



POTENTIAL CONTAMINANTS IN RESIDENTIAL RAIN BARREL WATER

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Potential Contaminants in Residential Rain Barrel Water

Residential gardeners often collect rainwater to supplement summer irrigation. They may also use rainwater as an unchlorinated water source for aquatic plants and animals. However, rooftop runoff can be contaminated with chemical and biological pollutants. This publication will examine the research behind residential rain barrel water safety in North America over the last 20 years. It will also provide science-based suggestions for using rain barrel water in ways that protect people, pets, and the environment.

Rain Barrel Practicality

Rain barrels can help reduce the use of relatively expensive, treated water for nonpotable applications such as watering garden and landscape plants. Alternative sources of nonpotable water are increasingly important in chronically or seasonally arid parts of the country. Rain barrels (Figure 1) are relatively inexpensive to obtain and install, and residential costs are typically recovered within 3–6 years of installation (Logan 2014).



Figure 1. Typical garden rain barrel installation. Photograph courtesy of William McCaleb.

Rooftop collected rainwater has been tested on container plants as well as those planted into gardens and landscapes. In all cases good results have been seen, with no plant disease or disorder problems apparent (Chen et al. 2003; Islam et al. 2013). But rain barrel water is untreated and unregulated. There are legitimate safety concerns about exposure of people, pets, and the environment to rain barrel water.

What Contaminants are Found in Rain Barrels?

Many studies have identified rain barrels as reservoirs for toxic materials and pathogenic microbes (Hart and White 2006; Lye 2009; Schuster et al. 2013). Possible rain barrel contaminants fall into two general categories: biological and chemical.

Biological Contaminants

- Bacteria
- Cyanobacteria
- Fungi
- Protozoa

Chemical Contaminants

- Metals, especially heavy metals
- Nutrients
- Particulates (adsorb other chemical contaminants)
- Pesticide residues

Researchers have looked at nutrient loads, heavy metal content, pesticide residues, and microbial contaminants in rainwater collection systems in hundreds of studies from all over the world (Table 1). In North America, the main concerns are fecal contaminants and heavy metals.

Country	Contaminants identified
Africa	heavy metals
Australia	heavy metals, mosquitoes, pathogens
Bermuda	pathogens
China	heavy metals, nutrients, pathogens
Finland	pathogens
France	heavy metals, nutrients, pathogens
Germany	heavy metals
Japan	pathogens
Korea	heavy metals
Netherlands	heavy metals
New Guinea	pathogens
New Zealand	copper, microbes
Nigeria	heavy metals, pathogens
Oman	pathogens
Palestine	heavy metals
Poland	fertilizers, pesticides
Saudi Arabia	heavy metals, pathogens
South Africa	microbes
South Korea	pathogens

Table 1. Contaminants identified in international rainwater collection studies from 1996–2016.

Where Do These Contaminants Come From?

Many contaminants, especially chemicals, are carried through the atmosphere and deposited by wind or rain onto roof surfaces. Particulates, heavy metals, and sprayed materials like pesticides are then washed into collector barrels with the next rainfall. Pesticides can remain potent for weeks or months after entering rain barrels (McDougall et al. 1994).

Biological materials drop from tree canopies, or are deposited directly by birds, squirrels, raccoons, and other animals that perch or crawl over roofs. Feces themselves are a source of pathogenic bacteria, viruses, and protozoans that can easily survive in rain barrels. A long-term study on residential rain barrels (Shuster et al. 2013) found unexpectedly high levels of coliform bacteria (used as indicators of human pathogenic bacteria). The water in all of the barrels in the study were consistently above USEPA standards for coliform bacteria in secondary recreational contact water quality (Shuster et al. 2013).

Although the levels of coliform bacteria are alarmingly high in studies like Shuster et al. (2013), there don't appear to be many reports of illnesses related to rain barrel water. The authors also discovered that rain barrels contain a rich microbial community that may contain bacteria predators, which may control the levels of coliform bacteria. (Shuster et al. 2013)

Do Roofs Themselves Affect Rainwater Quality?

Metal flashing, gutters, and galvanized nails are sources of heavy metals like zinc, lead, and chromium. Composite shingles, roofing membranes, and tar paper all contribute organic contaminants, heavy metals, and pesticides to runoff. Much research has focused on the characteristics of roofs themselves (de Kwaadsteniet et al. 2013).

Slope

The greater the slope, the less likely contaminants will remain on the surface.

Chemical Makeup

Metal roofs have lower concentrations of biological contaminants (Mendez et al. 2011) but higher levels of cadmium and zinc (van Metre and Mahler 2003). Asphalt shingles contain lead (van Metre and Mahler 2003). Green roofs can contain high levels of arsenic and other heavy metals from the growing media used (Mendez et al. 2011). Wood shingles appear to be the worst in terms of their effect on water quality (Chang et al. 2004).

Surface Roughness

Rough materials like asphalt catch and retain wind-deposited particulates and fecal matter (Shuster et al. 2013).

Surface Coating

Pesticides are often applied to roofing materials before installation (Bucheli et al. 1998).

Age

Newer wood-shingled roofs contain more zinc than aged roofs (Chang et al. 2004).

Maintenance History

Moss treatments typically contain zinc or copper, both of which are significant contaminants in rain barrels.

Action List for Using Roof-Collected Rain Barrel Water at Home

Rain barrels can be a valuable source of additional water for home gardens and landscapes. There are some simple, research-based practices gardeners can use to take advantage of collected rainwater that reduce the risks of contamination exposure.

Know your local pollution issues

If there is a history of airborne pollutants from industry or agriculture in your area, you will want to have your rain barrel water tested for heavy metals and other contaminants.

Avoid collecting rainwater in the following scenarios

- When air quality is low (smoggy, temperature inversions, little wind).
- If you've recently used a moss removal product on the roof.
- If pesticides have been recently applied nearby.

Use good garden hygiene

- Don't drink rain barrel water or allow pets to drink it either.
- Don't touch your eyes or mouth when handling rain barrel water.
- Wash hands with soap after using rain barrel water.
- Clean rain barrels regularly to remove residual contamination. Directions for cleaning rain barrels can be found online from commercial vendors of barrels.

Wash garden produce before eating

Unwashed leafy greens pose the highest risk, followed by botanical fruits such as tomatoes and cucumbers (Lim and Jiang 2013).

Install a diverter

Install a diverter to direct the first flush of rainwater runoff onto lawns or rain gardens and away from collector barrels (Figure 2). The first flush of harvested rain has the highest level of contaminants, as it moves deposited material off the roof and into the gutters.



Figure 2. A diverter for protecting water quality in the barrel. Photograph courtesy of Mary-Jane Pilgrim.

Prevent roof debris from entering the rain barrels

Prevent roof debris from entering the rain barrels by using leaf screens or other gutter covers (Figure 3). Debris not only serves as a source of chemical contamination but also as a nutrient source for bacteria and other microbes.



Figure 3. Gutter guards prevent the accumulation of biological debris in the gutters and rain barrels. Photograph courtesy of Dorothy Yee Leggett.

Buy simple coliform counters

Buy simple coliform counters or Petrifilms to test for fecal contaminants (Figure 4). These are available from science supply houses and can alert you to the need for further professional testing.



Figure 4. A Petrifilm system.

Use activated charcoal filters

Use activated charcoal filters to treat water before use on vegetables and other edible plants (Figure 5). These filters can remove sediments, organic contaminants, and some mineral contaminants from water, but will not remove heavy metals.



Figure 5. A filtering pitcher can be used to treat rain barrel water before application.

Use opaque barrels

Use opaque barrels to eliminate photosynthetic pathogens such as cyanobacteria.

Further Reading

Centers for Disease Control and Prevention. Rainwater Collection.

<https://www.cdc.gov/healthywater/drinking/private/rainwater-collection.html>

Washington State Department of Ecology. Roofing Materials Assessment. The Department of Ecology has conducted research on the quality of runoff associated with different roof materials.

<https://fortress.wa.gov/ecy/publications/documents/1403033.pdf>

Washington State Department of Ecology. Rainwater Collection in Washington State. The Department of Ecology maintains a website that discusses the practical and legal considerations of installing a residential rainwater collection system. <http://www.ecy.wa.gov/programs/wr/hq/rwh.html>

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