PATHOGENS IN PLANTS

Common pathogens like Salmonella spp., Echerichia coli, Listeria monocytogenes and Campylobacter spp., traditionally associated with animal products, are increasingly entering the food chain through contaminated fruit and vegetable products.

Consumption of fresh produce has increased in recent years, prompted by healthy eating campaigns in the USA, Europe and other parts of the world. However, compared to previous years, fruit and vegetables are now being identified more frequently as the source of a growing number of outbreaks associated with zoonotic pathogens.

Between 2003 and 2008, the food vehicles identified in 1,565 outbreaks reported to the Centers for Disease Control and Prevention (CDC) are a broad spectrum of animal- and plant-derived foods (picture 1). The list of implicated foods is regularly expanded as new ones are identified during outbreak investigations. Between 2006 and early 2012, 15 new specific food types were identified as food vehicles in outbreaks affecting the United States. It is curious that while many of the pathogens have animal reservoirs, many new food vehicles are plant derived. This includes plant-derived processed foods, like peanut butter, peanut paste, and spinach powder; spices such as black and white pepper; tree nuts and fresh produce items.

Consumer demand for greater choice, variety and year-round availability of fruit and vegetables, as well the vogue for convenient 'ready to serve' products, such as bagged salads, has driven the globalisation of supply chains and increased pressure on the food industry. Unfortunately, this may compromise safety. The standard of water used for irrigation, as well as hygiene at harvest and during storage, can vary widely between countries, potentially exposing consumers to increased numbers and varied strains of these pathogens.

Intensive farming is not new. It is becoming apparent though that lessons learned in livestock farming can also impact fresh produce growing and processing.

PROXIMITY INCREASES RISK

Zoonotic pathogens are not commonly present in fruit and vegetables in nature. Human intervention and commercial food production practices have brought the two into close proximity.

Pathogens may be naturally present in soil, or may become incorporated in the soil from organic wastes added as fertiliser, or by accidental contamination. For example, water supplies used to wash and irrigate crops can be contaminated with faecal material (and its pathogens) by run-off from nearby fields and livestock farming. The risk of contamination under these circumstances is far greater than the chances of accidental contamination caused by the intrusion of wild animals and birds into fields.

SURVIVAL ON AND IN PLANTS

Pathogens in water used for spraying can remain on fruits and vegetables and survive on these new carriers. Studies have shown that some enteropathogens are quite adept at surviving on the leaf surface (phylloplane). A study showed that E. coli applied to lettuce could be isolated from the plant for a further 15 days. Fruit and vegetable plants react differently to enteropathogens. Some have been shown to actively support their survival, while others resist. Effective washing and exposure to UV radiation can typically deal with surface contamination. While UV radiation is traditionally used to minimise contamination, successful phylloplane bacteria typically colonise sites that are

protected from UV, such as the base of structures (trichomes).

Pathogens do not always die on leaving the host animal, but may find a new carrier in the form of plants. Plants sprayed with contaminated water, either during growing or processing, can absorb pathogens through any wounds to the flesh. This is a particular issue with popular consumer items such as pre-prepared lettuce and salads. The cut surfaces exude nutrients and supply pathogens with the means to survive, penetrate to the internal tissue and grow – beyond the reach of chemical sanitisers. Internalisation of pathogens into plants may also be possible through stomata and hydathodes (permanently open water pores). Normally used to secrete water from a plant, a study has shown that under certain conditions pathogens can enter leaves through its hydathodes and move into the vascular system, which may even result in the internal translocation of the bacteria inside plants. Furthermore, contaminated irrigation water can be taken up by a plant's root system and any pathogens can be stored within its flesh.

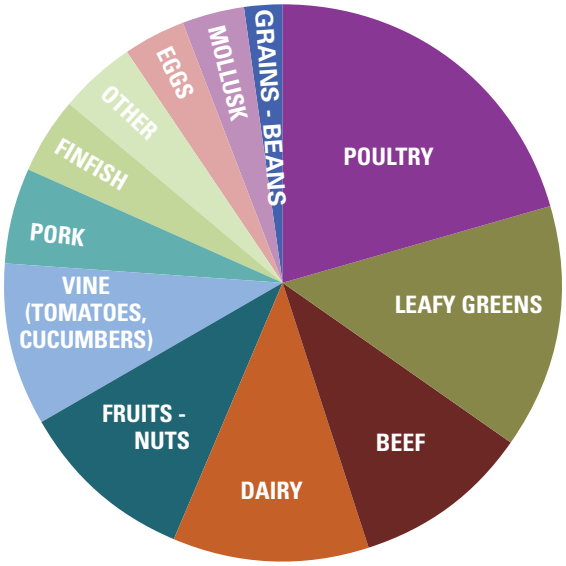
As a result the food industry must innovate and identify for ways to better protect and improve the microbial quality of fruit and vegetable produce.

PREVENTION, BETTER THAN CURE

There is little that consumers can do to protect themselves from fruit and vegetable contamination, as these products are often not cooked. Washing them has little effect on any contamination and being invisible to the naked eye it becomes increasingly important to prevent contamination occurring in the first place.

In theory, existing regulations and the food industry requirement that all processors and manufacturers implement hazard analysis and critical control point (HACCP) strategies, should prevent environmental contamination reaching the consumer. Overall evidence suggests that actual contamination of fruit and vegetables with pathogens is low. However, any outbreak has the potential to make consumers ill and in rare cases cause death.

Image 1: Distribution of illnesses by food type in 1,565 foodborne outbreaks caused by a single food type and reported to CDC's National Foodborne Disease Outbreak Surveillance System, 2003-2008. Source: NCBI (National Center for Biotechnology Information) on August 2013.



All HACCP plans should be reviewed regularly. They must deal not only with questioning whether the water at a facility is safe to use, but also if that water source is trusted and protected against potential contamination. Post-harvest contamination is also known to result from poor food handling processes and poor worker hygiene. Processors need to ensure that HACCP plans are robust, documented and perhaps most importantly, implemented. Poorly trained employees are potentially the weakest link in any plan.

END PRODUCT INTERVENTION

The food industry has, out of necessity, invested heavily in microbiological testing and surveillance programmes. Fruit and vegetable products can undergo microbiological testing at any stage of the supply chain but are most commonly checked as the end product. This enables processors to identify any pathogen contamination before goods reach the point of sale.

An integrated testing programme can verify the microbial quality of products and in the event of contamination being identified, prevent them reaching the consumer. This is preferable to suffering a product recall as a direct result of an outbreak. Product recalls cost the industry more than just money. They also damage consumer confidence and devalue the brand involved.

END PRODUCT INTERVENTION

Global supply chains mean that contamination issues in one part of the world can quickly spread. Existing food safety systems have focused on post-harvest safety, hygiene, handling and testing. Improving food safety going forward will likely rely on increased awareness of public health issues and enforcement of regulations in new and developing markets. This should be complemented by increased focus on identifying contaminations earlier, preventative in-field solutions and introducing stricter practices more in line with livestock farming.

For further information please visit our website www.foodsafety.sgs.com.

Ron Wacker, PhD
Global Food Testing Business Development Manager
SGS Germany
ron.wacker@sgs.com
t +49 6039 4696