Food Safety

Risk Assessment

Nanoparticle Food Applications and Their Toxicity: Current Trends and Needs in Risk Assessment Strategies.

Jefferson de Oliveira Mallia, Russell Galea, Rajat Nag, Enda Cummins, Ruben Gatt, Vasilis Valdramidis. *J Food Prot*. 2022 Feb 2;85(2):355-372. doi: 10.4315/JFP-21-184. **Article link**

Significance: This review presents trends and needs for future assessments in toxicity evaluation to ensure the safe application of nanoparticles in the food industry given chemical reactivity concerns.

Nanotechnology has developed into one of the most groundbreaking scientific fields in the last few decades because it exploits the enhanced reactivity of materials at the atomic scale. The current classification of nanoparticles (NPs) used in foods is outlined in relation to the production and physicochemical characteristics. This review aims to concisely present the most popular and widely used inorganic and organic NPs in food industries. Considering that the toxicity of NPs is often associated with chemical reactivity, a series of in vitro toxicity studies are also summarized, integrating information on the type of NP studies and reported specifications, type of cells used, exposure conditions, and assessed end points. The important role of the digestive system in the absorption and distribution of nanoformulated foods within the body and how this affects the resultant cytotoxicity. Examples of how NPs and their accumulation within different organs are presented in relation to the consumption of specific foods. Finally, the role of developing human health risk assessments to characterize both the potential impact of the hazard and the likelihood or level of human exposure is outlined. Uncertainties exist around risk and exposure assessments of NPs due to limited information on several aspects, including toxicity, behavior, and bioaccumulation. Overall, this review presents current trends and needs for future assessments in toxicity evaluation to ensure the safe application of NPs in the food industry.

Foodborne Pathogens

Inactivation of *Salmonella enterica* Serovar Typhimurium and *Staphylococcus aureus* in Rice by Radio Frequency Heating

Ki-Ok Jeong, Sang-Soon Kim, Sang-Hyun Park, Dong-Hyun Kang. *J Food Prot*. 2022 Mar 1;85(3):380-383. doi: 10.4315/JFP-21-275. **Article link**

Significance: This study evaluates the effect of the milling degree of rice on the heating rate, pathogen inactivation (*Salmonella typhimurium* and *Staphylococcus aureus*), and color change resulting from radio frequency heating.

The objectives of this study were to determine the effect of the milling degree (MD) of rice (*Oryza sativa L.*) on the heating rate, pathogen inactivation (*Salmonella Typhimurium* and *Staphylococcus aureus*), and color change resulting from radio frequency (RF) heating. Rice samples inoculated with pathogens were placed in a polypropylene jar and subjected to RF heating for 0 to 75 s. The heating rate of rice with a 2% MD was the highest during RF heating, followed by those with a 0, 8, and 10% MD; the reduction of pathogens showed the same trend. The reductions of pathogen levels in rice with MDs of 0 and 2% were significantly higher than those observed for rice with MDs of 8 and 10% under the same treatment conditions. For example, log reductions of *Salmonella Typhimurium* in rice by 55-s RF heating were 3.64, 5.19, 2.18, and 1.80 for MDs of 0, 2, 8, and 10%, respectively. At the same treatment conditions, log reductions of

S. aureus were 2.77, 5.08, 1.15, and 0.90 for MDs of 0, 2, 8, and 10%, respectively. The color of rice measured according to L*, a*, and b* was not significantly altered after RF heating, regardless of the MD. Therefore, the MD of rice should be considered before RF heating is applied to inactivate foodborne pathogens.

Desiccation Survival of *Salmonella enterica*, *Escherichia coli*, and *Enterococcus faecium* Related to Initial Cell Level and Cellular Components

Joelle K Salazar, Bereket Tesfaldet, Michelle Zamperlini, Rachel Streufert, Megan Fay, Susanne E Keller. J *Food Prot*. 2022 Feb;85(3):398-405. doi: 10.4315/JFP-21-320. **Article link**

Significance: Previous studies have indicated a link between the initial cell level and the population of *Salmonella* that survives after desiccation and subsequent storage; however, how the initial cell concentration affects survival is unknown. This study was conducted to examine this phenomenon and to determine whether it occurs in other microorganisms.

Salmonella enterica is well known for its ability to survive and persist in low-moisture environments. Previous studies have indicated a link between the initial cell level and the population of Salmonella that survives after desiccation and subsequent storage; however, how the initial cell concentration affects survival is unknown. This study was conducted to examine this phenomenon and to determine whether it occurs in other microorganisms, specifically *Shiga toxigenic Escherichia coli* (STEC) and *Enterococcus faecium. Salmonella, STEC,* and *E. faecium* were grown as sessile cells on Trypticase soy agar with yeast extract (TSAYE) and harvested in buffered peptone water (BPW). To determine recovery at different initial cell levels, cultures were diluted to 9, 7, and 5 log CFU/mL and applied to filters. Filters were dried for 24 h and then stored for 28 days at 25°C and 33% relative humidity. During storage, cells were recovered from filters with BPW and cultivated on TSAYE. Recovery of both *Salmonella* and *E. coli,* but not *E. faecium*, was nonproportional. Lower initial populations were less viable after 24 h of desiccation; ≥10 log CFU/mL was recovered when 11 log CFU/mL was desiccated, but <3 log CFU/mL was recovered when 5 log CFU/mL was desiccated. Once dried, persistence did not appear affected by initial cell concentration. When inactivated (heat-treated) cells were added to the diluent, recovery of *Salmonella* was proportional with respect to the initial cell level. To further examine the response to desiccation, *Salmonella* was diluted in BPW containing 1 of 11 test cell components related to quorum sensing or known to affect desiccation resistance to assess recovery and persistence. Of the 11 additions, only cell debris fractions, cell-free extract, and peptidoglycan improved recovery of *Salmonella*. Desiccation survival appears related to cell wall components; however, the exact mechanism affecting survival remains unknown.

Foodborne Illness

Hazard of Staphylococcal Enterotoxins in Food and Promising Strategies for Natural Products Against Virulence.

Chunmei Liu, Yong Shen, Meng Yang, Kunmei Chi, Na Guo. *J Agric Food Chem*. 2022 Feb 16. doi: 10.1021/acs.jafc.1c06773. **Article link**

Significance: This paper reviews the hazards of *Staphylococcal* enterotoxins and promising natural compounds with different inhibitory mechanisms are summarized and classified.

Staphylococcal enterotoxins (SEs) secreted by *Staphylococcus aureus* frequently contaminate food and cause serious foodborne diseases but are ignored during food processing and even cold-chain storage. Notably, SEs are stable and resistant to harsh sterilization environments, which can induce more serious hazards to public health than the bacterium itself. Therefore, it is necessary to develop promising strategies to control SE contamination in food and improve food safety. Natural products not only have various pharmaceutical properties, such as antimicrobial and antitoxin activities, but they are also eco-friendly, safe, nutritive, and barely drug-resistant. Here, the hazards of SEs and the promising natural compounds with different inhibitory mechanisms are summarized and classified. The key points of future research and applications for natural products against bacterial toxin contamination in food are also prospected. Overall, this review may provide enlightening insights for screening effective natural compounds to prevent foodborne diseases caused by bacterial toxins.

Leveraging Risk Assessment for Foodborne Outbreak Investigations: The Quantitative Risk Assessment-Epidemic Curve Prediction Model

Amir Mokhtari, Hao Pang, Sofia Santillana Farakos, Crystal McKenna, Cecilia Crowley, Vanessa Cranford, April Bowen, et. al. *Risk Anal*. 2022 Feb 16. doi: 10.1111/risa.13896. **Article link**

Significance: A new model allows for the evaluation of a wide range of scenarios representing various potential

root causes of illness outbreaks. The model was used to analyze the 2019 *Salmonella* melon outbreak.

Root cause analysis can be used in foodborne illness outbreak investigations to determine the underlying causes of an outbreak and to help identify actions that could be taken to prevent future outbreaks. We developed a new tool, the Quantitative Risk Assessment-Epidemic Curve Prediction Model (QRA-EC), to assist with these goals and applied it to a case study to investigate and illustrate the utility of leveraging quantitative risk assessment to provide unique insights for foodborne illness outbreak root cause analysis. We used a 2019 *Salmonella* outbreak linked to melons as a case study to demonstrate the utility of this model (Centers for Disease Control and Prevention [CDC], 2019). The model was used to evaluate the impact of various root cause hypotheses (representing different contamination sources and food safety system failures in the melon supply chain) on the predicted number and timeline of illnesses. The predicted number of illnesses varied by contamination source and was strongly impacted by the prevalence and level of *Salmonella* contamination on the surface/inside of whole melons and inside contamination niches on equipment surfaces. The timeline of illnesses was most strongly impacted by equipment sanitation efficacy for contamination niches. Evaluations of a wide range of scenarios representing various potential root causes enabled us to identify which hypotheses, were likely to result in an outbreak of similar size and illness timeline to the 2019 *Salmonella* melon outbreak. The QRA-EC framework can be adapted to accommodate any food-pathogen pairs to provide insights for foodborne outbreak investigations.

Mycotoxins

Current and Emerging Tools of Computational Biology to Improve the Detoxification of Mycotoxins

Significance: Computational tools can be used to discover strains and enzymes that detoxify harmful compounds. In particular, this review focuses on mycotoxins-fungus-produced toxins that contaminate food and feed-and biological enzymes that are capable of rendering them less harmful.

Biological organisms carry a rich potential for removing toxins from our environment, but identifying suitable candidates and improving them remain challenging. We explore the use of computational tools to discover strains and enzymes that detoxify harmful compounds. In particular, we focus on mycotoxins-fungus-produced toxins that contaminate food and feed-and biological enzymes that are capable of rendering them less harmful. We discuss the use of established and novel computational tools to complement existing empirical data in three directions: discovering the prospect of detoxification among underexplored organisms, finding important cellular processes that contribute to detoxification, and improving the performance of detoxifying enzymes. We hope to create a synergistic conversation between researchers in computational biology and those in the bioremediation field. We showcase open bioremediation questions where computational researchers can contribute and highlight relevant existing and emerging computational tools that could benefit bioremediation researchers.

Heavy Metals

Recommended Reference Values for Risk Assessment of Oral Exposure to Copper

Significance: A comprehensive review of the scientific literature best supports an oral reference dose of 0.04 mg/kg body weight/day derived by EPA from their Drinking Water Action Level for oral copper ingestion.

The U.S. Environmental Protection Agency's (EPA) Integrated Risk Information System (IRIS) database, the authoritative source of U.S. risk assessment toxicity factors, currently lacks an oral reference dose (RfD) for copper. In the absence of such a value, various health-based reference values for copper are available for use in risk assessment. We summarize the scientific bases and differences in assumptions among key reference values for ingested copper to guide selection of appropriate values for risk assessment. A comprehensive review of the scientific literature best supports the oral RfD of 0.04 mg/kg body weight/day derived by EPA from their Drinking Water Action Level. This value is based on acute gastrointestinal effects but is further supported by broader analysis of copper deficiency and toxicity.

Food Packaging

Application of Carbon Dots in Food Preservation: A Critical Review for Packaging Enhancers and Food Preservatives

Linlin Zhao, Min Zhang, Arun S Mujumdar, Haixiang Wang. *Crit Rev Food Sci Nutr*. 2022 Feb 17;1-19. doi: 10.1080/10408398.2022.2039896. **Article link**

Significance: This paper systematically reviews studies of Carbon Dots used to strengthen the physical properties of food packaging, including enhancing mechanical strength, ultraviolet and water barrier properties.

Carbon dots (CDs) have two unique advantages: one is ease of synthesis at low price, the other is desirable physical and chemical properties, such as ultra-small size, abundant surface functional groups, nontoxic/low-toxicity, good biocompatibility, excellent antibacterial and antioxidant activities etc. These advantages provide opportunities for the development of new food packaging enhancers and food preservatives. This paper systematically reviews the studies of CDs used to strengthen the physical properties of food packaging, including strengthen mechanical strength, ultraviolet (UV) barrier properties and water barrier properties. It also reviews the research of CDs used to fabricate active packaging with antioxidant and/or antibacterial properties and intelligent packaging with the capacity of sensing the freshness of food. In addition, it analyzes the antioxidant and antibacterial properties of CDs as preservatives, and discusses the effect of CDs applied as coating agents and nano-level food additives for extension the shelf life of food samples. It also provides a brief review on the security and the release behavior of CDs.

Chemical Contaminants

Processing Contaminants in Wheat-Based Foods – A Systematic Review, Meta-Analysis and Bibliometric Analysis

Andressa Cunha Lemos, Verônica Simões de Borba, Manuel Cezar Macedo Barbosa Nogueira de Souza, Priscila Tessmer Scaglioni, Maristela Barnes Cerqueira, Eliana Badiale-Furlong. *Crit Rev Food Sci Nutr*. 2022 Feb 9;1-12. doi: 10.1080/10408398.2021.2022594. **Article link**

Significance: The consumption of wheat in breads, pastas and cakes raises a concern with food safety, as toxic substances such as acrylamide, 5-hydroxymethylfurfural and polycyclic aromatic hydrocarbons are formed during their processing. This review provides occurrence data and examines gaps in research on some of these substances.

Wheat is one of the main cereals grown around the world and is the basis for several foods such as bread, cakes and pasta. The consumption of these foods raises a concern with food safety, as toxic substances such as acrylamide, 5-hydroxymethylfurfural and polycyclic aromatic hydrocarbons are formed during their processing. To assess the occurrence of processing contaminants in wheat-based foods, a systematic search was carried out in four databases: PubMed, Embase, Web of Science and Scopus. Of the 1479 results, 28 were included for a meta-analysis. Most studies (69.7%) evaluated acrylamide in bread, cookies, and pasta, while PAHs (26.2%) were determined mainly in wheat grains and pasta. HMF was the least determined contaminant (4.1%), with only four studies on cookies included in the meta-analysis. The highest concentration was for acrylamide (136.29 µg·kg-1) followed by HMF (70.59 µg·kg-1) and PAHs (0.11 µg·kg-1). Acrylamide is the main processing contaminant researched, and no studies on the subject have been found in commercial samples in some regions of the world. This result shows a gap in the dates available about process contaminants in wheat-based foods and how the levels can change depending on the process parameters and the ingredients used..

A Machine Learning-Driven Approach for Prioritizing Food Contact Chemicals of Carcinogenic Concern based on Complementary in silico Methods.

Chia-Chi Wang, Yu-Chih Liang, Shan-Shan Wang, Pinpin Lin, Chun-Wei Tung. *Food Chem Toxicol*. 2022 Feb;160:112802. doi: 10.1016/j.fct.2021.112802. **Article link**

Significance: The prioritization of 1,623 food contact chemicals concludes that there are 44 chemicals of high carcinogenic concern. The machine learning-based Weight-of-Evidence approach provides a fast and comprehensive way for prioritizing chemicals of carcinogenic concern.

Carcinogenicity is one of the most critical endpoints for the risk assessment of food contact chemicals (FCCs). However, the carcinogenicity of FCCs remains insufficiently investigated. To fill the data gap, the application of standard experimental methods for identifying chemicals of carcinogenic concerns from a large set of FCCs is impractical due to their resource-intensive nature. In contrast, computational methods provide an efficient way to quickly screen chemicals with carcinogenic potential for subsequent experimental validation. Since every model was developed based on a

limited number of training samples, the use of single models for carcinogenicity assessment may not cover the complex mechanisms of carcinogenesis. This study proposed a novel machine learning-based weight-of-evidence (WoE) model for prioritizing chemical carcinogenesis. The WoE model can nonlinearly integrate complementary computational methods of structural alerts, quantitative structure-activity relationship models and in silico toxicogenomics models into a WoE-score. Compared to the best single method, the WoE model gained 8% and 19.7% improvement in the area under the receiver operating characteristic curve (AUC) value and chemical coverage, respectively.

Caffeine

2B-Alert Web 2.0, an Open-Access Tool for Predicting Alertness and Optimizing the Benefits of Caffeine: Utility Study

Jaques Reifman, Kamal Kumar, Luke Hartman, Andrew Frock, Tracy J Doty, Thomas J Balkin, Sridhar Ramakrishnan et. al. *J Med Internet Res.* 2022, Jan. 27;24(1):e29595. doi: 10.2196/29595. **Article link**

Significance: A new evidence-based, publicly available tool can be used to automatically recommend safe and effective caffeine interventions (time and dose) that lead to optimal alertness levels at user-specified times under any sleep-loss condition.

Background: One-third of the US population experiences sleep loss, with the potential to impair physical and cognitive performance, reduce productivity, and imperil safety during work and daily activities. Computer-based fatigue-management systems with the ability to predict the effects of sleep schedules on alertness and identify safe and effective caffeine interventions that maximize its stimulating benefits could help mitigate cognitive impairment due to limited sleep. To provide these capabilities to broad communities, we previously released 2B-Alert Web, a publicly available tool for predicting the average alertness level of a group of individuals as a function of time of day, sleep history, and caffeine consumption. **Objective**: In this study, we aim to enhance the capability of the 2B-Alert Web tool by providing the means for it to automatically recommend safe and effective caffeine interventions (time and dose) that lead to optimal alertness levels at user-specified times under any sleep-loss condition. **Methods**: We incorporated a recently developed caffeine-optimization algorithm into the predictive models of the original 2B-Alert Web tool, allowing the system to search for and identify viable caffeine interventions that result in user-specified alertness levels at desired times of the day. To assess the potential benefits of this new capability, we simulated four sleep-deprivation conditions (sustained operations, restricted sleep with morning or evening shift, and night shift with daytime sleep) and compared the alertness levels resulting from the algorithm's recommendations with those based on the US Army caffeine-countermeasure guidelines. In addition, we enhanced the usability of the tool by adopting a drag-and-drop graphical interface for the creation of sleep and caffeine schedules. **Results**: For the 4 simulated conditions, the 2B-Alert Web-proposed interventions increased mean alertness by 36% to 94% and decreased peak alertness impairment by 31% to 71% while using equivalent or smaller doses of caffeine as the corresponding US Army guidelines. **Conclusions**: The enhanced capability of this evidence-based, publicly available tool increases the efficiency by which diverse communities of users can identify safe and effective caffeine interventions to mitigate the effects of sleep loss in the design of research studies and work and rest schedules.

The Influence of Coffee Consumption on Bioelectrical Impedance Parameters: A Randomized, Double-Blind, Cross-Over Trial

João F. Mota, Maria Cristina Gonzalez, Henry Lukaski, Gabriela L. Oto, Claire F. Trottier, Jennefer R. B. Tibaes, Carla M. Prado. *European Journal of Clinical Nutrition.* Vol. 76, pages 212–219 (2022). **Article link**

Significance: Coffee consumption influenced Bioelectrical impedance analysis-derived results after 70-minutes but was not related to caffeine content, likely due to water intake. Through its incorporation into selenoproteins, the use of interventions with micronutrients, like Se, might be an interesting approach to prevent allergic reactions.

Background: Bioelectrical impedance analysis (BIA) is a widely used method for estimating body composition. Avoiding foods/beverages containing caffeine is a frequently enforced pre-test protocol to ensure reliability of BIA measurements. However, few studies have evaluated whether this is necessary, with conflicting results. We aimed to determine whether the coffee consumption differing in caffeine content influences BIA parameters in healthy adults. **Methods**: Twenty-five healthy adults were enrolled in a randomized, double-blind cross-over trial. Three amounts of caffeine were given with 200 mL of coffee: 0 mg (11 g of decaffeinated), 200 mg (5.5 g of caffeinated plus 5.5 g of decaffeinated), and 400 mg of caffeine (11 g of caffeinated). BIA measurements were conducted at 6 different times, and coefficient variations (CV) explored. **Results**: No differences were observed for group × time interaction on impedance, resistance, or reactance ($p > 0.05$). Values of BIA parameters increased after 30-min of coffee consumption, independently of the caffeine dosage (all $p < 0.001$). Body fat percentage followed the same

pattern and increased after 45-min (p < 0.05). Median CV for consecutive impedance, resistance, and reactance measurements were >95%CI of expected device measurement error over 70-min, without difference between groups. Urine output volume was not different between groups (decaffeinated: 440.45 ± 197.57 mL; 200 mg: 471.80 ± 171.88 mL; 400 mg: 489.30 ± 204.10 mL, p > 0.05). **Conclusion**: Coffee consumption influenced BIA-derived results after 70-min but was not related to caffeine content, likely due to water intake.

Food Allergens

Role of Selenium in IgE Mediated Soybean Allergy Development

Xiaoli Zhao, Astrid Hogenkamp, Xin Li, Hongbing Chen, Johan Garssen, Leon M J Knippels. Crit Rev Food Sci Nutr. 2022 Feb 20;1-9. doi: 10.1080/10408398.2022.2039898. **Article link**

Significance: Nutritional supplementation is a new food allergy prevention strategy currently under evaluation. Selenium (Se), as one of the essential micronutrients for humans and animals, carries out biological effects through its incorporation into selenoproteins. The use of interventions with micronutrients, like Se, might be an interesting approach to prevent allergic reactions.

Food allergy is a pathological immune reaction triggered by normal innocuous dietary proteins. Soybean is widely used in many food products and has long been recognized as a source of high-quality proteins. However, soybean is listed as one of the 8 most significant food allergens. The prevalence of soybean allergy is increasing worldwide and impacts the quality of life of patients. Currently, the only strategy to manage food allergy relies on strict avoidance of the offending food. Nutritional supplementation is a new prevention strategy which is currently under evaluation. Selenium (Se), as one of the essential micronutrients for humans and animals, carries out biological effects through its incorporation into selenoproteins. The use of interventions with micronutrients, like Se, might be an interesting new approach. In this review we describe the involvement of Se in a variety of processes, including maintaining immune homeostasis, preventing free radical damage, and modulating the gut microbiome, all of which may contribute to in both the prevention and treatment of food allergy. Se interventionscould be an interesting new approach for future treatment strategies to manage soybean allergy, and food allergy in general, and could help to improve the quality of life for food allergic patients.

Emerging Research Areas

Scientific Rigor: Reproducibility

A Guide for Authors and Readers of the American Society for Nutrition Journals on the Proper Use of *P* Values and Strategies that Promote Transparency and Improve Research Reproducibility

John D Sorkin, Mark Manary, Paul AM Smeets, Amanda J MacFarlane, Arne Astrup, Ronald L Prigeon. *Am J Clin Nutr*. 2021;114:1280−1285. **Article link**

Significance: Improper use and reporting of *P* values in statistics, in addition to lack of transparency in recording study design and conduct, contribute to study irreproducibility. This article provides guidance on use of *P* values consistent with the scientific method, and how to increase transparency and reproducibility in the conduct and analysis of research.

Two questions regarding the scientific literature have become grist for public discussion: 1) what place should *P* values have in reporting the results of studies? 2) How should the perceived difficulty in replicating the results reported in published studies be addressed? We consider these questions to be 2 sides of the same coin; failing to address them can lead to an incomplete or incorrect message being sent to the reader. If *P* values (which are derived from the estimate of the effect size and a measure of the precision of the estimate of the effect) are used improperly, for example reporting only significant findings, or reporting *P* values without account for multiple comparisons, or failing to indicate the number of tests performed, the scientific record can be biased. Moreover, if there is a lack of transparency in the conduct of a study and reporting of study results, it will not be possible to repeat a study in a manner that allows inferences from the original study to be reproduced or to design and conduct a different experiment whose aim is to confirm the original study's findings. The goal of this article is to discuss how *P* values can be used in a manner that is consistent with the scientific method, and to increase transparency and reproducibility in the conduct and analysis of nutrition research.

Sleep/Obesity Research

Effect of Sleep Extension on Objectively Assessed Energy Intake Among Adults with Overweight in Real-life Settings A Randomized Clinical Trial

Esra Tasali, Kristen Wroblewski, Eva Kahn, Jennifer Kilkus, Dale A. Schoeller. *JAMA Intern Med*. doi:10.1001/

jamainternmed.2021.8098. February 7, 2022. **Article link**

Significance: A RCT study of overweight subjects found an inverse correlation between sleep duration and energy intake (r = −0.41; 95%CI, −0.59 to −0.20; P < .001). Extending sleep by an average of 1.5 hours significantly reduced energy intake in the sleep extended group compared to control group (−270 kcal/d; 95%CI, −393 to −147 kcal/d; P < .001). Maintaining healthy sleep duration may help in obesity prevention.

Importance: Short sleep duration has been recognized as a risk factor for obesity. Whether extending sleep duration may mitigate this risk remains unknown. **Objective**: To determine the effects of a sleep extension intervention on objectively assessed energy intake, energy expenditure, and body weight in real-life settings among adults with overweight who habitually curtailed their sleep duration. **Design, Setting and Participants**: This single-center, randomized clinical trial was conducted from November 1, 2014, to October 30, 2020. Participants were adults aged 21 to 40 years with a body mass index (calculated as weight in kilograms divided by height in meters squared) between 25.0 and 29.9 and had habitual sleep duration of less than 6.5 hours per night. Data were analyzed according to the intention-to-treat principle. **Interventions**: After a 2-week habitual sleep period at baseline, participants were randomized to either an individualized sleep hygiene counseling session that was intended to extend their bedtime to 8.5 hours (sleep extension group) or to continue their habitual sleep (control group). All participants were instructed to continue daily routine activities at home without any prescribed diet or physical activity. **Main Outcomes and Measures**: The primary outcome was change in energy intake from baseline, which was objectively assessed as the sum of total energy expenditure and change in body energy stores. Total energy expenditure was measured by the doubly labeled water method. Change in body energy stores was computed using regression of daily home weights and body composition changes from dual-energy x-ray absorptiometry. Sleep duration was monitored by actigraphy. Changes from baseline were compared between the 2 groups using intention-to-treat analysis. **Results**: Data from 80 randomized participants (mean [SD] age, 29.8 [5.1] years; 41 men [51.3%]) were analyzed. Sleep duration was increased by approximately 1.2 hours per night (95%CI, 1.0 to 1.4 hours; P < .001) in the sleep extension group vs the control group. The sleep extension group had a significant decrease in energy intake compared with the control group (−270 kcal/d; 95%CI, −393 to −147 kcal/d; P < .001). The change in sleep duration was inversely correlated with the change in energy intake (r = −0.41; 95%CI, −0.59 to −0.20; P < .001). No significant treatment effect in total energy expenditure was found, resulting in weight reduction in the sleep extension group vs the control group. **Conclusions and Relevance**: This trial found that sleep extension reduced energy intake and resulted in a negative energy balance in real-life settings among adults with overweight who habitually curtailed their sleep duration. Improving and maintaining healthy sleep duration over longer periods could be part of obesity prevention and weight loss programs.

Climate Change and Healthy Food System Sustainability

Circularity in Animal Production Requires a Change in the EAT-Lancet Diet in Europe

Benjamin van Selm, Anita Frehner, Imke J. M. de Boer, Ollie van Hal , Renske Hijbeek, Martin K. van Ittersum, Elise F. Talsma, et. al. *Nature Food*. Vol. 3, January 2022, p66–73. **Article link**

Significance: Are recommendations to reduce animal protein intake compatible with the adoption of food circuitry systems? A study using resource-allocation model compared the circularity in animal production on the supply of animal-source nutrients in Europe with the nutritional requirements of the EAT-Lancet reference diet. The study found compatibility in total animal-source proteins but not specific animal-source foods and feeding low-cost biomass (LCB) to animals can potentially decrease GHG emissions (31%) and land use (42%). Further evaluation of the feasible substitutability between animal-source foods is necessary to define potential roles of animal products in circular human diets.

It is not known whether dietary guidelines proposing a limited intake of animal protein are compatible with the adoption of circular food systems. Using a resource-allocation model, we compared the effects of circularity on the supply of animal-source nutrients in Europe with the nutritional requirements of the EAT-Lancet reference diet. We found the two to be compatible in terms of total animal-source proteins but not specific animal-source foods; in particular, the EAT-Lancet guidelines recommend larger quantities of poultry meat over beef and pork, while a circular food system produces mainly milk, dairy-beef and pork. Compared with the EAT-Lancet reference diet, greenhouse gas emissions were reduced by up to 31% and arable land use reduced by up to 42%. Careful consideration of the feasible substitutability between animal-source foods is needed to define potential roles of animal products in circular human diets.

Food Processing and Impact on Health

Nutrition Research Challenges for Processed Food and Health

Michael J. Gibney, Ciarán G. Forde. *Nat Food* 3, 104–109 (2022). doi.org/10.1038/s43016-021-00457-9. 7

February 2022. **Article link**

Significance: An immediate high priority need for assessing the impact of degree of food processing on disease and health is the need to better define the basis for definitions used to categorize foods as highly processed, and to distinguish between the contributions of nutrients, additives and sensory properties to health.

Existing highly processed food (HPF) classification systems show large differences in the impact of these foods on biochemical risk factors for disease. If public health nutrition is to consider the degree of food processing as an important element of the link between food and health, certain gaps in research must be acknowledged. Quantifying the food additive exposure derived from HPFs is a task made challenging by the lack of data available on the occurrence and concentration of additives in food and the degree to which the natural occurrence of additives in unprocessed foods confounds exposure estimates. The proposed role of HPFs in health outcomes could also be associated with altered nutrient profiles. Differences exist within and between HPF classification systems in this regard and there are conflicting data on the impact of controlling for nutrient intake. Furthermore, research is needed on how the sensory aspects of HPFs contribute to energy intake. Current data suggest that high energy intake rate may be the mechanism linking HPFs and increased energy intake. A high priority now is to clarify the basis of definitions used to categorize foods as highly processed and, in a constructive sense, to distinguish between the contributions of nutrients, additives and sensory properties to health.

Engage with IAFNS

- **Low- and No-Calorie Sweeteners Stakeholder Exchange** March 9, 2022, 2:00-5:00 pm, ET, Washington, DC. Invitation-only.
    - IAFNS has organized a Stakeholder Exchange. Representatives from organizations including Health Canada, the American Diabetes Association, the Academy of Nutrition and Dietetics, Center for Science in the Public Interest, Calorie Control Council, American Beverage Association, the International Food Information Council, and others, will share research, perspectives, and positions with the aim to inform priorities and consider collaborations. For more information, click **here**.

- **Back to Basics: Understanding Terms and Methods in the Gut Microbiome Space** March 16, 11:00-12:00 pm ET.
    - As nutrition researchers and healthcare practitioners across many specialties are, and will continue to be, required to respond to questions about gut microbiome, nutrition, and health it is of value to ensure a foundational understanding. For more information, click **here**.

- **Beyond the Headlines: Communicating the Science of Caffeine.** March 21, 2022. 1:00-2:30 pm ET.
    - 85% of Americans say they consume caffeine every day, but conflicting headlines on caffeine often produce more questions than answers. This webinar is designed for practitioners who seek to enhance their understanding of the science of caffeine and how to communicate evidence-based messaging to consumers. For more information, click **here**.

- **Understanding Gut Microbiota, COVID-19, and Nutrition: Interactions, Interventions, and Unknowns.** April 21, 2022. 10:00-11:00 am ET.
    - It is well-established that the gut microbiota plays a role in regulating the immune system, including modifying the response to viral infections. In fact, research indicates that the severity of COVID-19 is related in part to the composition of the gut microbiota. How can diet and nutrition support the microbiota-dependent immunoregulatory functions? What do we really know today, and what is under investigation? For more information, click **here**.

Back to Basics: Understanding Terms and Methods in the Gut Microbiome Space
Virtual, Event
March 16, 2022
11:00 am – 12:00 pm

Register here.

Microbiome or microbiota? Healthy microbiome or dysbiosis? Whole genome or shotgun sequencing? Gut microbiome science continues to evolve at speed – challenging the non-expert to keep pace! As nutrition and other healthcare practitioners across many specialties are, and will continue required to respond to questions about gut microbiome, nutrition, and health it is of value to step back and ensure a foundational understanding

This webinar is designed for the non-expert that seeks to improve the understanding of gut microbiome science – with a focus on common terms and continually evolving methods. Participation will support the ability of practitioners to evaluate gut microbiome research and the degree to which it supports dietary recommendations and guidance – now and in the future.

The Academy of Nutrition and Dietetics is an accredited CPE provider with the Commission on Dietetic Registration (CDR). Pending CPE approval, CDR Credentialed Practitioners will receive 1.0 CPEU for completion of either the live or recorded viewing of the webinar.

Panel:

Sarah Comstock, PhD, Michigan State – moderator

6.2.2 Selects and uses appropriate tools and skills to collect and interpret research data.

8.1.1 Interprets and applies evidence-based literature and standards for determining nutritional needs of target audiences.

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