

# Using Type 1 Water (18.2 M $\Omega$ -cm) for High Performance Liquid Chromatography in the Food and Beverage Industry

Tammy Goodman, Thermo Fisher Scientific, Asheville, NC

## Key Words

HPLC, water purification, lab water, ultrapure water, Type 1 water, contamination, food quality, eluent

High Performance Liquid Chromatography (HPLC) is widely used in the food and beverage industry at many stages, from new product development to quality assurance. HPLC can be used to determine the components of a given product in its raw, intermediate, and final states, and is commonly used to test these products for additives and contaminants in order to comply with regulatory standards. Additionally, important product information such as vitamin, lipid, and protein content can be determined.<sup>1</sup>

The process of HPLC involves the injection of a solvent (eluent) containing the sample (mobile phase), under high pressure, into a column with specific adsorbent material (stationary phase) that separates the sample components so they can then be identified and/or quantified.<sup>1</sup> One of the most common eluents is water mixed with a varying ratio of organic solvent, such as methanol. Because impurities in the water can interfere with accurate and reproducible results, it is imperative to pay close attention to using ultrapure water with a total organic carbon (TOC) content below 5ppb.

There are two different types of water that are acceptable for HPLC eluents: bottled HPLC grade water or ASTM Type 1 ultrapure laboratory water. Bottled water has a number of advantages. It is guaranteed to be the right quality when it is first opened, before there is any chance of environmental contamination, and is a good choice for users needing small volumes. However, bottled water also has several disadvantages. The largest drawback is



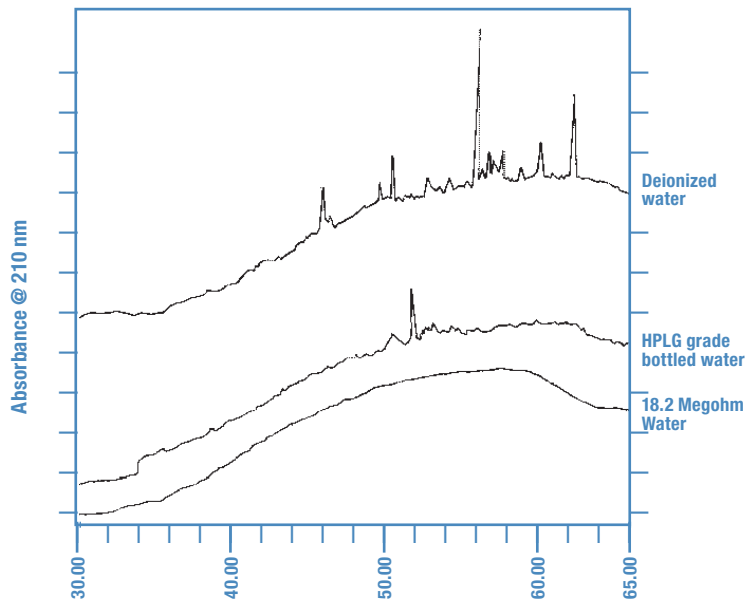
The Thermo Scientific™ Barnstead™ GenPure™ Pro water purification system delivers ultrapure water up to 24 inches from the unit with its flexible dispenser.

that bottled water can easily be contaminated if good laboratory practices (GLP) are not followed.

Also, TOC levels are not always available for bottled water, and organics from the atmosphere can contaminate the water once the bottle is opened. CO<sub>2</sub> is an example because it easily dissolves in pure water. Finally, bottled water can quickly become very expensive for high-volume users.

Ultrapure water produced from Type 1 water purification systems offers many benefits. The water is fresh when dispensed, so concerns about passive environmental contamination are removed. Additionally, ultrapure water purification systems fitted with a UV lamp can control the amount of organic impurities in the product water. Water systems that display the amount of TOCs in the product water are also available. The disadvantages of a water purification system include the cost to purchase

Figure 1. Ultrapure Water System with UV Lamp.



Determined with a Beckman HPLC system; 165 detector at 210 nm. 4.6 x 250 nm C-18 column; linear gradient mobile phase from 100% water to 100% acetonitrile at 2 mLs/minute in 30 minutes, 60 mL sample enrichment at 2 mLs/minute. Direct-Connecte™ Guard column.

Ultrapure Water Advantages and Disadvantages	
Advantages	Disadvantages
High quality every time water is dispensed (removes risk of environmental contamination)	Higher cost to purchase and maintain system for low volume usage
TOCs are tightly controlled and end-user is alerted when unacceptable levels are present when system with TOC monitoring option is purchased	System must be properly maintained to ensure high quality water
Good option for customers that are using a high volume of water	Lab space required for system

Bottled Water Advantages and Disadvantages	
Advantages	Disadvantages
Guaranteed quality first time opened but then end-user must exercise GPL to ensure quality	TOCs cannot be controlled and are not reported in some cases
Convenient to simply open and use without worry about maintenance	Can become expensive if demand becomes high, and expensive to ship and store
Good option for customers using low to mid-range water volumes	Must store the water so it is always on hand, requiring space in lab for bottles

the system, which may or may not include the first set of consumables required to purify water. Additionally, these consumables must be replaced on a regular basis to prevent contamination and ensure the water is consistently pure.

### How Contaminants Can Impact HPLC

Organic compounds, bacteria, ions, colloids, pyrogens, and particles can all potentially be present in water and can interfere with HPLC in a variety of ways. Bacteria, colloids, and particles can block pumps, injectors, and columns, and contaminating organics can create ghost peaks that can interfere with results. In addition, as the amount of organics increases, or if other ions are present, the reproducibility of the HPLC trace is more challenging. Figure 1 shows an example of how organic contaminants can adversely affect an HPLC chromatograph. The contaminants in the deionized water produce several peaks that could be mistaken for sample peaks or even hide the peaks from the sample, thus negatively impacting the ability to obtain accurate, reproducible data. The “HPLC grade bottled water” trace shows a potential ghost peak caused a contaminant organic(s) as well. The “Ultrapure Water System with UV Lamp” trace shows it has no background peaks, making it an ideal eluent source; the only peaks observed will belong to the sample, not the eluent.

Water purification systems directly monitor two important characteristics of the water being produced. One measure of the purity of Type 1 water is its resistivity. This is the ability of the water to resist conducting electricity, and is the mathematical inverse of conductivity. Resistivity is measured in megohm-centimeters ( $M\Omega\text{-cm}$ ). The theoretical maximum resistivity, indicating maximal ion removal, is 18.2  $M\Omega\text{-cm}$ . In addition to this high resistivity, water systems can also display the amount of TOCs in the product water. Ideally, ultrapure water with a UV lamp will have a TOC of 1-5 ppb.

### How a Type 1 Water Purification System Produces 18.2 $M\Omega\text{-cm}$ Quality Water with Low TOCs

Water purification systems are designed to provide reproducible quality water due to the group of purification technologies enclosed in the system. Incoming water in a typical Type 1 system has already been pretreated by deionization, distillation, or reverse osmosis (RO). Once the water is inside the water system, it passes through a UV lamp assembly using dual wavelengths of 254 and 185nm. The 254nm wavelength inactivates bacterial DNA and the two wavelengths combined effectively oxidize organic compounds down to 1-5 parts per billion (ppb). The water then moves to a deionization cartridge containing a high grade resin to remove ions (including any ions released by the UV lamp) to the theoretical maximum of 18.2  $M\Omega\text{-cm}$ . The last pass is through a 0.2 $\mu\text{m}$  filter to capture any remaining particles or bacteria that could cause clogging in the columns. At the end of the process the TOC levels are 1-5 ppb and the resistance is 18.2  $M\Omega\text{-cm}$ , which is ideal for HPLC working conditions.

In closing, HPLC is an important analytical tool in the food and beverage industry by helping to ensure food safety through its proper use. The process itself is highly sensitive to the components being introduced into the analysis, including any impurities that are potentially present in the water used in the analysis. One of the key components is the water used in the eluent. It is important to consider using ultrapure, Type 1, 18.2 M $\Omega$ -cm water, with 1-5 ppb TOCs to prevent potential physical interference such as clogging of columns. And more importantly, its use prevents interferences that could result in misread results.

## References

1. Leo M.L. Nollet and Fidel Toldra, Ed. Food Analysis by HPLC 3rd Ed., Boca Raton, FL: CRC Press, 2013.

[thermoscientific.com/purewater](http://thermoscientific.com/purewater)

© 2015 Fisher Scientific Inc. All rights reserved. All trademarks are the property of Thermo Fisher Scientific Inc. and its subsidiaries. Specifications, terms and pricing subject to change. Not all products are available in all countries. Please consult your local sales representative for details.

**Australia** +61 39757 4300  
**Austria** +43 1 801 40 0  
**Belgium** +32 53 73 42 41  
**China** +800 810 5118 or  
 +400 650 5118  
**France** +33 2 2803 2180  
**Germany national toll free** 0800 1 536 376  
**Germany international** +49 6184 90 6000

**India toll free** 1800 22 8374  
**India** +91 22 6716 2200  
**Italy** +32 02 95059 552  
**Japan** +81 3 5826 1616  
**Netherlands** +31 76 579 55 55  
**New Zealand** +64 9 980 6700  
**Nordic/Baltic/CIS countries**  
 +358 10 329 2200

**Russia** +7 812 703 42 15  
**Spain/Portugal** +34 93 223 09 18  
**Switzerland** +41 44 454 12 22  
**UK/Ireland** +44 870 609 9203  
**USA/Canada** +1 866 984 3766

**Other Asian countries** +852 2885 4613  
**Countries not listed** +49 6184 90 6000

**Thermo**  
 S C I E N T I F I C

A Thermo Fisher Scientific Brand