BEVERAGES

JUICE-ASSOCIATED OUTBREAKS OF HUMAN ILLNESS IN THE UNITED STATES, 1995 THROUGH 2005

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Outbreaks of illness associated with consumption of fruit juice have been a growing public health problem since the early 1990s. In response to epidemiologic investigations of outbreaks in which juice was implicated, the U.S. Food and Drug Administration implemented process control measures to regulate the production of fruit juice. The final juice regulation, which became effective in 2002, 2003, and 2004, depending on the size of the business, requires that juice operations comply with a hazard analysis critical control point (HACCP) plan. The Centers for Disease Control and Prevention (CDC) receives reports of food-associated outbreaks of illness. We reviewed fruit juice-associated outbreaks of illness reported to the CDC's Foodborne Outbreak Reporting System. From 1995 through 2005, 21 juice-associated outbreaks were reported to CDC; 10 implicated apple juice or cider, 8 were linked to orange juice, and 3 involved other types of fruit juice. These outbreaks caused 1,366 illnesses, with a median of 21 cases per outbreak (range, 2 to 398 cases). Among the 13 outbreaks of known etiology, 5 were caused by *Salmonella*, 5 by *Escherichia coli* O157:H7, 2 by *Cryptosporidium*, and one by Shiga toxin-producing *E. coli* O111 and *Cryptosporidium*. Fewer juice-associated outbreaks have been reported since the juice HACCP regulation was implemented. Juice operations that are exempt from processing requirements or do not comply with the regulation continue to be implicated in outbreaks of illness.

RAPID DETECTION OF ORGANOPHOSPHATE OF PESTICIDE RESIDUES FROM TEA USING SERS WITH A SILVER NANOROD ARRAY SUBSTRATE

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Tea is a popular beverage in the United States, however, recently food safety issues have arisen regarding pesticide residues on tea. To address this concern, a simple, rapid, and sensitive method to detect the pesticide is necessary. To achieve rapid determination of pesticide, the use of surface-enhanced Raman spectroscopy (SERS) with Ag nanorod array substrate produced by oblique angle deposition (OAD) method at vapor incident angle of 86° was investigated. Conventional gas chromatography method was used for confirmation. Chlorpyrifos, an organophosphate pesticide used for many crops and plants including tea, was studied at a laser excitation wavelength of 785 nm. The feasibility of SERS detection technique with the specific Ag nanorod array substrate to rapidly examine pesticide residues in tea was demonstrated. We showed that there was a quantitative relationship between the concentration of chlorpyrifos and the SERS peak intensities. Calibration curves based on Raman areas at bands 419, 691, 1343, and 1575 cm^{-1} had better correlation coefficients (0.9609-0.9901) than that based on Raman intensity at 691, 1343, and 1575 cm^{-1} (0.9285-0.9731) in a chlorpyrifos concentration range of 0.2-100 ppm. The use of SERS spectra for detection of chlorpyrifos left on off-shelf tea samples was successfully demonstrated. Principal component analysis (PCA) was objectively used to confirm false or positive pesticide residues. Our results suggest that the SERS combined with PCA can be used to identify pesticide residues in food systems via identifying the minute different fingerprints.

COMBINATIONS OF ANTIMYCOTICS TO INHIBIT THE GROWTH OF MOLDS CAPABLE OF PRODUCING 1,3-PENTADIENE

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Raw and pasteurized foods and beverages as well as products subjected to more rigorous thermal processes, e.g., hot-fill beverages, can contain a wide range of molds. These molds may grow during the expected shelf life of these products to cause visual spoilage or result in the production of volatile compounds that are offensive to the consumer. Some of the molds known to grow in the presence of potassium sorbate or survive thermal processes commercially applied to foods and beverages can also produce mycotoxins, thereby posing a public health concern. Degradation of sorbate through decarboxylation by some strains of penicillia can result in the accumulation of 1,3-pentadiene, a volatile compound having an odor described as being similar to that of kerosene, acrylic paint, or petroleum products. Other molds that may also degrade sorbate include *Aspergillus*,

Fusarium, *Mucor*, *Geotrichum*, and *Trichoderma* species. Strains of yeasts belonging to *Zygosaccharomyces rouxii* and *Debaryomyces hansenii* are also capable of spoiling sorbate-containing high-sugar foods by producing 1,3-pentadiene. While the control of sorbate-resistant molds and yeasts in some types of foods and beverages may be achievable through the addition of high concentrations of the preservative, the adverse effect of off aromas and off flavors that may result make this approach impractical. Instead, the use of antimycotics other than sorbate, e.g., natamycin, ethylenediaminetetracetic acid, and propionate, or a low concentration of sorbate in combination with other antimycotics may be an alternative to prevent or retard the growth of 1,3-pentadiene-producing molds. We did a study to evaluate potassium sorbate, sodium benzoate, calcium propionate, disodium ethylenediaminetetraacetic acid (EDTA), and natamycin, alone and in combination, for their effectiveness in preventing the growth of five molds isolated from Parmesan cheese and a lemon-flavored drink subjectively judged to contain 1,3-pentadiene. Growth of *Penicillium brevicompactum*, *Penicillium roqueforti*, *Paecilomyces variotii*, *Aspergillus niger*, and *Cephaloascus fragrans* on model agar media containing Parmesan cheese (PRM agar) (pH 5.5) and lemon-flavored drink (LD agar) (pH 2.6) supplemented with antimycotics was studied. All molds grew well at 21ºC on PRM agar containing potassium sorbate (3,500 µg/ml), calcium propionate (3,000 µg/ml), or natamycin (20 µg/ml). Combinations of potassium sorbate (250 - 1,000 µg/ml), calcium propionate (250 - 1,000 µg/ml), and/or natamycin (10 - 18 µg/ml) greatly inhibited or prevented growth of molds on PRM agar, indicating their potential as preservative systems at pH values resulting in large percentages of the acids in dissociated forms. Three of the five molds grew on LD agar containing potassium sorbate or sodium benzoate at a concentration of 200 µg/ml. Growth did not occur within 70 days on LD agar containing EDTA (30 µg/ml) in combination with potassium sorbate and sodium benzoate at 50 and 175 µg/ml, respectively, or 175 and 50 µg/ml, respectively. Results of this study show that preservative systems containing a reduced concentration of potassium sorbate, in combination with other antimycotics, particularly natamycin, have potential for controlling the growth of molds thought to be capable of producing 1,3-pentadiene.