

# The Biggest Food Safety Threat from the Tiniest of Crops

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During 2011 an unprecedented food-borne illness outbreak of bloody diarrhea and hemolytic uremic syndrome (HUS) centered in Germany occurred due to consumption of contaminated sprouted seeds. The number of documented cases of illness caused by the contaminated sprouts totaled 3,842, with 909 cases of HUS and 52 deaths reported (2). Although this will be remembered as the most deadly fresh produce-related outbreak to date, it came as no surprise to public health officials. Sprouted seeds are the most common vehicle of pathogenic *Escherichia coli* and salmonellosis outbreaks, with multiple outbreaks often occurring in a single year (as reported by the U.S. Centers for Disease Control and Prevention). Public health officials have warned the elderly, young, and immunocompromised to avoid sprouted seed consumption. However, healthy individuals can also succumb to infection from contaminated sprouts.

After 55 outbreaks in 14 years that have sickened more than 15,000 people and killed dozens, many retailers have determined that selling sprouted seeds is too risky. The liability associated with selling contaminated sprouted seeds led the largest U.S. retailer of fresh produce to stop selling sprouts in late 2010. One restaurant chain that featured sprouts in several sandwiches saw the number of clover sprout-related food-borne illness outbreaks and cases rise when they switched from alfalfa to clover sprouts ([www.cdc.gov/ecoli/2012/O26-02-12/index.html](http://www.cdc.gov/ecoli/2012/O26-02-12/index.html)). Both they and a rival chain have announced that they are dropping sprouts from their menu in 2012. Sprouted seeds are not alone in their capacity for contamination by enteric human pathogens, as shown by the discovery of Shiga toxin-producing *E. coli* (STEC) in cucumbers during traceback of a contaminated fenugreek seed outbreak. However, sprouted seeds pose a unique challenge.

## Sprouted Seeds and Food-borne Illness Outbreaks

Why do sprouted seeds cause so many food-borne illness outbreaks? First, bacterial pathogens that cause food-borne illnesses (e.g., *Salmonella* and STEC) replicate exponentially as seeds sprout (5). In contrast, STEC and *Salmonella* fail to replicate significantly on intact lettuce leaves or tomato fruits (7–9). As a result, small undetectable populations from contaminated seeds can increase to infectious doses either before a product is shipped to retailers or prior to consumption. The bacteria form biofilms that adhere to the sprouted seeds and cannot be cleaned off (1). The capacity for exponential growth, therefore, is linked to the most likely route of sprouted seed contamination, the seed.

The most contentious issue associated with contaminated sprouts is the seed. The route of fresh produce contamination implicated in food-borne illness outbreaks is rarely identified due to the fragility of fresh fruits and vegetables. In contrast, pathogenic bacteria can survive for years on seeds, which

simplifies epidemiological tracebacks to sprout producers who used a common seed lot (3,10–12,15–19). The long-term survival of human pathogens on seeds presents a serious obstacle for sprout producers and food safety risk for consumers.

## Solutions to Contaminated Sprouted Seeds

What is the solution to contaminated seeds? Attempts to decontaminate seeds have failed to date and testing seed or sprout lots for pathogens has proven unreliable. The U.S. Food and Drug Administration suggests that sprout producers treat seeds with calcium hypochlorite; however, outbreaks have occurred from both treated (4,6,11–14,17,19) and untreated seeds (3,10,15,16,18). Eliminating seed contamination remains the only viable option. However, avoiding risk factors for seed contamination by enteric human pathogens may not be feasible. For example, alfalfa seeds destined for sprout producers and human consumption are not produced separately from seeds destined for forage crops and animal consumption. The human consumption market for alfalfa seed is minuscule compared with that of animal consumption, and crop management practices to increase seed yield, such as use of raw manure for soil fertility, ignore human pathogen contamination risk factors. Once contamination occurs, seed represents the number one risk factor for sprout contamination.

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