell (2024). Healthy dietary pattern cycling affects gut microbiota and cardiovascular disease risk factors: Results from a randomized controlled feeding trial with young, healthy adults, *Nutrients, 16*,(21), 3619.

This paper documents significant shifts in human gut microbiome community structure and function in humans shifting to a healthy eating pattern in a full-feeding trial. The shifts arising from dietary pattern shifts from baseline to controlled (experimental) diets occur regardless of protein type in the diet (the intended experimental variable in the trial).

[75] C. Fiecke, M. Crimmins, C. Sims, L. Bode, A. Martinez, **M.G. Ferruzzi**, A. Andres (2024). Maternal FUT2 secretor phenotype is associated with human milk oligosaccharides and polyphenol metabolites following a mediterranean dietary intervention: A Pilot Study, *Current Developments in Nutrition, 8*.

The influence of maternal diet on human milk bioactive composition differs based on maternal secretor status.

[76] C. Fiecke, M. Crimmins, A. Hameed, C. Sims, D.K. Williams, L. Bode, A. Martinez, A. Andres, **M.G. Ferruzzi** (2024). Dietary modulation of human milk bioactives is associated with maternal FUT2 secretor phenotype: an exploratory analysis of carotenoids and polyphenol metabolites, *Frontiers in Nutrition, 11*.

The influence of maternal diet on composition of human milk oligosaccharides and polyphenol metabolites in human milk differs based on maternal secretor status.

[77] A.M.R. Simpson, M.J. De Souza, J. Damani, C.J. Rogers, N.I. Williams, C.M. Weaver, **M.G. Ferruzzi**, C.H. Nakatsu (2024). Gut microbes differ in postmenopausal women responding to prunes to maintain hip bone mineral density, *Frontiers in Nutrition, 11*.

A 12-month study on postmenopausal women consuming prunes (50–100 g/day) found that only some individuals ("responders") experienced improved bone mineral density (BMD), which was linked to differences in gut microbiome composition and immune responses. Responders had lower

inflammatory markers (IL-1ß, TNF-α) and a higher abundance of specific gut bacteria (Oscillospiraceae, Lachnospiraceae), suggesting that gut microbiota plays a key role in determining the bone-protective effects of prunes, informing potential precision nutrition strategies.

[78] K.J. Koltun, N.C.A. Strock, C. Weaver, H. Lee, N.I. Williams, C.J. Rogers, J. Damani, **M.G. Ferruzzi,** C.H. Nakatsu, M.J. De Souza (2024). Prunes preserve cortical density and estimated strength of the tibia in a 12-month randomized controlled trial in postmenopausal women: The Prune Study, *Osteoporosis International, 35*,(5), 863-875.

Prune consumption preserved three-dimensional BMD and estimated strength at the tibia.

[79] J.J. Damani, C.J. Rogers, H. Lee, N.C.A. Strock, K.J. Koltun, N.I. Williams, C. Weaver, **M.G. Ferruzzi,** C.H. Nakatsu, M.J. De Souza (2024). Effects of prune (dried plum) supplementation on cardiometabolic health in postmenopausal women: An ancillary analysis of a 12-Month randomized controlled trial, The Prune Study, *The Journal of Nutrition, 154*,(5), 1604-1618.

[80] B. Munoz, M. Hayes, P. Perkins-Veazie, N. Gillitt, M. Munoz, C.D. Kay, M.A. Lila, **M.G. Ferruzzi**, M. Iorizzo (2024). Genotype and ripening method affect carotenoid content and bio-accessibility in banana, *Food & Function, 15*,(7), 3433-3445.

The study investigates how genotype and ripening methods affect carotenoid content and bio-accessibility in bananas, with findings showing that total carotenoid content (TCC) generally increases as bananas ripen. The research highlights that ripening method (natural vs. ethylene-induced) significantly impacts carotenoid levels, and bio-accessibility varies across genotypes, suggesting that both ripening practices and banana varieties are crucial factors for optimizing carotenoid delivery in biofortification programs aimed at addressing vitamin A deficiency.

[81] C. Fiecke, S.B. Kalambur, A. Bhaskar, **M.G. Ferruzzi** (2024). Modification of starch digestibility and phenolic bioaccessibility in phenolic-rich flours by physical treatments with ferulic acid followed by vacuum oven and freeze-drying, *LWT, 197*, 115889.

Acidified water steeping with ferulic acid (FA) was used to modify starch digestibility and phenolic bioaccessibility in potato starch, black rice, and purple maize flours, but it resulted in reduced phenolic content (~75%) and increased starch digestibility. While FA loading capacity was higher in potato starch than in the flours, its bioaccessibility decreased with increased FA content, and steeping enhanced cyanidin 3-O-glucoside bioaccessibility while FA addition reduced it.

[82] A. Cruz-Carrion, F.M.A. Langston, A.P. Neilson, J.R. Bows, G.R. Nash, **M.G. Ferruzzi** (2024). Ingredient processing influences the bioaccessibility of broccoli phytochemical from baked snacks, *Current Developments in Nutrition, 8*.

Pre-processing vegetable ingredients by drying (freeze and hot air) did reduce small intestinal bioaccessibility. However, when considering all phytochemicals, using fresh and frozen broccoli as ingredients rather than dried resulted in snacks with a higher content of bioaccessible phytochemicals.

[83] P.R. Trumbo, R. Bleiweiss-Sande, J.K. Campbell, E. Decker, A. Drewnowski, J.W. Erdman, **M.G. Ferruzzi**, C.G. Forde, M.J. Gibney, J.M. Hess, D.M. Klurfeld, M.E. Latulippe, L.E. O'Connor, K.J. Reimers, B.J. Rolls, J. Schulz, C. Weaver, L. Yu (2024). Toward a science-based classification of processed foods to support meaningful research and effective health policies, *Frontiers in Nutrition, 11*.

Based on a meeting held by the Institute for the Advancement of Food and Nutrition Sciences in May 2023, this paper provides perspectives on the broad array of foods classified as HPF/UPFs based on processing and formulation, including contributions to nutrient intake and dietary patterns, food acceptability, and cost.

HEALTHY OUTCOMES *(CONT.)*

[84] E.F. Ortega, **W. Guo**, J.L. Sevigny, D. Wu, J.W. Crott, L. Lijun, W.K. Thomas, M.C. Dao, R.S. Lan, **M. Ferruzzi**, S.K. Boehm, S.N. Meydani (2024). The gut microbiome across the murine lifespan: Impact of diet and its association with inflammation, lipids, liver cancer, and lifespan, *Current Developments in Nutrition, 8.*

Fruit and vegetable consumption shapes the aging gut microbiome by promoting the enrichment of bacterial genera associated with metabolism of plant-derived polyphenols and complex carbohydrates. It also attenuates the enrichment of microbial signatures linked to liver cancer and obesity in the context of a high-fat diet.

[85] K.C. Racine, L. Iglesias-Carres, J.A. Herring, K.L. Wieland, P.N. Ellsworth, J.S. Tessem, **M.G. Ferruzzi**, C.D. Kay, A.P. Neilson (2024). The high-fat diet and low-dose streptozotocin type-2 diabetes model induces hyperinsulinemia and insulin resistance in male but not female C57BL/6J mice, *Nutrition Research, 131,* 135-146.

A study evaluating a high-fat diet and low-dose streptozotocin (STZ) model for type 2 diabetes (T2D) in male and female mice found significant sex differences in disease manifestation. While both sexes developed impaired glucose tolerance, only males exhibited fasting hyperglycemia, hyperinsulinemia, and insulin resistance, suggesting this model is not suitable for studying T2D in females and highlighting the challenge of translating preclinical findings across sexes.

[86] **M.A. de Campos Costa**, V. da Silva Duarte, J. Bressan, H.S. Duarte Martino, **F.A. Ribeiro de Barros**, **B.R. Hamaker** (2024). Regular intake of black tea kombucha modulated the gut microbiota of individuals with and without obesity, *Current Developments in Nutrition, 8*.

Subjects were allocated into two groups, according to their features: normal weight + black tea kombucha; obese + black tea kombucha. After eight weeks of intervention, kombucha favored microorganisms such as Bacteroidota, Akkermanciaceae, and Prevotellaceae and reduced the abundance of microorganisms associated with obesity, such as Ruminococcus and Dorea, especially in the obese group.

[87] **M.A.d.C. Costa**, V. da Silva Duarte, G.M. Fraiz, R.R. Cardoso, A. da Silva, H.S.D. Martino, C.T. dos Santos D'Almeida, M.S.L. Ferreira, V. Corich, **B.R. Hamaker**, A. Giacomini, J. Bressan, **F.A.R.d. Barros** (2024). Regular consumption of black tea kombucha modulates the gut microbiota in individuals with and without obesity, *The Journal of Nutrition, In Press, Corrected Proof.*

[88] **E. Moncada**, **P. Andino**, T. Johnson, **B. Hamaker, L. Reddivari** (2024). Exploring the role of gut bacterial dysbiosis and gut inflammation in fiber tolerance, *Current Developments in Nutrition, 8*.

[89] M. Gurung, B.T. Schlegel, D. Rajasundaram, R. Fox, L. Bode, **T. Yao**, **S.R. Lindemann**, T. LeRoith, Q.D. Read, C. Simecka, L. Carroll, A. Andres, L. Yeruva (2024). Microbiota from human infants consuming secretors or non-secretors mothers' milk impacts the gut and immune system in mice, *mSystems, 9*,(4), e00294-24.

This paper explores how microbiota from infants fed mother's milk differs based upon the mother's ability to secrete 2-fucosyllactose when transplanted into germ-free mice and how that microbiota influences physiology.

[90] **J. Haro-Reyes**, J.K. Raghupathi, **L. Reddivari** (2024). Composition of human-associated gut microbiota determines 3-DF and 3-HF anti-colitic activity in IL-10 -/- mice, *Nutrients, 16*,(23), 4232.

The effects of 3-DF and 3-HF on gut inflammation and gut barrier protection depend on the composition of human-associated microbiota. Overall, anthocyanin-rich diets exhibited greater versatility than phlobaphenes in their capacity to improve colitis-associated conditions.

[91] **V.B. Nathan**, **S. Eckrote**, S. Li, **L. Reddivari** (2024). Crude blueberry phenolic extracts improve gut barrier integrity and exert anti-inflammatory and antimicrobial activity in an in vitro weaning stress model, *Antioxidants, 13*,(9), 1044.

Polyphenolic extracts from blueberries were able to improve the antioxidant status, decrease paracellular permeability and inflammation in vitro. Furthermore, high doses of the extract exhibited antimicrobial activity, suggesting functional feed rich in polyphenols could be used as a possible nutritional intervention in early weaning-stressed piglets.

[92] N.L.F. Gallina, N. Irizarry Tardi, X. Li, A. Cai, M.J. Horn, B.M. Applegate, **L. Reddivari**, A.K. Bhunia (2024). Assessment of biofilm formation and anti-inflammatory response of a probiotic blend in a cultured canine cell model, *Microorganisms, 12*,(11), 2284.

LabMAX-3 (Lactobacillus acidophilus, Enterococcus faecium, and Lacticaseibacillus casei) successfully inhibited the growth of notable canine-associated pathogens (Salmonella enterica, Listeria monocytogenes, and enterotoxigenic Escherichia coli) suggesting its potential to improve canine gut health.

[93] B. Jiang, N. Quinn-Bohmann, C. Diener, **V.B. Nathan**, Y. Han-Hallett, **L. Reddivari**, S.M. Gibbons, P. Baloni (2024). Understanding disease-associated metabolic changes in human colon epithelial cells using *i*ColonEpithelium metabolic reconstruction, *bioRxiv*, 2024.10.22.619644.

Constructed the first cell-type-specific GEM of human colonic epithelial cells to simulate and explore their metabolic activities. The *i*ColonEpithelium has the capacity to achieve essential metabolic functions of human colonic epithelial cells.

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General Research Areas

- Starch
- Carbohydrate chemistry

Specific Research Areas

- Starch granule structure, reactivity and behavior
- Chemical and biological modifications of starch
- Structure-functional property relationships of polysaccharide



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General Research Areas

- Process modeling
- Rheology
- Material structure and texture
- Extrusion

Specific Research Areas

- Application of rheology to food science and food engineering
- Mathematical modeling of food process operations
- Online rheological techniques
- Rheology of biomaterials, dough, dairy products
- Characterization of material structure and texture; relationship to rheological properties
- Effect of glass transition on product texture
- Bioplastics: Uses of food processing wastes
- Reactive extrusion in the production of foods and bioplastics
- Production of plant-based meat analogs by extrusion technology



Thaisa Cantu-Jungles

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General Research Areas

- Carbohydrates and health
- Gut microbiota function
- Dietary fiber physico-chemical structure

Specific Research Areas

- Mechanistic design of prebiotic fiber mixtures for gut and whole-body health
- Interactions between carbohydrates and other nutrients in gut microbiota modulation
- Physico-chemical modifications of fibers to enhance prebiotic activity
- Targeted promotion of beneficial gut bacteria through prebiotics and development of symbiotics
- Design of prebiotics for suppressing potential gut pathogens



Teresa Carvajal

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General Research Areas

- Surface science of carbohydrate materials
- Characterization of film and powder materials relevant to food and pharmaceuticals
- Food, pharmaceutical and biological processes

Specific Research Areas

- Physical (particle morphology) and surface chemical factors governing particulate interactions
- Relationships between surface-structure and process-performance of food and pharmaceutical powders, composites, films
- Concepts of particle and powder technology
- Assessment of surface particle interactions on powder flow, mixing/de-mixing agglomeration, caking, sintering



R. Chandrasekaran

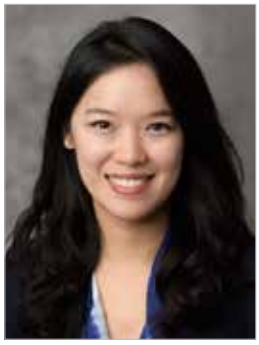
chandra@purdue.edu

General Research Areas

- X-ray diffraction
- Molecular architecture of biopolymers

Specific Research Areas

- Starch crystallinity
- Conformation of carbohydrates and nucleic acids
- Structure-function relationships in polysaccharides and polysaccharide mixtures



Tzu-Wen Cross

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General Research Areas

- Nutrition and the gut microbiome
- Health and disease with sex biases
- Germ-free and gnotobiotic animal models

Specific Research Areas

- Gut microbial metabolism of dietary compounds with estrogenic potentials
- The interactions between nutrition and the gut microbiome on metabolic dysfunction and fertility
- Gut microbial regulation of sex hormone homeostasis



Mario Ferruzzi

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General Research Areas

- Carbohydrate-micronutrient interactions as affecting health
- Analytical approaches for micronutrients, phytochemicals, and their metabolites in complex food and biological matrices

Specific Research Areas

- Characterization of matrix factors that optimize stability and bioavailability of micronutrients and phytochemicals from foods
- Exploration of plant genetic and ingestive factors that impact bioavailability and metabolism of micronutrients and phytochemicals from plant foods using preclinical and clinical models



Bruce Hamaker

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General Research Areas

- Carbohydrates and health
- Starch, chemistry and function
- Dietary fiber, chemistry and function

Specific Research Areas

- Glycemic carbohydrate digestion for slow digestion/low glycemic response, physiological and cellular response
- Dietary fiber, modifications in functionality and gut fermentability, gut microbiota and metabolites
- In vitro-, in vivo-, cell culture studies
- Cereal carbohydrate and protein functionality
- Textural properties influenced by carbohydrates
- Interactions between carbohydrates and other food components
- Processing and nutrition in developing countries



Owen G. Jones

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General Research Areas

- Energy and stoichiometry of polysaccharide interactions with other materials
- Determination of size, morphology and stability of colloidal suspensions
- Atomic force techniques to determine morphology and elasticity of sub-millimeter material

Specific Research Areas

- Role of chemical and physical structures in defining protein-polysaccharide interactions
- Controlled assembly of fibrous or particulate colloids from polysaccharides or proteins
- Emulsifying properties of colloidal materials
- Contributions of colloidal polysaccharide/protein assemblies to films, gels, or pastes



Jozef Kokini

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General Research Areas

- Food materials science
- Linear and non-linear rheology
- Computational fluid dynamics

Specific Research Areas

- Food nanotechnology and fabrication of nano-biosensors
- Phase behavior and compatibility of ingredients in food mixtures
- Food structure and texture during extrusion, mixing processes and computational fluid dynamics



Steve Lindemann

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General Research Areas

- Dietary fiber impacts on gut microbiome diversity, structure and function
- Species-resolved metagenomics and metabolism
- Genomic mechanisms of polysaccharide fermentation
- Carbon, nitrogen and energy cycling by gut microbiota
- Microbiome-mediated impacts on host physiology
- Microbial systems ecology

Specific Research Areas

- Particle size and processing method impacts on microbial metabolism of wheat bran
- Arabinoxylan structure influences on gut microbiome structure and function
- Predictive ecology of gut carbohydrate metabolism
- Fiber targeting to gut microbes
- Microbial division of labor in polysaccharide degradation



Mario Martinez

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General Research Areas

- Structure-function of biopolymers and biopolymeric systems
- Food structuring
- Binding interactions and digestion models

Specific Research Areas

- Structural elucidation of polysaccharides using MS- and NMR-based approaches
- Binding between small metabolites and food macromolecules
- Food and agricultural waste valorization through technology development
- Organocatalytic (or catalyst-free) derivatization of macromolecules
- Structuring of plant-based foods



Lisa J. Mauer

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General Research Areas

- Food chemistry and solid-state characterization
- Water-solid interactions, including moisture sorption
- Food materials science, including glass transitions

Specific Research Areas

- Structure-function relationships of food ingredients
- Small molecule effects on starch functional traits
- Deliquescence
- Crystallization and amorphization



Ganesan Narsimhan

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General Research Areas

- Emulsions and foams
- Biopolymer interactions

Specific Research Areas

- Pore formation by antimicrobial peptides in cell membranes and lipid bilayers
- Pasting behavior of starch
- Stability and texture of food emulsions and foams
- Adsorption of proteins and protein-polysaccharide complexes at interfaces
- Functional properties of proteins and protein-polysaccharide complexes
- Physical and chemical modification of proteins for use as food stabilizers
- Rheology of polysaccharide solutions and gels



Eun Joong Oh

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General Research Areas

- Fermentation science
- Metabolic engineering
- Synthetic biology

Specific Research Areas

- Biotechnological production of food ingredients and value-added chemicals using engineered microorganisms
- Multiplex CRISPR/Cas9-based genome engineering
- Microbial cell factories for industrial bioprocesses
- Regulatory networks in yeast
- Engineering probiotic strains for human health applications



Lavanya Reddivari

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General Research Areas

- Plant bioactive compounds and health
- Flavonoids, fiber and interaction
- Gut microbial metabolism

Specific Research Areas

- Anti-inflammatory plant bioactives for improved gut health
- Reciprocal interaction of gut microbiome and plant bioactives in health and disease
- Interactions between plant bioactives and fiber/starch in the modulation of gut bacteria



Bradley L. Reuhs

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General Research Areas

- Polysaccharide analysis
- Bacterial and plant cell wall compositions, structures and functions
- Sugars and polysaccharides in nutrition and food systems

Specific Research Areas

- Extractions and purification of acidic polysaccharides from cell walls of plants (including food products) and bacteria
- Pectin, hemicellulose, capsule, gum and lipopolysaccharides analysis
- Application of HPLC, MS, GC, GC-MS, FT-IR and NMR to structural studies of carbohydrates, including polysaccharides



Senay Simsek

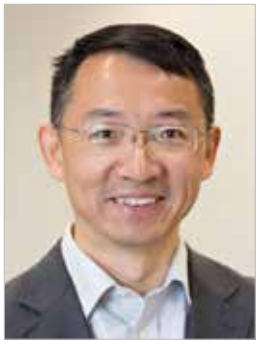
ssimsek@purdue.edu

General Research Areas

- Structure-function relationships of carbohydrates
- Carbohydrates in the baking industry
- Innovative uses for processing by-products and waste materials
- Carbohydrates and bioactives from grains for human health

Specific Research Areas

- Characterization and utilization of industrial hemp grain and byproducts
- Biodegradable superabsorbent materials from hemp fiber
- New carbohydrate functional ingredients
- Grain and legume quality & utilization



Yuan Yao

yao1@purdue.edu

General Research Areas

- Chemistry and genetics of carbohydrate polymers
- Plant-based proteins and meat alternatives
- Nanotechnology for foods and drugs

Specific Research Areas

- Structure, function and applications of phytoglycogen and its derivatives
- Natural emulsifiers and encapsulation wall materials
- New ingredients and formulations for meat alternatives
- Machine learning in food science and technology
- Stabilization, solubilization, and delivery of active ingredients
- Genetic, enzymatic and chemical modifications of carbohydrate polymers
- Evaluation and removal of pathogen biofilms
- Clean label of foods

Adjunct Faculty



Yonas Gizaw, PhD, is currently the CEO of GreenChemSolution consulting firm, leading R&D and formulation services for consumer goods, food, cosmetics, pharmaceutical and ingredient companies. The firm offers specialized consulting services on green chemistry, biodegradable natural polymers, hydrocolloids, surface and interface science, surface modification and self-cleaning technologies to SMEs and major corporations.

He is a co-founder of the Alliance for Research, Innovation, and Education for Africa, a nonprofit organization serving Africa. Before this position he was R&D director-principal scientist at Procter and Gamble Co. A technical leader for chemistry transformative platform technologies in corporate R&D. Dr. Gizaw is a 26-year veteran of P&G with broad experience in biopolymers, nanotechnology, polymers physical chemistry, surfactants, and colloids. He spent about eight years in Snack and Beverages, where he led technology development for beverages (Sunny D) and Snacks (Pringles), then moved to the Fabric Care Strategic Innovation and Technology division, where he was responsible for development of technologies for cleaning and fabric feel (Downy & Tide), etc.

For the last several years he has focused his research on the physical chemistry of wetting phenomena to develop disruptive technologies for cleaning and beautifying under resource-constrained environments (water, energy, ingredients). Before joining P&G, he received his doctoral degree from Purdue University in synthetic carbohydrate chemistry structure and function.

Adjunct Faculty



Bernhard Van Lengerich, PhD, is a former chief science officer and VP of strategic technology development at General Mills and former acting CTO at Beyond Meat. After apprenticeships as artisan baker and pastry chef, he studied food/biotechnology at Technical University of Berlin, Germany, and completed his PhD thesis in the field of extrusion, with summa cum laude. He joined Werner and Pfleiderer (Coperion) in New Jersey as senior process engineer for extrusion, then joined RJR Nabisco, New Jersey, as director of extrusion research. He subsequently assumed the position of vice president of global R&D food at the Buehler Group in Switzerland.

In 1994, Bernhard joined General Mills, Inc. in Minneapolis, where he led all GMI extrusion initiatives and GMI's Game-Changer Innovation Program, and created a novel GMI technology venturing initiative, enabling faster and higher impact innovations. As chief science officer and VP of technology strategy, he was responsible for science and technology development across the company. Bernhard retired from General Mills in 2015.

He is the inventor or co-inventor of more than 150 patents and patent applications, holds an honorarium professorship at Technical University of Berlin, Germany, teaching extrusion science and technology, and he is a fellow of the Institute of Food Technologists in Chicago. Bernhard has been an invited participant in discussions at the White House Office for Science and Technology Policy on global protein security under the Obama administration.

In 2016, he joined Beyond Meat in an advisory role as acting CTO and head of R&D, leading the development and launch of the first Beyond Burger in 2016. He served as board member of Beyond Meat until 2021. Bernhard is the founder of Seeding the Future Foundation, a 501(c) (3) organization focusing on seeding and supporting impactful innovations that help improve our food system. He also initiated the annual Global Food System Challenge, which is funded by the Seeding the Future Foundation.

In addition, Bernhard serves as board member of the German Institute of Food Technology (DIL), Bountifield International, and he is an advisory board member of S2G Ventures, Brightseed Bio, PetriBio, UKKO, and several organizations in the U.S. and Europe.

Visiting Professors



Frederico Barros received his BS degree from Universidade Federal de Vicosa (Brazil), and currently is a professor at the same university. He earned his MS and PhD degrees from Texas A&M University. He joined Dr. Hamaker's group as a visiting professor on sabbatical for one year, starting September 2023. His research investigates the effects of starch/condensed tannins complexes, phenolic compounds and dietary fibers on intestinal health.



Sung Keun Jung spent his sabbatical year in 2024 in Dr. Hamaker's lab researching the effect of fiber from Korean medical plants on the gut microbiota. He also wrote a perspective article on standardization of prebiotics with attention to industrial needs. Sung Keun is a professor at Kyungpook National University in South Korea.

Visiting Professors



Byung-Hoo Lee received his PhD degree from Purdue University under Dr. Hamaker's guidance and later worked as a postdoctoral researcher in the same group from 2008 to 2015. He is currently an associate professor at Sejong University, South Korea. He joined Hamaker's group as a visiting professor in January 2024. His current research focuses on regulating postprandial glucose spikes and insulin levels to control metabolic vicious cycles through three key mechanisms: (1) cellular aging, (2) modulating inflammatory responses via ectopic fat regulation, and (3) dietary cognitive modulation.



Seda Arioglu Tuncil earned her MS (2015) and PhD (2018) degrees in the Department of Food Science Department at Purdue University under the guidance of Dr. Mauer. She returned to Türkiye and worked as an assistant professor in the Department of Nutrition and Dietetics at Necmettin Erbakan University in Türkiye. In 2024, she joined Dr. Lindemann's lab for a one-year sabbatical, supported by a fellowship from the Scientific and Technological Research Council of Türkiye. During her sabbatical, she has been working on gnotobiotic mouse models to understand the diet-gut microbiome-health interactions.



Yunus E. Tuncil obtained his MS and PhD degrees from Texas A&M University and Purdue University, respectively, and completed postdoctoral training in the laboratories of Drs. Hamaker and Lindemann. He is currently an associate professor in the food engineering department at Necmettin Erbakan University in Türkiye. He joined Dr. Lindemann's group as a visiting professor for his sabbatical year in July 2024. His research primarily focuses on elucidating the interactions between dietary components (fibers and phenolic compounds) and the composition of the colonic microbiota, with a particular emphasis on their implications for human health.

Visiting Scientists



Muzzamal Hussain graduated with a BS degree in food science and nutrition (2017) from Government College University, Faisalabad, Punjab, Pakistan. He received his MS degree from there, too, in food science and technology (2019) with a specialization in cereal technology. He is a PhD student researching the extraction of bioactive compounds from maize bran. In 2024, he joined Dr. Simsek's group as a visiting researcher to study nonstarch polysaccharides and bioactive compounds, including extraction, isolation and purification of ferulated arabinoxylans from maize bran using different solvent, time, and temperature modes combined with characterization by chromatographic and spectroscopic methods.



Noriaki Kitagawa received his MS degree in science from Kyoto University, Japan, in 2015. He joined Nagase Viita Co., Ltd. and has worked in the R&D division for nine years. He was engaged in the acquisition of novel carbohydrate-metabolizing enzymes and establishing efficient production methods for useful carbohydrate-related materials. In 2022, he joined Drs. Mauer and Hamaker's laboratories as a visiting scholar for three years. His current research is about the effects of small compounds with unique structures on starch from the aspect of physicochemical properties.



Carolina Lagunes Delgado is a PhD candidate in science in biotic product development from the National Polytechnic Institute (IPN) of Mexico and a visiting scholar in Dr. Campanella's laboratory. She has an MS degree in biotic product development from IPN and a BS degree in biotechnology engineering from Polytechnic University of the State of Morelos (Mexico). Her research focuses on developing pregelatinized starches through an extrusion process with different moisture and temperature conditions for their application in plant-based food products.



Marcos Leon Bejarano received his BS degree from Universidad de Sonora (México) and his MS degree in biosciences there also. He is currently a PhD Candidate studying materials sciences at the Universidad de Sonora. He was a visiting scholar in Dr. Simsek's group from June 2023 to August 2024. His research is focused on the use of plant byproducts as a source of bioactive compounds and their combination with biopolymers for the development of medical materials and functional foods.



Rajashri Lun is a PhD student at CSIR-Central Food Technological Research Institute (CFTRI) in Mysuru, India. She was awarded the SERB-Overseas Visiting Doctoral Fellowship, which she utilized to join Dr. Hamaker's lab as a visiting scholar. Her current research focuses on investigating the impact of prebiotics and nano-encapsulated spice oleoresins on alleviating depression, emphasizing their role in modulating the gut microbiome. She aims to develop functional food-based interventions targeting mental health and neuroprotection.



Zannatun Noor earned her MS degree in chemistry at Brown University, studying the synthesis of precursor organic compounds for the release of reactive sulfur species in biological systems. She joined the laboratory of Dr. Yao as a visiting scholar in 2024. Her current research focuses on the micro-encapsulation of active ingredients using natural emulsifiers to enhance their stability and solubility.



Boram Park is a research scientist at the National Institute of Crop Science, Ministry of Agriculture, Food and Rural Affairs in Korea, and has been working there since 2011. She received her PhD in 2020 for research on an alpha-1,6-rich glucan-synthesizing enzyme. Her current research focuses on starch-based slowly digestible polysaccharides and cereal dietary fibers to investigate their effects on carbohydrate digestion, metabolism, and gut health, and works with Dr. Hamaker on a funded project from her institute.



Miranda Ramos Campos is a BS student in biotechnological engineering at Tecnológico de Monterrey, Mexico. She joined the laboratories of Drs. Jungles and Hamaker as a visiting scholar in August 2024 as part of a student research internship. Her research focuses on designing prebiotics that specifically support gut bacteria related to human health.

Graduate Students



Paola Andino is a MS student in Dr. Reddivari's laboratory. She completed her BS degree in food science and technology at Zamorano University (Honduras). She joined Reddivari's program as a visiting scholar and began her research on fiber before returning as a graduate student. Her current research focuses on evaluating the role of gut bacterial dysbiosis in fiber fermentation and tolerance.



Sajal Bhattarai is a PhD student in Dr. Lindemann's laboratory. He received a BS degree in food technology from Tribhuvan University (Nepal) and a MS degree in biological sciences from South Dakota State University. Sajal completed undergraduate research in water-based edible wood smoke flavors devoid of polycyclic aromatic hydrocarbons and completed his master's thesis on sustainable and strong ligno-cellulosic films as UV-resistant and antioxidant food packaging material. His PhD research is exploring the principle behind the division of labor among gut microbiota members when fed with sorghum arabinoxylans.



Joseph Bogdanovitch is a MS student in Dr. Campanella's laboratory. He received his BS degree in food science and technology from Ohio State University. His current research, funded by the ENGIE-Axium Fellowship, focuses on the modification of high-amylose starches through twin-screw extrusion, investigating their flavor volatile complexing ability, rheological and thermodynamic properties, and functionality in high-moisture plant-based meat analogues.



Kasper Brandhøj Skov is a PhD student in Dr. Martinez' laboratory at Aarhus University (Denmark). He earned his MS degree in chemistry and biotechnology engineering from Aarhus University. Kasper's thesis explored the development of anisotropic structures using proteins, starch and extrusion technology. His current focus is on utilizing chemo-mechanical methods to upcycle waste bread into high-performance biomaterials.



Nuseybe Bulut is a PhD student in Dr. Hamaker's laboratory. She obtained her BS degree in food engineering from Istanbul Technical University (Turkey). Nuseybe received her MS with Hamaker, studying the fabrication of plant cell wall-like materials and their impact on the human gut microbiota. She continues her studies in the area of dietary fiber and the gut microbiome.



Laura Castellanos Suarez is a PhD student in Dr. Campanella's laboratory at Ohio State University. She completed her BS and MS degrees in chemical engineering from Universidad Industrial de Santander (Colombia). Currently, Laura is developing and evaluating an enriched protein ingredient for the food and feed industries. The ingredient is derived from fermenting acid whey waste and mechanically separated poultry using an optimized eREX approach.



Fangxin Chen is a PhD student in Dr. Cross' laboratory. She obtained her bachelor's degree in nutrition science from the University of North Carolina at Chapel Hill. Fangxin's current research project is to study the effects of microbial metabolites on reproduction in the context of obesity.



Anna Clapp Organski is a PhD student in Dr. Cross' laboratory. She received her BS degree in human nutrition, foods and exercise with a concentration in dietetics from Virginia Tech. Anna's research objective is to illuminate the interplay between the gut microbiome and sex hormones homeostasis. The long-term goal of this work is to identify microbial targets for therapeutics, such as pre- and pro-biotics, aimed at treating sex-hormone sensitive diseases.



Erica de Jong is a MS student in Dr. Hamaker's laboratory. She obtained her BS in food and nutrition sciences from California Baptist University. Erica is researching the impact of GLP-1 on second meal intake.



Dila Donmez was a PhD student in Dr. Campanella's laboratory at Ohio State University. She holds a BS degree and MS degree in chemical engineering from Middle East Technical University in Turkey. Dila studied production of Pickering emulsions in a stirred tank. Currently, she is conducting postdoctoral research in another laboratory at Ohio State on encapsulation of bioactive compounds in extrudates, pH-triggered natural polymer gels and 3D printed formulations.



Sarah Eckrote is a PhD student in Dr. Reddivari's laboratory. She obtained her BS degree in biology from Purdue University with undergraduate research on blueberry phenolic compound-pathogen interactions in relation to gut barrier integrity in weaning stress of piglets. Sarah's current research aims to understand polysaccharide-anthocyanin interactions and their potential use as therapeutic agents to address ulcerative colitis and IBD.



Vidarshani Ellepola was a MS student in Dr. Campanella's laboratory at Ohio State University. She earned her BS degree in tea technology and value addition from Uva Wellassa University of Sri Lanka and a professional master's degree in Food Science and Technology from the University of Peradeniya, Sri Lanka. Vidarshani received a Fulbright master's scholarship for her studies at Ohio State. Her dissertation focused on encapsulating vitamin D3 dissolved in hemp seed oil that was protected by a Maillard reacted glycated lecithin matrix for enhanced transdermal delivery. She is currently a lecturer in the Department of Export Agriculture at Uva Wellassa University.



Fang Fang is a PhD student in Dr. Martinez' laboratory at Aarhus University (Denmark). She received her BS and MS degrees in food science and technology from Nanchang University (China). Fang's master's thesis determined the effect of different thermal processing on the in vitro digestion and fermentation characteristic of different whole grains. At Aarhus University, her research focuses on the non-covalent (de-)binding between flavonoids and plant cell walls and their role on the promotion of beneficial colonic bacteria and derived catabolites.



Maria Franco Marcos is a PhD student in Dr. Martinez' laboratory at Aarhus University (Denmark). She earned BS and MS degrees in biology from the University of Leon (Spain), specializing in plant physiology and seed technology. She has actively worked in the food industry for 10 years as the general manager of family businesses (La Tahona de Sahagún, Spain), dedicated to artisan bakery and pastry production. Maria's current research studies the integration of fibers and hydrocolloids, such as psyllium, into wheat dough/bread systems to understand their impact on water and biopolymer dynamics. She also investigates the bioavailability and digestibility of polyphenols after incorporation into bakery products.



Gabriel Santiago Galeano-Garcia is a MS student in Dr. Cantu-Jungle's laboratory. He received his BS in Biology from National University of Colombia. His research focuses on optimizing dietary fiber mixtures to enhance gut health and investigating their effects on short-chain fatty acid production and gut microbiota modulation. Gabriel aims to advance scientific understanding of how mechanistic insights into fiber-microbiota interactions can inform targeted dietary interventions.



Miguel Alvarez Gonzales is a PhD student in Dr. Lindemann's laboratory. He obtained his BS degree in food science and technology from Zamorano University (Honduras) and his MS degree in food science from Purdue University with an emphasis in carbohydrate chemistry. He is currently researching structure and function of carbohydrates, chromatographic techniques, molecular biology techniques, and bioinformatics to characterize wheat bran interactions with the gut microbiome.



Marcelo Guerrero is a MS student in Dr. Lindemann's laboratory. He researches how bacteria degrade and utilize polysaccharide fiber structures, with a broader interest in understanding these processes at the systems level. In addition, he collaborates with other research groups at Purdue University to explore bacteriophages for potential medical applications.



Wanxiang Guo is a PhD student in Dr. Martinez' laboratory at Aarhus University (Denmark). She received her MS degree from South China University of Technology. Wanxiang's research explores the molecular and supramolecular transformations of wheat endosperm biopolymers during bread-making and how these changes can be harnessed to repurpose stale white bread into flexible films and (meso-)porous materials.



Victoria Gutierrez is a MS student in Dr. Lindemann's laboratory. She received her BS in food science and technology from Zamorano University (Honduras). Victoria was previously a visiting scholar at Purdue University, analyzing the degrading capacity of monocultures on sorghum arabinoxylan. Her research, supported by National Science Foundation, assesses the division of labor within the gut microbiota synthetic community and their capacity to degrade sorghum arabinoxylan.



Mariana Guzman is a MS student in Dr. Lindemann's laboratory. She earned her BS degree in agroindustrial production engineering and bioproduction engineering from La Sabana University, Colombia. Her current research focuses on how fiber and fatty acid substrates shape the bacterial metabolome in human gut-derived *in vitro* cultures.



Jose Haro was a PhD student in Dr. Reddivari's laboratory. He earned his BS degree in animal science and his MS degree in animal production at Universidad Nacional Agraria La Molina (Peru). His prior work included several agriculture projects in nutritional ecology, impact of livestock in climate change, and transformation of native food resources. Jose joined Reddivari's lab as a "Bicentenario" Scholarship Fellow (Peruvian government) to determine the impact of bacterial dysbiosis associated with IBD on the anti-colitic effects of dietary 3-deoxy and 3-hydroxy flavonoids.



Veeramani Karuppuchamy is a PhD student in Dr. Campanella's laboratory at Ohio State University. He completed his BS degree in agricultural engineering from Tamil Nadu Agricultural University (India) and a MS degree in agricultural and biosystems engineering from South Dakota State University. Veeramani worked in the food industry as a lab supervisor and quality assurance supervisor before returning to graduate school for another MS degree in food science and technology from Ohio State. His current research focuses on value addition of food industry byproducts using twin screw extrusion for nutrition enhancement and application of rheology in expanded snacks.



Anael Kimble is a PhD student in Dr. Jones' laboratory. She received her BS degree in food science from McGill University (Canada) and worked in the food industry for a few years. Anael obtained her MS degree with Dr. Jones and Dr. Campanella, studying reactive extrusion of bean flour with polysaccharide-specific enzymes. She is currently researching the physical functionality of extracted bean flour components.



Chih-Chun (Ariel) Kuo is a PhD student in Dr. Campanella's laboratory at Ohio State University. She earned her BS degree in nutrition and health sciences from Taipei Medical University (Taiwan) and her MS degree in food science and human nutrition from Iowa State University. Her master's thesis was on biopolymer-based delivery systems using 3D printing technology for probiotic applications in food. Chih-Chun's current research focuses on the valorization of byproducts from the meat, fish and dairy industries using lactic acid fermentation and extrusion, aiming to develop sustainable and value-added ingredients through integrated bioprocessing technologies.



Dahye Lee is a PhD student in Dr. Oh's laboratory. She obtained her BS and MS degrees in food engineering and biotechnology from Dongguk University in South Korea. Her master's thesis was on the anti-biofilm effect of bacteriocins produced by lactic acid bacteria in fermented food. Dahye then worked on a typhoid vaccine clinical trial as a research assistant at the International Vaccine Institute. Her current research engineers Saccharomyces cerevisiae metabolic pathways and produce value-added chemicals from agricultural and forestry residues.



Chenhai Li is a MS student in Dr. Oh's laboratory. He received his BS degree in food science from Purdue University in 2023. His research focuses on discovering unknown metabolic pathways in yeast xylose utilization and applying CRISPR/Cas9-based genome engineering to the acid-tolerant yeast *Issatchenkia orientalis* for enhancing biomass fermentation ability and producing value-added chemicals.



Rafael Linan is a PhD student in Dr. Martinez' laboratory at Aarhus University (Denmark). He received his BS degree in Chemistry from the Universidad de Granada (Spain) and his MS degree in Food Science from Universidad Autónoma de Madrid (Spain), focusing on the valorisation of food by-products. Rafael's current research involves the synthesis of plant cell wall analogues with the aim of understanding the structure and organization of polysaccharides to develop sustainable and bioactive packaging.



Rosa Lopez is a PhD student in Dr. Hamaker's laboratory. She obtained her BS degree in biotechnology at the Monterrey Institute of Technology and Higher Education and a MS degree from the Center for Research and Assistance in Technology and Design of the State of Jalisco, Mexico. Her master's thesis was on delivery capabilities of mucoadhesive polymeric films and emulsions. Rosa's current research focuses on the formation of starch-based complex materials and their evaluation to reach the small intestine and colon to activate physiological systems related to appetite, food intake and weight management.



Ivan Misael Lopez Rodulfo is a PhD student in Dr. Martinez' laboratory at Aarhus University (Denmark). He received his BS degree in chemical bacteriology and parasitology from the Universidad Autónoma de Nuevo León (México) and his MS degree in biomedical physics and engineering at Centro de Investigación y Estudios Avanzados (México). During the past three years, Ivan conducted research on *in vitro* digestion models, high-resolution mass spectrometry, and fecal fermentations at Aarhus University and Purdue University.



Hector Lozano Perez is a PhD student in Dr. Carvajal's laboratory. He was an undergraduate visiting scholar at Purdue University before receiving his BS degree in pharmaceutical sciences from the Universidad Nacional de Colombia. Hector then worked as a quality assurance inspector within the pharmaceutical industry in Colombia. He obtained his MS degree in agricultural and biological engineering at Purdue. Hector's current research focuses on the dynamics of starch particle interactions with enzymes and the flow properties of plant-based proteins. He employs advanced surface characterization techniques of particles and powders.



Duery Fernando Mayta Apaza is a MS student in Dr. Campanella's laboratory at Ohio State University. He earned his BS degree in food engineering from Universidad Mayor de San Andres (Bolivia). Duery was previously a plant manager in cereal storage and processing. His current research is centered on enhancing the processability and digestibility of cereal fibers through reactive enzymatic extrusion for human food and animal feed.



Edward Moncada is a PhD student in Dr. Reddivari's laboratory. He received his BS degree in food science and technology from Zamorano University (Honduras), during which he came to Purdue as a visiting scholar. Edward's research, supported by Whistler Center-funded projects, focuses on assessing dietary fiber tolerance, the role gut bacterial dysbiosis plays in fiber metabolism, and the endogenous polyphenol-polysaccharide interactions in starch absorption and fiber fermentation.



Heather Milliron is a MS student in Dr. Reddivari's laboratory. She obtained her BS in food science and crop science from Purdue University with undergraduate research on phenolic compound extraction efficiency from potato peel waste. She worked as an intern at Cargill, improving flavor replacement and shelf-life of alternative protein products. Her current research is to understand the effect of various combinations of plant extracts against inflammation.



Kamrun Nahar is a MS student in Dr. Yao's laboratory. She received her bachelor of engineering degree in biomedical engineering from National University of Singapore. Kamrun spent six years working in the food industry on plant-based food product development, quality and functionality. Kamrun's current research focuses on functional plant-based materials for emulsification and (micro)encapsulation.



Vignesh Nathan is a PhD student in Dr. Reddivari's laboratory. He completed his BS degree in health and disease (biology) from Purdue University. He studied probiotic feed additives to improve swine nutrition and health. Vignesh worked as an intern at B2S Life Sciences, developing a COVID-19 antibody test. He is currently researching the role that various anthocyanins play in improving the integrity of the gut barrier in piglets during early weaning stress.



José Carlos Orellana is a PhD student in Dr. Martinez' laboratory at University of Valladolid (Spain). He received his BS degree in chemistry from the University of Castilla-La Mancha (Spain) and his MS degree in applied chemistry and pharmacology from the University Jaume I (Spain). José worked for two years as a research assistant in the University of Castilla-La Mancha to valorize byproducts from the agro-industrial sector, particularly plant-based proteins, and obtain valuable biocompounds. Currently, he is studying the upcycling of apple pomace to develop flexible biomaterials using fluid-based technologies.



Theresa Parr is a MS student in Dr. Campanella's laboratory at Ohio State University. She received her BS degree in chemistry from Notre Dame College of Ohio while playing Division II basketball. Her research determines the impact of high moisture extrusion on the rheological and textural properties of extrudates prepared with alternative plant-based protein sources.



Anurag Pujari is a PhD student in Dr. Lindemann's laboratory. He obtained his BS degree in industrial microbiology and his MS degree in microbiology from the University of Pune (India). Anurag's research focuses on the development of chemical probes that mimic certain characteristics of polysaccharides to study the microbial transport and hydrolysis traits as a response to consumption of these polysaccharides. Specifically, Anurag works on understanding the mechanism of hydrolysis of arabinoxylan from the GH43 family of enzymes.



Adam Quinn is a PhD student in Dr. Lindemann's laboratory. He received his BS and MS degrees from Brigham Young University. His doctoral research has investigated impacts of wheat genotypes on gut microbiota fermentation within the context of fiber and microbiome interactions. More recently, he has studied the effects of whole grain consumption on the functionality of gut microbiomes in humans.



Rajsri Raghunath is a PhD student in Dr. Lindemann's laboratory. She obtained her BS degree in food science from Michigan State University. Her undergraduate research was focused on characterizing the allergens in ancient wheat (specifically, *Aegilops tauschii*) and durum wheat. She also worked with mouse models on food allergy and immunology-focused research to understand how wheat allergy develops in transdermally-sensitized BALB/cJ mice. She is currently investigating how cereal fibers originating from different cereal grains influence anaerobic fermentation by intestinal bacteria.



Kayla Roy is a PhD student in Dr. Reddivari's laboratory. She earned her BS degree in biological science-microbiology at the University of Maryland, College Park. Currently, her research investigates colitic animal models, and the role of bacterial dysbiosis on colitis biomarkers and Vitamin D metabolism. The goal of the research is to assess dietary interventions that could be used to restore Vitamin D function.



Shirley Clyde Rupert Brandão is a PhD student in Dr. Campanella's laboratory at Ohio State University. She received her MS degree in chemical and biochemical process engineering at the Federal University of Pernambuco (Brazil), where she determined how infrared drying increased the process efficiency by reducing the drying time and affected the quality parameter. Shirley is currently studying computational fluid dynamics (CFD) to better understand the mass transfer and reaction when ozone gas is applied to prevent mycotoxin production in grains.



Fransheska Semidey is a PhD student in Dr. Oh's laboratory. She received her BS degree in biomedical sciences at the University of Puerto Rico at Ponce and a MS degree in food science and technology at the University of Puerto Rico at Mayaguez. She is engaged in developing methods to minimize undesirable oligosaccharides by utilizing engineered baker's yeast.



Hrithik Shetty is a PhD student in Dr. Campanella's laboratory at Ohio State University. He received his BTech degree in food engineering and technology from the Institute of Chemical Technology, India. His prior research used models to predict moisture transfer effects on the stickiness of vegetable chip mix. Hrithik's research objectives include modeling the complex viscoelastic rheological behavior of protein melts using finite element multiphysics and investigating protein-starch interactions under high-pressure conditions, both providing insights for high-moisture extrusion optimization.



Narakorn Tanasupawimon is a MS student in Dr. Hamaker's laboratory. She completed her BS degree in food science and technology from Kasetsart University (Thailand). Narakorn received a scholarship from the Thai government (Anandamahidol Foundation) for graduate study. Her current research investigates the design of soluble fiber mixtures to promote beneficial gut microbiota growth with the consistent response across individuals.



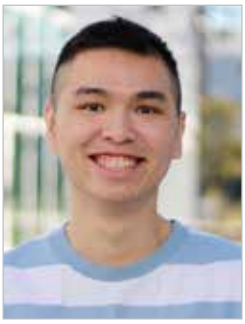
Ana M. Velásquez-Giraldo is a PhD student in Dr. Campanella's laboratory at Ohio State University. She holds a BS degree in agro-industrial engineering from Universidad Pontificia Bolivariana (Colombia) and a MS degree in public policy and administration with a food science policy concentration from the University of Massachusetts, Amherst. Her dissertation work focuses on lipids and their influence in structure development in high moisture extruded plant-based foods. She utilizes imaging approaches to study texturization and determine parameters for extrusion process control.



Kartik Verma is a PhD student in Dr. Campanella's lab. He earned his BS degree in food technology from Panjab University in Chandigarh, India, and a MS in food science from the University of Tennessee. His master's thesis was on multiphysics models for solid-state microwave ovens to improve heating uniformity. Kartik's current research focuses on multiphysics modeling of the extruder cooling die to optimize the texturization of plant-based meat analogs. He is also investigating the structural and functional properties of starch-protein interactions for meat analog applications.



Thomas Vianna is a PhD student in Dr. Campanella's laboratory at Ohio State University. He earned his BS in chemical engineering from Federal University of Viçosa (Brazil) and his MS in the same field from the University of Campinas (Brazil). His current research, in collaboration with Université Paris-Saclay (France), focuses on biopolymer structuring through extrusion for applications in materials and food. Specifically, his goal is to develop a hemp-based meat analogue with an improved textural profile.



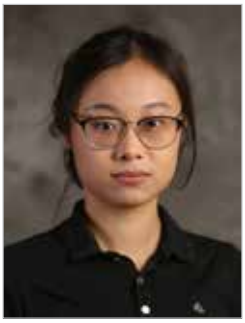
Giang Vu is a PhD student in Dr. Campanella's laboratory at Ohio State University. He earned his BS in food science from University of Massachusetts, Amherst. Giang worked in industrial R&D for two years in plant-based and frozen food sectors. His current research is on how the content of denatured protein impacts overall protein functionality and how this affects product development of plant-based food and ingredients.



Ankur Upadhyay is a MS student in Dr. Campanella's laboratory at Ohio State University. He received a BS in food engineering and technology from ICT, Mumbai (India). Ankur's research topic is on the metal-chelating ability of glycated soybean phospholipids and their application in extruded plant-based meats.



Jared Ward is a MS student in Dr. Mauer's laboratory. He obtained his BS degree in food science from Brigham Young University, where his undergraduate research focused on gluten-free bread staling timeframes and texture profiles. Jared currently researches physical modifications of starch utilizing guest inclusion molecules and evaluates how they compare with unmodified starch in complex food systems.



Luping Xu is a PhD student in Dr. Oh's laboratory. She received her BS and MS degrees in food science from Purdue University. Her master's thesis was on the development of a mammalian cell-based sensor for pathogen detection. Luping has interned at PepsiCo and later worked at Acerand Therapeutics as a scientist, focusing on *in vitro* characterization of small molecule drugs for targeted cancer therapy. She is currently developing bioengineered probiotic yeast strains that can reduce enteric pathogen colonization and promote gut health.



Lauren Sofia Yepes Fernandez is a MS student in Dr. Cantu-Jungles' and Dr. Hamaker's laboratories. She earned her BS in biology from Universidad Nacional de Colombia (Colombia), where her undergraduate research focused on human genetics in disease and microbiome analysis. She was previously in Cantu-Jungles' laboratory as a visiting scholar before beginning her graduate studies. Her research explores strategies to modulate the human gut microbiota through the design of whole food fibers.



Dan Zhang was a PhD student in Dr. Campanella's laboratory at Ohio State University. She received her BS degree from Nanjing Agriculture University and her MS degree from Shanghai Jiao Tong University, both in food science and technology. Dan's master's thesis was on isolation and identification of antimicrobial compounds in galanga using HPLC and GC/MS. Her current research identifies improved functionality of plant proteins by incorporating polysaccharides in gel-reinforced products for potential food packaging applications.



Rui Zhu is a PhD student in Dr. Mauer's laboratory. She received her MS degree from Purdue University; in Dr. Jones' laboratory she determined the effect of associative interactions with gellan gum and heating on the foaming properties of whey proteins. Her current research is on the formation of novel starch granule-sugar inclusion complexes with desirable functional properties in food products.

Postdoctoral Research Associates



Adriana Maribell Aguilar Torres is a postdoctoral research fellow in Dr. Martinez' laboratory at Aarhus University (Denmark). She received her PhD degree in food science from Aarhus University with a dissertation on polysaccharide-polyphenol interactions. She received her MS degree in molecular nutrition and food technology from Aarhus University and her BS degree in food science from Universidad Autónoma de Nuevo León (México). Her research topics include interactions between primary (polysaccharides) and secondary metabolites of plants (e.g., polyphenols, aldehydes and terpenes), interactions between secondary metabolite of plants (anthocyanins and phenolic acids), and microencapsulation of fish oil. Besides her academic career, she worked in the food industry for 2.5 years (Mondelez International and Bachoco México).



Rwivoo Baruah is a Fulbright postdoctoral fellow and researcher in Dr. Lindemann's laboratory. He obtained his PhD degree from Indian Institute of Technology Guwahati (Assam, India). He worked as a research associate at the Central Food Technological Research Institute (CSIR, Mysore, Karnataka, India) for three years. His current research focuses on the consumption of exopolysaccharides from cyanobacterial communities by gut microbiota, the enzymes involved and their safety studies.



Julia Bechtner is a Novo Nordisk postdoctoral fellow and researcher in Dr. Martinez' laboratory at Aarhus University (Denmark). She received her MS degree in Molecular Biotechnology in 2016 and her PhD degree in food microbiology in 2021, both from Technical University of Munich (Germany). She continued her research on exopolysaccharide-forming microorganisms at the University of Alberta (Canada) before joining Martinez´s group in 2022. She studies non-covalent interactions of polyphenols with plant polysaccharides and their influence on gut microorganisms. Julia is simultaneously working on the isolation of macromolecules from plant-processing byproducts using precision fermentation.



Mirian de Campos Costa is a postdoctoral researcher in Dr. Hamaker's laboratory. She earned her BS degree in nutrition from the Federal University of Viçosa (UFV, Brazil), during which she collaborated with Southern Illinois University-Carbondale. She earned her MS degree in nutrition science and PhD degree in food science and technology from UFV. In 2021, she joined Dr. Hamaker's group as a visiting scholar. In August 2023, she became a postdoctoral researcher in the same lab. Mirian has experience with human nutrition, particularly clinical trials investigating bioactive compounds and slowly digestible carbohydrates. Her research focuses on how these nutrients influence glycemia, satiety, and gut microbiota in individuals with or without obesity.



Pablo Gallego-Lobillo is a postdoctoral researcher in Dr. Martinez' laboratory at Aarhus University (Denmark). He obtained his PhD degree in food science from Autonomous University of Madrid (Spain) with research focused on the characterization of novel bioactive compounds and their effect on colonic microbiota. His main work is based on the biochemistry of dietary and prebiotic carbohydrates. Pablo has carried out *in vitro* and *in vivo* research related to carbohydrate digestion, modulation of the microbiota of prebiotics in pathologies, such as cancer, and production of new carbohydrate derivatives through various synthesis mechanisms. He is currently investigating polysaccharide-polyphenol interactions and their implications on cardiometabolic protection.



Peter Jackson is a postdoctoral researcher in Dr. Lindemann's laboratory. He earned his BS degree in human nutrition from Bournemouth University (United Kingdom) and an MS degree and PhD degree from the University of Reading (United Kingdom). His dissertation was on the effect of the food matrix on the efficacy of prebiotics in relation to the gut-brain axis. Peter's current work focuses on understanding differences in the rate and extent of change of the gut microbiota between individuals in response to inulin supplementation.



Deokyeol Jung is a postdoctoral researcher in Dr. Oh's laboratory. He completed two BS degrees in food science and biotechnology and in mathematics at Kyungpook National University (South Korea) in 2015. He received his MS and PhD degrees in food science and biotechnology at Kyungpook National University (South Korea) in 2018 and 2022, respectively. Deokyeol's current research focuses on 1) the production of value-added chemicals from pectin-rich biomass using engineered yeast; and 2) the Cas9-based metabolic engineering of probiotic yeast to improve the gut bacteria.



Guillermo Portillo is a postdoctoral researcher in Dr. Martinez' laboratory at Aarhus University (Denmark). He obtained his BS degree in food and chemical engineering in 2006 at the University of Colima (Mexico) and his MS degree in environmental sciences at the University of Applied Sciences in Cologne, Germany. He then spent five years as a project engineer in the chemical industry, leading optimization projects applying statistical modeling and process simulations. Guillermo obtained his PhD degree in bioresources engineering in 2021 from McGill University (Canada). He currently studies sustainable chemical modifications of natural polymers for use in packaging materials. His main research interests are focused on food waste valorization into valuable platform chemicals, green chemistry, development of novel materials, heterogeneous catalysis, and process simulation.



María Julia Spotti is a postdoctoral researcher in Dr. Martinez' laboratory at Aarhus University (Denmark). She earned her BS degree in biotechnology and her PhD degree in food chemistry at National University of Littoral in Argentina. Julia was previously a postdoctoral researcher at Purdue University (2015-2016), an associate researcher at the Scientific and Technical Research Council of Argentina and associate professor at National University of Littoral (2016-2021). Since 2021, she has studied structure-function relationship of biomolecules in food matrices in Dr. Martinez' group. Her research interests focus on the physicochemical study of food colloids and their modifications through enzymatic, physical and chemical processes for improving their functional and nutritional properties, as well as extraction and characterization of biomolecules from food byproducts for the development of functional foods.



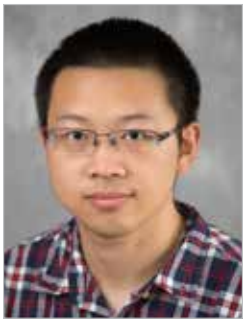
Busra Gultekin Subasi is a postdoctoral researcher in Dr. Martinez' laboratory at Aarhus University (Denmark). She received her PhD degree in food science and engineering from Istanbul Technical University (Turkey) in collaboration with the Technical University of Denmark. Busra worked as a postdoctoral researcher at Chalmers University of Technology (Sweden), focusing on a holistic biorefinery approach to primarily target protein fractions from plant sources. Her current work involves food structuring and biophysics through extrusion technology with specific interests in plant-based and hybrid food structuring, valorization of industrial food byproducts, nonthermal food processing and protein modification, improvement of techno-functional properties of biological macromolecules, and data science and machine learning approaches for data-driven techno-functional properties predictions.



Clay Swackhamer is a USDA-NIFA postdoctoral fellow and researcher in Dr. Hamaker's laboratory. He completed his BS degree in biological engineering at Penn State University and his PhD degree in biological systems engineering at University of California, Davis. His dissertation was on the mechanical breakdown of solid foods during *in vitro* gastric digestion with simulated peristalsis. He currently researches the effect of arabinoxylan's chemical and physical complexity on the taxonomic composition of the colonic microbiome. Clay is a registered professional engineer in agricultural engineering.



Antonio Vela is a postdoctoral researcher in Dr. Hamaker's laboratory. He obtained his PhD degree from the University of Valladolid (Spain), where his research focused on the physical modification of gluten-free flours by ultrasound treatments. Antonio currently works on the PERU-Hub Extension project by providing training, technical assistance, development of value-added products and improvement of processing conditions and product quality. His research focuses on fibers obtained from locally grown produce in the San Martin region in Peru.



Tianming Yao is a postdoctoral researcher in Dr. Lindemann's laboratory. He obtained his BS degree in food science and technology from Shanghai Jiao Tong University (China) and his MS degree at Purdue University, where he studied the interaction of polyphenols and starch networks. Tianming received his PhD degree with Drs. Lindemann and Hamaker with a focus on how complex structures of dietary fibers govern fecal microbial ecologies using chromatography, bioinformatics and next-generation sequencing techniques. Tianming currently studies microbial communities in the human gut and other environmental sites with the goal of establishing a mechanistic understanding of how microbial division-of-labor regulates polysaccharide consumption and modulates community assembly and succession. The ultimate goal is to formulate a precise strategy to improve human gut health.

Whistler Center Staff



Maverick Cook is a computational research scientist in Dr. Lindemann's laboratory. He studied computer science and has worked as a software engineer in the industry. His role involves learning from and helping academic researchers. His current work focuses on making software and tools for the lab to make research easier and more efficient.



Dane Deemer is a senior computational biologist in Dr. Lindemann's laboratory. He specializes in connecting and subsequently automating analyses that transcend wet- and dry-lab techniques. Dane bridges the gap between life scientists and computer scientists/software engineers, facilitating the translation of biological challenges into computational tools. He is passionate about research efficiency and conducting research both in the laboratory and behind a computer.



Melissa Jones is the Whistler Center's coordinator. She began this role in October 2023. She received her bachelor's degree in business administration from Midland University. Melissa enjoys working with graduate students, postdocs and member companies.



Tanja Kirkeby is a research assistant in Dr. Martinez' laboratory. She earned her MS degree in chemistry and biotechnology engineering from Aarhus University in June 2023. For her thesis, she studied methylotrophs and the possibility of utilizing metabolic engineering to construct a strain capable of overproducing essential amino acids while being grown solely on inexpensive one-carbon compounds, such as methanol. Currently, she is working on how to enzymatically synthesize structured high-molecular polysaccharides.



Bhavesh Patel performs short-term research projects for Whistler Center member companies. He received a BS degree in dairy technology from Gujarat Agricultural University, Anand, India, and an MS degree in food technology from Central Food Technological Research Institute, Mysore, India. Bhavesh received a PhD degree in food science from Pennsylvania State University; his research involved the study of starch and polysaccharide structures and the effect of processing conditions on thermal and physical properties.



Anton Terekhov is director of analytical services for the Whistler Center. He is proficient in analytical chemistry, molecular biology techniques and analytical instruments such as NMR, GCMS, LCMS and FTIR. Anton has more than 15 years of experience in an interdisciplinary laboratory environment, including the fields of analytical chemistry, microbiology, genetics, geology and chemical and civil engineering. His main research area is carbohydrate analysis using above-mentioned analytical instruments.



Yuxin Wang is lead scientist and lab manager of Dr. Lindemann's laboratory. She obtained her PhD degree from the Institutes for Nutritional Sciences, Chinese Academy of Sciences in 2017. She did her postdoc training at UMass-Amherst and UC-Davis. She focused on the effect and mechanisms of the eicosanoid signaling pathway and the metabolites in colon permeability and colon diseases. As an assistant project scientist at UC Davis, she established a cellular system to determine the mechanism of PROTAC small-molecule degraders. Currently, Yuxin is designing an *in vitro* cellular system to determine the effect and mechanisms of microbiome metabolites and pathogens that affect the colon monolayer and the immune system.



Elise Whitley is a research assistant in Dr. Simsek's laboratory. She obtained her BS degree in food science from Purdue University in May 2023. Elise also studied Spanish and completed her minor after studying for two months in Mallorca, Spain. Previously, she worked on projects concerning the gut microbiome, anti-inflammatory plant bioactives, and effects of polysaccharide fermentation in the colon. She is currently developing projects on the functionality of carbohydrates in underused crops and their byproducts.



Kristin Whitney is a senior research associate in Dr. Simsek's laboratory. She completed her BS degree in food science and MS degree in cereal science at North Dakota State University. She previously worked in the Department of Plant Sciences at NDSU as a research specialist in the carbohydrate chemistry and wheat quality group. In August 2021, Kristin joined the Department of Food Science at Purdue University. Kristin assists with research projects related to structure-function relationships of carbohydrates and grain macromolecules. She is responsible for coordinating research projects and sample analyses related to crop utilization, carbohydrate functionality, and functional ingredients in baking.

Scholarly Activities

Presentations, Conferences, and Public Lectures

January

Campanella, O. Extrusion, reactive extrusion, and the future. Whistler Center for Carbohydrate Research, Purdue University. West Lafayette, IN.

Iorizzo, M., Bassil, N., Mengist, M.F., Lila, M.A., Abid, M., Grace, M.H., **Ferruzzi, M.G.**, Kay, C. Identification and characterization of genes associated with anthocyanin acylation in blueberry. Plant and Animal Genome Conference. San Diego, CA.

Hamaker, B. and **Cantu-Jungles, T.** Next generation prebiotics & microbiome modulators. Future of the Microbiome. Online.

Haro-Reyes, J., **Reddivari L**. The anti-colitic activity of phlobaphenes and anthocyanins in humanized IL-10 -/- mice Is independent of ulcerative colitis-associated dysbiosis. American Society of Nutrition Annual Meeting. Myrtle Beach, SC.

Moncada, E., **Andino, P.,** Johnson, T., **Hamaker, B.**, **Reddivari L**. Exploring the role of gut bacterial dysbiosis and gut inflammation in fiber tolerance. American Society of Nutrition Annual Meeting. Myrtle Beach, SC.

Naraghi, S.; **Simsek, S.**; **Whitney, K.**; Lee, R.; Ohm, J.; Yeruva, C.; Ardayfio, N.; Kinney, C.; Fiedler, J.; Carlson, C.; et al. Does vromindolines influence the stability of oat-based beverages? International Plant & Animal Genome Conference. San Diego, CA.

February

Hamaker, B. Precision nutrition through food carbohydrate structures and health-related endpoints. Seminar Series. University of Connecticut Nutrition Department. Storrs, CT.

March

Hamaker, B. Emerging developments for fiber innovation. IAFNS Fiber Symposium. Online.

Kokini, J. Understanding non-linear rheology and comparing the pros and cons of the sequence of physical processes method with the Fourier transform method. What new information do we learn from non-linear rheology methods? Whistler Center for Carbohydrate Research, Purdue University. West Lafayette, IN.

April

Bechtner, J.D., **Lopez-Rodulfo, I.**, **Gallego-Lobillo, P.**, Hosek, J., Schwab, C., **Martinez, M.M.** Implications of polyphenol binding on the prebiotic effect of plant cell walls and resulting catabolites. 8th International Conference on Food Digestion. Porto, Portugal.

Cantu-Jungles, T. Designed prebiotic fiber mixtures for gut microbiota and whole-body health. Whistler Center Technical Conference, Purdue University. West Lafayette, IN.

Carvajal, T. A critical assessment on starch-based formulations studies for dry powder products: Which are relevant and what interactions to expect? Whistler Center for Carbohydrate Research, Purdue University. West Lafayette, IN.

Gallego-Lobillo, P., **Lopez-Rodulfo, I.**, **Martinez, M.M.** Assessing rat intestine extract for polyphenol deglycosylation in apple tissue via INFOGEST. 8th International Conference on Food Digestion. Porto, Portugal.

Hamaker, B.R. Slow digestion of sorghum foods and potential health benefits. SIGNA annual conference. Online.

Hamaker, B. Unpacking the health benefits and limitations of cereal products, plenary lecture. 17th International Cereal and Bread Congress, ICC. Nantes, France.

Jones, O. Carbohydrate modification to alter protein interactions. Whistler Center Technical Conference, Purdue University. West Lafayette, IN.

Lopez-Rodulfo, I.M., Stentoft, E.W., **Tsochatzis, E.D.**, **Martinez, M.M.** Polyphenol hierarchical clustering using static and semi-dynamic INFOGEST by LCQTOF-MS. 8th International Conference on Food Digestion. Porto, Portugal.

May

Cantu-Jungles, T. Designed prebiotic fiber mixtures for gut microbiota and whole-body health. Whistler Center Technical Conference, Purdue University. West Lafayette, IN.

Carvajal, T. A critical assessment on starch-based formulations studies for dry powder products: Which are relevant and what interactions to expect? Whistler Center for Carbohydrate Research, Purdue University. West Lafayette, IN.

Clapp Organski, A., Reddivariu, A., Fuller, K.N.Z., Thyfault, J.P., **Cross, T.-W.L.** Oral contraceptive usage impacts exercise-induced changes in the gut microbiota. Annual Nutrition Science Meeting. Chicago, IL.

Cross, T.-W.L. Gut microbiome and the hypothalamic-pituitary-gonadal axis. Experimental Animal Nutrition GEM Forum, American Society for Nutrition. Chicago, IL.

Hamaker, B. Food carbohydrates targeted for health-related outcomes. Seminar series, Cornell University Nutrition Division. Ithaca, NY.

Hamaker, B. and **Cantu-Jungles, T.** Making sense of fiber response in the gut microbiome. USDA NIFA annual PI meeting, Purdue University. West Lafayette, IN.

Hamaker, B. Precision carbohydrates and health research, Nagase Viita. Okayama, Japan.

Jones, O. Carbohydrate modification to alter protein interactions. Whistler Center Technical Conference, Purdue University. West Lafayette, IN.

Martinez, M. Polyphenol-polysaccharide interactions: Insights from advanced spectroscopy and implications for gastrointestinal health. Whistler Center Technical Conference, Purdue University. West Lafayette, IN.

Mauer, L. Effects of oligosaccharides on starch functionality. Nagase Viita. Okayama, Japan.

Mauer, L. Harnessing the power of oligosaccharide interactions with starch for reduced sugar applications. Whistler Center Technical Conference, Purdue University. West Lafayette, IN.

Reddivari, L. Anti-colitic effects of maize 3-deoxyflavonoids: Role of healthy vs. colitis-associated human gut bacteria. USDA Project Directors Meeting. West Lafayette, IN.

Reddivari, L. Role of gut microbiota in flavonoid bioactivity. W5002 Multi-state meeting. Davis, CA.

Jiang, B., Bohmann, N., **Nathan, V.**, Han-Hallett, Y.**, Reddivari, L.**, Gibbons, S., Baloni, P. Predicting the host-microbiome interactions leveraging iColonEpithelium and microbial community-scale metabolic model. Midwest Microbiome Symposium. West Lafayette, IN.

June

Carvajal, T. Surface relaxation of dry-milled material: Surface characterization approach. 46th annual general meeting of International Fine Particle Research Institute. Toronto, ON, Canada.

Hamaker, B. Human health benefits of soluble and insoluble fibers from cereal byproducts. RDA Symposium. Seoul, South Korea.

Hamaker, B. Opportunities in carbohydrates for health. CJ Company, Seoul, South Korea.

Hamaker, B. and **Cantu-Jungles, T.** Making sense of fiber response in the gut microbiome. Kyungpook National University, Daegu, South Korea.

Mauer, L. Novel starch granule-guest inclusion complexes: Formation, structure, and function. USDA 2024 Project Directors Meeting, University of Massachusetts. Boston, MA.

Oh, E.J. Probiotic yeast as a biofactory platform: Surface display system for protein expression in saccharomyces boulardii. The Korean Society for Microbiology and Biotechnology. Busan, South Korea.

July

Campanella, O.H. Extrusion technology for the development of plant-based products. 1st Conference on Alternative Proteins. Campinas, Brazil.

Campinas, Brazil. Cross, T.-W.L. From gut to gonads: The interactions between microbiome and sex hormones. Gordon Research Conference: Mammalian Reproduction — Diverse Strategies to Advance Reproductive Science and Health. Barcelona, Spain

Hamaker, B. Can weight loss be achieved through design of carbohydrates? Whistler Center for Carbohydrate Research, Purdue University. West Lafayette, IN.

Nathan, V., **Haro-Reyes, J.**, Gallina, N., **Moncada, E.**, Richert, B., Pasternak, A., **Reddivari, L**. Effect of blueberry polyphenols on improving intestinal health of weaning piglets. Institute of Food Technologists annual meeting. Chicago, IL.

Oh. E.J. Yeast metabolic engineering for sustainable production of food ingredients and value-added products. Sarawak Biodiversity Center. Kuching, Malaysia.

Moncada, E., **Andino, P.**, Johnson, T., **Hamaker, B.**, **Reddivari, L.** Dietary fiber structure complexity influences fiber-tolerance in a humanized germ-free IL-10 KO mice. Institute of Food Technologists annual meeting. Chicago, IL.

He, M.; **Whitley, E.**; **Whitney, K.**; **Simsek, S.** Enzymatic treatment of hemp for highly functional plant-based meat ingredients in commercial manufacturing. Summer Undergraduate Research Symposium, Purdue University. West Lafayette, IN.

August

Campanella, O.H. Fabrication, characterization, and potential applications of texturization of biopolymers for nutritious and high-quality food products. Conference of Food Engineering. Seattle, Washington.

Hamaker, B. Precision design of starch and dietary fibers for health-related outcomes. Kasetsart University Anniversary Special Symposium. Bangkok, Thailand.

Lindemann, S.R. Engineering polysaccharide structure to manipulate diversity and metabolic output of fermenting microbial consortia. 19th International Symposium in Microbial Ecology. Cape Town, South Africa.

September

Clapp Organski, A., Reddivari, A., Jorgensen, J.S., Schrage, W.G., Pasternak, J.A., **Cross, T.-W.L.** Gut microbiota changes rapidly in response to suppression of the hypothalamic-pituitary-gonadal axis and directly impacts reproductive parameters. Upper Midwest Summit for Reproductive Science. Urbana, IL.

Cross, T.-W.L. Interplay between the gut microbiome and sex hormone regulation. Invited speaker for the Seminar Series at the Department of Microbiology and Immunology, Loyola University. Chicago, IL.

Lindemann, S.R. Microbial division of labor and maintenance of diversity in polysaccharide degradation. Principles of Microbial Ecosystems Symposium. Tokyo, Japan.

Guo, W., Budtova, T., **Martinez, M.M.** Upcycling stale bread into porous materials: xerogels and aerogels. 6th EPNOE Junior Scientist Meeting. Vienna, Austria.

Oh, E.J. Exploring saccharomyces boulardii: Probiotic yeast and its innovative food applications. Whistler Center for Carbohydrate Research, Purdue University. West Lafayette, IN.

October

Hamaker, B. and **Cantu-Jungles, T.** Potential of aligning prebiotic fibers to beneficial gut bacteria for better health outcomes. Pontificia Universidad Javeriana. Bogota, Colombia.

Hamaker, B. Activation of the gut-brain axis for appetite control through slowly digestible carbohydrates. Pontificia Universidad Javeriana. Bogota, Colombia.

Hamaker, B. and **Cantu-Jungles, T.** Potential of targeted dietary fibers for predictable gut microbiome response for health. Universidad Nacional de Columbia, Bogota, Colombia.

Lindemann, S.R. Optimizing cereal bran fibers for microbiome function. KFN International Symposium and annual meeting. Jeju-do, South Korea.

Martinez, M.M. Diseño preciso de ingredientes y alimentos basados en hidratos de carbono para una optima calidad nutritiva. XXXVI Jornadas Técnicas de la Spanish Association of Cereal Technologists. Zaragoza, Spain.

Martinez, M.M. Di crafting sustainable polysaccharide ingredients for precision nutrition. XVII Encontro de Química dos Alimentos: XVII EQA. Vila Real, Portugal.

Ramirez, J., Smith, M., Ramirez Gutierrez, D., Xia, Z., **Narsimhan, G.**, Carvajal, M.T., Mosier, N.S., Reeling, C., Ladisch, M. Scale up for a high solids loading aqueous slurry formation in a biorefinery. AIChE annual meeting. San Diego, CA.

Whitney, K.; López, A.M.M.; **Simsek, S.** Inhibitory effects of dry bean soluble dietary fiber on 3T3-L1 adipocyte differentiation. Cereals and Grains Association annual meeting. Schaumburg, IL.

Whitney, K.; Magallanes-Lopez, A.; **Simsek, S.** Immunomodulatory activity of dry bean soluble fiber fractions. Cereals and Grains Association annual meeting. Schaumburg, IL.

November

Campanella, O.H. Manufacture and characterization of texturized foods using plant-based ingredients. 17th Food Hydrocolloids Conference. Palmerston North, New Zealand.

Gogelu, L., **Clapp Organski, A.**, **Cross, T.-W.L.** Identifying the presence of arylsulfatase A in gut-associated bacteria: Implications for sex hormone homeostasis. Fall Undergraduate Research Expo. West Lafayette, IN.

Hamaker, B. A path towards precision carbs for health, Distinguished Professor 5-year Presentation. Purdue University, West Lafayette, IN.

Hamaker, B. and **Cantu-Jungles, T.** Moving towards targeted prebiotic fibers to support the gut microbiome for health. Grains for One Health, ICC, Taipei, Taiwan.

Lindemann, S.R. Engineering gut microbiome composition and function using polysaccharide fine structure. 7th International Conference on Microbiome Engineering. Boston, MA.

Lindemann, S.R. Engineering fermenting microbiome composition and metabolism through modulation of polysaccharide fine structure. SIMB Connecting Microbiome Communities Meeting. San Diego, CA.

Mauer, L. From amorphous to crystalline and back again: ISOPOW session in honor of Ted Labuza. International Symposium on the Properties of Water. Florianopolis, Brazil.

Aguilar-Torres, A.M., Catalano, J., Wimmer, R., Kirkensgaard, J.J.K., Correia, B.S.B., **Lopez-Rodulfo, I.M.**, **Martinez, M.M.** Multidimensional spectroscopy reveals the nature and intensity of polysaccharide-polyphenol interactions. 17th International Hydrocolloids Conference. Palmerston North, New Zealand.

Franco, M., **Lopez-Rodulfo, I.M.**, **Gomez, M., Martinez, M.M.** Understanding the effect of exogenous fibers on the chemical stability of apple plant cell wall-bound polyphenols during baking. 17th International Hydrocolloids Conference. Palmerston North, New Zealand.

Bechtner, J.D., **Lopez-Rodulfo, I.M.**, **Gallego-Lobillo, P.**, Josek, J., Schwab, C., **Martinez, M.M.** Exploring and modulating the prebiotic potential of plant cell call fibers by non-covalently bound polyphenols. 17th International Hydrocolloids Conference. Palmerston North, New Zealand.

Reddivari, L. Fiber intolerance: Does fiber type matter? Whistler Center for Carbohydrate Research, Purdue University. West Lafayette, IN.

Mohammed, A., **Milliron, H.**, Heller, W., **Reddivari, L**. Role of beneficial fungi on polyphenol content and antioxidant activity of potato tubers. Fall Undergraduate Research Expo. West Lafayette, IN.

Hicks, J., **Moncada, E., Reddivari, L**. Polyphenol and polysaccharide interactions in whole food matrices – Role in starch digestion. Fall Undergraduate Research Expo. West Lafayette, IN.

Graduate Degrees Awarded

Spring 2024

1. Dila Donmez, PhD, *Encapsulation of fish oil within Maillard reacted lecithin-dextrose matrix using a batch reactor and reactive-extrusion process*
2. Anael Kimble, MS, *Reactive extrusion of bean flours*

Summer 2024

3. Sune Huss, MS, *Structuring plant proteins in extruder cooling dies for the scalable mimicry of meat analogues*
4. Vidarshani Ellepola, MS, *Encapsulating vitamin D3 dissolved in hemp seed oil for enhanced transdermal delivery both protected by a Maillard reacted glycated lecithin matrix*
5. Theresa Parr, MS, *Development and evaluation of high moisture extruded ingredients enriched with hemp protein: Sensory, tribological, and textural analysis*

Fall 2024

6. Adriana M. Aguilar-Torres, PhD, *Nature of polysaccharide – polyphenol interactions and implications to fabricate multifunctional bioplastics*
7. Wanxiang Guo, PhD, *Structure and interactions of wheat biopolymers during bread-making: Implications to upcycle bread waste into flexible packaging and porous materials*
8. Dan Zhang, PhD, *Incorporation of carbohydrates with proteins to Improve functional properties of proteins in food and packaging applications*
9. Ankur Upadhyay, MS, *Iron binding capacity of crude lecithin and its Maillard reaction products for fortification in high moisture extruded plant-based meat analogues*

Recognitions and Awards

Osvaldo Campanella
Professor of the Year Award – Ohio State University, Department of Food Science & Technology, Food Science Club

Fellow – International Academy of Food Science and Technology

Thaisa Cantu-Jungles
Microbiome Accelerator Shortlist – Nature Awards

Bruce Hamaker
Harald Perten Prize – International Association for Cereal Science and Technology

Jose Haro Reyes
B.J. Liska Outstanding Teaching Assistant Award – Purdue University

Chih-Chun (Ariel) Kuo
1st place poster: "Lactic Acid Bacteria Fermentation for Sustainable Valorization of Fish and Dairy Byproducts into Bioactive Protein Hydrolysates" – 2024 Ohio Valley Section Suppliers Expo for the Institute of Food Technologists

Steve Lindemann
AgSEED Recipient – Purdue University, College of Agriculture

Outstanding Undergraduate Counselor – Purdue University, Department of Food Science

Mario M. Martinez
Tenured Professor and Consolidated AEI Researcher – University of Valladolid

Edward Moncada
Kirleis Graduate Student Award – Purdue University

1st place, Graduate Student Oral Competition – Institute of Food Technologists, Carbohydrate Division

A. Clapp Organski
Second place - oral presentation competition, Upper Midwest Summit for Reproductive Science, Urbana, IL, October, 2024

Guillermo Portillo-Perez
Villum Experiment Grant Recipient – Villum Foundation

Lavanya Reddivari
Outstanding Graduate Educator – Purdue University, Department of Food Science

Special Events

Whistler Center Short Course

Oct. 1-3, 2024

As is our tradition, the course is designed for one day on carbohydrate fundamentals followed by two days of advanced special topic sessions. All sessions were simultaneously presented online (hybrid) and recorded so that our off-site members could attend or later visit our website to view the recordings. This provides our members with an opportunity to attend all offerings. The Short Course recordings were available for one month for individuals subscribing to our Educational Package.

Oct. 1, 2024

- Introduction to carbohydrates: Basic concepts — monosaccharides, oligosaccharides, and polysaccharides, Y. Yao
- Starch granule structure and properties, S. Simsek
- Modifications of starch and other polysaccharides, Y. Yao
- Basic principles of rheology and viscoelasticity and applications in the world of cereal products, J. Kokini
- Polyols and high-intensity sweeteners, Y. Yao
- Carbohydrate nutrition and labeling, B. Hamaker

Oct. 2, 2024

- Potential of digestible carbs and fiber for increasing GLP-1 for weight management, B. Hamaker
- Polyphenol and polysaccharide interactions in gut health, L. Reddivari
- Precision prebiotics through a new lens, T. Cantu-Jungles
- The science of food materials and its application to study food processing (e.g., extrusion) and food quality, O. Campanella
- Understanding caking development and flowability of powders, T. Carvajal
- Modification of starch for enhancement of functional and nutritional properties, S. Simsek & Y. Yao

Oct. 3, 2024

- Polysaccharide fundamentals and food formulation, M. Martinez
- Polysaccharide interactions with proteins or polysaccharides, O. Jones
- Enhancing carbohydrate profiles: the power of microbial fermentation, E. Oh
- Complex carbohydrate structure analysis (non-starch), B. Reuhs

Webinar Series

The Whistler Center webinar series is given to member companies and others who have purchased our Educational Package.

Extrusion, reactive extrusion and the future / Jan. 17, 2024

Osvaldo Campanella
Professor and Carl E. Haas Endowed Chair in Food Industries, Department of Food Science and Technology, The Ohio State University

Understanding non-linear rheology and comparing the pros and cons of the sequence of physical processes method with the Fourier transform method. What new information do we learn from non-linear rheology methods? / March 27, 2024

Jozef Kokini
Professor and Scholle Endowed Chair in Food Processing, Department of Food Science, Purdue University

A critical assessment on starch-based formulations studies for dry powder products: Which are relevant and what interactions to expect? / May 23, 2024

Teresa Carvajal
Research scholar and faculty member, Agricultural & Biological Engineering, Purdue University

Can weight loss be achieved through design of carbohydrates? / July 11, 2024

Bruce Hamaker
Distinguished Professor and Roy L. Whistler Chair, Department of Food Science, Purdue University

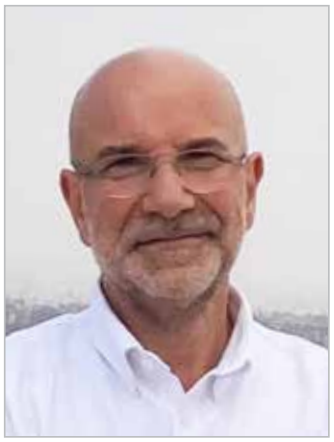
Exploring *Saccharomyces Boulardii*: Probiotic yeast and its innovative food applications / Sept. 26, 2024

Eun Joong Oh
Assistant professor, Department of Food Science, Purdue University

Fiber intolerance: Does fiber type matter? / Nov. 20, 2024

Lavanya Reddivari
Associate professor, Department of Food Science, Purdue University

2024 Belfort Lecture



2024 Belfort Lecturer

Manuel A. Coimbra

Department of Chemistry
University of Aveiro, Portugal

Polysaccharide structure and function relationships in foods and industrial applications

The Belfort Lectures were established and endowed by Dr. Anne D. Belfort in memory of her late husband, Dr. Alan M. Belfort, who was awarded a PhD from Purdue University in carbohydrate chemistry in 1960. Their daughter, Anne E. Belfort, generously continued support for the Belfort Lectures. Scientists who have made outstanding contributions to glycoscience are honored by being chosen to give a Belfort Lecture.

Our 2024 Belfort lecturer, Dr. Manuel Coimbra, is a full professor at the University of Aveiro in Portugal. He is an author or co-author on eight patents and 340 peer-reviewed research articles, editor in chief of the Elsevier journal Carbohydrate Polymers (IF2022 = 11.2) and president of the Scientific Panel of Food Additives and Food Chain Contaminants within the Portuguese Food Safety Agency (ASAE). He is a former president of the Carbohydrate Group of the Portuguese Society of Chemistry (2001-2003 & 2017-2019) and member of the executive board of the Portuguese Society of Biotechnology (2011-2019).

His program focuses on carbohydrate chemistry, polysaccharide structure, polysaccharide applications and valuation of industrial byproducts. Recent projects discussed at the lecture highlighted strategies used in carbohydrate isolation and utilization to enhance function in films or suspensions. This included using chitosan-based films to absorb sulfur dioxide from white wines or carboxylic acid derivatives from vinegars. Other described projects were strategies to increase incorporation of dietary fiber polysaccharides in fruit juices, glycogen-rich extracts from brewers' spent grains as emulsifiers and delivery vehicles, use of inulin to partially replace sucrose in fruit jams, and modified starch as whitening agents.



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