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How Salmonella Bacteria Contaminate Salad Leaves

ScienceDaily (Sep. 5, 2008) — How Salmonella bacteria can cause food poisoning by attaching to salad leaves is revealed in new research presented September 3 at the 21st International ICFMH Symposium 'Food Micro 2008' conference in Aberdeen.

The new study shows how some Salmonella bacteria use the long stringy appendages they normally use to help them 'swim' and move about to attach themselves to salad leaves and other vegetables, causing contamination and a health risk.

Food poisoning from Salmonella and E. coli is commonly associated with eating contaminated bovine or chicken products, as the pathogens live in the guts of cows and the guts and egg-ducts of chickens, and contamination of meat can occur during the slaughtering process.

However, some recent outbreaks of food poisoning have been associated with contaminated salad or vegetable products, and more specifically, pre-bagged salads. For example, in 2007 a Salmonella outbreak in the UK was traced back to imported basil, and an E. coli outbreak in the USA in 2006 was traced to contaminated pre-packed baby spinach.

Between 1996 – 2000, 23% of the UK's infectious intestinal disease outbreaks like salmonella and E. coli were caused by contaminated food, and of these, 4% were linked to prepared salad.

The new research, led by Professor Gadi Frankel from Imperial College London and carried out with Dr Rob Shaw and colleagues at the University of Birmingham, has uncovered the mechanism used by one particular form of Salmonella called Salmonella enterica serovar Senftenberg, to infect salad leaves, causing a health risk to people who eat them.

Understanding the mechanism that pathogens such as salmonella use to bind themselves to salad leaves is important if scientists are to develop new methods of preventing this kind of contamination and the sickness it causes.

Scientists know that Salmonella and E. coli O157 – a strain of E. coli that can cause serious sickness in humans - can spread to salads and vegetables if they are fertilised with contaminated manure, irrigated with contaminated water, or if they come into contact with contaminated products during cutting, washing, packing and preparation processes. However, until now, scientists did not understand how the pathogens managed to bind to the leaves.

Professor Frankel and his colleagues at the University of Birmingham found that Salmonella enterica serovar Senftenberg bacteria have a secondary use for their flagella - the long stringy 'propellers' they use to move around. The flagella flatten out beneath the bacteria and cling onto salad leaves and vegetables like long thin fingers. To test this observation the scientists genetically engineered salmonella without flagella in the lab and found that they could not attach themselves to the leaves, and the salad remained uncontaminated.

Professor Frankel says: "Discovering that the flagella play a key role in Salmonella's ability to contaminate salad leaves gives us a better understanding than ever before of how this contamination process occurs. Once we understand it, we can begin to work on ways of fighting it."

The team's next steps will involve looking at the extent to which different types of salad leaves are affected by salmonella. Professor Frankel explains that some types of leaves are less susceptible to salmonella contamination than others: "If we can find out what factors affect susceptibility, we may be able to develop new technologies to harness the 'immunity' found in some salad leaves to protect others from contamination," he says.

However, Professor Frankel says that even though such a small minority of cases are currently linked to salads, the numbers are likely to increase in coming years. "In their efforts to eat healthily, people are eating more salad products, choosing to buy organic brands, and preferring the ease of 'pre-washed' bagged salads from supermarkets, than ever before. **All of these factors, together with the globalisation of the food market, mean that cases of Salmonella and E. coli poisoning caused by salads are likely to rise in the future. This is why it's important to get a head start with understanding how contamination occurs now,**" he said.

In a previous study, Professor Frankel and his colleagues discovered the mechanism by which E. coli O157 binds to salad leaves. They have shown that E. coli O157 bacteria use short needle-like filaments, which are normally used to inject bacterial proteins into human cells, to attach them to salad leaves, causing contamination and a risk of transmission via the food chain to humans.

<http://www.sciencedaily.com/releases/2008/09/080902221812htm>