

REDUCING FOOD SAFETY RISKS FROM PRE-HARVEST WATER



Pre-harvest water

Vegetables can't grow without water. In Australia's often dry and unpredictable climate, irrigation is essential. Water is also used to apply fertilisers, spray pesticides, provide cooling and stabilise soils. Sources of water include dams, rivers, underground bores or town water supplies.

Water is also a potential source of microbial contamination. Human pathogenic bacteria, such as *Escherichia coli* (*E. coli*), *Salmonella* spp., *Listeria monocytogenes*, *Campylobacter* spp., *Yersinia enterocolitica* and others, can readily contaminate water. Certain strains of these bacteria – particularly *Salmonella* spp. and *E. coli* – can cause severe illness or death. Human pathogens can potentially survive for extended periods in contaminated water, reaching populations of millions in every litre.

Faeces, dead animals and birds are key sources of these microbes. Surface water in dams can be easily contaminated by wild birds, runoff, or animals entering water to drink. Bores usually pose less risk but may still be contaminated by seepage from septic systems or intensive livestock production. Even rainwater tanks can be contaminated by birds or animals entering them, or by faeces from birds or rodents washed into tanks after rain.

The quality of water that contacts the plant is the most important factor affecting the safety of leafy vegetables. Most of the significant food safety outbreaks associated with salad greens can be traced back to contaminated water.

Reducing risk

The best way to reduce risk is to prevent water becoming contaminated. Livestock should be kept away, and runoff diverted from dams, watercourses and cropping areas. Water pipes and tanks should be constructed so as to prevent pest entry (e.g. enclosing water tanks) and kept well maintained.

If water may contain human pathogens, then the best way to ensure vegetables are safe is to avoid contact with the harvestable part. Sub-surface irrigation, drippers and hydroponic systems all avoid irrigation water touching plant leaves and fruit.

If water does contact the harvestable part, then withholding periods apply. Withholding periods allow any human pathogens on the crop surfaces to die-off before harvest.

The current recommendation is that **vegetables must not be harvested for at least 48 hours** if irrigation water or sprays have contacted the harvestable part. The exceptions to this are:

- Water has been tested to show it contains <100 CFU (colony forming units i.e. individual bacteria) of *E. coli*/100ml OR
- Product is always eaten cooked (e.g. rhubarb, potatoes).

Is 48 hours enough?

Trials conducted as part of the project "Pathogen Persistence from Paddock to Plate" (VG16042) examined how long *E. coli* and *Salmonella* spp. survive



LEAST RISK

MOST RISK

Figure 1. Limiting contact between water and the harvestable part of crops reduces the risk of contamination.

REDUCING FOOD SAFETY RISKS FROM PRE-HARVEST WATER

on the surfaces of leafy vegetables after irrigation with contaminated water. Both bacteria fell below or close to detectable levels within 48 hours. Results were similar for different vegetables (lettuce, spinach, parsley, etc.) and for plants grown in the glasshouse as well as in the open field.

However, results were very different if the plants were damaged shortly before irrigation. In this case, bacteria survived for at least six days. Detections were increased even if the injury was minor and the product appeared commercially acceptable.

Cos lettuce was particularly susceptible. Lettuce damaged up to four days before irrigation with contaminated water still had high populations of *E. coli* after the 48-hour withholding period. This suggests that lettuces can remain vulnerable to contamination well after damage occurs. In contrast, baby spinach damaged 24 hours or more before irrigation was no more contaminated than intact plants.

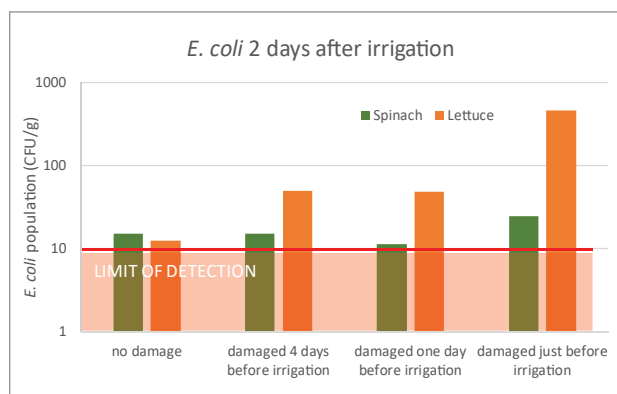


Figure 2. *E. coli* populations on cos lettuce and baby spinach damaged up to four days before irrigation with contaminated water, then sampled after a standard 48-hour withholding period.

Once internalised, human pathogens cannot easily be removed. Even triple washing with sanitisers cannot eliminate bacterial populations if vegetables were contaminated before harvest.

Recommendations

- Irrigation systems that avoid water contacting the harvestable part of the vegetable (e.g. sub-surface drip, run to waste hydroponics) reduce the risk of contamination
- The risk that water contains *E. coli* >100 CFU /100 ml can be reduced by:
 - Keeping livestock away from dams and other water sources
 - Diverting runoff from contaminated areas (e.g. feedlots, manure storage or septic systems) away from dams and cropping areas
 - Discouraging water-birds from lingering on dams used for irrigation
 - Keeping irrigation and spray equipment clean and well maintained
 - Cleaning rainwater collection areas and keeping tanks sealed against vermin
 - Maintaining irrigation and spray equipment
- Water quality should be verified through regular testing
- Water containing *E. coli* >1,000 CFU/100ml should not be used in ways that contact the harvestable part of crops
- If water quality is poor, investigate ways to reduce microbial load, such as filters, chemical sanitisers and electrolyzed water systems
- If water quality is poor or unknown, a 48-hour withholding period between irrigation and harvest significantly reduces the risk that vegetables will be contaminated at harvest
HOWEVER:
 - Longer withholding periods are needed if plants have been physically damaged
 - If spinach crops have been damaged, avoid water contacting the leaves for at least 24 hours
 - Avoid contact between lettuce plants and contaminated water at all times.