ACM/1064

ADVISORY COMMITTEE ON THE MICROBIOLOGICAL SAFETY OF FOOD

DISCUSSION PAPER

INTERNAL COLONISTION OF FRESH PRODUCE BY PATHOGENIC BACTERIA

1. Ready-to-eat salad vegetables and fruit have been implicated in 8 outbreaks of foodborne disease in England and Wales between 2007 and 2010[1,2]. The most commonly identified aetiological agent was *Salmonella* (6 outbreaks). The other identified agents were *E,coli* O157 and Norovirus One issue periodically questioned is the possibility and extent to which pathogens can become internalised into plant tissue and thereby become protected from the action of any washing or sanitising process.

2. A 2008 FAO/WHO report[3] on 'Microbiological hazards in fresh leafy vegetables and salads' examined the available research and concluded that internalisation is possible during pre-harvest but only after exposure of young plants to high pathogen loads. Similarly, during post harvest, internalisation into damaged or cut surfaces of leafy vegetables has been demonstrated under experimental conditions using high inocula.

3. Their view was that there was no evidence to indicate that internalization is significant in practice, particularly when Good Agricultural Practice (GAP) is implemented. However, the available information on non-experimentally induced internalisation under actual GAP, Good Manufacturing Practice and Good Hygiene Practice is limited.

4. More recently, a review on internalisation of *E. coli* O157:H7 and *Salmonella* spp. in plants[4] concluded that many studies have shown that both these pathogens can internalise within a variety of tissue types during many different points in the growing and distribution process. There are also a number of factors, such as type of plant, strain and/or serovar of bacteria, route of contamination and age of plant that can influence the extent of internalisation. Two major routes of entry are suggested:

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[1] Little *et al* Update on the Microbiological Status of Ready-To-Eat Foods (Focussing on Fruit and Vegetables), September 2008 (ACM/922)
[2] Little *et al* Outbreaks of Infection Associated With ready-To-Eat Food, January 2011 (ACM1014)
[3] FAO/WHO 2008 Microbiological hazards in fresh leafy vegetables and salads. Meeting report. Microbiological Risk Assessment Series No. 14
[4] Deering, A.J., et al., Internalisation of *E. coli* O157:H7 and *Salmonella* spp. in plants: A review. Food Research International (2011)

- Bacteria enter through natural openings in the plant surface (e,g, stomata, lenticels) or through sites of biological or physical damage.

- Bacteria are pulled into the internal tissues along with water.

5. A further review by Hirneisen et al[5] examined root uptake into food crops and concluded:

   - Uptake through internalisation is a plant-pathogen specific interaction.
   - The plant growth substrate used plays a large role in the uptake of both bacterial and viral pathogens in plants.
   - Intact, healthy, non-injured roots seem to discourage the uptake of bacteria and viruses into plants.
   - Generally, the presence of internalised pathogens in roots of plants does not directly correlate with internalised pathogens in the edible or foliar tissues of crops.

   In addition, contaminated soil, for the most part, resulted in little to no observed internalisation as compared to contaminated hydroponic solution. For those studies where internalisation was observed, it was sporadic and at low levels.

6. The FSA is considering whether to undertake research to examine uptake and persistence of pathogens within plants in commercially relevant growth cycles in the UK, plus the viability and pathogenicity of the bacteria which have been internalised. The Agency would welcome the Committee's views on this issue and have invited Nicola Holden from the James Hutton Institute to give a presentation on the current evidence.

7. Members are invited to respond to the following questions:

   - Based on the current evidence, does the Committee consider there to be a need for further research to establish the implications for consumer health of the internalisation of pathogens in fresh produce?

   - If so, what does the Committee consider to be the key evidence gaps that need to be addressed?

Secretariat
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[5] Kirsten A. Hirneisen, Manan Sharma and Kalmia E. Kniel. Foodborne Pathogens and Disease. May 2012, 9(5): 396 - 405