

Food Borne Chemical Contaminants

Dioxins, Polychlorinated Biphenyls, Methyl Mercury and Omega-3 Polyunsaturated Fatty Acids as Biomarkers of Fish Consumption

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Significance: Environmental contaminants seemed to be slightly better fish consumption biomarkers than omega-3 PUFAs in the Baltic Sea area.

Biomarkers and frequency questions as measures of fish consumption among participants in the Fishermen substudy (n=125 men and n=139 women, aged 22–74) and in the Health 2000 substudy (n=577 men and n=712 women, aged 45–74) were assessed. The Fishermen study examined the overall health effect of fish consumption in a high-consumption population, whereas the Health 2000 substudy obtained in-depth information on cardiovascular diseases and diabetes. Dioxins, polychlorinated biphenyls (PCBs) and methyl mercury (MeHg) (in the Fishermen substudy alone), and omega-3 polyunsaturated fatty acids (omega-3 PUFAs) were analyzed from fasting serum/blood samples. The Spearman's correlation coefficients between food frequency questionnaire (FFQ) fish consumption and dioxins, PCBs, MeHg and omega-3 PUFAs were respectively 0.46, 0.48, 0.43 and 0.38 among the Fishermen substudy men, and 0.28, 0.36, 0.45 and 0.31 among women. Similar correlation coefficients were observed between FFQ fish consumption and serum omega-3 PUFAs in the Health 2000 substudy, and also between FFQ fish consumption and the frequency questions on fish consumption in the Fishermen substudy.

Food Allergy: Soy

The Natural History of Soy Allergy

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Significance: Absolute soy IgE levels were useful predictors of outgrowing soy allergy.

This study described the natural history of soy allergy and identified predictors of oral tolerance/outgrowing soy allergy by reviewing the records 133 patients (n=96 males; n=37 females) with soy allergy seen in a tertiary referral clinic. Data collected included soy allergy-related symptoms, history of other food allergies and atopic diseases, soy-specific IgE levels, peanut-specific IgE levels, and food challenge results. Sixty-four percent had asthma, 71% had allergic rhinitis, and 85% had atopic dermatitis. The median age at the initial visit was 1 year; the median

duration of follow-up was 5 years. Kaplan-Meier analysis predicted resolution of soy allergy in 25% by age 4, 45% by age 6, and 69% by age 10. By age 6, 59% of children with a peak soy IgE level <5 kU/L, 53% of children with a peak s-IgE level of 5-9.9 kU/L, 45% of children with a peak s-IgE level of 10-49.9 kU/L, and 18% of children with a peak s-IgE level >50 kU/L had outgrown soy allergy ($P<0.01$ for trend).

Food Allergy: Peanut

Threshold Dose for Peanut: Risk Characterization Based Upon Diagnostic Oral Challenge of a Series of 286 Peanut-Allergic Individuals

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Food and Chemical Toxicology, Vol. 48, No. 3; pp. 814-819, 2010

Significance: This modeling approach could be used to establish population thresholds for peanut-allergic consumers and thereby provide a sound basis for allergen control measures in the food industry.

Clinical records of 286 consecutive patients reacting positively with objective symptoms to double-blind, placebo-controlled oral peanut challenges were examined for individual No Observed Adverse Effect Levels (NOAELs) and Lowest Observed Adverse Effect Levels (LOAELs). After fitting to a log-normal probability distribution model, the ED₁₀ and ED₀₅ were 14.4 and 7.3mg (expressed as whole peanut), respectively, with 95% lower confidence intervals of 10.7 and 5.2mg, respectively. Compared to results from a previous study where the ED₁₀ was based upon individual peanut thresholds gleaned from 12 publications, a statistically significant difference was observed between the ED₅₀'s, but not the ED₁₀'s of the two probability distribution curves. Minimum eliciting dose-distributions for patients with histories of more severe reactions (grade 4 or 5; n=40) did not differ significantly from those of patients with histories of less severe reactions (grades 1-3; n=123).

E. Coli

Infrequent Internalization of *Escherichia coli* O157:H7 into Field-Grown Leafy Greens

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Significance: Internalization of *Escherichia coli* O157 via plant roots in the field is rare and when it does occur, O157 does not persist 7 days later.

This field study evaluated the potential for internalization of *Escherichia coli* O157:H7 (O157) into leafy greens from contaminated irrigation water and improperly composted animal waste. Irrigation water inoculated with green fluorescent plasmid-labeled Shiga toxin-negative strains (50ml of 10², 10⁴, or 10⁶ CFU of O157/ml) was applied to soil at the base of spinach plants of different maturities in one field trial. In a second trial, contaminated compost (1.8kg of 10³ or 10⁵ CFU of O157/g) was applied to field plots prior to transplantation of spinach, lettuce, or parsley plants. *E. coli* O157 persisted in the soil up to harvest (day 76 posttransplantation) following application of

contaminated irrigation water; however, internalized O157 was not detected in any spinach leaves or in roots exposed to O157 during the early or late growing season. Internalized O157 was detected in root samples collected 7 days after plants were contaminated in mid-season, with 5 of 30 samples testing positive for O157 by enrichment.

Inactivation of *Escherichia coli* O157:H7 on Lettuce, Using Low-Energy X-Ray Irradiation

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Significance: Low-energy X-ray irradiation appears to be a promising microbial inactivation strategy for leafy greens and potentially for other types of fresh produce.

Low-energy X-ray irradiation was assessed as a means of eliminating *Escherichia coli* O157:H7 on lettuce. Round-cut iceberg lettuce samples (2.54-cm diameter) were dip or spot inoculated with a three-strain cocktail of *E. coli*, stored for 24h at 4°C, and then irradiated at four dose levels up to 0.25kGy using a prototype low-energy (70kV) X-ray irradiator. Dip inoculation yielded a D_{10} -value of 0.040 ± 0.001 kGy, which is 3.4 times lower than a previously reported value of 0.136 kGy using gamma radiation. The D_{10} -value for *E. coli* on spot-inoculated samples was 0.078 ± 0.008 kGy, which is about twice that of dip-inoculated samples. When 10 stacked leaves were irradiated from both sides, a dose of 0.2kGy was achieved at the center of the stack with a surface dose of 1kGy, corresponding to a ~5-log reduction of *E. coli* at the center of the stack.

Listeria

Influence of Fatty Acid Precursors, Including Food Preservatives, on the Growth and Fatty Acid

Composition of *Listeria monocytogenes* at 37 and 10°C

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Applied and Environmental Microbiology, Vol. 76, No. 5; pp. 1423-1432, 2010

Significance: The ability of a precursor to modify fatty acid composition was probably a reflection of the substrate specificities of the first enzyme, FabH, in the condensation of primers of fatty acid biosynthesis with malonyl acyl carrier protein.

As a possible novel approach for control of the growth of the organism, the influences of various fatty acid precursors, including branched-chain amino acids and branched- and straight-chain carboxylic acids, on the growth and fatty acid composition of the organism at 37°C and 10°C were studied in order to investigate whether the organism could be made to synthesize fatty acids that would result in impaired growth at low temperatures. The results indicate that the fatty acid composition of *Listeria monocytogenes* could be modulated by the feeding of branched-chain amino acid, C₄, C₅, and C₆ branched-chain carboxylic acid, and C₃ and C₄ straight-chain carboxylic acid fatty acid precursors, but the growth-inhibitory effects of several preservatives were independent of effects on fatty acid composition, which were minor in the case of preservatives metabolized via acetyl coenzyme A.

Growth of *Listeria* spp. in Shredded Cabbage Is Enhanced by a Mild Heat Treatment

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Significance: Mild thermal treatments of cut cabbage may promote pathogen growth if other inimical barriers are not implemented downstream of the thermal treatment.

The survival and growth of *Listeria* spp. on cabbage treated by mild thermal processing was examined. Twenty-four strains of *Listeria* spp. (including *L. monocytogenes*) were inoculated onto cut and intact cabbage tissues and stored at 5°C. All strains on intact tissues exhibited a moderate decline in numbers (up to 1.0 log CFU/cm²) over the 28-day storage period. Cut tissue supported growth of most strains during the first 7 to 14 days of incubation with maximum increases of 1.2 log CFU/cm². The survival or growth on heat-treated (50°C for 3 min) and untreated shredded cabbage of four *L. monocytogenes* and four nonpathogenic *Listeria* spp. strains were compared during storage for 21 days at 5°C. Growth on untreated shred for all strains was similar to the results observed on cut tissue with a maximum increase of approximately 1.0 log CFU/g. However, in the heat-treated cabbage shred all strains displayed a rapid increase in growth (up to 2.5 log CFU/g) during the first 7 days of incubation.

Inactivation of *Listeria monocytogenes* in Skim Milk and Liquid Egg White by Antimicrobial Bottle Coating with Polylactic Acid and Nisin

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Significance: This study demonstrated the commercial potential of applying the antimicrobial bottle coating method to milk, liquid eggs, and possibly other fluid products.

An antimicrobial bottle coating method to reduce the risk of outbreaks of human listeriosis caused by contaminated liquid foods was tested. Liquid egg white and skim milk were inoculated with *Listeria monocytogenes* Scott A and stored in glass jars coated with a mixture of polylactic acid (PLA) polymer and nisin. The pathogen grew well in skim milk without PLA/nisin coating treatments, reaching 8 log CFU/mL after 10d and then remained constant up to 42d at 10°C. The growth of *Listeria* at 4°C was slower than that at 10°C. At both storage temperatures, the PLA coating with 250mg nisin completely inactivated the cells of *L. monocytogenes* after 3d and throughout the storage period. In liquid egg white, *Listeria* cells in control and PLA coating without nisin samples declined 1 log CFU/mL during the first 6d at 10°C and during 28d at 4°C, and then increased to 8 or 5.5 log CFU/mL. The treatment of PLA coating with 250mg nisin reduced the cell numbers of *Listeria* in liquid egg white to undetectable levels after 1d, then remained undetectable throughout the 42d storage period at 10°C and the 70d storage period at 4°C.

Salmonella

Survival and Growth of *Salmonella* in Salsa and Related Ingredients

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Significance: *Salmonella* were rapidly and gradually inactivated in salsa formulations that contained both fresh garlic and lime juice.

Experiments were performed to determine the survival and growth characteristics of *Salmonella* in salsa and related major ingredients, i.e., tomatoes, jalapeño peppers, and cilantro. Intact and chopped vegetables and different formulations of salsas were inoculated with a five-strain mixture of *Salmonella* and then stored at 4, 12, and 21°C for up to 7 days. *Salmonella* did not grow, but survived on intact tomatoes and jalapeño peppers, whereas significant growth at 12 and 21°C was observed on intact cilantro. Growth of *Salmonella* occurred in all chopped vegetables when stored at 12 and 21°C, with chopped jalapeño peppers being the most supportive of *Salmonella* growth. Regardless of differences in salsa formulation, no growth of *Salmonella* was observed in salsa held at 4°C; however, rapid or gradual decreases in *Salmonella* populations were only observed in formulations that contained both fresh garlic and lime juice. These results highlight the importance of preharvest pathogen contamination control of fresh produce and proper formulation and storage of salsa.

Foodborne Pathogens

Fate of *Escherichia coli* O157:H7 and *Salmonella* on Fresh and Frozen Cut Pineapples

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Significance: Fresh and frozen cut pineapples are potential vectors for *E. coli* O157:H7 and *Salmonella* transmission and preventive procedures should be implemented during production and postharvest processing.

This study evaluated the fate of *Escherichia coli* O157:H7 and *Salmonella* on fresh and frozen cut pineapples and the influence of acid adaptation on *Salmonella* survival on fresh cut pineapple at ambient storage (23°C). Cut pineapples were spot inoculated with a four-strain cocktail of *E. coli* or a five-strain cocktail of *Salmonella*. Inoculated samples were air dried, placed in containers, and stored at 4, 12, 23, and -20°C. Samples were stomached and then enumerated on nonselective and selective media at days 0, 1, 3, 5, 7, 10, 14, 21, and 28 (4 and 12°C); 0, 1, 3, 5, and 7 (23°C); and 0, 7, 14, 21, 28, 60, 90, 120, 150, and 180 (-20°C). *E. coli* and *Salmonella* inoculated onto pineapple did not grow but survived for the shelf life at each temperature, with improved survival at lower temperatures. *E. coli* and *Salmonella* can survive on frozen cut pineapples for at least 180 days. Acid adaptation of *Salmonella* did not allow growth and did not increase survival.

Synergistic Effects of Ethanol and UV Radiation to Reduce Levels of Selected Foodborne Pathogenic Bacteria

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Significance: A significant synergistic benefit results from combining ethanol and UV treatments against foodborne pathogens in vitro.

The study determined whether combined treatments would produce synergistic disinfection effects on food products during food processing compared with single treatments. The bactericidal effects of a commercial chemical disinfectant (ethanol) and of UV radiation on *Bacillus cereus* F4810/72, *Cronobacter sakazakii* KCTC 2949, *Staphylococcus aureus* ATCC 35556, *Escherichia coli* ATCC 10536, and *Salmonella enterica* Typhimurium NO/NA in vitro were investigated. Various concentrations of ethanol were tested with various exposure doses of UV radiation with a UV lamp. The combined ethanol-UV treatments resulted in greater reductions in bacterial counts than did either treatment alone. The synergistic effect values for *B. cereus*, *C. sakazakii*, *S. aureus*, *S. enterica* Typhimurium NO/NA, and *E. coli* were 0.40-1.52, 0.52-1.74, 0.20-2.32, 0.07-1.14, and 0.02-1.75 log CFU/ml, respectively.