Reusing plastic bottles for drinking water

Introduction

Reusing water bottles is the practice of refilling and reuse of plastic water bottles designed for one use, with tap water. Reusing single-use bottles is a common domestic practice as it saves both money and the environment , as it cuts down on waste and landfill. However reusing a water bottle could pose a health risk. It is estimated that many more people become sick through drinking contaminated water than is ever recorded. The hygienic handling of drinking water is as important as the handling of food. Bacteria can cause serious illness and one source of bacteria people often forget about is in their water bottle. Bacteria can grow inside drink bottles in a matter of hours from from saliva or food particles. Bacteria can also come from sharing with others, and unwashed hands opening or holding the drink bottle. Many people simple re-fill their water bottles without properly washing and drying them. This warm moist environment creates a perfect place for bacteria to survive and multiple. During the summer of 2009/2010, Sydney’s average daily maximum temperature was close to 30 degrees (1). Temperatures are of course much higher on above average days, in unshaded areas such as on the sports field or beach, or inside the car where the temperature inside the car can be 30 to 40 degrees hotter than the outside the car. So in Sydney people’s drink bottles can regularly be exposed to temperatures as high as 70 degrees. Simply by following a good hygiene regime the chance of contamination are reduced.

Safe Drinking Water

Drinking water should be safe from pathogenic microorganisms and should be aesthetically pleasing appearance taste and colour. In Australia the authoritative body for determining safety guideline on drinking water is the National Health and Medical Research Council. This Australian Government run body released in 2004 the Australian Drinking Water Guidelines (ADWG) in collaboration with the Natural resources Management Ministerial Council. The ADWG incorporate the framework for the management of drinking water quality and provides the community with with guidance on what constitutes good quality drinking water.

Bacteria

Bacteria are a group of unicellular microorganism which can exist as either as a free living organism or as a parasite. Bacteria are found in every habitat on earth. Bacteria are typically 0. 5 to 5. 0 micrometers in length and only very few species are visible to the unaided eye. If a large umber of bacteria are present you can see the bacteria l clusters that form. To produce a bacterial cluster large enough to be seen by the naked eye, you need to collect a small number of bacteria and provide them with food so that they grow into a large enough cluster to see them. Clusters of bacteria are called colonies. Most bacterial species are either spherical, called cocci, rod shaped, called bacilli or spiral shaped are called spirilla.

Almost all bacteria reproduce asexually which means that the cells simply divide into two parts; this is called binary fission. Bacteria can multiply quickly doubling their number in twenty minutes whilst other bacteria reproduce quite slowly. Bacteria can be quite beneficial. For example some

bacteria in your body help digest your food. Bacteria in the water and soil are very important in recycling carbon, nitrogen, sulfur and other chemicals used by living things. Bacteria help decompose dead animals into chemical elements. Other bacteria’s help make medications, drugs, and antibiotics.

Bacteria can also be harmful to humans. Harmful bacteria can get into your body through openings such as your nose, mouth, cut, laceration or by digestion. Harmful bacteria enter your body can make you sick or give you an infection.

Micro-organisms in drinking water

Most waterborne diseases are caused by organisms originating in the gut of humans or other animals. Contamination from these organisms comes from human or animal excreta i. e the faces.

Many other organisms of environmental origin can also be in water and in some circumstance causes disease in humans.

Waterborne pathogens include bacteria, viruses and protozoa. The diseases they cause varies from mild gastroenteritis to severe diarrhoea, dysentery, hepatitis, cholera or typhoid fever. In some instances this can even result in death.

Waterborne Bacterial Pathogens

Bacterial pathogens can be transmitted by consuming contaminated drinking water, and can cause diseases include Salmonella, Shigella, enterovirulent E. coli, Vibrio cholera, Yersinia enterocolitica , Campylobacter jejuni abd C. coli.

Once the bacterial pathogens are excreted from the body of their host in the faeces they gradually decay and lose the ability to cause infection. The rate of decay varies with different bacteria and after a certain period a pathogen will become undetectable. The most common waterborne pathogens are those that are highly infectious or highly resistant to decay outside the body.

Other environment bacteria may also cause disease in humans. Those people most at risk are those with impaired defence mechanisms, such as the elderly, the very young, people with burns, people who have undergone recent surgery or who have suffered serious injury, and people with severely compromised immune systems. These opportunistic pathogens can cause infections of the skin, the eye, ear, nose and throat. Examples of environment pathogens include Pseudomonas aeruginosa, species of Klebsiella and Aeromonas, and certain slow-growing mycobacteria.

Although infection is the main problem, other algea and bacteria can produce toxins that affect humans. Other organisms can also affect the taste, colour, odour, or promote disposition and corrosion.

Specific Bacteria Pathogens

- Aeromonas

Has been isolated in Australian drinking water but the relationship of isolates to disease is not clear.

- Burkholderia pseudomallei

Causes Melioidosis, found in soil and muddy water in tropical regions. Limited evidence for the involvement of drinking water in its transmission in Australia.

- Campylobactera

Causes gastroenteritis, can be transmitted in water or food. Has been detected in Australian drinking water.

- Klebsiellaa

Widespread environmental organism, spread by handling, especially in hospitals. Has been detected in Australian drinking water but there is no evidence of disease caused through this route.

- Legionella

Frequently occurs in natural water but of no health concern unless numbers are amplified at specific sites and conditions (usually thermal enrichment); may then be spread by aerosols and inhaled, causing legionellosis and pontiac fever.

- Mycobacterium

Some species associated with opportunistic infections in a minority of susceptible people.

- Pseudomonas aeruginosa

Common in faeces, soil, water and sewage. Opportunistic pathogen causing wound and respiratory infections often in hospitals, though not usually through drinking water. Has been detected in Australian drinking water

- Salmonellaa

May enter water through faecal contamination. Has been found in various Australian source waters and occasionally in reticulated waters. Can cause outbreaks of gastroenteritis. Occasionally present in the absence of microbial indicators. Risk of disease from water born pathogens

- Shigellaa

Causes bacillary dysentery; highly infective. Presence in water indicates recent faecal contamination. Australia has a low incidence of infection with no conclusive evidence of transmission by drinking water.

- Vibrioa

V. cholerae 01 causes cholera and is associated with waterborne epidemics. Vibrio spp have been found in source waters in Australia but not in reticulated supplies.

- Yersiniaa

Some strains can cause gastroenteritis if ingested

Risk factors

The impact of a particular organism in water can vary considerably; for example, a potentially pathogenic organism will not always cause symptomatic disease in a particular individual. The impact can vary due to different concentrations of pathogenic organisms, the susceptibility of individuals, the dose of the pathogen , the level of immunity and other factors.

Microbial indicator organisms

Testing for the presence of specific bacteria pathogens can be expensive and time consuming, therefore water is often tested for microbial indicator organisms. E. coli or thermotolerant coliforms are the recommended indicators for faecal contamination while total coliforms and heterotrophic plate counts can be used for other bacterial monitoring.

Coliforms refers to the broad group of bile tolerant bacteria. They are found naturally in water, soil, organic matter and faeces. They produce gas and acid from lactose at 35° to 37°C. Thermotlerant coliforms are a subset of coliforms and exhibit the same properties when grown at 44°C. E. coli is the major species within the thermotolerant group of coliforms which is separated from them by being able to carry out a particular set of other biochemical reactions. They are the most common form of thermotolerant coliform present in faeces.

E. coli and thermotolerant coliforms come from the family of bacterian known as Enterobacteriaceae meaning the family of bacteria living in the gut. E. coli is nearly always present in the intestines of humans and warm blooded animals. Only a few strains of E. coli may themselves be pathogenic, however, both pathogenic and nonpathogenic strains are equally significant as indicators of faecal contamination

Total coliforms have also been used as indicators for pathogens in the past. As coliforms are also normal inhabitants of soil and water, and can grow in water in the absence of faecal contamination, they are not as reliable. However, total coliforms can be used together with other parameters as indicator organisms. Coliform bacteria are capable of multiplying in water to

high numbers, given the right conditions. When there is evidence of these indicator organisims in drinking water increased health risk to consumers is implied.

Unfortunately microbial indicator organisms do not detect all pathogens.

Microbiological testing

Nutrient agar plates are used to grow microbial colonies. Agar is a jelly like substance obtained from seaweed. It is dissolved in water and nutrients suitable for microbial growth are added before it sets. The colonies are then studies to determine the types of microorganisms present in the sample. The agar plates are contaminated then incubated at 30° to 37°C. The colonies usually start growing within 24 hours.

Dipslides containing a nutrient agar plate are a convenient simple to use and inexpensive method of testing for indicator organisms. When these are incubated at 37°C the presence of bacteria belonging to the broad coliform group will start to grow. To test for thermotolerant colifomr they need to be incubated at 44°C.

Bacterial colonies are identified according to colour, the shape of the colony, shape of the cross section, type of boundaries the colony possesses and surface of the colony. Colonies tend to be small, smooth, glossy and colour

ed. Fungal colonies tend to be furry and quite large.

When working with micro-organisms it is important to ensure all equipment and working surfaces are as sterile as possible to avoid contamination of the sample from other sources.

Preventing bacterial growth in water bottles

Refilling water bottles can result in contamination of the water with bacteria and fungi that can grow in damp or partially full bottles once they have been opened. These organisms generally come from the air, your hands and mouth, or anything that comes in contact with the mouth of the bottle. With time and in warm conditions, bacteria can multiply to harmful levels, but safe handling and proper cleaning can help prevent this from happening.

Cleaning a used water bottle

Reusable water bottles should be thoroughly cleaned, rinsed and dried between uses. Dishwashing soap and hot water are acceptable for cleaning your water bottle. The risks of bacterial and fungal growth are higher if you use the bottle with a drink that contains sugars or other foods. Immediately drain, rinse, and wash the water bottle after using it with sports drinks or juices.

Sanitising a water bottle

If there is visible bacterial slime or mould in your water bottle, you should sanitise it with a dilute bleach solution of 1 teaspoon bleach and 1 teaspoon of baking soda in 1 litre of water. Allow the solution to sit in the bottle overnight, then thoroughly rinse and dry the bottle before using it again.

Other concerns about reusing water bottles

Some reports have specifically suggested that a common plasticiser, DEHA, can leach from plastic soft drink bottles into the liquids they hold, particularly with reuse. However, the majority of plastic water and soft drink bottles are made with a substance called PET, and do not contain DEHA.

While current research indicates chemicals are not released into water by reuse, many of these bottles are manufactured to be recycled, not reused. Some plastic bottles can warp when exposed to heat in the cleaning process. It is therefore important to ensure that after the bottle has been washed in hot water and left to air dry that it is intact and has not been damaged.

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