Pathogen Detection

Rapid Detection of *Escherichia coli* O157:H7 in Fresh Lettuce Based on Localized Surface Plasmon Resonance Combined with Immunomagnetic Separation


**Significance:** This paper describes a novel method for rapid detection of *E. coli* in food samples using immunomagnetic nanoparticles.

This study presents a method for rapid detection of *Escherichia coli O157:H7* in fresh lettuce based on the properties of target separation and localized surface plasmon resonance of immunomagnetic nanoparticles. The multifunctional immunomagnetic nanoparticles enabling simultaneous separation and detection were prepared by synthesizing magnetic nanoparticles (ca. 10 nm in diameter) composed of an iron oxide (Fe₃O₄) core and gold shell and then conjugating these nanoparticles with the anti-*E. coli* O157:H7 antibodies. The application of multifunctional immunomagnetic nanoparticles for detecting *E. coli* O157:H7 in a lettuce matrix allowed detection of the presence of <1 log CFU mL⁻¹ without prior enrichment. In contrast, the detection limit of the conventional plating method was 2.74 log CFU mL⁻¹. The method, which requires no preenrichment, provides an alternative to conventional microbiological detection methods and can be used as a rapid screening tool for a large number of food samples.

Evaluation of a Method for Rapid Detection of *Listeria monocytogenes* in Dry-Cured Ham Based on Impedanciometry Combined with Chromogenic Agar


**Significance:** This study identifies an alternative method for rapid detection of *Listeria monocytogenes* in ready-to-eat products.

The food industry is in need of rapid, reliable methodologies for the detection of *Listeria monocytogenes* in ready-to-eat products, as an alternative to the International Organization of Standardization (ISO) 11290-1 reference method. The aim of this study was to evaluate impedanciometry combined with chromogenic agar culture for the detection of *L. monocytogenes* in dry-cured ham. The experimental setup consisted in assaying four strains of *L. monocytogenes* and two strains of *Listeria innocua* in pure culture. The method was evaluated according to the ISO 16140:2003 standard through a comparative study with the ISO reference method with 119 samples of dry-cured ham. Significant determination coefficients (R² of up to 0.99) for all strains assayed in pure culture were obtained. The comparative study results had 100% accuracy, 100% specificity, and 100% sensitivity. Impedanciometry followed by chromogenic agar culture was capable of detecting 1 CFU/25 g of food. *L. monocytogenes* was not detected in the 65 commercial samples tested. The method evaluated herein represents a promising alternative for the food industry in its efforts to control *L. monocytogenes*. Overall analysis time is shorter and the method permits a straightforward analysis of a large number of samples with reliable results.

Food Processing Safety

Survival of *Salmonella* During Production of Partially Sprouted Pumpkin, Sunflower, and Chia Seeds Dried for Direct Consumption


**Significance:** This study identifies drying and storage conditions to reduce *Salmonella* survival and growth in ready-to-eat foods containing partially sprouted seeds.
Ready-to-eat foods based on dried partially sprouted seeds have been associated with foodborne salmonellosis. Whereas research has focused on the potential for Salmonella initially present in or on seeds to grow and survive during fresh sprout production, little is known about the potential for growth and survival of Salmonella associated with seeds that have been partially sprouted and dried. The goal of this study was to determine the growth of Salmonella during soaking for partial germination of pumpkin, sunflower, and chia seeds and subsequent survival during drying and storage. Pumpkin, sunflower, and chia seeds were inoculated with a four-serotype Salmonella cocktail by the dry transfer method and were soaked in sterile water at 25 or 37°C for 24 h. During the soaking period, Salmonella exhibited growth rates of 0.37 ± 0.26, 0.27 ± 0.12, and 0.45 ± 0.19 log CFU/h at 25°C and 0.94 ± 0.44, 1.04 ± 0.84, and 0.73 ± 0.36 log CFU/h at 37°C for chia, pumpkin, and sunflower seeds, respectively. Soaked seeds were drained and dried at 25, 51, and 60°C. Drying resulted in >5 log CFU/g loss at both 51 and 60°C and ~3 log CFU/g loss at 25°C on partially sprouted pumpkin and sunflower seeds. There was no decrease in Salmonella during drying of chia seeds at 25°C, and only drying at 60°C provided losses >5 log CFU/g. Dried seeds were stored at 37 and 45°C at 15 and 76% relative humidity (RH) levels. The combination of temperature and RH exerted a stronger effect than either factor alone, such that rates at which Salmonella decreased generally followed this order: 37°C at 15% RH < 45°C at 15% RH < 37°C at 76% RH < 45°C at 76% RH for all seeds tested. Rates differed based on seed type, with chia seeds and chia seed powder having the smallest rate of decrease, followed by sunflower and pumpkin seeds. Drying at higher temperatures (50 and 61°C) or storing at elevated temperature and humidity (45°C and 76% RH) resulted in significantly different rates of Salmonella decrease.

Response Surface Methodology for Salmonella Inactivation during Extrusion Processing of Oat Flour

Significance: A surface response model was developed to predict Salmonella inactivation in oat flour.

An increase in the number of foodborne outbreaks and recalls due to Salmonella in low-moisture foods has resulted in the need for the development and validation of process controls to ensure their microbiological safety. Furthermore, the Food Safety Modernization Act Preventive Controls for Human Food final rule requires food processors to validate their process controls to ensure food safety. The objective of this study was to develop a response surface model to predict Salmonella inactivation in oat flour, as affected by moisture, fat content, screw speed, and temperature. Oat flour was adjusted to different moisture (14 to 26% wet basis) and fat (5 to 15% [w/w]) contents and was then inoculated with a five-strain cocktail of Salmonella. Inoculated material was extruded through a single-screw extruder running at different screw speeds (75 to 225 rpm) and temperatures (65 to 85°C), without a die. Once steady-state conditions were attained, extruded samples were collected, cooled, and stored under refrigeration, and Salmonella survivors were enumerated. A split-plot central composite second-order response surface design was used, with the central point replicated six times. Temperature showed a significant (P < 0.0005) positive effect on microbial reduction. Moisture content showed significant linear (P = 0.0014) and quadratic (P = 0.0005) effects, whereas higher fat content showed a significant (P < 0.0001) protective effect on Salmonella destruction. The screw speed did not play a major role in inactivating Salmonella, but it had a significant (P = 0.0004) interactive effect with temperature. Results indicated that a >5.5-log reduction was achieved in oat flour extruded at a temperature above 85°C at all moisture and fat contents evaluated at a screw speed of 150 rpm. The developed response surface model can be used to identify the extrusion process conditions to achieve a desired reduction of Salmonella based on the moisture and fat contents of the product.

Food Packaging

Active Chicken Meat Packaging Based on Polylactide Films and Bimetallic Ag-Cu Nanoparticles and Essential Oil

Significance: A bionanocomposite film exhibiting antimicrobial effects of Gram (+) and (-) bacteria was developed.

Plasticized polylactide (PLA) composite films with multifunctional properties were created by loading bimetallic silver–copper (Ag–Cu) nanoparticles (NPs) and cinnamon essential oil (CEO) into polymer matrix via compression molding technique. Rheological, structural, thermal, barrier, and antimicrobial properties of the produced films, and its utilization in the packaging of chicken meat were investigated. PLA/PEG/Ag–Cu/CEO composites showed a very complex rheological system where both plasticizing and antiplasticizing effects were evident. Thermal properties of plasticized PLA film with polyethylene glycol (PEG) enhanced considerably with the reinforcement of NPs whereas loading of CEO decreased glass transition, melting, and crystallization temperature. The barrier properties of the composite films were reduced with the increase of CEO loading (P <
0.05). Their optical properties were also modified by the addition of both CEO and Ag–Cu NPs. The changes in the molecular organization of PLA composite films were visualized by FTIR spectra. Rough and porous surfaces of the films were evident by scanning electron microscopy. The effectiveness of composite films was tested against Salmonella Typhimurium, Campylobacter jejuni and Listeria monocytogenes inoculated in chicken samples, and it was found that the films loaded with Ag–Cu NPs and 50% CEO showed maximum antibacterial action during 21 days at the refrigerated condition. The produced PLA/Ag–Cu/CEO composite films can be applied to active food packaging. Practical Application: The nanoparticles and essential oil loaded PLA composite films are capable of exhibiting antimicrobial effects against Gram (+) and (–) bacteria, and extend the shelf-life of chicken meat. The bionanocomposite films showed the potential to be manufactured commercially because of the thermal stability of the active components during the hot-press compression molding process. The developed bionanocomposites could have practical importance and open a new direction for the active food packaging to control the spoilage and the pathogenic bacteria associated with the fresh chicken meat.

**Food Allergy**

**Altering Allergenicity of Cow’s Milk by Food Processing for Applications in Infant Formula**


**Significance:** This paper reviews the impact of traditional and novel processing methods on allergenicity of cow’s milk in infant formulas.

Cow’s milk-based infant formulas have a long tradition in infant nutrition, although some infants are unable to use them due to presence of several known allergens. Various processing methods have been identified capable of reducing cow’s milk protein allergenicity including thermal and non-thermal methods and their combinations. Heat treatment and enzymatic hydrolysis have been in production of hypoallergenic infant formulas. However, modulation of allergenic epitopes depends on the extent of heat treatment applied, which consequently may also reduce a nutritional value of these proteins. In addition, enzymatic hydrolysis may not target allergenic epitopes thus allergenicity may persist; however released peptides may have detrimental impact on taste and functional properties of final products. Modulation of allergenicity of milk proteins appears to require a concerted effort to minimize detrimental effects as clinical studies conducted on commercial hypoallergenic formulas demonstrated persistence of allergic symptoms. This article covers traditional and novel processing methods and their impact on reduction of cow’s milk allergenicity in milk-based infant formulas.

**Can Glycation Reduce Food Allergenicity?**


**Significance:** This article discusses how glycation of proteins may influence the immunoreactivity of proteins.

As a naturally occurring reaction during food processing, glycation, also known as non-enzymatic browning or Maillard reaction, can improve food protein physiochemical properties and functionality. In this perspective, three aspects of glycation (terminology confusion between glycation and glycosylation, its current application, and its impact on immunoreactivity) are elaborated. Overall, the immunoreactivity of glycated proteins may decrease, remain unchanged, or even increase after food glycation. Also, it should be noted that the effect of glycation on the immunoglobulin (Ig)E- or IgG-binding capacity of allergens does not necessarily and correctly predict the allergenicity of the glycated protein in the allergic patient population.

**Application of Multiantigen Profiling To Detect Pecan**


**Significance:** An assay was developed to generate multiantigen profiles targeting peanuts, tree nuts and legumes.

A problem often encountered in the detection and identification of undeclared tree nut food allergens is the lack of analytical methods. This problem is accentuated by the current trend, whereby the primary methods used to detect food allergens are antibody-based enzyme-linked immunosorbent assays (ELISAs) and the development of analyte-specific antibodies takes months. The recently developed xMAP food allergen detection assay (xMAP FADA) has the ability to generate multiantigen profiles with tree nuts, thereby providing a potential solution to this problem. The xMAP FADA includes 22 antibodies targeting peanut, soy,
and nine tree nuts. The high number of antibodies to a diverse group of tree nuts and legumes and the propensity of tree nuts to cross-react have enabled the development of multiantigen profiling, whereby an analyte reacts with the various antibodies to generate a profile. Recently, a question arose regarding the possible presence of pecan dust at a manufacturer of pecan products that also stored fresh produce. The lack of suitable pecan ELISAs created an analytical challenge that was resolved using multiantigen profiling with the xMAP FADA. Pecan was detected on swab samples by using multiantigen profiling and confirmed by DNA analysis. The use of multiantigen profiling provided an analytical capability beyond what was possible with an analyte-specific analytical method.

**Risk Assessment**

**Red Meat and Colon Cancer: A Review of Mechanistic Evidence for Heme in the Context of Risk Assessment Methodology**


**Significance:** This review examines the weight of the mechanistic evidence associating exposure to red meat with colorectal cancer.

On October 26, 2015, IARC published a summary of their findings regarding the association of cancer with consumption of red meat or processed meat (IARC 2015a; *The Lancet Oncology* 2015). The Working Group concluded that there is limited evidence in human beings for carcinogenicity from the consumption of red meat and inadequate evidence in experimental animals for the carcinogenicity of consumption of red meat. Nevertheless, the working group concluded that there is strong mechanistic evidence by which ingestion of red meat can be linked to human colorectal cancer and assigned red meat to Group 2A “probably carcinogenic to humans”. The Working Group cited supporting mechanistic evidence for multiple meat components, including those formed from meat processing, such as N-nitroso compounds (NOC) and heterocyclic aromatic amines, and the endogenous compound, heme iron. The mechanism of action with colorectal cancer for each of these components is different and so it is critical to evaluate the evidence for each component separately. Consequently, this review critically examined studies that investigated mechanistic evidence associated with heme iron to assess the weight of the evidence associating exposure to red meat with colorectal cancer. The evidence from *in vitro* studies utilized conditions that are not necessarily relevant for a normal dietary intake and thus do not provide sufficient evidence that heme exposure from typical red meat consumption would increase the risk of colon cancer. Animal studies utilized models that tested promotion of preneoplastic conditions utilizing diets low in calcium, high in fat combined with exaggerations of heme exposure that in many instances represented intakes that were orders of magnitude above normal dietary consumption of red meat. Finally, clinical evidence suggests that the type of NOC found after ingestion of red meat in humans consists mainly of nitrosyl iron and nitrosothiols, products that have profoundly different chemistries from certain N-nitroso species which have been shown to be tumorigenic through the formation of DNA adducts. In conclusion, the methodologies employed in current mechanistic studies of heme and colorectal cancer have not provided sufficient documentation that the mechanisms studied would contribute to an increased risk of promotion of preneoplasia or colon cancer at usual dietary intakes of red meat in the context of a normal diet.

**Existing Regulatory Approaches to Reducing Exposures to Chemical- and Product-Based Risk and Their Applicability to Diet-Related Chronic Disease**


**Significance:** This paper highlights how policies adopted to protect against harmful exposures could be relevant for addressing diet-related chronic diseases.

We aimed to identify and categorize the types of policies that have been adopted to protect Americans from harmful exposures that could also be relevant for addressing diet-related chronic diseases. This article examines and categorizes the rationales behind government regulation. Our interest in the historical analysis is to inform judgments about how best to address newly emergent risks involving diet-related chronic disease within existing regulatory and information-based frameworks. We assessed exemplars of regulation with respect to harmful exposures from air, water, and food, as well as regulations that are intended to modify voluntary behaviors. Following the comparative analysis, we explored how exposures that lead to diet-related chronic diseases among the general population fit within models of regulation adopted for other comparable risks. We identified five rationales and five approaches that protect people from harmful exposures. Reasons for regulation include: protection from involuntary exposure to risk, high risk of death or chronic illness, ubiquity of risk, counteraction to limit compulsive behaviors, and promotion of population health. Regulatory approaches include: mandatory limits on use, mandatory limits on exposure, mandatory controls on quality, mandatory labeling, and voluntary guidance. In contrast to the use of mandates, the prevention of diet-related chronic diseases thus far has largely relied on information-only approaches and voluntary adoption of guidelines. There is ample precedent for mandatory regulatory approaches that could address harms related to exposure to unhealthy diets, but several barriers to action would need to be overcome.
Nanomaterials

Micronization and Nanosizing of Particles for an Enhanced Quality of Food: A Review

Significance: This paper reviews current technologies for reducing particle size, and how these technologies may enhance food quality.

Size reduction to micron to nanosize range is rapidly developing technology applied to foods in the recent decades. This article reviews the particle size reducing technologies for solid particulate and liquid materials. For solid particulate materials, the jet milling, ball milling and colloid milling are mainly used. For liquid materials, primarily the high pressure homogenization, ultrasonic homogenization and microfluidization technologies are used. Due to the reduction in particle size, micron- and nanotechnology significantly enhance the physico-chemical and functional characteristics of food materials, resulting in the improvement of food quality.

Heavy Metals

Aluminum and Heavy Metal Accumulation in Tea Leaves: An Interplay of Environmental and Plant Factors and an Assessment of Exposure Risks to Consumers

Significance: This study identifies trackable factors that affect heavy metal accumulation in tea leaves.

Environmental and plant factors (soil condition, variety, season, and maturity) and exposure risks of aluminum (Al), manganese (Mn), lead (Pb), cadmium (Cd), and copper (Cu) in tea leaves were investigated. The concentrations of these metals in tea leaves could not be predicted by their total concentrations in the soil. During any one season, there were differences in Al, Mn, and Cd levels between tea varieties. Seasonally, autumn tea and/or summer tea had far higher levels of Al, Mn, Pb, and Cd than did spring tea. Tea leaf maturity positively correlated with the concentrations of Al, Mn, Pb, and Cd, but negatively with Cu. The calculated average daily intake doses (mg/[kg•d]) for these metal elements were 0.14 (Al), 0.11 (Mn), 2.70 × 10⁻³ (Cu), 2.80 × 10⁻⁴ (Pb), and 2.88 × 10⁻⁶ (Cd). The hazard quotient values of each metal were all significantly lower than risk level (=1), suggesting that, for the general population, consumption of tea does not result in the intake of excessive amounts of Al, Mn, Pb, Cd, or Cu. This study identified the factors that can be monitored in the field to decrease consumer exposure to Al and Mn through tea consumption. Practical Application: Environmental and plant factors influence aluminum and heavy metal accumulation in tea leaves. Consumers of tea are not ingesting excessive Al, Mn, Pb, Cd, or Cu. Trackable factors were identified to manage exposure levels.

In Vitro Model To Assess Arsenic Bioaccessibility and Speciation in Cooked Shrimp

Significance: This study evaluated the impact of cooking and gastrointestinal digestion on arsenic bioavailability in shrimp.

Shrimp, a popular and readily consumed seafood, contains high concentrations of arsenic. However, few studies have focused on whether arsenic in the shrimp could be transformed during the cooking process and gastrointestinal digestion. In this study, a combined in vitro model [Unified Bioaccessibility Research Group of Europe (BARGE) Method–Simulator of Human Intestinal Microbial Ecosystem (UBM–SHIME)] was used to investigate arsenic bioaccessibility and its speciation in raw and cooked shrimps. The results showed that the cooking practices had little effect on the arsenic content and speciation. Bioaccessibility of arsenic in raw shrimp was at a high level, averaging 76.9 ± 4.28 and 86.7 ± 3.74% in gastric and small intestinal phases, respectively. Arsenic speciation was stable in all of the shrimp digestions, with nontoxic arsenobetaine (AsB) being the dominated speciation. The cooking practice significantly increased the bioaccessibility of arsenate (p < 0.05) in shrimp digestes, indicating the increase of the potential health risks.
Caffeine

Consumption of Green Coffee and the Risk of Chronic Diseases

Significance: This article reviews the health effects of green coffee in humans.

Green coffee contains macro nutrients such as carbohydrates, protein, fat, as well as minor components such as caffeine, trigonelin and chlorogenic acid. Phenolics, chlorogenic acids and brown pigments are sources of natural antioxidants. High polyphenolic materials found in green coffee and especially chlorogenic acid in it have an important place. It is considered that; green coffee has effects on body mass, blood glucose and lipid levels, blood pressure, prevention from cardiovascular diseases which is based on chlorogenic acid consisting antioxidant activity. However, many topics like toxicological effects, doses, amounts, usage in the body, advantages and disadvantages, etc. of these active molecules need to be examined. For these reasons this article was reviewed to evaluate health effects of green coffee.