

## It's not easy being green

Those of us who, mindful of microbiological hazards, look askance at chicken on the buffet table and select a supposedly healthy salad instead, may need to adjust our perspective. For although recent improvements in animal husbandry have helped to stem and even reverse rising tides of salmonella, campylobacter, and toxigenic *Escherichia coli* infections in many countries, fresh fruit and vegetables are attracting increasing attention as vehicles of foodborne diseases.

As emerged during another of the Society for Applied Microbiology's (SfAM) judiciously timed meetings, held recently in Cardiff, UK, the problem does not reflect any changes in microbial virulence or transmissibility. The most likely causes seem to be greater global trade in "fresh" produce, switches in consumer choices towards more prudent diets, and the proliferation of prepacked, ready-to-eat salads in supermarkets.

*Salmonella enterica* serovar Senftenberg is one organism whose recent travels illustrate the internationality of the problem, described at the SfAM meeting by Christine Dodd of the University of Nottingham (Nottingham, UK). Earlier this year, *S. senftenberg* caused 31 cases of food poisoning in England and Wales. Four patients with previous underlying illness became sufficiently unwell as to require hospitalisation and one died. Prepacked fresh basil cultivated in Israel was the almost certain cause, established by molecular typing of isolates from that source and from patients. Associated cases came to light in Scotland, Denmark, the USA, and the Netherlands.

Such dangers can, in principle at least, be diminished by washing salad vegetables, a practice sometimes supplemented by disinfection with chlorine. However, these measures rarely achieve more than a ten to 100-fold reduction in microbial counts. Many organisms, especially salmonellae, adhere tenaciously to leaf surfaces where they are more resistant to disinfectants. Even worse, they sometimes become internalised by invading plant tissues through stomata.

Mike Doyle of the University of Georgia (Griffin, GA, USA) highlighted other factors that can complicate investigations into the contamination of fresh produce. Discussing three separate gastroenteritis outbreaks in the USA in the autumn of 2006, he pointed out that, although both spinach and lettuce were probable causes, only the growing regions had been identified. "Suspected risk factors included the proximity of irrigation wells and surface waterways exposed to faeces from cattle and wildlife, and improperly composted animal manure used as fertiliser", he said. "But the specific mode of contamination remains unconfirmed. It is difficult to decipher events of this sort because they occur sporadically."

The ineffectiveness of suppliers' washing procedures, and thus the dubiousness of ready-to-eat labels, was



described by Asja Asceric and Elizabeth Scott of Simmons College (Boston, MA, USA). The investigators simply compared the microbial flora of spinach straight from the field with those of samples described as "thoroughly" and "triple" washed. They found that all three types had high and indistinguishable loads of bacteria, including faecal coliforms.

Although Asceric and Scott's advice to customers was to disregard reassuring labels and wash packaged salads themselves, there is little likelihood that such assiduousness will be particularly effective. Because the attachment of microorganisms to leaves and their subsequent survival have attracted interest only with recent recognition of disease outbreaks attributable to prepacked produce, there is little knowledge on which to base countermeasures.

Fortunately, the Food Refrigeration and Process Engineering Research Centre in Langford, UK, is on the case, and two speakers from there described both novel physical methods and alternatives to chlorine, which might in future be adopted to ensure vigorous decontamination. The use of ultraviolet radiation, pulsed electric and magnetic fields, microwaves, ultrasound, and high-intensity pulsed light all show promise on a laboratory scale, whereas a continuous steam-based system is beginning to be used commercially for the treatment of herbs.

From *S. senftenberg* in basil to *Listeria* spp in Irish vegetables, the SfAM audience heard ample evidence of newly appreciated sources of enteric pathogens. Doubters may, however, have been more shocked by another organism shown vividly on the screen. Sitting in a bag of prepacked, ready-to-eat salad purchased across the counter was a live frog.

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