Food Safety Risks Associated with Flood Conditions

With the recent floods in our area, the safety of our food and water supplies has been questioned. The U.S. Food and Drug Administration (FDA) defines flooding as “flowing or overflowing of a field with water outside a grower's control” (U.S. FDA, 2009). Flood waters may contain heavy metals (such as arsenic, mercury, lead, cadmium), human sewage, bacteria, parasites (such as Salmonella spp., Escherichia coli 0157:H7, Giardia spp.), chemicals (petroleum, chemical spills, etc.) and other contaminants that can be transferred to drinking water, crops and other food. Flood waters can also leave chemicals and microorganisms behind in the soil, causing other problems for farmers later. The FDA has published several guidance documents for the industry with advice on flood-affected food crops (see references), and their material along with information from other universities is summarized here.

- **FDA considered a crop to be too contaminated to be saved or adulterated** (not for human consumption) if the edible portion is exposed to flood waters.
  - FDA’s regulation states that crops that are under water during flood condition cannot be sold for human consumption [402(a)(4)] (21 U.S.C. 342(a)(4) of Food, Drug and Cosmetic Act).
  - FDA does not recognize any method of saving or reconditioning for crops where the edible portion is exposed to flood waters. The reference here is for crops where the edible portion was under water.
  - There is also the risk that flooded-crops can contaminate non-flooded crops. Care should be taken to minimize contact between flooded and no-flooded crops (don’t mix the two).

- **If the edible portion of the crop did not come into contact with the flood waters or if the edible portion develops after the water recedes, then the safety of the crop has to be evaluated on a case-by-case basis** (for above ground crops only). The safety of crops that are exposed to flood waters but are not under water is dependent upon the local environment because this determines what is in the flood water. Some items to consider include:
  - Contamination of crops from flood waters is not something we can see so extreme caution is recommended. If the edible part of the crop was under water, it should not be eaten (US FDA, 2011). If the crop was splashed with flood waters (even a remote chance), it should be sent to the Packaging House or Processing Plant to be washed and treated with an antimicrobial (see for recommendations below). Since leafy greens are a high risk commodity and are very difficult to clean, they should receive a heat treatment if you suspect they were splashed with flood waters.
  - If the edible portion of the crop was not developed when the flooding happened, then you need to consider the time it will take for maturation. If it takes 4 weeks or more for the crop’s edible portion to develop after flood waters have receded, then it is safe to consume. We recommend submitting a soil sample for testing during this time (see information below).
Other recommendations

1. **Discard any fresh produce that was submerged** under flood water and do not consume it (US FDA, 2011).
2. **Do not eat any produce suspected of contamination without fully cooking it** (Ingham and Ingham, 2007). Produce not submerged but suspected to have come in contact with flood waters can be cooked to ensure safety. This is especially important for individuals who are at a higher risk of food borne illness (young children, elderly, pregnant women, and those with compromised immune system).
3. **Discard any produce that is cracked, bruised or has an open cut, scratch or other defect where contamination could enter it** (Ingham and Ingham, 2007).
4. **Do not allow your equipment and tools to be a source of cross-contamination** (Produce Safety Alliance, 2014). Make sure you clean and sanitize farm equipment that has been used in flooded fields
   - Thoroughly sanitize all equipment after using it on a previously flood field. If this same equipment is then used on non-flooded crops, it could be a source of cross-contamination.
   - Equipment can be sanitized using a variety of chemicals. One of the cheapest and most effective to use bleach (liquid chlorine or sodium hypochlorite). You can buy this at the local grocery store at an 8.25% concentration (non-floral scented variety). For equipment sanitation, first clean the equipment with water, detergent and a post-rinse before applying bleach. The best concentration to use for equipment is 200 ppm chlorine bleach (prepared by adding 3.5 ounces of an 8.25% bleach to 10 gallons of potable water). You can apply this to clean equipment using a clean pump-up garden sprayer.
5. **Wait at least 60 days after the flood waters rescind to re-plant fields** (Produce Safety Alliance, 2014). This is not a FDA recommendation, but rather comes from University research. It would also be a good idea to submit a soil test during this time period (recommended tests are heavy metals listed as ‘in solution ICP analysis’ by Clemson University Agricultural Services laboratory
   The cost for heavy metal testing of soil by Clemson’s Agricultural Service Laboratory is $15 per sample. This lab does not perform microbiological testing, but you can contact your local County Extension Office for information on other private labs that test for microorganisms. The most common test needed for soil will be fecal coliforms counts.

Pack House and Processors:

Thoroughly washing fresh produce with potable water (drinking water) that contains an antimicrobial will reduce any potential contamination from flood waters. According to FDA, you need to consider the amount of the antimicrobial and the conditions under which it is used - such as water temperature,
acidity [pH], water hardness, contact time, amount and rate of product throughput, type of product, water to product ratio, amount of organic material, and the resistance of pathogens to the particular antimicrobial agent. It is important to follow the manufacturers or FDA guidelines on using antimicrobials treatments on food (US FDA, 2010). Some of the common antimicrobials that work well on fresh produce include: Chlorine (sodium hypochlorite at 50 to 200 ppm for 1-2 min, pH 6 to 7.5); Chlorine Dioxide (3 ppm); Acidified Sodium Chlorite (500 to 1200 ppm) and Peracetic Acid (blend of 15% peroxyacetic acid and 11% Hydrogen Peroxide applied at 60 to 80 ppm for 45 seconds by submersion).

For fresh produce, FDA recommends: 1) remove as much soil/dirt as possible before using the antimicrobial; 2) use a series was washes, such as triple wash because this removes more bacteria than a single wash; and 3) use an appropriate wash method (dip, spray or both). You can find more information on antimicrobials at the following FDA web link [http://www.fda.gov/Food/FoodScienceResearch/SafePracticesforFoodProcesses/ucm090977.htm](http://www.fda.gov/Food/FoodScienceResearch/SafePracticesforFoodProcesses/ucm090977.htm).

Contact your local County Extension Office if you have additional questions ([http://www.clemson.edu/extension/](http://www.clemson.edu/extension/)) or call the Clemson University Home and Garden Information Center at 1-888-656-9988 ([http://www.clemson.edu/extension/hgic/](http://www.clemson.edu/extension/hgic/)).

**References:**