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Bottled Water Myths: Separating Fact from Fiction


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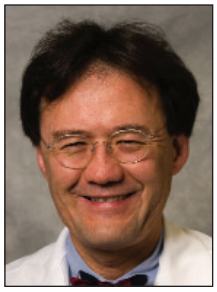
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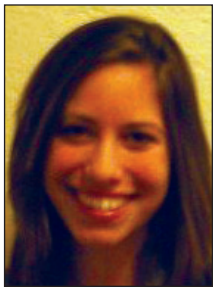
Melissa McKernon

Bottled water consumption in the United States is continuing to grow annually, and it is now the second most popular commercial beverage choice of consumers according to the Beverage Marketing Corporation (1). And no wonder—it is conveniently packaged, portable, refreshing, and perceived by many consumers to be safer than tap water. Some choose bottled water simply because they feel its taste profile is superior to that of municipally treated tap water, others because of concerns regarding potability. This article examines the basic differences between tap water and bottled water, the safety of reusing plastic water bottles, and the safety of popular refillable sports bottles.

WELL WATER

Water from municipal wells serving highly populated areas is considered safe for the general public to consume from a microbe perspective, as the water is usually tested on a daily basis for bacterial contamination (3). However, water from private wells and public wells serving small populations are usually not tested daily, making the water safety highly questionable. For this reason, it is recommended that consumers with health conditions negatively impacting their immune systems (e.g. HIV+, those receiving chemotherapy, transplant patients or patients receiving immunosuppressive therapy) heat their water to a

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rolling boil for a minimum of one minute prior to using it for drinking or oral hygiene (3).

TAP WATER VS. BOTTLED WATER

Tap water is regulated by the U.S. Environmental Protection Agency (EPA), which mandates standards for tap water production, distribution, and quality (2). The EPA sets the standards for acceptable water contaminant levels as well as requirements for testing and reporting. If a laboratory test of municipally treated tap water reveals the water is not safe to drink, the treatment facility is mandated by the EPA to issue a mass media "boil water order"(3). While this order is in

Table 1
Examples of Bottled Water

Brand	*Manufacturer*	*Source*	*1 micron or < Filtration*	*Reverse Osmosis*	*Distillation*	*UV Light*	*O_3*	*Approximate Cost*
Aquafina	Pepsi	Municipal	X	X		X	X	$1.05/liter
Dasani	Coca-Cola	Municipal		X				$0.75/liter
Deer Park Brand Drinking Water	Nestle Waters	Municipal	X	X	X	X	X	$1.49/gallon
Deer Park Natural Spring Water	Nestle Waters	Spring	X			X	X	$1.49/gallon
Evian	Groupe Danone	Spring						$1.25/liter
Great Bear Natural Spring Water	Nestle Waters	Spring	X			X	X	No longer Commercially Available Per manufacturer
Ice Mountain Natural Spring Water	Nestle Waters	Spring	X			X	X	$1.40/gallon
Ice Mountain Brand Drinking Water	Nestle Waters	Municipal	X	X	X	X	X	$1.49/gallon
Ice Mountain Drinking Fluoridated Water	Nestle Waters	Municipal	X	X	X	X	X	$1.65/gallon
Poland Spring Natural Spring Water	Nestle Waters	Spring	X			X	X	$1.25/gallon

Adapted from Reference 3. Approximate costs determined from survey of random supermarket retailers and manufacturers direct retail. Prices reflect average price/liter or average price/gallon calculated using largest container size per brand available (liter, 1- gallon or 5-gallon container).

effect, consumers are advised to heat tap water to a rolling boil for at least one minute prior to utilizing this water for drinking purposes (4).

The Food and Drug Administration (FDA) regulates bottled water quality and production standards based on established EPA standards. Under the Safe Water Drinking Act (SWDA) passed in 1974, EPA standards mandate testing of drinking water for numerous potential contaminants. Each potential contaminant has an established maximum contaminant level (MCL). Water must be tested for organic chemicals, (e.g. acrylamide, benzene, dioxins, and PCBs), inorganic chemicals (e.g. asbestos, lead, and fluoride), radiological contaminants (e.g. alpha and beta particles, uranium, and radium), and microorganisms, including but not limited to *Cryptosporidium*, *Giardia lamblia*, *Legionella*, and Total Coliforms, such as *E. Coli* (4). When the EPA sets a standard for a contaminant in tap water, the FDA must in turn establish a new standard for the same contaminant in bottled water unless the particular contaminant in question is not applicable to bottled water (2). The FDA regulates bottled water as a food. Therefore, the original water source, the water contained in the bottle, and the packaging it is provided in must meet the FDA standards for quality and safety (5).

Municipal treated tap waters and bottled waters meeting the FDA standards are considered to be safe for general public consumption. However, consumers with health conditions negatively impacting their immune systems should carefully select bottled water based on the method(s) used by the individual bottled water manufacturer to treat the water brand. The Centers of Disease Control (CDC) has determined that specific treatment methods make bottled water safer for immunocompromised individuals. These include distillation, reverse osmosis, and absolute 1-micron filtration (6). However, it is important to keep in mind that no existing method of water treatment is guaranteed to yield a 100% microbe-free water product for consumer consumption. The water treatments listed by the CDC are the most effective treatment methods available to date to yield the safest possible drinking water product for the consumer, from a microbe perspective.

Bottled water varies in price by brand, manufacturer, treatment method(s) used, and quantity. Gallon sizes average $1.20 to $1.99 each, while liter sizes range from $0.75 to $1.59 each. Cost of a particular brand of water is not always indicative of potential safety based on treatment method(s) used—or not used—from a microbial perspective. Refer to Table 1 for examples of water sources, treatments, and approximate retail cost of some popular, commercially available bottled waters.

Table 2
Summary of Recommendations for Drinking Water

Well Water
- If private, will need to be tested frequently to ensure safety. If municipal, may or may not be tested for microbes on a regular basis—depending on population served.
- Should be boiled prior to consumption for the immunocompromised consumer.
- Should be boiled by all consumers in the event of a "boil water order."

Tap Water
- Municipally treated tap water must meet EPA standards of quality under the Safe Water Drinking Act.
- Safe for the general public to consume.
- Should be boiled by all consumers in the event of a "boil water order."

Bottled Water
- Regulated by the FDA based upon EPA standards for quality.
- Safe for general public consumption. If consumer is immunocompromised, select a brand of bottled water treated by at least one of the following methods:
  - Reverse osmosis
  - Distillation
  - Absolute 1-micron filtration

Plastic Water Bottles:
- Appears to be safe to drink water that has been frozen in plastic bottles from a chemical release perspective.
- Consumer reuse of commercially packaged bottles of water is not recommended from a microbe perspective: recycling of the plastic bottles is preferred.
- BPA risk from polycarbonate plastics requires further study to determine overall safety.

SAFETY OF THE PLASTIC WATER BOTTLE

As the FDA regulates bottled water as a packaged food product, the safety of the plastic bottle the water is sold in must also meet FDA standards (7). PET (polyethylene terephthalate), a plastic used to manufacture bottled water containers, as well as DEHA (di-ethylhexl adipate) which is used to produce PET, are considered to be safe "for food contact applications and would not pose a health risk"(7). Additionally, freezing water in plastic bottles does not appear to pose any known health risk. Halden notes that, "freezing actually works against the release of chemicals" (8). Therefore, it appears to be a safe practice to freeze water bottles from the perspective of chemical release from the plastic, such as dioxins. Heating plastics appears to pose more of a health risk, as it is more likely for chemicals to be released from plastics under the condition of heat than that of cold (8).

Reuse of polycarbonate plastic bottles is generally not recommended by commercial bottled water manufacturers, as it may pose a health risk from two perspectives. First, everyday wear and tear from repeated washings and reuse can lead to physical breakdown of the plastic, such as visible thinning or cracks. Bacteria can harbor in the cracks, posing a health risk. Secondly, reuse of plastic water bottles can lead to bacterial contamination unless washed regularly. If a consumer wishes to reuse a plastic water bottle, it should be washed after each use in mild detergent only and rinsed well (9). The plastic should not be subjected to extreme, hot temperatures or harsh detergents, and should be carefully inspected for physical breakdown prior to reuse.

SPORTS BOTTLES

Lexan® is a polycarbonate plastic used for reusable sports bottles such as Nalgene® bottles. These bottles are quite popular, as they are made of a rigid yet lightweight plastic, are reusable, and come in a variety of colors. They generally retail for $7.00 to $10.00 each, and are available at sporting good stores. A 2003 *Sierra Magazine* article concluded polycarbonate bottles could pose a possible health risk, as bisphenol A (BPA) could leach from the plastic and be consumed via the liquid in the bottles. This serendipitous finding was described when mice were found to have developed chromosomal abnormalities after a lab worker washed the mouse cages in a harsh detergent. The abnormalities were ascribed to the BPA leaching from the polycarbonate cages (9). Polycarbonate is used for many plastic items, and comes in many grades. These grades of plastic are developed for specific uses, and therefore it is inappropriate to conclude that a finding for one item made with polycarbonate would hold true for other grades of polycarbonate products (11).

Further studies have had variable results regarding the safety of BPA consumption. Some studies have concluded that typical use of polycarbonate bottles does not yield migration of BPA levels beyond trace amounts, and would not be attributable to a health risk (10). In contrast, a recent publication by vom Saal and Hughes has pointed out two interesting facts regarding the studies of BPA that have been published to date. First, the majority of government-funded published studies report "significant effects at doses of BPA <50 mg/kg/day" (12). Industry-funded studies have failed to show significant effects of identical BPA doses. Secondly, BPA is an "environmental estrogen," and its effects are "mediated by both genomic and nongenomic estrogen-response mechanisms, with disruption of cell function occurring" at low doses (12). As low doses of a hormone typically do not emulate the same response as higher doses, it is plausible that research to date is not a reliable marker to determine if BPA causes harmful effects for humans (12). It is proposed that further studies be conducted to reevaluate the safety of BPA in polycarbonate plastics.

As with bottled water, there is a risk of microbial contamination from reusing the Lexan® bottles without washing them appropriately or reuse despite visual evidence of wear and tear. Bacteria that may settle in the cracks and scratches of the bottle appear to pose a greater health risk than the possibility of chemicals leaching from the plastic during daily use.

CONCLUSIONS

Based on the evidence available to date, it appears the true health risks (if any) related to drinking commercially manufactured bottled water or water in refillable plastic bottles may or may not come from the plastic itself. Further study is warranted to determine if poly-

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carbonate plastics can cause harm to humans. Consumers should focus more on the quality of the drinking water, particularly from a microbe perspective as this point is indisputable, rather than chemicals leaching from the container.

Municipal treated water is highly regulated, and is certainly safe to recommend for consumption. Bottled water is regulated, but not as stringently as municipally treated water. Consumers need to be aware that the quality of commercially manufactured bottled waters is quite variable, depending on the quality of the original water source as well as treatment(s) used to eliminate microbes in the final product.

Anyone reusing plastic bottles should wash them thoroughly after each use with a mild detergent, and carefully inspect them for cracks or thinning before using them again. The better—and safer—alternative is to pitch the plastic bottle in the recycle bin and not reuse it at all. Allowing the bottle to be commercially recycled protects the consumer, and promotes a better environment for all. ■

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