Taste and Odour in Drinking Water

It is important to pay attention to odour outbreaks because they can provide important clues about the health and safety of our water supplies. Short-term, they can signal treatment malfunction or chemical/biological hazards in the raw water. Long-term, they can provide an early warning of the decline in freshwater resources increasingly stressed by human activity.

We avoid water with an unpleasant taste and smell, which we instinctively link with disease and decay, and we question the fundamental safety of municipal drinking water that delivers bad taste to our tap.

The problem of bad taste and odour in our drinking water can increase the use of alternatives such as bottled and tanker-trucked water, which in fact may be less well regulated and stored. Ironically, bottled water consumption is highest, and increasing, in countries such as Canada, where we have the greatest collective access to treated water.

Most often, drinking water taste and odour is caused by potent organic compounds produced by organisms growing in the source water. The few toxicological studies of these compounds indicate that at the levels found in water supplies, they do not present a human health risk, although little is known about the long-term effects of consuming water that is repeatedly affected.

We have a very limited understanding of the environmental conditions that trigger many taste and odour episodes, making it difficult to predict when and where they will occur. Many taste and odour compounds are detectable at trace levels (parts per billion or even trillion) and require sophisticated analytical techniques to identify and monitor. Measures to remove them from drinking water in municipal water purification plants are usually expensive. Although some municipalities have implemented such controls, many cannot afford the cost, or are reluctant to commit large expenditures to treat such an unpredictable problem.

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NWRI and Taste and Odour in Drinking Water

Taste and odour is a national concern, and a key focus of NWRI scientists. It is a highly complex problem that can be caused by one or more of numerous compounds produced by a diversity of organisms, and triggered and modified by different conditions.

Taste and odour has long plagued water supplies across the country, and in some more heavily developed water basins, consumer complaints are increasing. For example, the western basin of Lake Ontario provides drinking water to over 5 million consumers. In late summer of 1994, 1998 and 1999 the whole region suffered severe outbreaks of earthy-musty-smelling drinking water. Since then, these late summer events have continued to occur erratically.

Similar, more protracted muddy flavour affects water drawn from the Bay of Quinte and St. Lawrence River every year, and many waterbodies in the Prairies. These source waters differ tremendously in their physical, chemical and biological traits, yet are all afflicted by one or both of the same two odour compounds, geosmin and 2-methylisoborneol (MIB).

To learn more about the mechanisms that trigger such outbreaks, NWRI researchers are studying the production and environmental dynamics of these two highly potent compounds. Geosmin and MIB are produced in surface waters by bacteria - cyanobacteria (also known as blue-green algae) - and in some cases, *Streptomyces* (Actinomycetes). Geosmin, which has an earthy odour, is frequently produced by planktonic (free-floating) cyanobacteria. MIB, which has a mustier odour, is more often produced in the biofilms growing on rocks, aquatic plants and sediment. The two compounds are also produced by numerous bacteria and fungi in soil (and are in fact responsible for the characteristic smell of earth), and some drinking water odour can originate on land, caused by heavy soil runoff during storms or spring melt.

Photo credit: USDA Natural Resources Conservation Service

In 1999, NWRI joined seven major municipalities, the Ontario Provincial Government (Ontario Clean Water Agency and Ontario Ministry of the Environment) and two university partners to form the Ontario Water Works Research Consortium. This cooperative group, a unique model in Canada, was first established to address taste and odour problems in Lake Ontario and the St. Lawrence River, and in the past five years, has made substantial progress towards understanding and predicting these outbreaks. In 2000, scientists expanded their research program to investigate the role played by large-scale water movements and shoreline nutrient inputs in recurring outbreaks.

NWRI is assessing the toxin levels and risks associated with blue-green algal blooms in areas of the Great Lakes such as Hamilton Harbour, the Bay of Quinte, lakes Ontario and Erie, and, farther west, prairie and rural source waters. Scientists are investigating possible links between development of these algal blooms and taste and odour outbreaks.

Impacts of NWRI Research on Decision Making

Much of the research effort is aimed at improving prediction of severe taste and odour problems in a given year. This helps regional and municipal governments develop their management options, and design control measures and programs to minimize taste and odour problems. Advance warning will also help water utilities to communicate effectively with their customers during severe outbreaks.

Already, researchers have found there is little taste and odour in the bottom waters of Lake Ontario, and municipalities are using or considering deep water intake, based on information provided by researchers in 2004.

This research can also be used to develop source-water protection strategies, increasingly mandated by provincial and territorial governments, and implemented by local agencies and watershed authorities.

Benefits to Canadians

Local governments are understandably cautious about implementing expensive taste and odour control measures at water purification plants, given that the ecological and environmental causes and impacts of the problem are not well understood. Nevertheless, municipalities are fully engaged with researchers at NWRI and the Ontario Water Works Research Consortium to develop a more complete understanding of causes so that control measures are successful and cost effective. But perhaps more importantly, this knowledge is essential to ensure improved public confidence in the source and safety of our drinking water.

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