

QUESTIONS & ANSWERS

As B.C. fisheries managers explore options for dealing with invasive species issues, people have questions about the use of rotenone to manage fish communities. They want to know, “Has rotenone been adequately tested to assure our safety and protect the environment?” The answer is “Yes”. Below are questions that have been raised in the past and the answers to those questions based on scientific evidence and studies.

GENERAL INFORMATION

Q. How does rotenone work?

- A. Rotenone inhibits a process at the cellular level making it impossible for fish to use the oxygen absorbed in the blood and needed in the release of energy during respiration.

Use of rotenone in Fisheries Management

Q. Why use rotenone to manage fish communities?

- A. Sometimes managers need to eradicate an entire population or community of fishes and replace them with a desirable population or community. Rotenone can be used to accomplish these objectives with minimum impact to non-target wildlife. In B.C., the use of rotenone at this time will only be considered for use on invasive fish species that threaten native aquatic ecosystems. **Globally, invasive species have been identified as the second greatest threat to biodiversity after habitat loss (The World Conservation Union, IUCN)**

Q. How is rotenone applied?

- A. Rotenone is applied either as a powder made from ground-up plant roots, or as a liquid. Rotenone is very water insoluble (i.e., like oil). Liquid formulations of rotenone contain additional materials (dispersants and emulsifiers such as naphthalene, methylnaphthalenes and xy-lenes) that aid in the dispersal of rotenone throughout the water column.

Q. How much rotenone is used?

- A. Treatment rates range from 0.5 to 10.0 parts per million (ppm) of the commercial products. Because commercial products contain only 2.5% to 5% of rotenone, the actual concentration in the water is only 0.012 to 0.250 ppm of rotenone. The commercial products are most commonly applied at a concentration 1.0 to 2.0 ppm (0.025 to 0.100 ppm of rotenone). The 1 ppm

rate is 1 part of the commercial formulation in 1,000,000 parts of water; or the 2 ppm rate is roughly equivalent to 1.3 ounces of the commercial formulation in a 5,000 gallon swimming pool.

Q. How do fisheries biologists determine when it is safe to restock fish?

A. The simplest test used by most fishery specialists is to place several fish in a cage and hold them in the treated water for several days. If they survive, the water is safe for restocking. Analytical techniques can also be used to determine how much rotenone is still present. Generally, restocking can occur within a few weeks of treatment, however the lakes are typically monitored for invertebrate recovery.

PUBLIC HEALTH

Q. How safe is rotenone to people?

A. Millions of dollars were spent on research to determine safety of rotenone prior to registration by the U.S. Environmental Protection Agency (EPA). The EPA concluded that the use of rotenone for fish control does not present a risk of unreasonable adverse effects to humans and the environment when used according to label instructions.

Q. What is a safe exposure level for rotenone?

A. The National Academy of Sciences has suggested a safe level in drinking water of 0.014 ppm of rotenone. The California Department of Health Services has suggested 0.004 ppm of rotenone. These safe levels assume a **lifetime exposure** to rotenone. For comparison, most rotenone treatments result in exposure levels within the range of 0.012 to 0.25 ppm of rotenone, but rotenone generally **persists for no longer than a few weeks**, making lifetime exposure highly unlikely.

Q. Is there any danger associated with accidentally drinking rotenone-treated water?

A. The hazard associated with drinking water containing rotenone is very slight because of the low concentration of rotenone used in the treatment (0.012 to 0.25 ppm of rotenone) and the rapid breakdown of rotenone. Estimates on the oral toxicity to humans are 0.023 to 0.039 ounces of rotenone per pound of body weight. **Hence, a 160 pound person would have to drink more than 23,000 gallons of water treated at 0.25 ppm of rotenone at one time to receive an effect.**

Q. Can rotenone-treated water be used for public consumption or irrigation of crops?

A. Tolerances for rotenone in drinking and irrigation water have not yet been established by EPA even though the studies required for setting tolerances have been completed. This does not mean that rotenone concentrations in drinking or irrigation waters is actually unsafe; it just means that the EPA has not established rotenone tolerances at this time. As a result, water containing residues of rotenone cannot be legally allowed for use as a domestic water source or on crops.

Q. Is there a relationship between Rotenone Use in Fisheries Management and Parkinson's disease

A. Recent public concern has developed around the link between rotenone use and Parkinson's disease, which stems from information published by Emory University in 2000. This information has generated unfounded fears, caused by the inaccurate and incomplete reporting of the study and its implications.

For more detailed information on this study, please see the ["Relationship between Rotenone Use in Fisheries Management and Parkinson's disease"](#)

Q. Are there any risks to human health from materials in the liquid rotenone formulations?

A. The EPA has concluded that the use of rotenone for fish control does not present a risk of unreasonable adverse effects to humans and the environment. Liquid rotenone formulations contain trace amounts of the carcinogen trichloroethylene (TCE). However the TCE concentration in water immediately following treatment (less than 0.005 ppm of TCE) is below the level permissible in drinking water (0.005 ppm of TCE), and these levels quickly dissipate within a few days.

Q. How soon can people safely enter water treated with rotenone?

A. The EPA concluded that a re-entry interval was not needed for persons who swim in waters treated with rotenone based on an assessment of the toxicology data and exposure level. The EPA said there was no reason to restrict the use of rotenone in waters intended for livestock consumption and recreational swimming.

Q. Is there any risk to public health from airborne rotenone?

A. No public health effects from rotenone use as a fish management substance are known. The use of powder and liquid formulations have been monitored for airborne drift into adjacent areas. The highest rotenone concentrations that were monitored during a treatment were approximately 1,000-fold lower than the estimated safe level of rotenone in air.

Q. Why can't we eat fish killed by rotenone?

A. The EPA has not established guidelines for consuming fish killed with rotenone. There is a valid concern of salmonella and other bacteriological poisoning that may occur from consuming fish that have been dead for over a period of time. However, fish that end up on land as a result of wave or wind action are no more a threat to public health than fish that die of natural causes.

Q. Why is there no risk to people from consuming fish that have been stocked into a recently treated water body?

A. Fish are not stocked into a treated area until rotenone has neutralized. Hence, stocked fish cannot accumulate residues of rotenone from the water. Residues of rotenone in tolerant fish that survive a rotenone treatment will not last for more than several days because the fish quickly metabolize and excrete rotenone.

ENVIRONMENTAL QUALITY

Q. Why are there no problems with dead and decaying fish on the recovery of fishing?

A. Most dead fish will sink in several days to the bottom of the treated body of water, decompose, and release nutrients back into the water. These nutrients will directly stimulate phytoplankton and indirectly stimulate insect and zooplankton production. These organisms are a good food base for the ecosystem.

Q. How can the effects of rotenone to fish and other aquatic life be neutralized?

A. If biologists want to quickly neutralize the effects of rotenone in lakes or rivers, potassium permanganate can be used. Potassium permanganate is an oxidizing agent. This substance is used worldwide in treatment plants to purify drinking water.

Q. What is the smell sometimes associated with the use of liquid rotenone formulations?

A. The aromatic (mothball) smell associated with the use of liquid rotenone formulations is from naphthalene and methylnaphthalene. This smell may last for several days, depending on air and water temperatures and wind direction. These compounds remain close to the ground and move down-wind. There are no health effects from this smell.

Q. What happens to rotenone after it has been applied?

A. Rotenone is a compound that breaks down very rapidly when exposed to light, heat, oxygen, and alkaline water. Ultimately, rotenone breaks down into carbon dioxide and water.

Q. How long does rotenone's effects persist?

A. Rotenone is generally neutralized in lakes in less than four weeks and in a matter of hours within running waters. The time for natural neutralization of rotenone is governed primarily by temperature. Studies show that rotenone completely degrades within one to eight weeks within the temperature range of 50⁰F to 68⁰F.

Q. How long do the materials other than rotenone persist from liquid formulation treatments?

A. Researchers have found most of the other ingredients in the liquid formulations degrade more rapidly than rotenone through exposure to light, heat, oxygen, and alkaline waters. Many of these materials are the same as those found in fuel oil and are commonly in water because of frequent use of outboard motors and motorized personal watercraft. None of these materials pose a health hazard at the concentrations available in the environment from any rotenone treatment.

Q. Why is rotenone unlikely to enter ground water and pollute water supplies?

A. The ability of rotenone to move through soil is low. This is because rotenone is strongly bound to organic matter in soil so it is unlikely that rotenone would even enter ground water. Monitoring studies in ground waters adjacent to treatment areas have found no contamination associated with rotenone treatments.

Q. Why are there no degradation products from rotenone that can cause environmental problems?

A. The degradation product rotenolone can persist longer than rotenone, especially in cold, alpine lakes. To err on the side of safety, fish stocking would be delayed until both rotenone and rotenolone residues have completely

dissipated. Since rotenone has less effect than rotenone, it poses even less risk to human health and the environment than rotenone.

FISH AND WILDLIFE

Q. How does rotenone affect aquatic animals?

A. Recent studies have revealed that the effects of rotenone on non-target species is far lower than originally believed. All animals including fish, insects, birds and mammals have natural enzymes in the digestive tract that neutralize rotenone, and the gastrointestinal absorption of rotenone is inefficient. However, fish (and larval forms of amphibians and aquatic invertebrates) are more susceptible because rotenone is readily absorbed directly into their blood through their gills (non-oral route). Studies have shown that amphibians and invertebrates will repopulate an area when rotenone neutralizes.

Q. Will wildlife that eat dead fish and drink treated water be affected?

A. Birds and mammals that eat dead fish and drink treated water will not be affected. Rotenone residues in dead fish are generally very low, are broken down quickly, and not readily absorbed through the gut of the animal eating the fish.

Q. How will wildlife species be affected by the loss of their food supply following a rotenone treatment?

A. During treatments, fish-eating birds and mammals can be found foraging on dying and recently dead fish for several days following a treatment. Following this abundance of dead fish, a temporary reduction in food supplies may result until the fish and invertebrates are restored. However, most of the affected species are mobile and will seek alternate food sources or forage in other areas.

ADDITIONAL INFORMATION

Q. How can more information be obtained on the fishery uses of rotenone and its effects on the environment?

A. An excellent source of information is the *Rotenone Use in Fisheries Management: Administrative and Technical Guidelines Manual* published by the American Fisheries Society. It is available on its website at

www.fisheries.org/rotenone. The manual will be updated periodically as new information becomes available.

SUMMARY

Rotenone is an important fisheries management tool that has been used successfully for almost 70 years in the United States and Canada. Its use is carefully regulated to protect the safety and well being of the public and the environment. Most rotenone projects are supported by specific management plans that define the objectives and expected results. Although there maybe some short-term losses of fishing opportunities when rotenone issued, the benefits greatly outweigh the losses because the use of rotenone restores balance to the fish community.