Most food processors use water from city and municipal suppliers or from wells. Processors are responsible for ensuring the quality of their water supply using a Water Testing System. Authorities recommend processors to test their water supply within required periods in a year. Processors who use water from rivers or other sources must ensure the water supply is properly treated and that it meets provincial and national quality standards.
Where Food Industry use water?

Water is essential in the food industry as an ingredient or as part of a process.

- Food manufacturing,
- Cleaning,
- Ice making,
- Steam production and
- Product transport.

Water Contaminants

- Biological
- Chemical
- Physical agents
**Biological Contaminants**

- Enteric pathogens (bacteria, viruses and protozoa) are the main source of biological contamination
- They can exist naturally or can occur as a result of contamination from human or animal waste
- Bacteria will not multiply in water if the water does not contain a source of nutrients

---

<table>
<thead>
<tr>
<th>Biological Contaminants</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bacteria</strong></td>
</tr>
<tr>
<td>Aeromonas, Campylobacter, Coliforms*, E. coli O157:H7, Legionella, Salmonella, Shigella, Yersinia, Vibrio</td>
</tr>
<tr>
<td><strong>Viruses</strong></td>
</tr>
<tr>
<td>Enteroviruses, Hepatitis A, Noroviruses</td>
</tr>
<tr>
<td><strong>Protozoa (parasites)</strong></td>
</tr>
<tr>
<td>Amoeba, Cryptosporidium, Cyclospora, Giardia, Roundworms, Toxoplasma</td>
</tr>
</tbody>
</table>

*Coliforms are a group of bacteria found in human and animal fecal material, soil and untreated environmental water. This group includes strains of *Escherichia* (including *E.coli* O157:H7), Klebsiella, Enterobacter and Citrobacter.*
Microbiological Limits

- Maximum acceptable concentration (MAC) for coliforms is 0 organism/100 mL
- Up to 10 total coliform organisms per 100 mL are detected from a single sample
- Sample contains either more than 500 heterotrophic plate count (HPC) colonies/mL
- More than 200 colonies on a total coliform membrane filter, the water should be resampled.

Numerical guidelines for viruses and protozoa are not proposed at this time. Their presence is not desirable.

For more information on water quality requirements consult with the Regional Health Authority.

How can these waterborne illnesses be prevented?

- Municipal drinking water treatment providing filtration and disinfection with chlorine can reduce the risk of contracting giardiasis and cryptosporidiosis.

- Chlorine by itself is not effective against Cryptosporidium but can inactivate Giardia.
Presentation at the 3rd SAFOODNET seminar
St Olav’s Hotel, Tallinn, Estonia; May 4-6, 2009

Disinfection of Well Water

Disinfection with Unscented Household Bleach

<table>
<thead>
<tr>
<th>Depth of water in well</th>
<th>Volume of bleach added (5.2% Hypochlorite)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Casing diameter 15 cm (drilled)</td>
</tr>
<tr>
<td></td>
<td>Casing diameter 90 cm (dug)</td>
</tr>
<tr>
<td></td>
<td>New well*</td>
</tr>
<tr>
<td>1.0 m</td>
<td>100 mL</td>
</tr>
<tr>
<td>3.0 m</td>
<td>300 mL</td>
</tr>
<tr>
<td>5.0 m</td>
<td>500 mL</td>
</tr>
<tr>
<td>10.0 m</td>
<td>1000 mL</td>
</tr>
</tbody>
</table>

*New wells require a chlorine concentration of 250 parts per million (ppm) for effective disinfection, whereas existing wells require 50 ppm chlorine.

Analytical methods for water testing

Various method steps involved in the analysis of the microorganisms

<table>
<thead>
<tr>
<th>Common methods component</th>
<th>Microbial groups</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Virus</td>
</tr>
<tr>
<td>Concentr.</td>
<td>Adsorption-elution</td>
</tr>
<tr>
<td>Detection/ enumerat.</td>
<td>Cell cultures</td>
</tr>
<tr>
<td></td>
<td>Count plaque forming units</td>
</tr>
</tbody>
</table>

IMS: Immunomagnetic separation
Benefits of Chlorine

- Disinfecting our drinking water, ensures it is free of the microorganisms that can cause,
  - cholera
  - typhoid fever

- Chlorine also reacts with the organic matter, naturally present in water. This chemical reaction forms a group of chemicals
  - Disinfection by-products; trihalomethanes (THMs), which include chloroform

- Chlorine remains the choice of water treatment experts. When used with modern water filtration methods, chlorine is effective against all microorganisms
  - Easy to apply,
  - Small amounts of the chemical remain in the water
  - As it travels in the distribution system from the treatment plant to the production line.

Alternatives to Chlorination

OZONATION

- A number of cities use ozone to disinfect their water, because ozonation does not produce THMs.
  - Upon release of the 3rd oxy.atom ozon acts as a strong oxidizing agent
  - Although ozone is a very effective disinfectant, it breaks down quickly and cannot be used to maintain disinfection in the distribution system.
  - Small amounts of chlorine or other disinfectants still must be added.
  - 650 to 750 mV generated by an electrode kills all viable bacteria
Alternatives to Chlorination

UV LIGHT

GERMICEDE 254 NM

UV-C, UV-B, UV-A

• UV is 10-400 nm, UV-C is 100-280 nm
• UV forms part of the electromagnetic spectrum and the UV wavelength range is from 10-400 nm, placing it between X-rays and the visible part of the spectrum.
• It is UV-C that is able to inactivate microorganisms directly causing lesions or mutations on DNA, disrupting H bonds.

Alternatives to Chlorination

• Coliform contamination an effective possibility may be to install an ultraviolet disinfection system, which kills the bacteria and other microbes by separating/denaturing the DNA or RNA of their cells,
• It doesn't change the chemistry of the water like some other disinfection methods,
• UV-light is not going to remove the chemical contaminants
Alternatives to Chlorination

Chloramines and chlorine dioxide
- Chloramines are weaker disinfectants than chlorine, but are very effective in the distribution system, (chlorine (Cl₂) and ammonia (NH₃)).
- Chlorine dioxide can be used in the treatment plant, but it is not very effective in the distribution system.
- Chlorine dioxide is applied to various fields such as sterilization of foods, drinking water and environmental elements, as environment-friendly chemical agent.
- It has sterilization effect on wide range microorganism on various conditions, rapid sterilization, low corrosive activity, low-toxicity, microbial biodegradability, action without generation of hazardous by-products such as THM.

Alternatives to Chlorination

- When used as a pretreatment, chlorine dioxide aids in the prevention of carcinogens in your drinking water by selectively oxidizing containments that may otherwise be transformed by chlorine into THMs.
- ClO₂ acts as a biocide inactivating harmful microorganisms such as viruses, E. coli, cryptosporidium and more with minimum contact time.
- One of the most important qualities of chlorine dioxide is its high water solubility, esp. in cold water.
Alternatives to Chlorination

**Electrolyzed water**

- Use of electrolyzed water is the product of a new concept developed in Japan and getting popularity in other countries as well.
- The acid electrolyzed water (an oxidizing water) is used as a disinfectant and pesticide.
- The alkaline electrolyzed water (a reducing water) assists in the alleviation of gastrointestinal disorders, acidosis, chronic diarrhea, and poor digestion. High bactericidal, virucidal and moderate fungicidal properties.

- It is cost effective and possesses environment friendly properties.
- Studies have been done on its use as a sanitizer for fruits, utensils and cutting boards, fungicide at postharvest processing of fruits and vegetables, as a sanitizer for washing carcasses of meat and poultry.

Chemical Contaminants

- Chemical contamination of water can occur from chemical spills, incorrect use of pesticides, improper water treatment or improper disposal of industrial waste into waterways. Harmful chemicals in water can cause adverse health effects.

Examples of toxic chemicals include:

- pesticides
- mineral salts (ex: nitrates, copper, sulfates)
- heavy metals (ex: arsenic, lead, mercury, cadmium, silver, iron)
- volatile organic compounds (ex: phenols)
- asbestos
- organic chemicals
- radionuclides (ex: uranium, radium, radon)

Maximum acceptable concentrations for chemical contaminants are established by National Guidelines for Drinking Water Quality.
Physical Contaminants

- Physical contaminants of water pose a low health risk to consumers but may affect the quality of water.
- Water may contain suspended particles of fine sand, clay and precipitated salts.
- This cloudiness is called turbidity and can interfere with effective disinfection and purification of water.

- Unpleasant taste
- Odours are likely caused by organic substances.

Useful manuals on the water quality

- Analytical methods for water examination
  http://www.standardmethods.org/
- Guidelines for Canadian Drinking Water Quality
THANK YOU

TÜBİTAK MRC
PK. 21, 41470 GEBZE-KOCAELİ
Tel: +90-262-677 32 50; Fax: +90-262-641 23 09
Mehlika.borcakli@mam.gov.tr
www.mam.gov.tr